Challenges in the milk market (investments, disruptions, logistics, competitiveness, prices, and policy)

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PART II

STATE OF AND CHALLENGES FOR POLISH DAIRY FARMS

MAIN ABBREVIATIONS

CAP	-	Common Agricultural Policy
CCM	-	Corn Cob Mix
DE	-	Germany
DK	-	Denmark
EC	-	European Commission
EEA	-	Ecological Focus Area
ESU	-	European Size Unit
EU	-	European Union
FADN	-	Farm Accountancy Data Network
FAO	-	Food and Agriculture Organization
FR	-	France
GB	-	Great Britain
IE	-	Ireland
IT	-	Internet Technologies
IERiGŻ-PIB	-	Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej
MRiRW	-	Ministerstwo Rolnictwa i Rozwoju Wsi
NL	-	Holland
OECD-FAO	-	Organization for Economic Co-operation Development – Food and Agriculture Organization
PL	-	Poland
RDP	-	Rural Development Program
SAPARD	-	Special Accession Program for Agriculture and Rural Development
SNAP	-	Supplemental Nutrition Assistance Program
SO	-	Standard output
SOP	-	Sectoral Operational Program
UAA	-	Utilized Agricultural Area
USA	-	United States of America
USD	-	United States Dollar
USDA	-	United States Department of Agriculture
WIC	-	Women Infants and Children
WTO	-	World Trade Organization

INTRODUCTION

Milk production is one of the most important rural activities. This production has been accompanying population activity from the early years of human civilization. However, its role changed in history.

Milk production has been undergoing important changes in the United States of America. The number of dairy farms decreased by 74,1% from 155,339 to 40,219 in the years 1992-2017. The average herd of dairy cows in the USA is 115 head, and 75 percent of all U.S. dairy farms have fewer than 100 cows. Such results demonstrate the competitive advantage of big U.S. producers compared to the European Union milk producers.

The European Union is a very important milk producer in the world. The number of cows decreased by 0.5% on average, in the EU in 2017, compared to 2004. The main reason was the restructuring processes, especially in the EU13. Milk production was mainly given up by the owners of small dairy farms, and this decrease was compensated for by the increase in milk yield of cows. However, the average dairy farms in European Union keep 22 cows which place the activity in a weaker position compared to the U.S. milk producers.

Recently Poland has become an important milk producer in the EU and in the world. In 2019, Polish milk production exceeded 14 million tons, which placed Poland 5th in the EU and 13th in the world. The event that largely determined the development of the milk market in Poland and other EU countries was the abolition of dairy quotas in 2015. Since 2016, there has been an increase in the number of cows, milk yield and milk production in Poland.

The milk market is undergoing a process of concentration and consolidation in the production and processing structure. Large entities take over small dairies, which results in an increase in their scale of operation. Large companies are looking for ways to sell their products to large retail chains. For these companies, l large-format stores are stable entities.

Investments are also important factors of development of dairy farms. They depend on many factors and may have different dimensions in dairy farms. They may include the purchase of machinery, calves and heifers, modernization of buildings, increasing the area of agricultural land.

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PART I

GLOBAL AND POLITICAL CHALLENGES IN MILK MARKET

1

GLOBAL CHANGES IN INTERNATIONAL DAIRY TRADE IN 2005-2018 WITH SPECIAL EMPHASIS ON POLAND[1]

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1.1. Introduction

The global trade in commodities has been widely analyzed and documented in the history of economic thought. Various theories have been proposed to describe this phenomenon. In the 18th century, one of the first theoretical concepts to explain foreign trade was formulated by Adam Smith in his theory of absolute cost advantage. Smith postulated that countries gain a competitive advantage when they specialize in the production of goods for which domestic labor costs are lower than in the competing countries. Smith's theory has attracted considerable criticism, but it remains the cornerstone of modern economic thought despite its limitations (Maneschi 1998). Most analyses of international trade relate to Ricardo's theory of comparative advantage. This concept relies on similar assumptions to Smith's theory of absolute cost advantage, and it

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postulates that countries with different production costs can benefit from the exchange of goods. To obtain a comparative advantage, countries should specialize in the production of goods that can be manufactured at a relatively lower opportunity cost and import products that are relatively more expensive to manufacture domestically (Costinot and Donaldson 2012).

Globalization plays an important role in international trade, and it is a relatively new phenomenon in economic theory and practice. The concept first appeared in the 1980s, and it describes revolutionary changes in the global economy resulting from the liberalization of international trade, the dwindling significance of nation states, the digital revolution and the growing influence of international corporations (Intriligator 2003). The two major factors responsible for the rise of globalization are: 1) technical progress which facilitates transport and decreases transport costs, and 2) free flow of goods, services, capital and labor (at the level of nation states). On a globalizing market, economic relations differ subject to the type of the supplied goods and services as well as political decisions. Globalization processes are most visible in the financial sector. They are less pronounced on the food market (including the dairy market) which is highly specific and often regulated by separate national policies. Different regulations and support systems for the production of agricultural raw materials exist on the global market.

Globalization is linked with the broader concept of internationalization. For many companies that offer their products and services on foreign markets, the domestic market remains the main area of activity. Internationalization and globalization differ mainly in their geographic reach. Internationalization is a process that spans several countries, whereas globalization applies to the entire global market (Koźmiński 1999). From this perspective, the development of the dairy sector, in particular dairy farms, in the EU countries is influenced by internationalization. The intensity of this process is relatively low relative to other sectors of the food industry, and the highest levels of internationalization are observed in fish processing and tobacco production. Dairy businesses are least involved in international activities (Baran 2019). Despite the relatively low scale of internationalization in the European (including Polish) dairy sector, the geographic reach of most commercial dairy

products continues to increase. The geographic distribution of cheese has evolved from national to semi-global, and the market of skim milk powder has attained global status in 2005-2018. The Polish butter market had been a domestic market before Poland joined the EU, but it has since attained semi-global status. However, in the second decade of the 21st century, the geographic reach of the dairy sector was reduced to regional as most producers focused on selected export markets (Baran, 2019). In general, the distribution of dairy products continues to expand to geographically and culturally remote countries, and it is consistent with the successive stages of the internationalization model. The above applies particularly to commercial dairy products such as cheese, milk powder, whey powder and butter.

This chapter of the monograph discusses the changes on the global market in 2005-2018, with special emphasis on Poland, as well as potential changes on the global milk market in 2021-2028. The major reforms of the EU's common agricultural policy addressing the dairy sector are also presented. Data for the analyses were obtained from industrial reports and OECD-FAO forecasts.

1.2. Changes on the global dairy market in 2005-2018

In 2005-2018, the supply of dairy products was lowest in Asia, mainly China. In 2018, Asian imports of butter, cheese, skim and whole milk powder accounted for 48.7%, 37.4%, 60.7% and 60.6% of global imports, respectively. Skim and whole milk powder imports were highest in China. Japan and South Korea were the leading Asian importers of cheese. The global trade in dairy products increased substantially between 2005 and 2018. In the analyzed period, the greatest increase in dairy imports was reported in China. The spread of Western consumption patterns and the growing affluence of Chinese consumers has increased Chinese imports of all dairy products. In 2018, China's cheese imports increased 15-fold, and the imports of butter, skim milk powder and whole milk powder increased 8.8-, 6.5- and 8.1-fold, respectively, relative to 2005.

Table 1. Imports of commercial dairy products by different continents and selected countries in 2005 and 2018 [in thousands of tons]

Continent/ Country	Butter		Cheese		Skim milk powder		Whole milk powder	
	2005	2018	2005	2018	2005	2018	2005	2018
Asia	**326.87**	**491.43**	**589.00**	**1113.31**	**739.97**	**1525.29**	**858.21**	**1534.88**
China	12.84	113.33	7.18	108.28	42.65	280.44	64.23	521.00
Japan	4.76	12.30	211.69	285.70	34.00	52.07	0.04	0.12
South Korea	5.05	9.87	44.03	125.00	6.15	19.39	1.74	3.71
Europe	**323.42**	**247.49**	**830.54**	**1076.81**	**112.13**	**180.12**	**48.75**	**61.82**
UE-28	104.58	62.79	161.81	204.09	30.18	36.56	21.05	19.00
Russia	80.23	73.97	253.83	241.21	19.46	75.19	7.80	21.33
North America	**41.67**	**54.79**	**232.07**	**188.37**	**5.28**	**1.36**	**37.31**	**9.43**
USA	30.21	38.55	211.20	159.66	1.67	1.36	13.00	7.00
South America	**70.71**	**56.75**	**167.70**	**336.15**	**245.7**	**451.59**	**274.37**	**318.80**
Brazil	0.20	4.05	3.26	29.40	5.18	29.04	28.97	67.64
Mexico	50.80	23.29	78.3	111.83	173.97	331.50	44.00	40.73
Africa	**110.59**	**119.35**	**84.46**	**153.04**	**203.76**	**344.82**	**397.62**	**576.41**
Egypt	39.16	52.30	9.94	28.59	18.17	74.66	13.66	49.35
Australia and New Zealand	**12.03**	**40.32**	**55.58**	**109.31**	**4.44**	**10.77**	**9.26**	**31.00**

Source: own elaboration based on the **OECD-FAO Agricultural Outlook** (accessed on 11.07.2020).

In the analyzed period, dairy imports also increased in other Asian countries, but on a smaller scale than in China. Japanese imports of whole milk powder, butter, cheese and skim milk powder increased 3-, 2.5-, 1.4- and 1.5-fold, respectively. Russia is an interesting market due to its geographic location (Poland's neighbor) and a long history of food imports. In 2005-2018, Russia imported less cheese and butter, but skim milk powder imports increased nearly 4-fold. Whole milk powder imports reached 21,330 tons in 2018, marking a 3-fold increase from 2005. In the analyzed period, the increase in global milk and dairy production was driven mainly by the growing demand on Asian markets, in particular China.

Table 2. Exports of commercial dairy products from different continents and selected countries in 2005 and 2018 [in thousands of tons]

Continent/ Country	Butter		Cheese		Skim milk powder		Whole milk powder	
	2005	2018	2005	2018	2005	2018	2005	2018
Asia	**59.29**	**33.17**	**120.01**	**132.21**	**121.27**	**161.82**	**299.81**	**282.47**
India	6.18	7.03	0.95	6.17	53.25	19.68	10.68	1.08
Europe	**803.35**	**463.77**	**1092.06**	**1826.47**	**343.18**	**1061.82**	**596.75**	**403.30**
UE-28	674.69	306.62	733.25	1322.68	191.32	853.56	483.64	333.00
Russia	4.00	2.78	9.10	12.73	1.36	0.90	4.63	2.33
North America	**9.30**	**47.84**	**68.96**	**330.95**	**231.17**	**783.22**	**12.07**	**46.88**
USA	8.49	46.86	58.37	320.96	220.90	716.01	12.00	46.23
South America	**38.53**	**34.24**	**132.99**	**147.83**	**29.12**	**152.46**	**253.27**	**287.53**
Argentina	18.80	5.00	46.70	42.73	10.58	27.36	162.74	118.25
Mexico	0.96	8.31	0.70	5.85	0.16	104.00	1.78	5.74
Australia	**69.47**	**15.64**	**227.68**	**172.52**	**133.33**	**156.78**	**104.84**	**55.08**
New Zealand	**364.28**	**454.66**	**264.22**	**323.28**	**333.51**	**362.31**	**588.59**	**1377.83**

Source: own elaboration based on the **OECD-FAO Agricultural Outlook** (accessed on 11.07.2020).

A comprehensive analysis of changes in global dairy trade that accounts for all international processes and sets the directions for future growth should also include the current status of the world's leading producers and exporters of dairy products. In 2018, India was the unquestioned world leader in milk production with an output of 174.4 million tons of milk, marking an increase of 78.8 million tons from 2005. In the same year, milk production reached 150.1 million tons in the EU (increase of 15.0 million tons) and 98.8 million tons in the USA (increase of 18.5 million tons). New Zealand is also a key global supplier of dairy products. This country has a highly favorable climate for cattle farming and milk production, and most of its dairy output is exported due to low population and low domestic demand. In 2018, New Zealand produced 21.9 million tons of milk, up by 6.8 million tons from 2005. An analysis of changes in dairy exports indicates that the EU was a clear leader in this respect (Table 2). However, the volume of butter and whole milk powder exported by the EU countries decreased from 674,690 to 306,620 tons and from 483,640 to 333,00, respectively in the examined period. The observed decline was compensated by an increase in dairy exports

from New Zealand and the USA. These countries significantly increased their dairy exports between 2005 and 2018. In 2018, New Zealand increased its exports of butter, cheese, skim and whole milk powder by 24.8%, 23.4%, 8.6% and 134.1%, respectively, relative to 2005. New Zealand's exports of whole milk powder accounted for 56.2% of the global exports in 2018. The USA also increased its dairy exports, and in 2018, the volume of butter and cheese sold to other countries increased 5.5-fold from 2005. The increase in the US exports of whole and skim milk powder was somewhat lower, and it was estimated at 3.9% and 3.2% in the analyzed period. India has emerged as the global leader in milk production in 2018, and it witnessed the greatest increase in milk output between 2005 and 2018. However, most of its output was sold domestically, and India's milk powder exports experienced a stagnation in the evaluated period.

1.3. Changes on the Polish dairy market in 2005-2018

The economic rationality of trade in food and agricultural commodities is determined not only by the availability and productivity of capital and labor, but also by natural factors in agricultural production. The three-factor agricultural production function, where land (natural conditions) plays an important role, is still widely applied in analyses of the farming sector.

In 2005-2018, the Polish dairy sector, including dairy farms and milk processing plants, had a certain comparative advantage over other countries. Poland's milk output and dairy exports increased steadily in the analyzed period. The milk balance (Table 3) indicates that Poland's milk output significantly exceeded domestic demand (consumption and feedstuff production) in 2005-2018. When dairy imports are taken into account, the production surplus (in milk equivalents) that could/had to be exported ranged from 2,935,00 to 4,650,000 tons. Dairy exports accounted for 19% to 33% of domestic output.

Poland is a net exporter of dairy products, and despite an increase in domestic demand (which reached 224 liters of milk per capita in milk equivalents in 2018), dairy products will have to be exported in the coming years. Polish milk producers have to focus on countries that are

potential importers of dairy products. In 2018, Polish dairy products were sold mainly to other EU countries. The largest importer of Polish dairy products was Germany, followed by the Netherlands, the Czech Republic, Great Britain, Italy and Romania. Both the volume and value of Polish dairy exports increased between 2005 and 2018. In 2018, the value of dairy exports increased by EUR 1,325,500 relative to 2005. In 2018, cheese and tvorog (35%) had the highest share, whereas casein (1%), yogurt and fermented milks (6%) had the lowest share of Poland's dairy exports. The greatest increase was observed in the value of ice-cream (691%) and whey (423%) exports.

Table 3. Milk balance (in thousands of tons)

Specification	Year					
	2005	2007	2010	2013	2016	2018
Total output	11 922	12 096	12 364	12 736	13 271	14 213
Import	378	583	899	1 418	1 825	1910
Total stock	**12 300**	**12 679**	**13 263**	**14 154**	**15 096**	**16125**
Export	2 231	1 935	2 035	3 498	3 880	4 650
Feedstuff production	567	566	515	544	515	630
Consumption	9 502	10 178	10 713	10 112	10 701	10 845
Total utilization	**12 300**	**12 679**	**13 263**	**14 154**	**15 096**	**16 125**
Self-sufficiency [%]	118.4	112.6	110.1	119.5	118.3	123.9

Source: own elaboration based on *Analizy Rynkowe*: Rynek mleka – stan I perspektywy (*Market Analyses:* Milk market – current status and development prospects), 26-58, Institute of Agricultural and Food Economics-National Research Institute (IERiGŻ)

An analysis of the main trends in dairy imports revealed that: 1) the volume and value of dairy imports increased between 2005 and 2018 and exceeded dairy exports; 2) the value of dairy imports was 6.8 times higher in 2018 than in 2005; 3) cheese and tvorog (34%) had the highest share, whereas whey (4%), casein (4%) and ice-cream (5%) had the lowest share of dairy imports by value; 4) the greatest increase in the value of dairy imports was noted in the fluid milk and cream category (2,715%).

Table 4. Dairy exports

Specification	Year						Growth rate 2005=100%
	2005	2007	2010	2014	2016	2018	
in '000 tons							
Fluid milk and cream	205.4	171.5	280.0	385.5	607.1	678.5	330.3
Condensed milk and milk powder	152.6	99.2	100.0	157.7	107.9	165.6	108.5
including skim milk				117.9	79.8		
Yogurt and fermented milks	77.2	97.7	130.0	110.2	92.6	105.7	136.9
Whey	74.1	128.4	130.0	256.6	222.3	219	295.5
Butter and dairy fats	36.8	32.1	25.0	35.7	45.2	68.4	185.9
Cheese and tvorog	104.5	131.5	140.0	207.5	234.8	270.7	259.0
Ice-cream	15.0	23.3	25.0	41.5	49.8	74.2	494.7
Casein	9.7	2.4	4.5	2.4	3.4	2.9	29.9
in million EUR							
Fluid milk and cream	108.4	144.3	160.0	268.9	280.0	397.2	366.4
Condensed milk and milk powder	275.8	293.9	195.0	437.7	189.2	261.3	94.7
including skim milk				341	140.7		
Yogurt and fermented milks	71.4	99.0	125.0	132.2	102.7	129.2	181.0
Whey	43.9	123.1	95.0	194.4	150.1	185.8	423.2
Butter and dairy fats	85.5	87.9	70.0	121.9	131.1	322.4	377.1
Cheese and tvorog	272.2	363.7	390.0	662.9	625.2	785.2	288.5
Ice-cream	22.1	40.3	45.0	77.9	98.1	152.7	691.0
Casein	43.9	13.8	25.0	17.8	16.1	14.9	33.9

Source: own elaboration based on *Analizy Rynkowe*: Rynek mleka – stan i perspektywy (*Market Analyses:* Milk market – current status and development prospects), 26-58, Institute of Agricultural and Food Economics-National Research Institute (IE-RiGŻ)

Table 5. Dairy imports

Specification	Year						Growth rate 2005=100%
	2005	2007	2010	2014	2016	2018	
in '000 tons							
Fluid milk and cream	6.3	61.2	70.0	191.2	254.0	225.6	3 581.0
Condensed milk and milk powder	8.3	16.8	30.0	118.5	116.6	102.2	1 231.3
including skim milk	N/A	N/A	N/A	22.9	37.9	N/A	
Yogurt and fermented milks	4.3	35.7	25.0	34.2	63.3	74	1 720.9
Whey	8.3	44.9	25.0	91.6	61.1	97.9	1 179.5
Butter and dairy fats	3.6	6.6	10.0	14.9	16.7	20.7	575.0
Cheese and tvorog	14.8	26.8	40.0	65.6	88.4	94.1	635.8
Ice-cream	3.8	8.7	10.0	16.9	19.5	27.3	718.4
Casein	9.7	7.2	10.0	6.8	11.0	9.9	102.1
in million EUR							
Fluid milk and cream	6.1	34.9	35.0	89.7	128.0	165.6	2 714.8
Condensed milk and milk powder	15.3	37.5	50.0	223.9	232.2	150.0	980.4
including skim milk	N/A	N/A	N/A	66.9	60.9	N/A	
Yogurt and fermented milks	10.5	33.3	25.0	53.0	72.7	82.2	782.9
Whey	10.6	32.9	15.0	55.7	30.0	44.4	418.9
Butter and dairy fats	10.3	21.7	30.0	59.8	61.8	112.6	1 093.2
Cheese and tvorog	44.4	84.3	120.0	246.5	287.5	340.3	766.4
Ice-cream	5.3	11.8	15.0	31.1	40.2	60.2	1 135.8
Casein	44.4	43.4	55.0	46.1	48.5	45.6	102.7

Source: own elaboration based on *Analizy Rynkowe*: Rynek mleka – stan i perspektywy (*Market Analyses:* Milk market – current status and development prospects), 26-58, Institute of Agricultural and Food Economics-National Research Institute (IERiGŻ)
N/A – data not available

1.4. Dairy market outlook for 2021-2028

Humans rely on various tools to predict the future, and they take preemptive measures to pursue their goals. Data analyses, reports and miscellaneous information are useful only if they can be deployed in the decision-making process in the future. Prognostication (*prógnōsis* in ancient Greek) is the process of forecasting the future. Future facts, events and phenomena are predicted based on a set of research assumptions. The research process is composed of the following stages: analysis of past data (i.e., accumulation of data), diagnosis, and forecasting future

outcomes based on historical data with the use of specific tools. In other words, prognostication is the process of predicting the probability of future events (Hamulczuk 2013). On food and agricultural commodity markets, changes are difficult to predict due to the scale and complexity of the associated phenomena, as well as the presence of unpredictable factors (such as political decisions). Forecasts for the global dairy market are developed by various institutions and research centers, including the Organization for Economic Cooperation and Development (OECD).

Table 6. Imports of commercial dairy products by different continents and selected countries – outlook for 2028 [in thousands of tons]

Continent/ Country	Butter		Cheese		Skim milk powder		Whole milk powder	
	2028 ['000 tons]	Growth rate 2018 =100%	2028 ['000 tons]	Growth rate 2018 =100%	2028 ['000 tons]	Growth rate 2018 =100%	2028 ['000 tons]	Growth rate 2018 =100%
Asia	**589.43**	**120.0**	**1430.17**	**128.5**	**1864.29**	**122.2**	**1686.13**	**109.9**
China	138.52	122.2	168.65	155.8	344.28	122.8	600.02	115.2
Japan	12.3	100.0	327.65	114.7	42.25	81.1	0.12	100.0
South Korea	13.46	136.4	163.72	131.0	18.83	97.1	3.84	103.3
Europe	**329.43**	**133.1**	**1200.04**	**111.4**	**192.14**	**106.7**	**71.02**	**114.9**
UE-28	116.87	186.1	206.34	101.1	29.51	80.7	19.00	100.0
Russia	97.13	131.3	317.30	131.5	93.62	124.5	28.23	132.3
North America	**33.32**	**60.8**	**212.91**	**113.0**	**1.36**	**100.0**	**8.43**	**89.4**
USA	21.32	55.3	158.39	99.2	1.36	100.0	6.00	85.7
South America	**79.37**	**139.9**	**429.72**	**127.8**	**535.11**	**118.5**	**315.62**	**99.0**
Brazil	5.25	129.6	49.92	169.8	29.04	100.0	61.60	91.1
Mexico	36.09	155.0	153.18	137.0	402.63	121.5	**44.66**	109.6
Africa	**159.14**	**133.3**	**237.98**	**155.5**	**435.22**	**126.2**	**732.53**	**127.1**
Egypt	73.59	140.7	85.04	297.5	107.77	144.3	72.93	147.8
Australia	**57.03**	**143.1**	**107.16**	**109.0**	**10.13**	**100.0**	**18.93**	**64.9**
New Zealand	**0.47**	**100.0**	**11.2**	**100.0**	**2.92**	**453.3**	**2.62**	**141.9**

Source: own elaboration based on the **OECD-FAO Agricultural Outlook** (accessed on 11.07.2020).

According to the OECD report of 2019, the global demand for dairy products will continue to increase until 2028. However, this increase will proceed at a different rate in various regions of the world. The

greatest increase in demand for dairy products is expected in Asia, in particular in China. The demand for cheese will rise by 55% relative to 2018. The demand for imported dairy products will also remain relatively high in Russia. According to estimates, by 2028, the demand for imported cheese in Russia will increase by 76,090 tons (31%) relative to 2018.

The projections for the global dairy market until 2028 will be influenced by milk production. In 2028, India will remain the world's largest milk producer, and its milk output is expected to increase by 58.4 million tons (33.5%) relative to 2018. However, most of India's milk output will still be consumed domestically. An increase in milk production is also expected in Pakistan (from 55.3 million to 75.0 million tons, i.e. by 35.6%) and Brazil (from 36.4 million to 44.6 million tons i.e. by 22.6%). Milk output will also increase in the EU and the USA, but at a lower rate than in India or Pakistan. An analysis of the dairy market outlook for 2028 also indicates that milk production in China will increase by only 6.4%, from 34.8 million tons in 2018 to 37.1 million tons in 2028. China does not have favorable natural conditions for cattle farming or milk production. Fertile soils are scarce, which limits the production of fodder crops used as roughage for dairy cattle.

Table 7. Milk production on different continents and in selected countries – outlook for 2028 [in thousands of tons]

Specification	Year					2028	
	2018	2020	2022	2024	2026	'000 tons	Growth rate (%) 2018 =100%
Asia	**347 163**	**361 310**	**380 705**	**405 853**	**426 430**	**447 167**	**128.8**
India	174 399	181 798	193 025	209 658	221 348	232 835	133.5
Pakistan	55 311	57 892	61 856	66 037	70 418	75 012	135.6
China	34 833	35 410	35 852	36 274	36 682	37 076	106.4
Europe	**222 923**	**225 457**	**228 541**	**230 905**	**233 239**	**235 529**	**105.7**
UE-28	150 142	152 232	154 545	156 195	157 808	159 384	106.2
Russia	29 589	29 819	30 036	30 248	30 460	30 666	103.6
North America	**108 839**	**109 845**	**110 908**	**111 900**	**113 094**	**114 218**	**104.9**
USA	98 793	99 693	100 643	101 549	102 568	103 587	104.9
South America	**83 558**	**86 677**	**89 513**	**92 529**	**95 430**	**98 155**	**117.5**
Brazil	36 406	38 126	39 719	41 386	43 040	44 625	122.6
Mexico	12 363	12 547	12 737	12 939	13 140	13 340	107.9
Africa	**43 920**	**44 814**	**46 777**	**48 823**	**50 990**	**53 245**	**121.2**
Egypt	5 615	5 542	5 693	5 847	6 009	6 168	109.9
Australia	**9 577**	**9 555**	**9 588**	**9 617**	**9 648**	**9 682**	**101.1**
New Zealand	**21 926**	**22 068**	**22 331**	**22 593**	**22 875**	**23 150**	**105.6**

Source: own elaboration based on the **OECD-FAO Agricultural Outlook** (accessed on 11.07.2020).

Political and environmental factors can influence the performance of the global dairy market by 2028. The outbreak of the Covid-19 pandemic in March 2020 took world markets by surprise. The popular belief that that humans exercise full control over the world crumbled virtually overnight. The pandemic demonstrated that global economic ties, forged through technological advancement under the military and political leadership of the USA (after 1990), are not eternal. During the crisis, many countries realized that they can rely only on their own resources. The long-term effects of the pandemic are difficult to predict at this stage. Many scenarios are possible before a new drug targeting the pathogen is developed. The escalation of the trade war between the USA and China further complicates international trade and prevents reliable economic forecasts (Wang and Sun 2021). Both powers exert increasing pressure

on other countries in the search for allies. The above is well exemplified by Australia which remains within the sphere of influence of the USA (in particular military influence), but remains China's largest two-way trading partner (Zhao 2021). When the Australian government called for an investigation into China's role in spreading the Covid-19 pandemic (following the US narrative), China retaliated by imposing duties totaling 80.5% on Australian barley and announced its intentions to introduce duties on other food imports (including pork) from Australia. Tensions have been escalating since 2018 when Australia banned Huawei from participating in the construction of Australia's 5G network (Jaisal 2020). Trade relations between the EU, China and the USA were also fraught with difficulties in recent years. The EU countries have different military and economic interests. In 2013, the Chinese president announced plans to build new road and railway links between China and Europe. This initiative, popularly referred to as the New Silk Road, has been contested by the USA, and the debate on the resulting economic opportunities has ceased in Poland. The military protection offered by the USA has outweighed the potential benefits of trade with China.

1.5. Common agricultural policy and intervention mechanisms on the EU dairy market

1.5.1. Measures adopted and implemented in 2005-2018

The common agricultural policy (CAP) has undergone several reforms since its introduction. The main provisions of the CAP were set out in Articles 32-38 of the Treaty of Rome of 25 March 1957. Its main goals were to: 1) increase agricultural productivity by promoting technical progress and the optimal utilization of the factors of production; 2) ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture; 3) ensure the availability of agricultural supplies; 4) ensure that supplies reach consumers at reasonable prices; 5) improve the performance of the agricultural sector; 6) stabilize agricultural markets; 7) increase the competitive advantage of national markets (Cardwell 2004). The priorities of the CAP have been modified over the years. A major reform

was introduced in 1992 by the Commissioner for Agriculture Ray McSharry. The main goal of the reform was to limit rising production, preserve the social structure of rural areas and protect the environment. These changes were continued in successive programming periods by reducing support for agricultural production, increasing farming incomes and improving the quality of the natural environment (Garzon 2006).

After 2015, the reforms targeting the dairy market eliminated subsidies for milk and dairy product exports outside the EU, reduced private storage aid for the dairy sector, and abolished the milk quota system that had been originally introduced to stabilize milk production in the EU. These measures increased competition on the EU dairy market. In July 2016, the European Commission introduced an aid package for the agricultural sector to address the difficulties faced by EU farmers. As part of the scheme, financial support was offered to farmers to incentivize a reduction in milk production. In July 2016, a decision was made to pay direct subsidies in the amount of EUR 14 per 100 liters of milk to farmers who reduced their production over a period of three months relative to the same period in the preceding year. The EU allocated a total of EUR 500 million to the scheme, and Polish milk producers received EU 60 million (http://europa.eu/rapid/press-release_IP-15-5599_pl.htm). The situation on the dairy market changed in December 2016. Dairy prices on the global market increased, and market performance improved and stabilized in 2017 and 2018. In 2020, the Commission granted private storage aid for skim milk powder, butter and cheese to support agricultural and food markets that were most affected by the outbreak of the Covid-19 pandemic. The package was introduced on 22 April 2020, and dairy producers were compensated for keeping the agreed quantities in storage and off the market over a period of 3-6 months. This intervention measure was not highly successful in counteracting the adverse impacts of the pandemic on the food supply chain, and it failed to resolve the financial liquidity problems faced by dairy farms. However, the prices of dairy products on the global market increased in the second half of 2020 due to a relatively stable demand and reduced supply of dairy products, which resolved the problem of ineffective regulatory measures.

1.5.2. Measures planned for 2023-2027

The aim of the New Common Agricultural Policy proposed by the European Commission in June 2018 is to "help farmers improve their environmental and climate performance through a more results-oriented model, better use of data and analysis, improved mandatory environmental standards, new voluntary measures and an increased focus on investments into green and digital technologies and practices" (https://ec.europa.eu/commission/publications/natural-resources-and-environment) (The Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, 2020). In May 2020, the EU adopted the Farm to Fork Strategy for agriculture which lies at the heart of the European Green Deal. The European Green Deal is a set of policy initiatives aiming to transform the European Union, the third largest producer of greenhouse gas emissions worldwide, into a climate-neutral block by 2050. The European Green Deal is a package of several measures, including policies that will affect the direction of European agriculture. The farming sector is responsible for 10.3% of the EU's greenhouse gas emissions, where nearly 70% of farmhouse emissions come from livestock farming (EEA, 2019). In addition, 68% of the total agricultural land is used for animal production. The aim of the strategy is to increase organic farming in agricultural production to 25%, reduce pesticide use by 50%, curb the use of synthetic fertilizers by 20%, and decrease the use of antimicrobials in livestock production by 50%. Efforts will also be made to improve animal welfare and protect natural ecosystems and species against damage resulting from agricultural practices (pollution, emissions from industrial farms, wetland drainage, extensive monocultures). Farmers will be rewarded for practices that remove carbon dioxide from the atmosphere, such as wetland restoration and tree planting. To stimulate the EU's transition to a circular economy and promote renewable energy generation, farmers will receive support to develop anaerobic digesters for biogas production from agricultural waste. The use of local ingredients in the production of animal feeds will be encouraged. The future CAP and the goals of the Farm to Fork Strategy will be implemented by the EU countries at the national level. Each Member State is under obligation to draw up a CAP Strategic Plan. In Poland, this

document was prepared and submitted for public consultation in December 2020. The draft version of the Polish CAP Strategic Plan states that the received aid will be used to increase the competitiveness and productivity of the agri-food sector through support for investments relating to enhanced sustainability, and to improve the viability of farms by ensuring fairer and better targeting of income support. The draft document also notes that strong agricultural holdings are essential for sustaining the Polish and European agricultural model and ensuring food security (Strategic Plan for the Common Agricultural Policy, 2020).

The proposal for a regulation on the CAP Strategic Plans states that the EU countries should set up eco-schemes that are voluntary for farmers and fully coordinated with other relevant interventions. The proposed solutions include measures targeting cattle producers. According to Article 28 of the above regulation, the Member States should provide support for extensive grazing of cattle, sheep and goats on permanent pastures (eco-schemes for the climate and the environment). Farmers who go beyond the minimum (standard) animal welfare requirements established by national and EU laws will be eligible to financial support as compensation for the additional costs incurred and income forgone as a result of the undertaken commitment to improve animal welfare. Farmers who provide cattle with access to pasture for at least 120 days during the growing season (minimum 6 hours per day) will be entitled to a payment of PLN 185 per animal. Dairy farms that increase barn area by at least 20% will be eligible to a payment of PLN 595 per animal (eco-schemes for animal welfare). Articles 29-31 of the proposal for a regulation on the CAP Strategic Plans (eco-schemes supporting viable farm incomes and farm resilience across the Union to enhance food security) states that cattle breeders should be entitled to additional payments to mitigate the decrease in agricultural profits. Payments will be awarded for up to 20 animals.

The New Common Agricultural Policy for 2023-2027 will contribute to the extensification of agricultural production and organization. The proposed subsidies for cattle (including cows) that are grazed in pastures and housed in buildings with a larger area should encourage cattle rearing. The production of dairy cows is more labor- and capital-intensive; therefore, the proposed payments are more likely to stimulate beef cattle

farming. Cattle subsidies are limited to 20 animals, and this threshold will not encourage farmers to increase the scale of farming operations (milk production).

1.6. Summary and conclusions

The following conclusions can be drawn based on the analysis of changes in global dairy trade:

1. In 2005-2018, the greatest increase in dairy imports was noted in Asia. In 2018, cheese imports increased 15-fold, and the imports of butter, skim milk powder and whole milk powder increased 8.8-, 6.5- and 8.1-fold, respectively, relative to 2005.
2. In 2018, India was the unquestioned world leader in milk production with an output of 174.4 million tons of milk, marking an increase of 78.8 million tons from 2005. In the same year, milk production reached 150.1 million tons in the EU (increase of 15.0 million tons) and 98.9 million tons in the USA (increase of 18.5 million tons).
3. In 2005-2018, the Polish dairy sector, including dairy farms and milk processing plants, had a certain comparative advantage over other countries. The volume and value of Polish dairy exports increased in the analyzed period, and in 2018, the value of dairy exports increased by EUR 1,325,500 relative to 2005.
4. The global demand for dairy products will continue to increase until 2028, but the rate of this increase will differ across countries and continents. The greatest increase in demand for dairy products is expected in Asia, in particular in China, where the demand for cheese will rise by 55% relative to 2018. The demand for imported dairy products will also remain relatively high in Russia.
5. In 2028, India will remain the world's largest milk producer, and its milk output is expected to increase by 58.4 million tons (33.5%) relative to 2018. However, most of India's milk output will still be consumed domestically.
6. The escalation of the trade war between the USA and China complicates international trade and prevents reliable economic forecasts. Both powers exert increasing pressure on other countries in the

search for allies. The EU's position in the conflict is difficult to predict.

7. In 2020, the EU adopted the Farm to Fork Strategy for agriculture which lies at the heart of the European Green Deal. The European Green Deal is a set of policy initiatives aiming to transform the European Union, the third largest producer of greenhouse gas emissions worldwide, into a climate-neutral block by 2050. The proposed measures will contribute to the extensification of farming, promote organic farming and reduce livestock (in particular cattle) farming. These solutions could decrease milk production in the future.

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2

DISRUPTIONS IN THE U.S. MILK MARKET

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2.1. Introduction

The prices of dairy products in the United States are determined by a complex set of rules. A popular saying is that "one person in ten in the dairy industry will say he understands exactly how milk is priced and that person is lying". The essence of the milk price system is that when milk is used to produce more perishable products the seller receives a higher price and, accordingly, when milk is used to produce more storable products then the seller receives a lower price.

Classified Pricing

Milk is categorized in four classes according to how it is used. Class I milk is used to produce drinking milk and receives the highest price. Class II milk is used to produce soft products such as yogurt and ice cream. Class III milk is used to produce cheese and whey and Class IV milk is used to produce butter and dry products, such as powdered milk. The farmer receives a price that reflects the proportional usage of the milk in the region where the farm is located. Thus, milk prices are higher in areas that have a large population and fewer cows and lower in areas with many cows and fewer people.

In 2020 the traditional relationship between the prices changed dramatically. In some months the price paid for Class III milk was higher than the Class I price, whereas in the previous decade the Class III price for a year averaged about 85% of the Class I price. Why did this happen? Does it make sense? Will the relationship return to the old patterns in the future? The year 2020 was unique worldwide. With the Corona Virus outbreak, U.S. commerce was dramatically disrupted. After March 1, few restaurants in the USA offered on-site dining. Instead, any food the restaurants sold was food that the customer bought from the restaurant and consumed elsewhere, generally at home, or perhaps at work. The result was that the servers in the restaurant were unnecessary because customers could not dine there. Therefore, many dairy products were not consumed at their traditional levels, and the amount the farmer received from their sale was lower. If a consumer has milk with a meal at home, this milk is purchased from a grocery store for a much lower price per liter for home consumption than the cost per liter of a comparable amount of milk purchased in a restaurant. Similarly, if you eat a bowl of ice cream in a restaurant it will cost considerably more per bowl than if you purchased a container of ice cream in the supermarket and each member of your family enjoyed a dish of ice cream from this container after supper.

The Last Decade for Class III & Class IV milk prices

For many years, Class III & Class IV milk prices moved together. This milk was used to produce storable products and the manufacturer had minimal losses due to spoilage or out-of-date products. As a result, once the factory received the raw milk it was quickly transformed into a storable product that could be put into a refrigerated warehouse and sold when the manufacturer found a customer. This product will rarely go out of date before it is sold. Therefore, if there is a particularly large amount of farm milk produced in the spring, the manufacturer can make ice cream and freeze it for several months with no loss of value. Thus, the firm can hold the product with minimal risk of spoilage until the firm finds a customer to purchase it.

Class III – Cheese & Whey

Because of the Covid 19 virus pandemic in 2020, food consumed away from home dropped precipitously in the United States. However, milk produced per cow increased in 2020. In December 2020 the average amount of milk produced per cow in the United States exceeded 2,000 lbs. or 907 kgs. For the 31 days in December this is 29.25 kg. of raw milk per cow per day, which was a U.S. record output per cow for any December for which data was collected. Of course, now most U.S. dairy cows are on large farms that have confinement operations, so the cows never go outside. Instead, the cows stay in the barn and their feed is brought to them. The pandemic put a lot of downward pressure on milk prices as it changed the consumption patterns for dairy products completely from recent decades, with sizeable and uneven shocks across the industry.

Class IV – Butter and Powdered Milk

The Class IV milk price is paid for milk that is used to make butter and powdered milk, products that are commonly used for baking pastry products. When I was a child, my mother often baked cookies and cakes in our home, but now few young women have grown up with this tradition. Smaller family sizes, higher incomes, and more women employed outside of the home have changed American cooking habits and most younger women have different household skills and incentives than their mothers or grandmothers did. The result is that baked goods are generally purchased from retail stores and rarely does a family member bake bread or cakes or cookies.

2.2. What has happened?

As may be seen in Table 1, the relationship between the Pennsylvania all milk price and the Class III price has changed. This is a significant departure of a very long-time pattern. The overall price level is not unusual, but the high Class III milk price is unprecedented. During a recession, it is not unusual to see prices of consumer goods fall, but why would the Class IV price fall and the Class III price remain high? On the surface, one would think that all dairy products are similar in their affordability. Certainly, drinking milk is a more essential product than ice

cream, but that doesn't address why the cheese price did so well during this period. Cheese is an important source of affordable protein. Butter has a bit of bad reputation in the United States for dietary reasons, and margarine, a vegetable-based product is often substituted for it. Of course, butter is an animal product, while margarine contains unsaturated fats made from vegetable oils. As such margarine is purportedly healthier, but it still is not ideal since many Americans consume too much fat and are overweight.

Table 1. Pennsylvania U.S. Class III Price, U.S. Class IV Price, and Pennsylvania All Milk Price

Year	Average Annual Class III Price	Average Annual Class IV Price	Average Pennsylvania All-Milk Price	Difference between the All-Milk price and the Class III price
2010	$14.41	$15.07	$18.28	$3.87
2011	$18.37	$19.04	$22.12	$3.75
2012	$17.44	$16.01	$20.03	$2.59
2013	$17.99	$19.09	$21.48	$3.49
2014	$22.34	$22.09	$25.64	$3.30
2015	$15.81	$14.35	$18.48	$2.67
2016	$14.87	$13.77	$17.33	$2.46
2017	$16.73	$16.08	$18.66	$1.93
2018	$14.53	$14.25	$17.03	$2.50
2019	$16.96	$16.31	$19.16	$2.20
2020	$18.16	$13.49	$18.11	-$0.05

Source: U.S. Department of Agriculture

2.3. Why has this happened?

Many dairy processors are limiting the amount of milk they will purchase in order to get farmers to reduce production, although higher feed costs may be causing some dairy farmers to cut back in any case. There are undeniably adequate supplies of milk throughout the United States, and often milk is selling at prices well below the minimum class prices. With the Corona virus limiting the frequency of people eating meals in restaurants, the sales of dairy products for consumption away from home fell sharply. This affected the mixture of products purchased

and the amounts purchased by the different categories of customers. My own community contains a very large university and for much of 2020 the students were attending classes virtually, often from their hometowns in another location, and perhaps even a different state or country. Our many local eating venues suffered greatly while these students were elsewhere. Our community has a *de facto* population of 154,000. The local economy struggled greatly during the pandemic. While our city is not typical of the country as a whole, it illustrates the sizeable impact that the Corona virus had on food consumption and the market for dairy products generally. With fewer meals purchased from restaurants, the reduced consumption of the various categories of dairy products had a sizeable impact on price of milk, and especially on the price of some particular classes of milk. The premium on cheese prices reflects the uneven impact of the pandemic on some sectors of the economy, and the dairy industry. With the availability of the various vaccines perhaps the market will stabilize and return to the former relationships between the various dairy product prices. Nevertheless, the dairy producers and manufacturers will have a long road to recovery, irrespective of what the future may bring.

According to Khanal et al. (2010) the increased productivity can be attributed to improved management practices, animal selection, and technology adoption.

Table 2. U.S. Average Milk Production per Cow

Year	kg./cow/year	Year	kg./cow/year
2010	9,590	2016	10,324
2011	9,677	2017	10,394
2012	9,853	2018	10,501
2013	9,897	2019	10,610
2014	10,092	2020	10,784
2015	10,148		

Source: U.S. Department of Agriculture

Historically the Chinese did not consume many dairy products, but that is no longer the case. The younger Chinese are not as lactose intolerant as their parents were because they have been consuming dairy

products their entire life. Per capita consumption does not have to be high for the Chinese market to be important globally, given the enormous population.

Recently New Zealand renewed and expanded its Free Trade Agreement with China. The agreement was extended for another decade, further solidifying ties between the two nations. In addition, milk production growth in New Zealand has stalled, which could limit future output gains and the amount of product available for export markets. A greater focus on China could also provide an opportunity for EU and U.S. dairy producers to serve new markets that recently have been served by New Zealand imports. In recent years, American dairy farmers have produced more milk than the domestic market could absorb and have exported more dairy products. Mexico is a large customer for U.S. milk and Canada could be larger if its market was more open to U.S. products. However, Canada has very protective dairy policies, especially with respect to fluid milk. This is significant because most of Canada's population lives very near the United States border, often also near important milk-producing states, and most of Canada could easily be served by truck or rail shipments of U.S. dairy products, if Canada's trade policies were less protective.

A recent cold storage report showed that butter stocks were the highest at 2020 year-end in 28 years at 273.8 million pounds. Total cheese stocks were 1.398 billion pounds, an increase of 51 million pounds between November and December, the largest change for those months ever, and far exceeding the average increase over the previous five years. All of this reduced dairy farm income as the ratio of the milk price-to-feed price fell to the lowest level since May, with income over feed cost also the lowest since May, creating an unprofitable combination of high feed costs and low milk prices.

Although there was adequate milk available throughout the nation, and selling at prices that are well below class prices as some processors were limiting the amount of raw milk that they will purchase in order to get their farmer-suppliers to reduce production. Higher feed costs are also causing production decreases in regions where dairy farmers are losing money.

Butter prices have continued to rise, buoyed by more reopening of restaurants and other away-from-home eating establishments, while cheese prices were lower on reports of large milk production. Milk produced continues be at the highest levels in years, while stocks of most products are sizable and a shortage of transportation capacity is hampering export sales. The unprecedented disruptions brought about by the COVID-19 pandemic in 2020 caused the U.S. dairy industry to adjust to new rules for the food service, hospitality, and educational sectors. Despite volatile product markets, farm prices are favorable for more expansion of dairy herds. The dairy sector added 97,800 cows between January 1, 2020 and January 1, 2021, with much of the increase occurring in the second half of the year. Additionally, improvements in producer margins and favorable weather led to productivity gains, with average milk per cow growing about 1.4 percent on a per-day basis over last year, the fastest rate of growth since 2016. All of these events have led to a total milk production in the U.S. to increase by 2.1% in 2020, or 1.9% adjusted for the extra day because of leap year. The outbreak of COVID-19 and the resulting restrictions placed on the hotel, restaurant, and institutional sector, as well as global economic uncertainty, squeezed demand and led to a buildup of stocks for many dairy products, as well as creating volatility in product prices. Government dairy product purchases provided some support for milk prices. However, at the end of the year, inventories of some dairy products were quite large. For example, butter inventories were at the highest level since 1992, American-type cheese stocks were the highest since 1984, and nonfat dry milk stocks were the highest since 2004. In January 2021, the situation facing the dairy sector was challenging. There was uncertainty about the timing and path of a return to normal demand or even what "normal" will look like in the future. Milk production is forecast at 227.4 billion pounds, 1.9 percent more than 2020. With larger milk supplies and large inventories of some products hanging over markets, milk prices are likely to fall. Milk producers may see lower milk prices at the same time feed prices increase to their highest levels in many years. This would squeeze the farmers and lead to declines in cow inventory during the year.

Most of the decline in cow numbers will reflect a slower rate of cow additions rather a reduction of existing herds. The dairy herd in 2021

is expected to average 9.4 million head, 0.6 percent above 2020. Fueled by gains from continuing improvement in genetics and management, output per cow per day is forecast to increase about 1.7 percent in 2021, which is the highest growth rate since 2014. Feed prices are forecast to be higher during 2021, which would encourage slower increases in milk per cow in the second half of the year. Domestic demand remains uncertain, as restaurant re-openings have occurred in some places, but restrictions still remain in many areas. Although the impacts of COVID-19 on the economy in general, and on dairy demand specifically, are expected to diminish over the course of the year, the resumption of eating in restaurants and some government programs remain uncertain.

Table 3. US Dairy Exports 2020

Regions, countries	Million $
Mexico	$1,405
SE Asia	$1,264
Canada	$824
China	$540
South America	$385

Regions, countries	Million $
South Korea	$373
Middle East/North Africa	$328
Japan	$323
Caribbean	$218
Central America	$209

Source: U.S. Dairy Export Council

With President Biden, Congress considered a $1.9 trillion stimulus package and the confirmations of many new officials, causing delays in action on other business. The latest stimulus bill contains a large expenditure for the U.S. Department of Agriculture (USDA) for food procurement, loans for small and medium-sized food processors to help them respond to the Covid-19 disruption, and loans and grants for supply-chain adjustments, and payments for farmers to compensate them for crop losses due to severe winter weather. With various food purchasing programs under consideration, many dairy product buyers seem to expect additional funding for food relief, which would support markets, despite fundamental data that suggest that prices are too high, given the current supply and demand situation for dairy products. Most analysts believe programs like the Supplemental Nutrition Assistance Program (SNAP) and Women Infants and Children (WIC) will receive the bulk of the new funding, including a 15% increased allocation through at least the end of

the 2020-21 fiscal year. The USDA will likely focus more on environmental issues, including climate change. A recent presidential executive order stated, "America's farmers, ranchers, and forest landowners have an important role to play in combating the climate crisis and reducing greenhouse gas emissions." That was followed by a statement that the Biden administration will work to conserve 30 percent of the nation's land and water – a dramatic shift from the Trump administration, which rolled back many environmental rules and regulations to benefit farmers and ranchers. Given the new president, the USDA will increase its focus on environmental issues, including climate change. The Biden government in Washington has definitely shifted the focus from that of President Trump, and businesses should prepare for changes in policies. While the industry will welcome many of the Biden administration's new policies, such as immigration reform and a renewed focus on trade, a stricter policy for environmental regulations could face major opposition if they are not voluntary and/or accompanied by cost sharing. Even though most people understand that environmental restrictions are necessary—if not for the health of the planet, then at least to retain support with consumers and position the industry for the longer term, although new regulations tend to raise costs by requiring major investments in technology. Agriculture Secretary Tom Vilsack is very knowledgeable about dairy, the most complex of the major agricultural sectors. As the former head of the U.S. Dairy Export Council, he realizes the importance of trade and has already earned the respect of foreign governments and the food and agricultural industries. Moreover, the Biden administration and Vilsack will likely prove to be more predictable and consistent in their policies and their choice of words than President Trump was, which will provide farms and processors the information they need to plan and invest for the future, regardless of whether they agree or disagree with the changes. This shift of emphasis will force businesses to once again focus on charting a course that more closely aligns with reducing greenhouse gases and realize that President Trump's regulatory rollbacks were temporary. Dramatic and unprecedented weather events in recent years—everything from droughts to floods and frigid temperatures to sweltering heat—have disrupted U.S. milk production. Nevertheless, milk production increased in January compared to last year. The gain

was less than the industry expected, given the sizeable increases in 2020 over 2019. Wisconsin added 77 million pounds of milk, while output in states in the Southeast fell behind previous-year levels. Producers milked 85,000 more cows in January 2021 than last year, which could push production higher in the second quarter. January butter stocks were nearly 33% greater than a year ago at 328.4 million pounds on January 31. Total cheese stocks were 3.3% larger, which was a slower growth rate than the five-year average. While the impacts from these events have been undeniable, many in agriculture still are reluctant to attribute these events to climate change. To overcome this, the new administration has encouraged USDA to resume the discussion of climate change, but they will have to work hard to obtain widespread acceptance of increased environmental oversight. Immigration reform, another important issue, is one that many in agriculture can support given the pervasive shortages of experienced farm and food production labor, as well as rising labor costs. Immigrant workers provide much of the labor on larger dairy farms. Based on recent comments, President Biden is likely to propose small changes in immigration policy, while seeking bipartisan support for longer-term change. A permanent solution to the immigration issue is a major goal for U.S. agriculture and will likely be well received at the farm level. Few citizens are interested in the doing the demanding work on dairy farms. Although a larger labor pool will certainly help in the short term, it likely won't derail the ongoing trend toward more on-farm automation. Robotic milking systems are much more reliable than unskilled laborers. Also trade policy is an important challenge for the Biden administration. Despite the pandemic, U.S. dairy in 2020 had its best trade year ever, and now the industry is looking for additional opportunities to sell dairy products abroad. In recent years, the United States has been slow to join multilateral trade deals and instead has focused on bilateral agreements. Whether through multilateral or bilateral trade deals, dairy will continue to work toward leveling the playing field with New Zealand and Europe, two regions that have been actively signing trade deals over the past decade. Going forward, U.S. dairy exporters and food manufacturers could see more consistent sales as the Trump trade-war approach gives way to more pro-trade rhetoric.

2.4. Production and price

Production nationally has remained strong (2% higher than 2019) despite recent corrections for December 2020. Production was below expectations for January 2021, but were still higher than the same time last year. Production has consistently been growing for the U.S. over the past 12 years. Milk per total cow per day has climbed 18% nationally since 2008 with a low of 55 pounds per cow. Cow numbers in the last quarter also climbed to 12-year highs. This means production is set to outpace disappearance for the start of 2021, which should make any price increases unlikely (Figure 1).

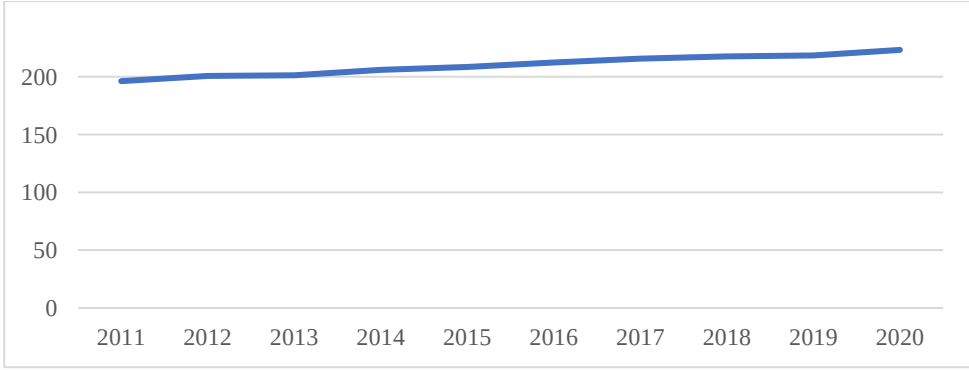

Figure 1. Total U.S. milk production (Million pounds)

Source: USDA, National Agricultural Statistics Service, 2021

The role of cooperatives

Most U.S. milk is handled by cooperatives. Cooperatives are a long-standing marketing effort by farmers to act as a group to attain a common goal. The net effect is that the cooperative can combine the milk from the many farmer members and negotiate with the processors to give the farmers more leverage in the marketplace. Since even the biggest farms produce a minor fraction of the milk, when the efforts of hundreds of farms are pooled, the relative market power is dramatically greater.

2.5. Summary

U.S. milk production was up 1.8% for January 2021 compared to January 2020 and for the October-December period milk production was the strongest since 2014, and the fourth-highest final quarter of the past 20 years. Relatively strong milk prices for most of the year, even with the pandemic and its accompanying volatility, reasonable feed prices for most of the year until the fall, generally favorable milking conditions during the most stressful weather periods of the year (summer and winter), and a continuing consolidation in the dairy industry, where larger operators with lower costs are accounting for a greater share of the nation's milk output, all have resulted in U.S. milk production increasing by 2.1% in 2020 compared to 2019, or 1.9% adjusting for the extra day because of Leap Year. This is a lot of milk, and forecasts for 2021 call for continued growth in milk production. The U.S. dairy cow herd has grown by almost 200,000 head since March of 2019, which is 100,000 more than the previous year and, a recent U.S. Department of Agriculture cattle report showed end-of-year dairy cow numbers of 9.44 million head, the largest value since 1995. Of course, if cow numbers grow rapidly, so does milk production, and that puts downward pressure on milk prices.

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3

FACTORS SHAPING PRICES OF DRINKING MILK AND DAIRY PRODUCTS IN POLAND AFTER ACCESSION TO THE EU[2]

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3.1. Introduction

Farmers do not have direct impact on dairy products prices. Location, production and the pace of development of dairy farms, which are responsible for the support of raw milk, have impacts on milk processors decisions and production scale (Parzonko 2013). Jarzębowski and Klepcki (2013) claim that the biggest impact on dairy products come from wholesalers and retailers, which are closest to the final consumers.

The price changes of milk and dairy products is the effect of increasing demand for milk in China and other countries of Asia and Africa. However, the level of milk consumption can be the result not only of price changes but also market conditions and consumer preferences (Seremak-Bulge and Bodył 2013).

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Dairy farmers are at the beginning of the dairy distribution chain. They are involved in the rearing of dairy cows and the production of milk, which is the raw material for the production of finished dairy products (Jarzębowski and Klepacki 2013).

The biggest milk and dairy products consumption countries are in the EU, USA, and they are almost three times the world average level. The consumption in China is increasing (Bórawski and Kowalska 2017). The milk consumption is varies widely in the world (Bórawski et al. 2020). The shortage of milk and dairy products in Asia is still high whereas the shortage of dairy products in Africa has not changed (Seremak-Bulge 2016).

The EU and U.S. are the main producers of milk and dairy products. However the conditions for the market differ. The average EU dairy herd is about 22 whereas in the U.S. it is 122. The U.S. is a leader in milk yield and low production costs, but some countries from the EU export milk to the U.S. These are the two largest milk producers and consumers play a key role in the world and have strong position in the World Trade Organization (WTO) negotiations creating the conditions for agriculture in the future (Bórawski et al. 2016).

The main aim of the research was to recognize factors shaping the prices of drinking milk and dairy products in Poland. To achieve this goal, we wanted to answer following questions:

– What is the price volatility of milk and dairy products in Poland?
– Which factors determine the prices of milk and dairy products?

3.2. Methods

The factors having an impact on milk and dairy products after accession to the EU were recognized. After accession to the EU, Poland gained access to the common market characterized by a broader customer base.

Descriptive statistics were used to analyze the changes in factors shaping the prices of milk and dairy products. The analysis included: the average, median, minimum, maximum, standard deviation, coefficient of variation, skewedness, and kurtosis.

Then the regression analysis was used. This method helps to discover relations between different factors and to realize the aim of the research (Wysokiński et al. 2016). It included dependent (Y) and independent (X) variables.

In this stage, historical data was used to estimate the development trend by the linear regression method of the dependent variable y based on the values of the independent variables x (forecast of the dependent variable based on the independent variable, e.g., year). The development trend was determined using a mathematical function:

$$y = \beta_0 + \beta_{1x} + \xi, \quad (1)$$

where: β_0 and β_1 are structural parameters of the regression function, and ξ is a random component. The β_0 parameter in the linear regression equation means the intercept, and the parameter β_1 is the regression coefficient of the *y* variable relative to the *x* variable. Then we have analysed the impact of chosen independent variables (X) on dependent variables (Y).

The dependent variables were:

Y_1 – Retail prices of drinking milk 3-3.5% [PLN/1 liter],
Y_2 – Butter prices [PLN/ 200 g],
Y_3 – Prices of cream 30% fat [PLN/0.5 l],
Y_4 – Natural yogurt prices [PLN/150 g],
Y_5 – Prices of ripening cheese, Gouda [PLN/ kg],
Y_6 – Prices of processed cheese [PLN/100 g],
Y_7 – Prices for cottage cheese [PLN/1 kg].

The independent variables were:

X_1 – Milk yield [thousand liters],
X_2 – Cow numbers [thousand],
X_3 – Milk production [thousand tons],
X_4 – Purchase prices of milk [PLN/ 100 liters],
X_5 – Average prices paid to farmers for milk [EUR/100 kg],
X_6 – FAO global milk price index,
X_7 – Milk consumption [liters/person],
X_8 – Disposable income [PLN],
X_9 – Average monthly expenses on food per 1 person [PLN],
X_{10} – The share of expenses on food (%),

X_{11} – Exchange rate euro-PLN,
X_{12} – Balance of foreign trade in dairy products [mln Eur],
X_{13} – Exports of milk and dairy products [Mln Eur],
X_{14} – Imports of milk and dairy products [Mln Eur].

The classical method of least squares was used to estimate the models. The R^2 coefficient of determination was used to select the models.

3.3. Independent variables shaping milk and dairy products prices

First, the descriptive statistics of factors shaping prices of dairy products in Poland were evaluated. The factors shaping milk and dairy products were chosen based on the available literature. Szajner (2017) analyzed the transmission of prices in milk market. The very important sources of information for the analysis were: production, processing, international trade, consumption, and self-sufficiency of milk. The factors were divided into four groups (table 1). The first group was the production stage. It was represented by milk yield, cow numbers and milk production

The coefficient of variation describes the dispersion of the analyzed variables. The dispersion creates greater uncertainty. The highest coefficient of variation was found in milk yield (15,87%) and cow numbers (10,07%). The increase in the milk yield of cows results mainly from genetic progress. Basic herds are genetically improved by artificial insemination with high quality semen and the purchase of better animals (Bórawski et al. 2020b).

The second group which was analyzed was prices. These included average purchase prices, average prices paid to farmers and the FAO global milk price index. The highest coefficient of variation was found in the FAO global milk price index (109%). However, the purchase prices had also a high coefficient of variation (16). The research conducted by Roman (2020) confirmed high differences of milk purchase prices in the voivodeships in Poland. The highest level of purchase prices of milk in the years 2009-2018 was observed in the western and northern-eastern voivodeships in Poland (Lubuskie, Zachodniopomirskie,

Warmińsko-Mazurskie and Podlaskie). The lowest purchase prices of milk occurred in Podkarpackie, Małopolskie, Świętokrzyskie and Łódzkie voivodeships. The reason for such differentiation is the highest milk production in the northern-eastern and western parts of Poland. These are the highest production regions where the farmers received lower purchase prices

The third group of independent variables concerned consumption. It is shown in the literature that domestic consumption generates the demand for milk and dairy products. According to Bouamra-Mechemach et al. (2008), demand is the main factor that drives dairy product market prices. The consumption of milk is slowly increasing in the EU (Popovics 2008). This is caused by four factors: milk consumption, disposable income, average monthly expenses of food per 1 person, and the share of expenses on food. As we can see the highest coefficients of variation were found in disposable income (117,04%) and average monthly expenses on food per 1 person (16,06%). The consumption of dairy products is the result of numerous factors including economic growth, demographic changes and increasing purchasing power of consumers.

Table 1. Descriptive statistics of independent variables in Poland in the years 2004-2019

Variable	Average	Median	Minimal	Maximal	Standard deviation	Coefficient of variation	Skewedness	Kurtosis
Production								
X_1 – Milk yield [liters per cow]	5147,6	4978,0	4140,0	6450,0	817,09	0,15873	0,33756	-1,3600
X_2 – Cow's number [thousand]	2432,6	2396,0	2130,0	2801,0	244,98	0,10071	0,16958	-1,5224
X_3 – Milk production [thousand tons]	12785,	12553,	11861,0	14400,	789,42	0,061745	0,76690	-0,48587
Prices								
X_4 – Purchase prices [PLN/100 liters]	113,98	112,09	87,360	139,05	18,192	0,15961	0,0073507	-1,3736
X5 – Average prices paid to farmers for milk [EUR/100 kg]	27,897	29,130	19,250	32,340	3,5866	0,12856	-0,99069	0,25639
X6 – FAO global milk price index	257,21	202,20	123,50	1297,0	279,74	1,0876	3,5059	10,585
Consumption								
X_7 – Milk consumption [liters/person]	197,44	193,50	173,00	225,00	18,633	0,094375	0,17936	-1,4228
X_8 – Disposable income [PLN]	1725,3	288,5	735,00	9229,0	2019,3	1,1704	3,5024	10,573
X_9 – Average monthly expenses per 1 person [PLN]	986,31	1043,5	697,00	1176,0	163,74	0,16601	-0,67338	-0,89979
X_{10} – The share of expenses	83,131	83,000	73,600	95,400	6,4195	0,077222	0,17448	-0,83231
Exports, imports and balance								
X_{11}- Exchange rate euro-PLN	4,1382	4,1909	3,5166	4,5640	0,25303	0,061146	-0,81009	0,64210
X_{12}- Balance of foreign trade in dairy products [mln Eur]	883,01	870,40	505,00	1210,0	200,26	0,22680	0,015245	-0,78852
X_{13}- Exports of milk and dairy products [Mln Eur]	1448,1	1422,2	617,9	2230,0	488,23	0,33716	0,093821	-1,0533
X_{14}- Imports of milk and dairy products [Mln Eur]	565,01	529,15	111,90	1020,0	319,16	0,56487	0,051587	-1,4408

Source: Own elaboration on the basis of milk market (Milk Market 2019)

An important factor explaining the consumption of milk and dairy products is the purchasing power of households. The level of income which provides the average expenses on food is essential to meet demand for food (Kibicová et al. 2014). Another group of factors increasing consumption include facilitation of transfer of technology, which causes bigger and cheaper production and liberalization of capital flow (Pawlak 2014).

The fourth group included exchange rates, balance of foreign trade of dairy products, exports, and imports (Table 1). The elimination of the trade barriers made it possible for new member states to access the

Common Market. This helped the processing enterprises and agricultural producers to develop opportunities to sell overproduction. Poland achieved in 2017 the highest positive trade balance in intra-EU milk and dairy products (765,596 thousand tons). Other countries with the high positive balance of dairy trade in intra-EU were: the Czech Republic (732.9 thousand tons), France (647.3 thousand tons) and Austria (603.6 thousand tons). In turn, the largest deficits in trade balance on milk and dairy products in 2017 were achieved by: Italy (-1.649.9 thousand tons), Belgium (-779.38 thousand tons) and Ireland (-489.08 thousand tons). This data shows the importance of the dairy sector in the EU market to meet consumer demand (Bórawski et al. 2020a).

The highest coefficient of variation was in imports of milk and dairy products (56,49%) and exports (33,72%). The kurtosis has reached the negative values indicating that they were different in relations to the mean. The positive skewedness showed that the tail of variables is on the right side of the distribution and is longer and flatter in comparison to the left side.

As we can see from table 2, the highest coefficient of variation was found in the prices of natural yogurt (45,16%) and butter prices (24,14%). The kurtosis has reached the negative values, which shows that they were different in relation to the mean. The negative skewedness showed that the tail of variables is on the left side of the distribution and is longer and flatter in comparison to the right side.

The results demonstrate the existence of single common trend. This trend was observed in other EU countries. The degree of market integration is almost perfect. It was the effect of the CAP which resulted in similar prices in the EU area. Dairy farmers who stay in the market have to cooperate with other dairy producers in the EU. The same situation is observed in the USA where farmers cooperate with market players. It does not lead to price increases but help to compete and not to lose market share (Novakovic and Walf 2016).

Table 2. Descriptive statistics of prices of dairy products in Poland in the years 2004-2019

Variable	Average	Median	Minimal	Maximal	Standard deviation	Coefficient of variation	Skewedness	Kurtosis
Y_1 – Retail prices of drinking milk 3-3.5% [PLN/1 liter]	2,7006	2,7500	2,3800	2,9900	0,16711	0,061879	-0,59910	-0,36164
Y_2 – Butter prices [PLN/ 200 g]	4,2687	4,1300	3,0300	6,1900	1,0304	0,24138	0,71810	-0,48654
Y_3 – Prices of cream 30% fat [PLN/0,5 l]	5,5675	5,7450	4,1200	6,9500	0,85947	0,15437	-0,24738	-0,83360
Y_4 – Natural yogurt prices [PLN/150 g]	1,2069	1,0150	0,96000	2,6100	0,54499	0,45157	2,2490	3,0958
Y_5 – Prices of ripening cheese, Gouda [PLN/ kg]	18,711	18,770	15,830	21,990	2,0280	0,10838	0,020868	-1,2636
Y_6 – Prices of processed cheese [PLN/100 g]	1,9456	2,0350	1,6000	2,1400	0,18290	0,094006	-0,89640	-0,78053
Y_7 –Prices for cottage cheese [PLN/1 kg]	12,799	13,520	9,7600	14,340	1,6090	0,12571	-0,92592	-0,72823

Source: own elaboration on the basis of milk market (Milk Market 2019)

3.4. Factors shaping prices of milk and dairy products

The changes in milk and dairy products depends on crop production. In many countries of the EU crop production dispersion is observed. Moreover, price volatility is an important problem not only for farmers, but also for consumers and processors. Stable prices are needed because they provide increased planning security (Buleca et al. 2018).

The correlation analysis is a useful tool to measure the reaction between variables. As we can see from table 3, four variables were negatively correlated with the prices of analyzed dairy products. The following variables were eliminated from the analysis: X_2 – Cow numbers, X_6 – the FAO global milk price index, X_8 – Disposable income, and X_{10} – The share of expenses on food. After elimination of negatively correlated variables, the analysis included ten variables positively correlated with prices of dairy products. The rest of the independent variables have a positive impact on the prices of dairy products. It allows us to conclude that the variables were properly chosen. The high coefficients of correlation allow the inclusion of the independent variable in the model.

During the analysis it was found that the prices of dairy products were positively correlated between one another. Therefore, the impacts of the independent variables were analyzed individually.

Table 3. Correlation between independent variables and dairy products prices in Poland in the years 2004-2019

Independent variables	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
X_1	0,6318	0,8920	0,9030	0,6370	0,7786	0,7987	0,8175
X_2	-0,7453	-0,7774	-0,8776	-0,3977	-0,7759	-0,8659	-0,8959
X_3	0,5798	0,9288	0,9055	0,7825	0,7559	0,7582	0,7605
X_4	0,7157	0,8672	0,8684	0,4598	0,9632	0,7815	0,8046
X_5	0,5392	0,5905	0,6316	0,2816	0,6776	0,6184	0,6278
X_6	-0,3814	-0,2851	-0,3284	-0,1286	-0,3054	-0,3473	-0,3761
X_7	0,6645	0,8614	0,9074	0,5933	0,7625	0,8331	0,8488
X_8	-0,1556	-0,1137	-0,1661	-0,0504	-0,0341	-0,2401	-0,1775
X_9	0,8319	0,8433	0,9565	0,4322	0,8003	0,9574	0,9734
X_{10}	-0,7282	-0,8834	-0,9319	-0,5201	-0,7949	-0,8738	-0,8962
X_{11}	0,0310	0,3064	0,2842	0,2668	0,1160	0,2111	0,2247
X_{12}	0,6189	0,8552	0,8066	0,6064	0,9096	0,6627	0,6674
X_{13}	0,7242	0,9332	0,9393	0,6233	0,9244	0,8307	0,8464
X_{14}	0,7197	0,8913	0,9311	0,5733	0,8437	0,8552	0,8762

Source: own elaboration on the basis of the milk market (Milk Market 2019)

The regression analysis shows the impact of independent variables on prices of dairy products. The variable X_5 – Average prices paid to farmers for milk have the impact on Y_1 – Retail prices of drinking milk 3-3.5%, Y_4 – Natural yogurt prices and Y_7 – Prices for cottage cheese. The findings confirm the transmission of prices in milk market. Average prices paid for milk for farmers have an impact on prices of dairy products.

The next variable X_9 – Average monthly expenses on food per 1 person also has an impact on dairy product prices. It shows that consumer spending determines the prices of dairy products. Consumer spending is the effect of achieved income. Although the milk and dairy products are basic products, the increase of their prices will not change the demand dramatically. People need milk to meet their nutritional

needs and the increase of their income increases prices even though the quantity demanded may not change.

The variable X_{11}- Exchange rate euro-PLN has an impact on dairy products such as Y_1 – Retail prices of drinking milk 3-3.5%, Y_2 – Butter prices, Y_3 – Prices of cream 30% fat, Y_4 – Natural yogurt prices, Y_6 – Prices of processed cheese. The analysis confirms that the prices of dairy products depend on exchange rates. Poland has not adopted the Euro yet. That is why the increase of exchange rate of Euro-PLN can have positive impact on exports and encourage exporters to sell the dairy goods in the intra-EU market.

Each analyzed regression model has a high coefficient of determination R^2, which indicates a high level of fit of the models (Borawski et al. 2020b). Moreover, the price analysis helped to investigate the integration of the milk market. The level of price relations help to evaluate that the market is globalized and organized (Romam and Roman 2020).

Table 4. Regression analysis of independent variables and dairy products prices in Poland in the years 2004-2019

Independent variables	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
X_3				0,308			
X_4					0,074		
X_5	0,041			0,055		0,044	
X_9		0,028	0,04				0,186
X_{11}	0,542	1,17	0,186	1,08		0,640	
X_{13}		0,053	0,024				
F	77968,78	38132,31	51063,41	27287,15	4018,05	97848,23	19132,42
R^2	0,999	0,999	0,999	0,999	0,999	0,999	0,999
p	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Source: own elaboration on the basis of milk market (Milk Market 2019)

3.5. Summary and conclusion

The production stage in Poland and the EU was regulated by the milk quota system. The system helped to maintain the production at a stable level. However, it was difficult for the members of the market to adjust to a changeable situation. The overproduction resulted in fines that were paid by milk producers. Even such obstacles as self-sufficiency in Poland increased to 123% in 2017 (Zuba-Ciszewska 2019).

The number of cows decreased in the analyzed period. The number of cows decreased from 2778 thousand in 2004 to 2167 thousand heads in 2019 (a 22% decrease). The number of dairy cows was larger in 2019 only in Germany (4012 thousand head) and France (3486 thousand head).

The average milk yield of dairy cows in 2019 was (5399 kg/head). However, the biggest yield for dairy cows was found in 2019 in Denmark (9851 kg/head) and Netherlands (9079 kg/head) (Milk Market 2019).

The authors of the paper analyzed the changes in milk and dairy products in Poland in the years 2004-19. It is a very important and difficult issue because it requires knowledge of modern approaches of statistical analysis. The problem of creating price forecast became very difficult because it requires the assessment of seasonal price fluctuations (Kussaiynov and Zhakupova 2019).

The prices of milk and dairy products are determined by consumption. The consumption of milk and dairy products in the EU Member States from 2000 to 2016 increased annually by about 406 thousand tons, or 0.28%, which means that it is lower than the growth rate of milk production by 363 thousand tons. The result of such milk overproduction is the need to export milk to third country markets (Stańko and Mikuła 2018). The demand for milk and dairy products is balanced in Common Market of the EU, although saturated in many Member States (Chatellier 2017).

The market system efficiently transmits the price signals. Moreover, the values in prices paid to farmers equals the value to the dairy processors (Gillmeister et al. 1996).

The analysis indicates that four independent variables were negatively correlated with the prices of dairy products, in particular: X_2 –

Cow numbers, X_6 – the FAO global milk price index, X_8 – Disposable income, and X_{10} –The share of expenses. The analysis confirmed the impacts of the following variables on dairy product prices: X_5 – Average prices paid to farmers for milk, X_{11}- the Exchange rate between the euro and PLN and X_{13}- Exports of milk and dairy products. The results confirm existing transmission of prices in milk market in Poland.

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4

MANAGING MILK MARKET DISRUPTIONS AT THE DAIRY FARM LEVEL IN THE USA

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4.1. Introduction

In the United States at the start of the COVID-19 pandemic, milk market disruptions due to restaurant and school closures resulted in raw milk excess in the supply chain as well as limits for milk sales in grocery stores. Part of the reason for this dichotomy between excess milk at the farmgate and a lack of milk on grocery store shelves had to do with disruptions in the processing and distribution portions of the supply chain (Howard 2020; Huffstutter 2020). Dairy products that were normally processed and packaged for food service or as milk for school lunches were in either very large or very small containers – neither of which "fit" into the retail dairy case for sales. Panic buying of milk in grocery stores led to empty shelves and limits on how much milk could be purchased in stores. Unable to sell milk and dairy products to food service and schools and unable to make a rapid shift to retail sized containers,

processors saw milk back up in the supply chain pipeline while consumers were clamoring for more milk at the store. Milk dumping during the COVID-19 pandemic due to the unprecedented supply chain disruptions happened nationwide in the United States (Wiener-Bronner 2020). Local partnerships arose where a tanker load of milk scheduled for dumping was able to be rerouted and processed for use in food banks, but this was very limited in scale. As the pandemic continued, some shifts were made to create a home for dairy products – school lunch distributions began happening through local groups, take-out food options expanded, and limited outdoor dining reopened. Meanwhile the pandemic travel restrictions and curfews created more demand for dairy at home as more meals were cooked and consumed at home. This shift of cooking more at home has created an increased demand for dairy products that has continued even as some pandemic restrictions have eased (Berry 2020).

Milk prices plummeted early in the pandemic due in part to market instability (Goodling 2020). As pandemic conditions continued and supply chains started to adapt, milk prices began to rebound, and oversupply became a concern in some areas. To deal with the wide swings in supply, many milk processors exercised options to enact penalties for overproduction of milk at the farm level during some portions of 2020. The overproduction penalty combined with negative producer price differentials from the milk marketing orders (Natzke 2020) made for a doubly difficult time for dairy producers to realize positive milk margins. Short term government payments were available for dairies to help weather the low milk price storm that followed milk dumping, but it was becoming clear that sound options for short term on-farm milk reduction needed to be explored.

4.2. Aim and methods

Economic stability and the ability to manage cost of production to achieve profitability is in part dependent on being able to withstand these volatile market forces by making strategic decisions about temporary reductions in milk production and about maintaining or lowering the cost of production for producing milk at the farm level. Being able to use sound data about production, feed costs and impacts on cost of

production when making decisions about short term management changes will be key to long term dairy farm viability.

The aim of our current research project was to address on-farm decision making that could lead to healthy and reversible reduction in milk yields for herds on an as needed basis as well as sound cost-control measures that maintain profit under changing market conditions.

4.3. Managing milk market disruption

The relationship between intake of feed, especially energy, and milk yield is well documented (Hristov et al. 2005). Therefore, reduction in feed intake in the lactating herd will reduce milk yields in the short term while feed is either restricted or rations are adjusted to feed less nutrients. However, reduction in the intake of nutrients, especially energy, early in lactation will negatively impact peak milk and may lead to increased metabolic issues like ketosis. For example, reduction in feed intake in early lactation resulted in an increased incidence of metabolic disorders, lower peak milk, and less milk yield over the entire lactation (Jaynes, 2014). In one recent study, (Seifi et al. 2021) addition of straw to early lactation diets reduced dry matter intake and increased the prevalence of ketosis over time compared to a more energy-dense diet for early lactation cows. Likewise, Pérez-Báez et al. (2019) showed that reduced dry matter intake both pre and postpartum resulted in negative energy balance and increased incidence of both ketosis and mastitis. So, reduction in feed intake or adjustments in diets for early lactation cows in the herd as part of a short-term milk reduction strategy may have negative impacts beyond simply lowering milk yield. Early lactation cows are more vulnerable to reduced feed intake and may have costly increases in health disorders or reductions in peak milk production which will lead to reduced milk yield over the full lactation. On-farm strategies to reduce or adjust feed intakes for short term milk yield reductions should be targeted to mid to late lactation animals in the herd in order to prevent the unintended consequences of increased health issues or longer-term reductions in milk yield.

Another on-farm strategy for short term reduction in milk yield because of market disruptions or penalties on overproduction imposed by

milk processors may be to dry off lower producing cows early; thereby lengthening their dry period. Longer dry periods can lead to higher body condition scores and negative health events after calving like ketosis, fatty liver, and milk fever (Roche et al. 2013). Recent data about restricting intakes during the dry period (Esposito et al. 2020) also shows the potential for negative health impacts. Lengthening the dry period as a strategy for short term reductions in milk yield due to market disruptions or processor penalties when combined with lower energy or restricted dry cow diets may result in poor long term production performance, decreased cow longevity and increased animal health costs. Further research is needed to better understand and predict the impacts of the short-term decisions on the longer-term consequences for both cow productivity and health as well as overall farm profitability when strategies for lengthening dry period are being considered.

Disruptions in the regional, national, or international marketplace that impact milk prices are not very easily managed at the farm level, as the biology of milk production follows a predictable lactation curve and short term drops in herd level milk yield may have long term impacts. Even when targeting milk reduction strategies to mid and late lactation animals in the herd, it is important to consider how the resulting changes in feed cost and milk yield will impact not only income over feed cost but also cost of production per unit of milk and overall farm level profitability. Dairies in the Northeastern US have relatively high cost of production for both milk and home-grown feeds compared to some areas of the US (Shoemaker 2019). If cost of production per unit of milk is to be competitive, then maximizing production of milk and milk solids per cow is often the goal. For individual herds decisions are made about the number of cows to be milked and targeted milk yield desired based on factors like facilities and feed available, budgeting, debt repayment and family living needs as well as a host of factors that impact how those on-farm goals are set, and decision are made. Strategies to reduce milk yield in the herd in the short term must consider those individual farm needs but also should consider the impact on overall cost of production per unit of milk. Changes to the diet or amount of feed fed per cow and the resulting reduction in milk yield over the short term for targeted groups of cows within the herd may increase the annual cost of production per unit

of milk to a level that is not competitive for the farm. Additionally, strategies for short term reductions in milk yield due to penalties imposed by the milk processor need to be evaluated against the overall economic loss or benefit. For example (all calculations in USD), a 100- cow herd that sells 1,000,000 liters of milk per year with total expenses of $350,000 would have a cost per liter of $0.35/liter. If milk price averages $0.38 per liter for the year but there is a penalty for overproduction that is imposed that reduces this price by $0.05 per liter but only for one month of production (about 85,000 liters), then is it economically worthwhile to enact a milk yield reduction strategy to try to offset the penalty? Reducing annual milk yield by 10% without any decrease in expenses would increase the overall cost per liter and would drive up cost of production from $0.35 to $0.39 ($350,000 / 900,000 liters of milk). To maintain the current level of cost of production per unit milk, expenses would need to be reduced by $35,000 annually. This is a large reduction given the small penalty ($4,250) put in place for a short time. Decisions being made at the farm level are complex and producers can benefit from decision tools that utilize sound data for various scenarios.

4.4. Preliminary findings

Preliminary data has been analyzed to examine the impact of reducing nutrient consumption to decrease milk yield in the short term. Dairy production data along with the resulting savings in feed costs and decreased income from less milk and components shipped are being evaluated to better understand the economic impact of these short-term decisions. Utilizing herd level production data and feed cost information, we are developing some scenarios for short term milk reduction at the farm level by reducing the intake of feed for a limited period during milk market disruptions or times of penalty for oversupply of milk shipped. Since there is a clear relationship between feed intake and milk yield and since cows that are past peak milk production are less vulnerable to negative health issues associated with reduced intakes, targeting these animals in the herd for short term changes during periods of time when on-farm milk yields need to be decreased may be an option for some farms.

4.5. Conclusions

The decision to reduce herd level milk production in the short-term by either change in feeding management or drying off cows early and lengthening the dry period should be considered carefully to alleviate any unintended consequences. It is important to consider how all these short-term changes will impact overall cost of production per unit of milk as well as the long-term health and productivity of the dairy cows.

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5

COMPETITIVE POSITION OF POLISH DAIRY FARMS ON THE EU MARKET IN 2005-2018[3]

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5.1. Introduction

Competition or rivalry between individuals or stakeholder groups aiming to achieve the same goal is a process that has accompanied mankind since the beginning of human existence. In economic sciences, competition is usually described in the context of business competition. The definition of competition varies subject to the aim and subject of research. A relatively broad definition has been proposed by Gorynia (2002) who noted that competition is the ability to act and survive in a competitive environment. Most researchers agree that competition is a relative concept that should be examined in a comparative context and should be operationalized. Stankiewicz (2003) analyzed competition as a complex system composed of four elements: 1) competitive potential, namely the total resources of an enterprise, including employee competencies and skills; 2) competitive advantage, namely the ability to

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effectively utilize an organization's productive capacity to generate an attractive market offer and effective competitive instruments; 3) competitive instruments, namely tools and methods that are consciously and deliberately applied to build the clients' capital and create business value; 4) competitive position, namely a company's status on a given market relative to the results achieved by its competitors. Does competition exist between agricultural businesses, in particular companies from different countries? According to Woś (2001), agricultural businesses compete indirectly rather than directly, which is reflected in the costs associated with the production of agricultural goods (raw materials) which, to a certain extent, determines the economic rationality of food products in the processing stage.

The Common Agricultural Policy (CAP) determines the direction of enterprise development and the degree of competition between dairy farms in the European Union. The 2015 reform of the CAP and the introduction of new regulatory schemes in the dairy sector have increased competition between dairy farms and dairy plants in the EU (Bórawski et al. 2020). Subsidies for milk and dairy product exports outside the EU were withdrawn, customs duties on dairy products imported from non-EU countries were reduced, private storage aid for the dairy sector was limited, and the milk quota system that had been originally introduced to stabilize milk production in the EU was abolished (Parzonko and Bórawski 2020).

The aim of this study was to describe the competitive position of dairy farms from selected EU countries in 2005-2018, with special emphasis on Poland. The analysis involved representative dairy farms with a standard output (SO) of EUR 25,000-50,000 (small farms) and EUR 100,000-500,000 (large farms).

5.2. Research Methodology

A Composite (Synthetic) Indicator of Competitive Position (CICP) was built to evaluate the competitive position of dairy farms in the EU. The indicator was developed based on the resource-based theory. In view of the specific features of dairy cattle farming, the following material resources that determine the competitive position of dairy businesses

were identified: 1) owned land (area of owned agricultural land), 2) leased land (area of leased agricultural land), 3) value of farm buildings (EUR/farm), 4) value of tractors, agricultural machines and equipment (EUR/farm), 5) herd size (average), and 6) milk production (kg/year). The following factors were also taken into consideration when evaluating the competitive position of dairy farms based on their ability to expand material resources: 1) agricultural rents (EUR/ha), 2) cost of external financing (interest rates), 3) cost of hired labor (EUR/hour) and the debt-to-equity ratio (%). Dairy farm owners are members of local communities, and they assess their performance relative to other community members; therefore, the incomes derived by farmers from agricultural activities were compared with non-agricultural incomes in the process of calculating the CICP. The lower the disparity between farmers' incomes and non-agricultural incomes (or if farmers' incomes exceed non-agricultural incomes), the greater the incentive for developing agricultural production, including dairy production. The average gross wages and salaries in the evaluated countries were compared based on OECD data.

The competitive position of dairy farms was evaluated with the use of several measures and indicators relating to resources and income parity; therefore, a multidimensional analysis method had to be applied. This group of methods includes Hellwig's development pattern method, where the analyzed objects are grouped based on phenomena that cannot be measured with the use of a single indicator, such as technical progress, economic growth, standard of living, social and technical infrastructure (Krakowiak-Bal 2005). Measures and indicators that both enhance (stimulators) and inhibit (destimulators) business performance were applied to assess the competitive position of dairy farms.

Table 1. Classification of measures and indicators used for evaluating the competitive position of dairy farms as stimulants and destimulants

Stimulants		Destimulants	
Owned land (area of owned agricultural land)	X_1	Agricultural rent (EUR/ha)	X_7
Leased land (area of leased agricultural land)	X_2	Cost of hired labor (EUR/h)	X_8
Value of farm buildings (EUR/farm)	X_3	Equity-to-debt ratio (%)	X_9
Value of tractors, agricultural machines and equipment (EUR/farm)	X_4	Disparity between farmers' incomes and non-agricultural incomes	X_{10}
Herd size (average)	X_5		
Milk production (kg/year)	X_6		

Source: own elaboration

In the described approach, the variables are standardized to develop a pattern, namely an abstract object with the optimal values of each attribute (measure or indicator), as well as an anti-pattern containing the least desirable values of each attribute (measure or indicator). In the next step of the procedure, the similarity between each object and the pattern is measured by calculating the Euclidean distance (di0). The lower the value of di0, the higher the object's level of development and status relative to the analyzed phenomenon.

In the last stage, a composite (synthetic) indicator is calculated for arranging the analyzed objects in a linear series. In Hellwig's method, the composite indicator is computed with the use of the below formula:

$$m_i = 1 - \frac{d_{i0}}{d_0}, (i = 1, 2, \dots, n).$$

The composite indicator generally assumes values in the range of [0; 1]. The smaller the distance between the object and the pattern, the higher the value of the composite indicator. Denominator d_0 expresses the distance between the pattern (representative dairy farm) and the anti-pattern, and it is calculated with the following formula:

$$d_0 = \overline{d_0} + 2\,S_d \text{ where: } \overline{d_0} - mean, S_d - standard\ deviation$$

In the present study, dairy farms from selected EU countries were analyzed with the use of the methodology proposed by the Farm Accountancy Data Network (FADN). Dairy farms operating in Poland and in six other EU countries characterized by the highest increase in milk

production between 2005 and 2018 (Germany, France, Great Britain, the Netherlands, Ireland and Denmark) were selected for the study.

5.3. Results

5.3.1. Competitive position of representative dairy farms in the analyzed EU countries

The proposed Composite Indicator of Competitive Position (CICP) accounts for the internal productive capacity of dairy farms as well as external factors. The identification and characterization of the analyzed objects plays an important role in the process of assessing the competitive position of dairy businesses. The first step of the analysis should involve a general evaluation of the entire dairy sector in each country to identify factors that are characteristic of representative holdings. The results of the general assessment can be used to evaluate smaller groups of businesses, such as dairy farms with different milk output.

Table 2. Selected measures and indicators describing **representative** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**stimulants**)

Country	Year	Indicators (stimulants)					
		X_1	X_2	X_3	X_4	X_5	X_6
Germany	2005	59.41	38.59	85.37	71.82	43.17	6.84
	2010	70.44	46.63	100.38	98.04	53.20	7.42
	2018	79.30	50.71	145.85	139.11	70.42	7.91
Poland	2005	17.86	4.19	29.68	17.60	11.63	4.82
	2010	20.18	5.17	38.32	29.07	14.29	5.01
	2018	22.04	6.38	47.62	41.14	17.18	5.85
Nether-lands	2005	43.50	16.17	144.73	76.12	66.35	7.53
	2010	49.23	18.68	269.15	131.75	81.80	7.98
	2018	58.89	21.50	341.48	145.55	102.59	8.87
France	2005	75.61	65.62	75.92	57.70	43.35	6.40
	2010	86.87	77.80	109.39	73.37	51.91	6.65
	2018	97.62	85.21	114.09	92.63	64.68	6.89
Ireland	2005	49.02	9.59	75.15	32.78	51.77	5.27
	2010	59.18	14.17	139.94	58.06	63.75	5.45
	2018	63.82	16.98	118.31	72.01	82.81	5.88
Great Brit-ain	2005	91.78	36.27	54.13	79.36	97.33	6.99
	2010	105.21	44.10	91.66	113.24	120.96	7.42
	2018	124.25	52.31	117.34	159.64	146.49	7.48
Denmark	2005	90.62	17.58	672.023	158.671	96.64	8.07
	2010	145.13	40.00	638.19	335.82	149.96	8.54
	2018	180.56	59.19	602.44	315.36	187.56	9.82

X_1 – Owned land (ha); X_2 – Leased land (ha); X_3 – Value of farm buildings (EUR); X_4 – Value of tractors, agricultural machines and equipment (EUR); X_5 – Herd size (average); X_6 –Milk production (kg/year)

Source: own elaboration

In the compared countries, the competitive position of representative dairy farms changed over time due to variations in productive capacity and market factors. The values of partial measures and indicators considered in the CICP differed significantly between representative dairy farms in the evaluated countries as well as over time (Table 2 and 3).

Table 3. Selected measures and indicators describing **representative** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**destimulants**)

Country	Year	Indicators (destimulants)			
		X_7	X_8	X_9	X_{10}
Germany	2005	221.90	9.03	15.96	43.51%
	2010	204.74	10.04	17.56	28.58%
	2018	308.56	15.42	25.05	17.77%
Poland	2005	30.07	1.64	9.04	70.68%
	2010	53.00	2.59	6.13	58.96%
	2018	93.89	4.97	5.11	47.78%
Netherlands	2005	561.72	11.50	25.51	23.46%
	2010	703.37	13.35	30.48	22.79%
	2018	900.93	17.37	25.63	-1.82%
France	2005	124.20	9.76	39.38	40.03%
	2010	130.60	11.02	43.09	28.06%
	2018	140.25	12.84	48.64	27.35%
Ireland	2005	328.36	9.09	4.15	22.72%
	2010	223.38	11.13	16.04	-2.64%
	2018	401.71	12.24	5.51	-19.97%
Great Britain	2005	197.80	10.95	13.97	-12.77%
	2010	306.14	10.47	5.66	27.57%
	2018	275.28	12.87	17.63	-29.81%
Denmark	2005	592.78	17.68	65.28	52.96%
	2010	600.33	22.26	68.05	120.20%
	2018	608.09	23.86	76.71	-24.00%

X_7 – Agricultural rent (EUR/ha); X_8 – Cost of hired labor (EUR/h); X_9 –Debt-to-equity ratio (%); X_{10} – Disparity between farmers' incomes and non-agricultural incomes (%)

Source: own elaboration

In the entire analyzed period, the average value of the CICP was lowest in representative Polish dairy farms (and highest in British farms. In 2018, the remaining countries were arranged in the following descending order based on their CICP values: Denmark, Germany, the Netherlands, France and Ireland. Interesting observations were made in Denmark in 2010 and 2015, when dairy farms reported losses, which

influenced the value of the CICP and placed Danish businesses at the bottom of the ranking. In 2018, the performance of Danish dairy farms improved, and Denmark ranked second on the list. In 2005-2018, representative Polish dairy farms were characterized by the lowest competitive position in comparison with the remaining countries, and the value of the CICP was several dozen times lower relative to the compared EU Member States.

Table 4. Composite Indicator of Competitive Position (CICP) of **representative** dairy farms in selected EU countries in 2005-2018

Year	Country						
	PL	DE*	FR	GB	NL	IE	DK
2005	0.004	0.359	0.345	0.457	0.270	0.205	0.230
2010	0.015	0.333	0.299	0.435	0.227	0.184	0.217
2015	0.005	0.276	0.265	0.370	0.209	0.155	0.198
2018	0.005	0.325	0.261	0.462	0.267	0.201	0.403

*PL – Poland, DE – Germany, FR – France, GB – Great Britain, NL – Netherlands, IE –Ireland, DK – Denmark

Source: own elaboration

5.3.2. Competitive position of "small" dairy farms in selected EU countries

The definition of a "small" dairy farm poses the first problem in assessing the competitive position of milk producers. In economic and agricultural literature, various approaches and criteria have been applied in to define this category of businesses (Hornowski et al. 2020). Agricultural holdings are most often classified based on land resources (area of agricultural land). Other measures for describing the economic size of farms include the European size unit (ESU) and standard output (SO). In Polish economic and agricultural literature, Wojewodzic (2017) relied on economic size and the area of agricultural land to define "very small" farms as agricultural holdings with an area of 1-5 ha, less than 2 ESU (up to 2010) and 4 SO (after 2010), as well as "small" farms where the relevant values are twice higher. A different approach was proposed by Dzun (2013) who classified agricultural holdings based on economic size only and defined small farms as holdings with an SO of up to 4 (after 2010).

According to Sroka and Musiał (2013), in view of the specific attributes of small agricultural holdings in Poland, including a combination of agricultural and non-agricultural incomes, State subsidies, and diversification of business activities, the upper SO limit for classifying small farms in Poland should not exceed EUR 8,000. A different approach was adopted by Zegar (2012) who postulated that the upper limit for classifying small farms differs across countries, regions and municipalities, and changes over time. In some countries (such as Poland and Romania), a farm can be defined as "small" when it occupies an area of 2 or 5 ha, whereas in others (such as France and Great Britain), the size of a small farm can reach 20 ha or more. Similar observations were made by Wilkin (2013) who noted that only several decades ago, Polish farms with an area of 5-7 ha were classified as medium-sized holdings. The upper size limit continues to evolve and increase over time. In the future, much larger farms (15-20 ha) will probably be classified as small holdings, and this change of perspective can be already observed in some Western European countries. The financial performance and productive capacity of farms is also influenced by the type of production which, to a certain extent, determines resource use efficiency. In the dairy industry, the scale of production based on which dairy business are classified as "small" has increased steadily in recent decades. According to the data collected by FADN and *Statistics Poland*, dairy farms with an SO of EUR 8,000-25,000 were no longer classified as a separate group in 2018. The first group of commercial dairy farms comprised holdings with an SO of EUR 25,000-50,000. In the compared countries, the lower SO limit was considerably higher, which suggests that "small" dairy farms were characterized by a much higher productive potential and production scale than Polish businesses. The purpose of this study was to evaluate the competitive position of dairy farms in selected EU countries; therefore, "small" farms were defined as agricultural holdings with an SO of EUR 25,000-50,000. This approach is somewhat problematic because the corresponding groups of commercial dairy farms was identified only in Poland and Germany in 2018 in the FADN system. In the remaining countries, commercial dairy farms were characterized by higher SO. In addition to Poland and Germany, in 2005-2015, commercial dairy farms with an

economic size of EUR 25,000-50,000 were also classified as a separate group in Ireland and France.

Table 5. Selected measures and indicators describing **"small"** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**stimulants**)

Country	Year	Indicators (stimulants)					
		X_1	X_2	X_3	X_4	X_5	X_6
Germany	2005	12.66	7.58	40.92	30.19	15.95	5719.56
	2010	13.27	7.83	32.14	20.61	13.03	5510.77
	2018	12.79	6.48	21.75	24.98	12.07	4728.03
Poland	2005	21.45	8.12	45.22	33.16	20.67	5067.89
	2010	18.61	6.39	46.00	38.09	18.74	4841.00
	2018	15.16	4.36	40.67	32.20	14.71	4859.72
France	2005	14.09	22.39	24.59	28.94	21.95	5410.42
	2010	15.25	19.19	19.66	28.31	20.72	5414.71
	2018	-	-	-	-	-	-
Ireland	2005	23.39	2.26	37.83	9.53	24.27	4704.14
	2010	26.91	4.60	59.59	18.06	22.78	4434.59
	2018	-	-	-	-	-	-

X_7 – Owned land (ha); X_2 – Leased land (ha); X_3 – Value of farm buildings (EUR); X_4 – Value of tractors, agricultural machines and equipment (EUR); X_5 – Herd size (average); X_6 –Milk production (kg/year)

Source: own elaboration

Table 6. Selected measures and indicators describing **"small"** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**destimulants**)

Country	Year	Indicators (destimulants)			
		X_7	X_8	X_9	X_{10}
Germany	2005	183.64	8.75	6.95	74.90
	2010	199.87	6.84	4.48	78.10
	2018	267.59	8.19	3.46	75.05
Poland	2005	30.17	1.29	11.52	42.30
	2010	55.71	2.01	5.92	47.79
	2018	86.93	2.92	2.36	59.16
France	2005	69.81	8.66	20.86	71.60
	2010	95.73	9.93	16.27	72.29
	2018	-	-	-	-
Ireland	2005	260.62	5.15	1.41	67.50
	2010	135.43	9.76	2.58	77.34
	2018	-	-	-	-

X_7 – Agricultural rent (EUR/ha); X_8 – Cost of hired labor (EUR/h); X_9 –Debt-to-equity ratio (%); X_{10} – Disparity between farmers' incomes and non-agricultural incomes (%)

Source: own elaboration

"Small" commercial dairy farms differed in the values of partial indicators and measures that were included in the calculation of the CICP. It should be noted that average incomes in this group of agricultural holdings was considerably lower than average incomes outside agriculture in the compared countries. The analyzed farms were characterized by a relatively low debt-to-equity ratio, and the cost of hired labor was lowest in Poland.

In the evaluated group of "small" agricultural holdings, the highest value of the CICP was noted in Poland in the analyzed period. However, in 2005-2015, Poland was compared against three countries, whereas in 2018, the comparison involved only Poland and Germany. In 2005-2015, French dairy farms ranked second, with only a minor advantage over Irish businesses.

Table 7. Composite Indicator of Competitive Position (CICP) of **"small"** dairy farms in selected EU countries in 2005-2018.

Year	Selected EU countries			
	PL	DE*	FR	IE
2005	0.587	0.212	0.240	0.222
2010	0.534	0.150	0.258	0.222
2015	0.484	0.097	0.271	0.252
2018	0.750	0.250	-	-

*PL – Poland, DE – Germany, FR – France, GB – Great Britain, NL – Netherlands, IE –Ireland, DK – Denmark

Source: own elaboration

5.3.3. Competitive position of "large" dairy farms in selected EU countries

The identification of "large" dairy producers poses a similar methodological problem to the classification of "small" dairy farms. A rational approach is needed to determine the relevant criteria and threshold values. Economic size determined by the SO of an agricultural holding appears to be a robust criterion. An analysis of FADN data indicates that the largest group of dairy farms is composed of businesses with an SO higher than EUR 500,000. The above group is preceded by a group of dairy farms with an SO of EUR 100,000-500,000. The latter group can be identified in all compared countries; therefore, business in this economic size category were classified as "large" dairy farms for the needs of this study.

Table 8. Average values of selected measures and indicators describing **"large"** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**stimulants**)

Country	Year	Indicators (stimulants)					
		X_1	X_2	X_3	X_4	X_5	X_6
Germany	2005	25.16	51.94	112.55	97.14	58.52	7045.13
	2010	25.65	51.16	122.44	122.10	64.27	7476.69
	2018	27.25	45.98	137.63	134.51	67.80	7611.00
Poland	2005	85.02	86.38	159.76	128.50	97.59	6531.17
	2010	60.60	36.07	185.32	182.81	70.39	6656.84
	2018	40.03	24.84	148.14	149.43	59.47	7571.96
Nether-lands	2005	28.32	16.80	148.52	77.54	68.91	7516.96
	2010	29.02	18.43	259.72	126.86	78.50	8049.07
	2018	28.22	17.44	246.50	110.53	74.05	8525.19
France	2005	5.84	101.92	124.51	84.28	59.74	6716.94
	2010	6.83	99.20	139.23	91.14	63.45	6881.50
	2018	11.32	92.14	118.51	97.25	68.77	6915.56
Ireland	2005	56.27	17.79	120.84	56.56	83.05	5413.31
	2010	59.56	21.58	204.64	89.13	93.70	5624.63
	2018	52.08	19.19	138.30	83.62	94.87	5903.25
Great Brit-ain	2005	60.08	35.49	53.35	87.15	103.33	7016.75
	2010	57.68	35.07	79.09	97.46	103.02	7189.16
	2018	54.97	27.84	69.94	99.79	90.26	7013.93
Denmark	2005	70.51	13.02	627.11	140.14	87.95	8142.16
	2010	68.29	22.27	314.26	171.63	86.87	8263.83
	2018	65.99	18.22	172.14	83.69	70.80	8610.76

X_1 – Owned land (ha); X_2 – Leased land (ha); X_3 – Value of farm buildings (EUR); X_4 – Value of tractors, agricultural machines and equipment (EUR); X_5 – Herd size (average); X_6 – Milk production (kg/year)

Source: own elaboration

The partial indicators that were included in the CICP to denote the average productive capacity of dairy farms were similar in "large" dairy farms in the analyzed countries (Table 8). In 2018, the average herd size ranged from 59 head in Polish farms to 103 head in British farms. Excluding Dutch holdings which differed considerably from the remaining countries in this respect, land resources (owned and leased land) were determined in a range of 65 ha in Poland to 103 ha in France in 2018.

Notable differences in the values of partial indicators classified as destimulants were observed between the examined countries (Table 9). In 2005-2010, Poland was characterized by the lowest cost of hired labor and the lowest agricultural rents, and farmers' incomes in "large" holdings were substantially higher than incomes in other economic sectors.

Table 9. Average values of selected measures and indicators describing **"large"** dairy farms in selected EU countries that were used to develop the Composite Indicator of Competitive Position (CICP) (**destimulants**)

Country	Year	Indicators (destimulants)			
		X_7	X_8	X_9	$X_{10}0$
Germany	2005	274.84	7.36	19.93	21.48
	2010	236.12	8.25	18.86	4.29
	2018	300.28	14.44	21.66	7.05
Poland	2005	34.46	2.19	29.02	-174.85
	2010	52.40	2.50	14.08	-145.77
	2018	118.56	3.13	12.17	-119.88
Netherlands	2005	542.26	11.37	25.10	22.72
	2010	683.99	12.80	29.83	27.35
	2018	845.07	17.03	22.61	32.85
France	2005	132.64	10.35	45.01	13.28
	2010	136.75	11.21	46.35	8.04
	2018	141.21	12.73	49.22	21.88
Ireland	2005	355.99	9.54	5.13	-17.71
	2010	322.94	10.55	7.19	-6.06
	2018	399.64	12.05	5.36	-38.68
Great Britain	2005	233.87	11.14	16.56	-11.90
	2010	181.15	10.60	12.99	3.23
	2018	232.90	11.45	12.93	16.84
Demark	2005	450.23	16.99	63.80	51.54
	2010	492.46	21.35	51.96	80.99
	2018	501.54	23.64	51.58	38.61

X_7 – Agricultural rent (EUR/ha); X_8 – Cost of hired labor (EUR/h); X_9 –Debt-to-equity ratio (%); X_{10} – Disparity between farmers' incomes and non-agricultural incomes (%)

Source: own elaboration

An evaluation of the competitive position of "large" dairy farms indicates that Polish businesses were characterized by the highest

average value of the CICP in the entire analyzed period (Table 10). In 2005-2018, the competitive position of dairy farms was highest in Poland, but it decreased steadily in subsequent years, and Poland's advantage over Germany (which ranked second) decreased considerably in 2018. The observed decline in the competitive position of "large" Polish dairy farms can be attributed to decrease in their average productive potential relative to 2005 due to a higher number of smaller businesses in the group of "large" farms, as well as a steady increase in agricultural rents and cost of hired labor, and a decrease in the agricultural incomes derived by farmers and their families.

Table 10. Composite Indicator of Competitive Position (CICP) of **"large"** dairy farms in selected EU countries in 2005-2018

Year	Selected EU countries						
	PL	DE*	FR	GB	NL	IE	DK
2005	0.602	0.262	0.208	0.352	0.157	0.191	0.217
2010	0.427	0.227	0.073	0.261	0.156	0.195	0.135
2015	0.380	0.232	0.106	0.249	0.114	0.206	0.078
2018	0.377	0.301	0.121	0.247	0.149	0.215	0.047

*PL – Poland, DE – Germany, FR – France, GB – Great Britain, NL – Netherlands, IE –Ireland, DK – Denmark

Source: own elaboration

5.5. Summary and conclusions

In 2005-2018, representative Polish dairy farms were characterized by the lowest competitive position relative to the equivalent businesses in Germany, France, Great Britain, the Netherlands and Denmark. The average value of CICP calculated for representative dairy farms was several dozen times lower in Poland than in the compared countries. The CICP was developed based on the resource-based model, also known as the resource-based theory of entrepreneurship. The relationship between the incomes derived by dairy farmers and non-agricultural incomes was an important factor that was considered in the analysis. The lower the disparity between farmers' incomes and non-agricultural incomes (or if farmers' incomes exceed incomes in other economic sectors), the greater the incentive for developing agricultural production, including dairy

production. Representative dairy farms in selected EU countries were compared based on the calculated values of the CICP.

The competitive position of dairy farms is considerably influenced by the scale of production; therefore, to expand the scope of the analysis, CICP values were compared in groups of agricultural holdings with different economic size in selected EU countries. Two groups of businesses were identified. The first group of "small" dairy farms included holdings with an SO of EUR 25,000-50,000. The fact that in 2018, this category of commercial dairy farms was identified only in Poland and Germany based on FADN data was somewhat problematic. In the remaining countries, dairy farms were characterized by higher SO values. In addition to Poland and Germany, in 2005-2015, commercial dairy farms with an economic size of EUR 25,000-50,000 were also classified as a separate group in Ireland and France. In the identified group of "small" dairy farms, the average value of the CICP was highest in Poland in the analyzed period. Polish farms were characterized by a higher competitive position relative to similarly sized farms in the compared countries. However, "large" dairy farms were significantly more competitive than "small" farms in the evaluated countries in 2005-2018. Therefore, the CICP was also calculated and compared in "large" dairy farms, which were defined as agricultural holdings with an SO of EUR 100,000-500,000. This comparison revealed the highest average values of the CICP in "large" Polish dairy farms. In 2005-2018, the competitive position of "large" dairy farms was highest in Poland, but it decreased steadily in subsequent years, and Poland's advantage over Germany (which ranked second) decreased considerably in 2018. The study revealed that Polish dairy farms in different economic size groups possess competitive potential. Despite the above, a large number of "small" dairy farms in Poland decreases the competitive strength of the Polish dairy sector.

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6

ASSESSMENT RESULTS OF THE DAIRY CATTLE MILK RECORDING IN POLAND AND SELECTED COUNTRIES

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6.1. Introduction

In Poland, the share of animal products in agriculture and total food production is significant. Dairy cattle farming and milk processing have been the most important sectors of domestic agriculture since time immemorial (Litwińczuk and Grodzki 2014), which can be proved by the structure of commercial livestock production (Czekaj and Żmija 2011). Keeping dairy cows, due to milk production, is the most demanding among all cattle keeping categories (Wysokiński and Baran 2012). An important element in managing and increasing the herd's efficiency, apart from biological progress and breeding work, is performance control in the field of feeding and keeping dairy cattle (Ziętara 2007). Such control supports farmers' decisions regarding the rationalization of production costs, the possibility of increasing its scale, and optimization of fodder management, which are important internal factors influencing the positive prospects of milk production (Parzonko 2004). Also Klepacki (2006, 2007) indicates a greater impact of information, knowledge or

technology on the degree of farm development than the possession of classic factors of production.

The number of cows has decreased in recent years. It is compensated by improving their performance. Bórawski and Kowalska (2017) point out that the decrease in the number of dairy cows in the country is a result of the fact that many farms still have cows with lower milk yield, which are successively replaced with animals with higher milk yield.

Considering the milk yield of cows in the European Union countries in 2018, it must be said that Poland is not among the leaders. It is missing over 800 kg / pc. to the average European yield (7,280 kg / cow). Producers from Denmark, Estonia and Finland achieved the highest level of productivity with respectively 9,851 kg / cow and 9,353 kg / cow and 9,095 kg / cow (Cook 2019). In the following years, an increase in cows' milk yield is expected in Poland, although it will depend on the improvement of production technology, breeding value and the assessment of the utility value of cows in new herds.

The use of cattle milk recording enables the recognition of the current productivity of the herd and determines the directions of changes in the production process in order to achieve high milk yield (Gaworski and Wójcik 2013), the model chemical composition of milk and increase the farm income. The use of milk recording results in farms allows for rationalization of inputs and direct production costs. Through the optimal selection of nutrition, disease prevention, incl. mastitis, selecting animals with good fertility and construction for a long production cycle, it is possible to obtain the benefits of a higher milk production volume with high protein and fat content without significantly increasing the cost level.

6.2. Milk recording and International Committee for Animal Recording

The first information about adoption milk recording is from 1883 from the USA, while the first Milk Recording Syndicat, came into operation in the Seine Maritime Department in 1907 in France. In the following years, milk recording began to be used in other countries (Figure 1) according to individual methodologies, which were characterized by a different level of advancement and different precision. The main area of

interest was the measurement of milk fat content. The first attempts at international standardization of milk recording took place in the years 1922, 1923, 1925, 1930, 1931. It was postulated to standardize the research method and the form of reporting results. In 1924, the first report on the state of milk recording entitled Dairy Cow Recording in Different Countries was published by the International Institute of Agriculture in Rome. It presents information on over twenty countries using milk recording and on 1.8 million recorded cows. After a decade, in 1935, the Institute published an updated report entitled Dairy Cow Recording World Wide, in which he presented information about 34 countries using milk recording, 14 thousand. zootechnicians, 285 thousand farms practicing milk recording and about 4.5 million units of participating cows.

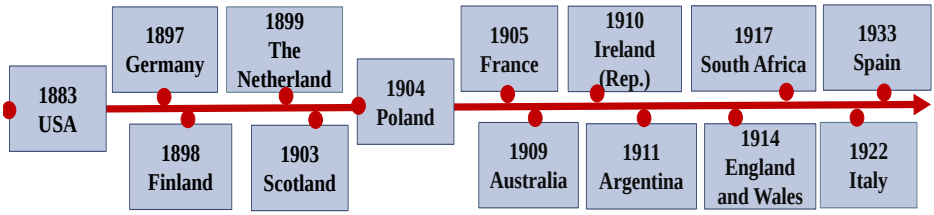


Figure 1. Starting milk recording in selected countries
Source: own elaboration based on ICAR data

Following the regulation of issues related to herd books and frequent replacement of animals in Europe, it became necessary to regulate the milk yield of these animals. The European Committee for Milk Registration has been created. It consisted of representatives of the organizations concluding the agreement. In 1951, the Food and Agriculture Organization of the United Nations (FAO), as a result of many months of work of a group of experts, led to the conclusion of an agreement on the harmonization of milk registration methods, calculation procedures and reporting of results (FAO 1951). Over the years, the European Committee has grown into an international organization – the International Committee for Animal Recording (ICAR). As a global organization, it sets the standards for animal registration and milk recording. Its guidelines unify the registration and measurement system and are an expression of participation in its creation.

6.3. Historical outline of milk recording in Poland

The first mentions of milk recording in Poland date back to the second half of the 19th century. Milk recording was introduced to the national animal science practice in 1904 after the establishment of Koło Kontroli Obór in Wilczyce near Sandomierz (Goździkiewicz 2004). It was a period of significant changes in domestic agriculture. Cattle were gradually released from traction use. Innovative crop rotations were introduced. The cultivation of plants friendly to the development of dairy cattle farming was started. In the years 1914-1920, due to hostilities, the work of Koła Kontroli Obór was interrupted. In 1921, already in the territory of the Second Polish Republic, milk recording was reactivated. Uniform milk recording rules have been introduced. As well as high standards of milk sampling and keeping breeding documentation. In 1940-1944, the control system was reorganized by the German occupier (Stolzman 1983). They introduced all-German breeding and milk control regulations. In 1945, right after the Second World War, the Association of Kół Kontroli Obór was reborn. Their rapid development was possible thanks to milk recording assistants trained by the Germans, equipped with German Gerber devices, pipettes, lip meters, and milk scales. In 1947, they handed over the milk recording to the Provincial Cattle Breeders Association. Then, until 1958, milk recording was carried out by employees of Samopomoc Chłopska Association, and then by zootechnicians employed in the Presidiums of Poviat National Councils. By order of the Minister of Agriculture No. 92 of May 31, 1958, Wojewódzkie Stacje Oceny Wartości Użytkowej i Hodowlanej Zwierząt Gospodarskich (WSOZ) (Goździkiewicz 2008) were established. The separation of the milk recording service in WSOZ allowed for the widespread introduction of milk recording in state and cooperative herds, as well as its significant extension to better herds of individual farmers. Farmers who introduced milk control on their farms, apart from the benefits of nutritional and breeding advice, had a chance to sell breeding material and increase their income. In the first half of the 1970s, people began to be interested in the use of electronic records system. Subsequently, a unified

data processing system was developed, later named SYMLEK. It was applicable all over the country. On August 26, 1975, by the Regulation of the Minister of Agriculture No. 170, the Central Animal Breeding Station, 16 District Animal Breeding Stations and 52 Breeding and Insemination Stations were established. On January 1, 1977, Animal Breeding and Insemination Stations took over the supervision of milk recording. Then, at the beginning of the 90s, after another reorganization, District Animal Breeding Stations ran milk recording. Subsequently, on July 1, 2006, the Polish Federation of Cattle Breeders and Dairy Farmer (PFCBDF) took over from the National Animal Breeding Center (Central Animal Breeding Station until December 31, 2000) carrying out milk recording tasks pursuant to the Regulation of the Minister of Agriculture and Rural Development of October 26, 2005 amending the regulation on entrusting breeders' associations and other entities authorized to keep books of breeding animals with tasks in the field of milk recording or breeding animals (Journal of Laws No. 214, item 1813).

6.4. Methods of milk recording, the use of electronic computing techniques and the presentation of its results

Milk recording is the basis on which the improvement of production characteristics is based. It provides information on cow milk recording ancestors, their milk yield, milk composition (fat, protein content), calving, mating and drying dates, diseases, birth and loss dates, and other events related to the assessed animals. The most important element of milk recording is the milk yield of cows. It is determined systematically on the basis of milk sampling. Daily, periodic and annual productivity is determined, as well as for 100 and 365 days of lactation and for the entire lactation (from calving to dry). These data are used to calculate the average milk yield of cows, the whole herd or the whole race. By analyzing the milk yield of cows, it is possible to evaluate the progress in the following areas: milk production, high milk yield transmission, desired milk composition, easy milking ability and other useful features.

Milk recording enables the use of standardized feeding according to the needs of each cow. This means that the ration depends on the body weight of the cow, the physiological state (pregnancy, dryness) and milk

production. Individual nutrition is economical thanks to the maximization of milk yield and rational fodder management.

In Poland, it is run by the Polish Federation of Cattle Breeders and Dairy Farmer. The scope and methodology of milk recording are approved by the Ministry of Agriculture and Rural Development.

In Poland, the methods of milk recording approved by ICAR are used. They belong to the group of methods A. This means that all milk samples and entries in the breeding documentation are made by an authorized representative of the organization conducting milk recording. The milk test is carried out by a person authorized by the teacher of milk recording. Control always covers all animals in the herd and is uniform for all dairy cows. In the case of herds with a milking robot, the system used determines the choice of the milk recording method. Table 1 lists the milk recording methods used in Poland.

Table 1. Types of milk recording methods used in Poland

Method	Minimum number of milk samples per year	Description of the method
A4	11	consists of determining the quantity of milk milked for 24 hours and taking a cumulative milk sample made up of samples from each milking carried out during that period; 4 weeks interval until the next milk sample collection
A6	8	consists of determining the quantity of milk milked for 24 hours and taking a cumulative milk sample made up of samples from each milking carried out during that period; 6 weeks interval until the next milk sample collection
A8	6	consists of determining the quantity of milk milked for 24 hours and taking a cumulative milk sample made up of samples from each milking carried out during that period; 8 weeks interval
AT 4/6	11 / 8	**only for herds with double milking;** consists of determining the quantity of milk milked for 24 hours and taking a milk sample from a single milking on the day of the test, alternately in the morning or in the evening; 4/6 weeks interval until the next milk sample collection
AR 4/6/8	11 / 8 / 6	**only for milking robots**; consists in determining the amount of milk on the basis of data from the robot's computer system and a milk sample collected automatically for each cow from one milking a day; 4/6/8 weeks interval until the next milk sample collection
AZ 4/6/8	11 / 8 / 6	**only for herds equipped with computerized milking hall with calibrated milk meters** (milking up to 3 times a day); it consists in determining the daily milk production based on the data from the computer system of the hall and the milk sample taken by the zootechnician for each cow from one milking a day; 4/6/8 weeks interval until the next milk sample collection

Source: own elaboration based on the milk recording methodology used by PFCBDF.

In order to ensure full reliability and comparability of the collected data, devices for measuring milked milk must be traceable to SI units, permanently or temporarily approved by ICAR. In addition, they must be systematically assessed or calibrated. The amounts of milk milked are measured using scales, mechanical milk meters and electronic devices for automatic milk measurement. The collection, processing and sharing of information collected in the milk recording process takes place with the use of the SYMLEK information system. This process is becoming more and more automated with each passing year. The basic method of presenting the results of milk recording conducted in their herds to breeders are the Result Reports (RW) generated from the system (Table 2). The reports support the daily work of breeding in a cow herd, enabling

efficient detection of infections and other health abnormalities, and also allow to rationalize the nutrition of cattle (Słoniewski 2010).

Table 2. Types of milk recording Result Reports (RW)

Appellation	Report details
RW-1 HERD	Periodic report presenting summary information on milk production in a recorded herd.
RW-2 ASSAY	It contains basic information such as the results of the last milk sampler and the lactation performance of each cow from milk recording herd.
RW-3 REPRODUC-TION	It presents synthetic indicators characterizing the state of reproduction in a herd in relation to cows and heifers.
RW-4 YOUTH	Contains information on registered heifers in the herd.
RW-6 OCCURRENCE	Supports reproduction management in dairy herds by presenting chronologically the dates of predicted events (drying off, calving, mating).
RW-7 BREED-ING VALUE	Provides information on the breeding value of the cows in the herd for which this value was estimated during the last valuation.
RW-8 SOMAT-ICS	Analysis of the content of somatic cells in milk, showing a significant increase in their level or a chronically high level in the milk.
RW-9 RACE – COWS	It presents information about the milk yield of cows by race and the reproduction rates for the current and previous lactation.
RW-10 RACE – HERD	It presents information about cows' productivity, but presented in total for all cows belonging to a given race.
RW-11 NUTRI-TION	It enables the assessment of cow nutrition on the basis of milk yield and chemical composition. It presents the lactation curve and the urea content in milk.

Source: own elaboration based on PFCBDF data.

In addition, breeders can use the data collected about their animals in the Stado OnLine (SOL) program. A large range of data is collected and stored there. Data can be shared and effectively used in the process of work planning and management of a cattle herd. The system also allows the user to keep records of events in his herd of cows.
The costs of using milk recording include the fee for taking a milk sample. Its amount depends on many factors:

1. assessment methods,
2. a holding equipped with its own calibrated measuring devices and samplers or the necessity to use milk recording devices of the service provider,
3. co-financing the service from the state budget,
4. forms of documentation (paper or electronic).

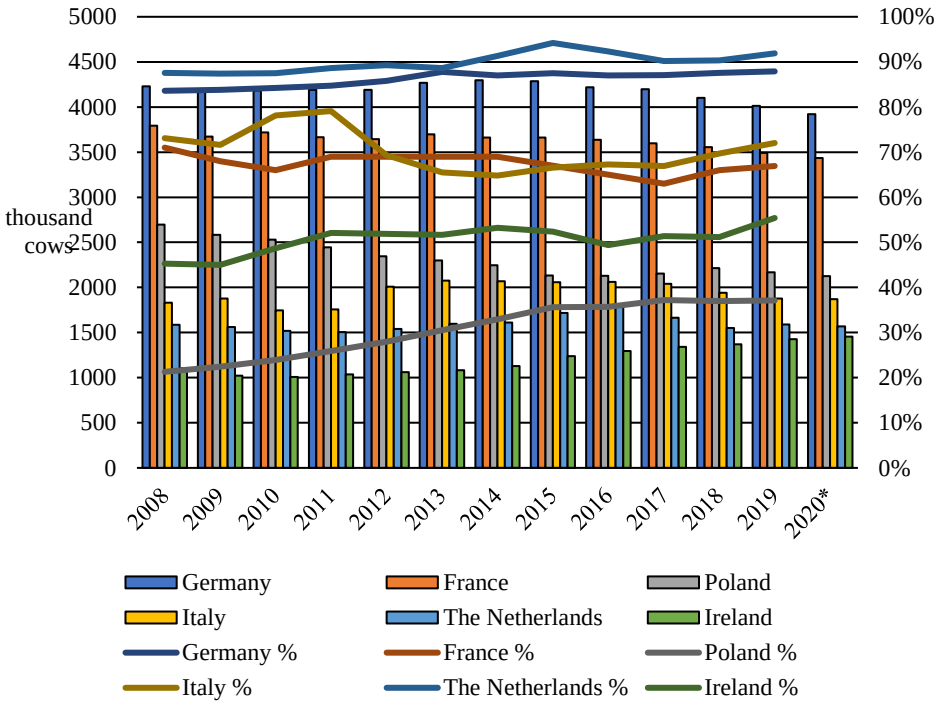
As part of this fee, the breeder receives the results reports RW-1 and RW-2 in paper or electronic form. In addition, the breeder can pay for services such as:

1. other selected reports,
2. nutrition counselling,
3. feed composition analysis,
4. assessment of meat functional properties,
5. testing of additional milk samples.

6.5. Economic aspects of the development of milk production and milk recording

At the end of 2020, the number of cows in milk recording decreased by 2.3%, i.e. to the level of 785,008 cows, and the number of milk recording cows accounted for 36.9% of the total dairy cows (PFHBiPM 2021). Nevertheless, a systematic increase in the share of milk recording cows is observed in Poland. In the past decade, it has increased by over 151 thousand. cows, i.e. by 23.8% (Gandecka 2012, PFHBiPM 2021).

The share of milk recording cows in the general population in Poland differs significantly from the share of cows in other ICAR member countries. In 2019, in the Netherlands it was 91.9%, in Germany – 87.9%, while in Italy and France it was 72.0% and 66.9%, respectively, compared to 37.1% in Poland (Figure 2).

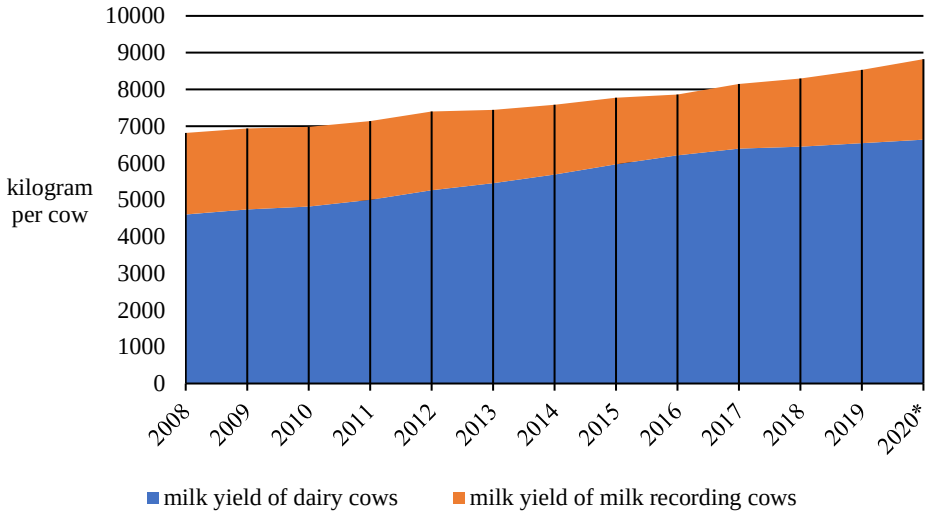


* prognosis: France, Poland

Figure 2. The number of dairy cows in selected EU countries and the share of milk recorded cows

Source: own elaboration based on ICAR, PFHBiPM and IERiGŻ-PIB data

An important indicator in the context of the efficiency of milk production is the milk yield of cows, the improvement of which is the main goal of milk recording. In the last decade, the average milk recording capacity of cows in Poland has increased by 1,688 kg/cow (to 8,823 kg/cow in 2020), i.e. by 23.7% (Figure 3). At the same time, the parameters of milk, on which its price depends, were maintained at a high level (Jurczak 2005). In 2020, the average fat content was 4.07% and protein 3.41% (PFHBiPM 2021).



* estimation IERiGŻ-PIB – milk yield of dairy cows

Figure 3. Milk yield of dairy cows and milk recording cows in Poland

Source: own elaboration based on PFHBiPM and IERiGŻ-PIB data

Despite the increase in milk yield of cows under milk recording, its level still differs from that of our European neighbors. Impressive results in 2018 were achieved by Portuguese and Danish breeders with an average yield of 10,812 kg / cow and 10,263 kg / cow, while production over 9,700 kg / cow was recorded in Belgium (9,941 kg / cow), in the Netherlands (9,853 kg / cow), Sweden (9,827 kg / cow), Finland (9,795 kg / cow) and Estonia (9,785 kg / cow) (ICAR 2019).

The marketability of farms' production is determined by the economic and natural environment. The dynamic development of modern technologies, in particular related to cow breeding and milking, provides breeders with tools to improve the economics of production. Skillful use of these possibilities allows for the improvement of its process (Wójcik 2013). Farmers may be interested in milk recording in their herds because of the ability to monitor production performance and the health of the herd. This will allow better use of the potential of the entire herd, increase in income and improve the profitability of production. Nevertheless, attention should be paid to the costs associated with the purchase of such a service and the level of knowledge possessed by breeders necessary to interpret the obtained milk recording results.

6.6. Summary and conclusion

The dairy cattle stock varies across the European Union. It is influenced by the organizational and production possibilities of the region, climatic conditions, concentration of dairy cows rearing and milk processing, modernization and the hygienic and sanitary condition of farms. Poland is one of the European leaders in dairy cattle breeding, keeping almost 10% of the cows in the Community.

In the last decade, the Common Agricultural Policy has been the main stimulus for the restructuring of the Polish dairy sector. Therefore, an annual decrease in the total number of cows is observed. At the same time, it compensates for the improvement in their efficiency. Apart from biological progress and breeding work, an important element in managing and increasing the herd's efficiency is milk recording. It is important in the context of the feeding and maintenance of dairy cattle. On the other hand, the key indicator of the efficiency of milk production is the milk yield of cows. Its improvement is the primary goal of milk recording. In the last decade, the average milk yield of milk recording cows in Poland has increased by over 20%. Despite the annual increase, its level still differs from the results achieved in other EU countries.

The increase in milk yield of cows in Poland in the coming years will depend on the improvement of production technology, breeding value and launching milk recording in new herds. Like in whole UE, milk yield will increase. But due to the need to differentiate milk production systems, the process will be much slower. Its current intensification, motivated by economic benefits, has a negative impact on the environment, animal welfare, socio-economic welfare and human health.

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PART II

STATE OF AND CHALLENGES FOR POLISH DAIRY FARMS

7

ORGANIZATION AND ECONOMIC SITUATION OF POLISH DAIRY FARMS KEEPING FADN AGRICULTURAL ACCOUNTING AND INVESTING[4]

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7.1. Introduction

Dairy farming is one of the important branches of agricultural production. In recent years, a dynamic increase in cows' milk yield and milk production has been observed, which takes place mainly on farms with a conventional farming system (Runowski 2009).

The milk market was one of the most regulated in the EU. Milk quotas were an important instrument. In addition, there were intervention purchases on the milk market, as well as subsidies for the processing and storage of products. An important group of instruments were the

[4] The research was carried out as part of a project financed by the National Science Center (NCN) in Poland, 2018/29 / B / HS4 / 00392.

regulations of foreign trade through export subsidies, tariffs and others (Hamulczuk and Stańko 2009). The liquidation of these and other instruments on the milk market meant that dairy farms had to increase the acreage and milk production in order to stay on the market. Moreover, in order to develop, they must increase the efficiency of the production scale (Parzonko 2009). At present, market factors are of greater importance in the development of milk production.

Poland's accession to the EU had a positive impact on the milk market. In addition, access to EU markets and the need to adapt farms to EU standards resulted in the improvement of sanitary and veterinary conditions and animal welfare (Korolewska 2006). Moreover, EU aid in the form of subsidies and Rural Development Programs (RDPs) had a positive effect on the development of dairy farms. Therefore, it is appropriate to study the changes that took place on dairy farms after the accession to the EU. Dairy farms implement various strategies to survive and develop. One of them is investing. Therefore, the IERIGŻ-PIB in Warsaw obtained data on dairy farms implementing investments.

The aim of the research was to find out about the economic situation and changes that took place after integration with the EU. As part of the main objective, the following specific objectives were implemented:

- assessment of changes in the area of dairy farms,
- getting to know the organization of plant and animal production,
- identification of the economic situation and its changes in dairy farms,
- evaluation of investments in dairy farms.

7.2. Characteristics of the researched dairy farms

In the years 2007-2017, the number of dairy farms keeping FADN agricultural accounting in Poland decreased from 6,474 to 4,406 (i.e. a decrease by 32%). Among the dairy farms keeping FADN agricultural accounting and implementing investments, few benefited from financial support. The largest number was in 2012 (383 farms, which constituted 8.2%).

The economic size of dairy farms increased in 2017 to PLN 45,477.3 from PLN 17,773.02 in 2007 (i.e. an increase by 255.9%). The data presented in Figure 1 clearly indicate large changes in the economic size of dairy farms, which in 2007-2017 increased by 156% (Figure 1).

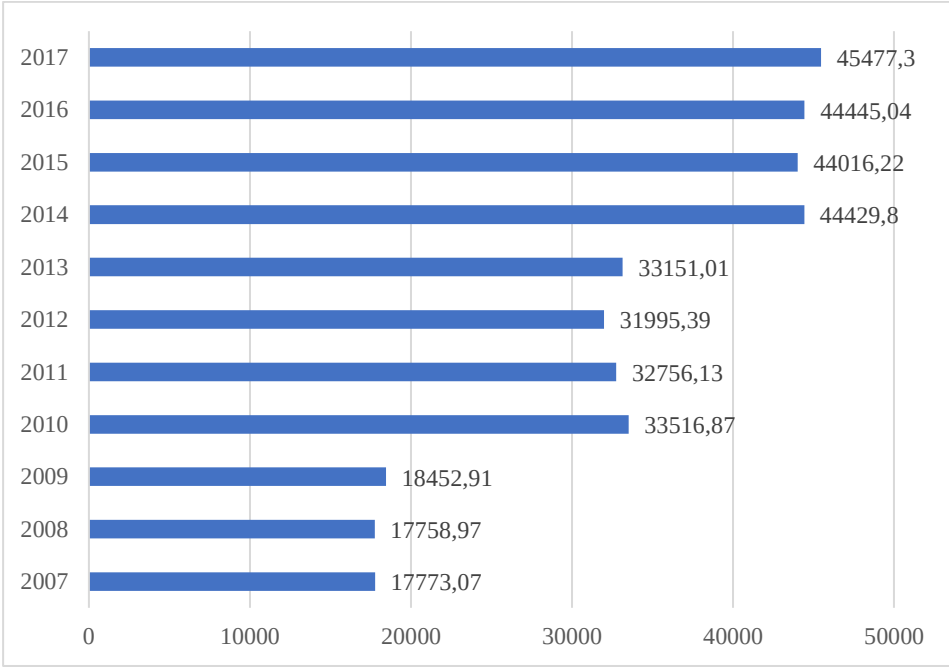

Figure 1. Economic size of dairy farms

Source: own studies based on FADN data

In the analyzed period, total labor inputs increased by 1.4%, own labor inputs by 4.1%, and hired labor inputs decreased by 35% (Table 1). The results may indicate that dairy farm owners are reducing external employment. This may be the result of investments made and difficulties in obtaining employment from the market. Labor resources in the countryside are shrinking and the owners of dairy farms, in order to stop and develop, buy machines and devices that allow them to do the work independently.

Table 1. Labor inputs in the researched dairy farms

Number of dairy farms		Year	Total labor inputs	Own labor inputs	Hired labor inputs
Toal	benefiting from financial support for investments				
6474	n.o.	2007	1,91	1,78	0,13
6218	n.o.	2008	1,92	1,81	0,12
5984	320	2009	1,94	1,82	0,11
5312	289	2010	1,92	1,82	0,10
5046	336	2011	1,91	1,83	0,09
4695	383	2012	1,92	1,84	0,08
4003	130	2013	1,86	1,81	0,05
5097	148	2014	1,95	1,85	0,10
4933	185	2015	1,90	1,84	0,05
4682	n.o.	2016	1,94	1,86	0,08
4406	n.o.	2017	1,94	1,86	0,08
Changes 2017/2007	-	-	1,6	4,5	-38,5

Source: own studies based on FADN data

Land resources are an important factor in the development of dairy farms. Poland has favorable conditions for the development of milk production (Trajer and Krzyżanowska 2015). The provinces with large resources of grasslands are predisposed to the development of dairy production (Cieślik 2010). In 2007-13, the largest area was occupied by cereals, and in 2014-17 by fodder crops. The average area of UAA (Utilized Agricultural Area) in the researched farms increased from 26.4 ha in 2007 to 31.2 ha in 2017 (i.e. an increase by 18.2%). In turn, the area of field crops increased from 9.7 ha in 2007 to 15.9 ha in 2017 (i.e. an increase by 64%). The results obtained from IAFE-NRI prove that farm owners adapt crops to the needs of animal production (Table 2).

Table 2. Land resources in the researched dairy farms

Year	Farmland	Leased farmland	Crops area	Area of other field crops	The area of field crops	Orchard area	Forage crops area
2007	26,40	7,59	13,69	2,68	0,08	0,08	9,68
2008	27,68	8,12	14,44	2,45	0,10	0,10	10,42
2009	28,73	8,38	14,40	2,48	0,10	0,10	11,47
2010	28,85	8,31	13,82	2,62	0,09	0,09	11,99
2011	28,40	8,09	13,71	2,44	0,08	0,08	11,87
2012	27,94	7,87	13,60	2,25	0,07	0,07	11,74
2013	24,89	6,86	11,86	2,23	0,08	0,08	10,45
2014	30,86	9,08	13,28	2,56	0,06	0,06	14,62
2015	30,69	8,99	12,66	2,66	0,06	0,06	14,99
2016	30,81	9,12	12,38	2,48	0,06	0,06	15,58
2017	31,19	9,48	12,27	2,61	0,06	0,06	15,89
Changes 2017/2007	18,1	24,9	-10,4	-2,6	-25,0	-25,0	53,5

Source: own studies based on FADN data

An important branch of production on dairy farms is the rearing of dairy cows. Their number increased from 10.54 in 2007 to 18.56 in 2017 (Table 3). The number of remaining cattle also increased during the period considered. On the other hand, the number of sheep and goats, pigs and poultry decreased. The results demonstrate a specialization in milk production. Increasing the number of dairy cows and other cattle proves the development of this branch on farms. On the other hand, the decrease in the number of pigs proves that dairy farms are getting rid of this type of production. In addition, the decisive factor in increasing the cow population is the modernization of the raw material (Milk Market 2018). In the Polish dairy industry, there is an increase in the number of cows on the largest farms, with the simultaneous liquidation of the smallest farms. According to IERiGŻ-PIB, there are approximately 230,000 jobs in the country. farms keeping cows, of which 120 thousand are suppliers for processing plants. Increasing the number of dairy cows and thus milk production causes changes in the supply chain, transport, processing, trade, and of course has negative environmental consequences (Sonneson and Berlin 2003).

Milk production systems in the EU vary from extensive to intensive and are implemented from lowland to mountain areas (European Commission 2000). Polish milk production systems are classified as extensive and located in lowlands, although on many farms an increase in the milk yield of cows was observed.

Table 3. Animal production (Lu)

Year	Total livestock	Dairy cows	Other cattle	Sheep and goats	Pigs	Poultry
2007	25,95	10,54	6,44	0,06	8,64	0,10
2008	26,06	11,51	7,19	0,05	7,03	0,11
2009	27,57	12,64	7,96	0,05	6,62	0,14
2010	28,86	13,21	8,63	0,05	6,70	0,12
2011	28,38	13,03	8,70	0,06	6,36	0,11
2012	27,89	12,85	8,76	0,06	6,01	0,10
2013	23,72	11,40	6,92	0,08	5,10	0,12
2014	34,10	16,69	12,43	0,05	4,73	0,10
2015	33,79	17,20	11,99	0,06	4,34	0,11
2016	34,25	17,82	12,53	0,06	3,66	0,10
2017	35,40	18,56	13,21	0,05	3,40	0,10
Changes 2017/2007	36,4	76,1	105,1	-16,7	-60,6	0,0

Source: own studies based on FADN data

Animal production is an important area of activity on dairy farms. The density of animals and the milk yield of cows were used for its evaluation. The FADN data show that the stocking density in 2007-2017 increased from 2.26 l / ha to 2.38 l / ha (i.e. an increase by 5.3%). Increasing the stocking density on the farm is the result of increasing the herd of cows and other cattle.

In turn, the milk yield of cows increased in the analyzed period from 3,984.5 kg / cow to 4,931.6 kg / cow (Table 4). In the Polish, European dairy industry, an increase in the milk yield of cows is observed. This is due to the selection of more efficient animal breeds and a better feeding system. Changes in the stocking density and milk yield of cows cause changes in milk production, which is regionally differentiated. The largest milk producers include the following voivodeships: Podlaskie,

Mazowieckie, Wielkopolskie and Warmińsko-Mazurskie (Seremak-Bulge 2005).

Table 4. Stocking density and milk yield of cows

Year	Stocking density Lu/ha	Milk yield kg/cow
2007	2,26	3894,46
2008	2,28	3986,92
2009	2,21	4092,00
2010	2,29	4081,69
2011	2,32	4160,1
2012	2,35	4238,46
2013	2,21	4094,73
2014	2,37	4550,76
2015	2,31	4609,83
2016	2,30	4751,43
2017	2,38	4931,57
Changes 2017/2007	5,3	26,6

Source: own studies based on FADN data

The value of livestock production increased in 2007-2017 by 128.9%, and milk by 178.1%, and live cattle by 193.2% (Table 5). Increasing the production of milk and live cattle proves the progressive specialization. Dairy farm owners increase the production of milk and live cattle and reduce the remaining livestock production. The observed increase in the value of milk resulted from many factors. One of them was the liquidation of the quota system in 2015. Another factor was the increase in milk prices. The elimination of milk quotas and an increase in milk production may have consequences for the dairy industry, land use, and the environment, and may lead to increased nitrogen and phosphorus emissions (Groenevel et al. 2016).

A decrease in the value of livestock production was recorded in individual groups: pork livestock (-40.4), poultry livestock (-25.1%), other production (-20.5) and other animals (-15.8%).

Table 5. The value of livestock production in dairy farms (PLN)

Year	Livestock production	Milk	Beef livestock	Pork livestock	Sheep livestock	Poultry livestock	Eggs	Other animals	Other production	Transfer to farm	Internal consumption
2007	88001,1	55169,0	12026,8	19638,4	55,9	394,3	121,7	578,2	1200,3	2038,8	23313,7
2008	95520,9	60162,3	13232,4	19746,0	51,4	487,1	212,9	1609,9	1910,8	2168,8	24550,9
2009	95591,0	59576,6	16539,3	19074,2	45,5	528,8	217,9	-405,7	1341,8	2032,9	24063,9
2010	108865,6	72685,9	18487,7	16821,2	47,6	418,8	242,1	147,2	1283,5	2025,9	21276,9
2011	117879,4	75939,3	21605,9	19200,6	71,8	391,6	233,1	559,5	1344,5	2048,4	24764,1
2012	126893,2	79180,5	24724,1	21580,0	95,9	364,4	223,9	713,4	1405,5	2055,0	28251,4
2013	110578,9	72746,5	18580	18272,9	99,9	347,5	226,1	287,0	1216,9	2080,9	24803,4
2014	171121,8	128024,2	28577,2	13927,1	59,4	324,3	236,9	-44,8	1346,8	1831,6	26924,4
2015	155103,1	112106,5	30342,6	11791,7	60,4	455,0	189,4	146,7	1296,7	1576,9	24686,7
2016	159949,8	115360,4	30834,3	11526,7	82,4	446,0	204,6	1483,1	1164,1	1449,9	23387,5
2017	201474,9	153451,1	35257,3	11698,7	57,1	295,4	220,6	486,7	954,3	1474,5	24151,
Changes 2017/2007	128,9	178,1	193,2	-40,4	2,1	-25,1	81,2	-15,8	-20,5	-27,7	3,6

Source: own studies based on FADN data

Another section in dairy farms is plant production. Cereal crops are used for its evaluation. Wheat yield increased in 2007-2017 from 24.36 dt / ha to 26.12 dt / ha (an increase by 7.2%).

In turn, the yield of maize increased from 3.2 dt / ha to 7.78 dt / ha (i.e. an increase by 142%). Great interest in the cultivation of maize on dairy farms results from the use of this plant as feed. CCM (Corn Cob Mix) silage is prepared from the stalks and cobs, which is used in feeding cows, which improves milk yield (Table 6).

Table 6. Yields of wheat and maize

Year	Wheat yiels dt/ha	Maize yields dt/ha
2007	24,35	3,21
2008	26,74	3,28
2009	25,39	2,93
2010	23,33	2,30
2011	10,35	*1,37*
2012	22,59	6,70
2013	24,75	6,18
2014	29,00	7,93
2015	26,46	4,61
2016	24,13	7,48
2017	26,12	7,78
Changes 2017/2007	5,3	26,6

Source: own studies based on FADN data

Plant production is most often used as feed in livestock production. In 2017, compared to 2007, there was an increase in the value of protein plants (177.25), oil plants (69.75) and cereals (0.8%). In turn, the largest decrease in value was recorded for fodder crops (-49.5%), potatoes (-42.1%), vegetables and flowers (-41%), fruit (-40%), energy crops (-25.9%). %) and sugar beet (-5.1%). The value of plant production increased by 7.1% over the period considered, although for total production it was 75% over the period considered (table 7).

Table 7. Value of plant production in dairy farms (PLN)

Year	Total production	Plant production	Cereals	Protein crops	Energy crops	Potatoes	Sugar beets	Oil crops	Vegetables, flowers	Fruit	Forage crops
2007	145075,7	55874,3	33708,9	454,1	44,6	4934,0	3631,2	2920,7	2782,7	701,8	5227,2
2008	142013,2	44581,3	25625,7	301,5	45,7	4388,4	2647,6	3942,8	2316,2	674,3	3344,5
2009	135558,9	38626,1	21984,3	363,9	40,4	4393,6	3394,8	3479,6	2290,6	592,5	1280,6
2010	161047,7	50898,7	33378,7	618,9	5,4	5672,0	2941,4	3845,9	2420,7	719,4	515,3
2011	175029,2	55305,3	38197,2	929,8	0,0	4796,7	3608,9	3997,6	2293,7	682,3	592,2
2012	189010,7	60711,9	42835,7	1240,7	3,5	3921,4	4276,4	4139,3	2166,8	645,2	669,1
2013	160780,3	48984,4	31226,6	1044,2	0,0	5021,1	3572,3	4077,2	1989,8	759,7	673,2
2014	224304,4	51835,8	36294,7	1292,2	0,0	3358,4	3939,0	5071,6	1908,2	468,6	-1221,8
2015	199557,2	43157,4	31868,5	1473,8	8,9	3599,7	2785,8	5010,9	1739,4	604,1	-4115,5
2016	209001,2	47887,2	30000,8	1353,4	34,3	3223,1	3468,8	3777,9	1401,5	487,3	3612,4
2017	254328,7	51899,5	33965,8	1258,7	33,0	2856,8	3446,1	4957,6	1642,7	420,9	2639,9
Changes 2017/2007	75,3	-7,1	0,8	177,2	-25,9	-42,1	-5,1	69,7	-4,1	-40	-49,5

Source: own studies based on FADN data

7.3. Efficiency of dairy farms keeping FADN agricultural accounting and investing

In the production process, dairy farms incur costs related to fodder and other factors. The main and the largest category in terms of value is total costs, which include intermediate consumption, depreciation and external factors costs. Direct costs, on the other hand, are part of indirect consumption.

The highest increase in value in 2017 compared to 2007 was recorded for the costs of external factors (106.2%) and depreciation (98.9%). The greatest increase in the value of external factors costs resulted from the need to hire employees, use loans, rent land and others. On the other hand, the greatest increase in the depreciation value resulted from the investments carried out, the purchase of machines, which in the initial period of use are characterized by high value. In agriculture, we calculate depreciation linearly by dividing the value by the planned number of years (Table 8).

A factor conducive to the development of milk production in Poland is lower labor costs, which make it possible to compete on European markets (Roman 2017). Recently, labor and land costs have increased significantly, which has led to a decline in the cost competitiveness of Polish dairy farms (Parzonko 2013).

Table 8. Costs in the researched dairy farms (PLN)

Year	Total costs	Indirect consumption	Direct costs	Depreciation	Costs of external factors
2007	102640,3	80211,2	58340,8	17983,9	4445,2
2008	114950,2	88570,9	64079,1	21236,8	5142,5
2009	118917,2	89620,1	64310,1	23696,3	5600,8
2010	121155,9	91070,6	62832,3	24361,7	5723,5
2011	133134,4	101970,2	71680,9	25380,5	5783,0
2012	145112,9	112870,8	80529,5	26399,7	5842,4
2013	127965,9	97433,8	68674,5	25807,1	4725,1
2014	174148,8	132779,0	94550,8	33232,1	8137,7
2015	169671,2	126920,7	90393,4	34615,4	8135,2
2016	172203,7	128462,5	91323,6	35383,6	8357,5
2017	182194,8	137254,2	96546,6	35775,1	9165,4
Changes 2017/2007	77,5	71,1	65,5	98,9	106,2

Source: own studies based on FADN data

An important aspect of the work was to learn about the economic results of dairy farms keeping FADN agricultural accounting. The data show that in 2017, compared to 2007, the value of economic results increased by over 100%. A particular increase in value was observed in the case of net value added per full-time employee (108.3%) and family farm income (108.1%). Such a large increase in the value of economic results resulted from the increase in the value of livestock production as well as subsidies and other external financial flows. It was also the result of an increase in the milk yield of cows and the production of live cattle (Table 9).

Table 9. Economic results of the researched dairy farms (PLN)

Year	Gross value added	Net value	Income from family farms	Net added value per full-time employee	Income from family farms PLN per a full-time employee
2007	80382,5	62398,7	56480,4	30296,4	31349,0
2008	77428,9	56192,1	50771,0	27291,3	27548,4
2009	72326,4	48630,1	43013,5	23428,8	23196,7
2010	99589,7	75227,9	70192,5	36959,9	37774,7
2011	101670,6	76289,5	71109,7	38031,3	38242,7
2012	103751,4	77351,7	72026,8	39102,6	38710,6
2013	91384,6	65577,6	61802,4	34506,3	33806,2
2014	121354,4	88122,3	81529,9	42409,9	43111,0
2015	103269,6	68654,2	61782,9	34633,0	33067,8
2016	140089,2	104705,6	97981,6	52563,9	52734,0
2017	161406,4	125631,3	117542,9	63114,8	63701,2
Changes 2017/2007	100,8	101,3	108,1	108,3	103,2

Source: own studies based on FADN data

7.4. Equipping dairy farms with fixed and current assets

Dairy farms and farms keeping FADN accounting use total assets in their production, which include fixed and current assets. The analyzes show that in 2017, compared to 2007, an increase in all fixed assets was recorded. The largest increase in value was recorded for land, which increased by 535%. Such a large increase in the value of land results from the fact that land resources are used to produce milk. Moreover, after accession to the EU, an increase in demand for land was recorded, which translated into an increase in its value. Direct payments and other financial streams increased the price of agricultural land.

Buildings used to keep animals in good conditions were another group of assets (an increase of 146.6%). A rapid increase in value was also recorded for the livestock, the value of which increased by 139%. The smallest increase in value was recorded in the case of machines and tools (Table 10).

Table 10. Value of fixed assets on dairy farms (PLN)

Year	Total assets	Fixed assets	Land	Buildings	Machines and equipment	Basic herd
2007	487276,3	408141,7	96879,38	164501,4	112298,5	34462,41
2008	530119,5	446961,1	97986,26	178884,1	132637,4	37453,3
2009	947860,3	857697,2	466374,9	190259,5	159569,4	41493,39
2010	976621,6	876486,6	477098,7	193058,1	161538,3	44791,62
2011	1009846,3	899003,3	484076,1	193229,6	174978,2	46719,5
2012	1043071	921519,9	491053,4	193401,1	188418	48647,44
2013	965232,7	858649,5	456098,8	180804,8	177064,4	44681,6
2014	1268557	1133488	584805,0	234754,7	244920,1	69008,27
2015	1266561	1134890	583554,0	234943,2	244565,2	71827,72
2016	1297213	1146976	597051,7	236412,9	237202,6	76308,96
2017	1350251	1184840	615158,3	242735,1	244566,3	82380,3
Changes 2017/2007	177,1	190,3	535,0	146,6	117,8	139,0

Source: own studies based on FADN data

Dairy farms and FADN farms keep current assets in the production process. It consists of stocks of agricultural products and long and short-term liabilities. Its management is one of the important aspects of the functioning of both enterprises and farms (Wasilewski and Chmielewska 2006). It allows for the maintenance of financial liquidity, optimization of the structure of current assets and the implementation of an appropriate financial structure related to the minimization of costs (Sierpińska and Wędzik 1997).

The data show that in 2017, compared to 2007, an increase in the value of all current assets was recorded (Table 11).

Table 11. Value of current assets on dairy farms (PLN)

Year	Current assets	Stock of agricultural products	Total liabilities	Long-term liabilities	Short-term liabilities
2007	79134,6	33054,2	52164,9	38885,9	13279,0
2008	83158,4	37500,9	58186,0	44394,1	13791,9
2009	90163,1	32861,9	63306,9	47793,7	15513,2
2010	100135,0	39424,9	63410,8	48370,7	15040,1
2011	110843,2	44872,7	62115,0	47072,7	15042,3
2012	121551,3	50320,6	60819,2	45774,7	15044,5
2013	106583,2	42824,7	47689,9	36155,2	11534,8
2014	135069,2	50623,0	82639,7	64703,9	17935,7
2015	131671,2	43614,9	82275,1	63586,5	18688,6
2016	150237,0	46877,9	80720,5	62212,6	18507,9
2017	165410,8	52578,2	88200,4	67170,5	21029,9
Changes 2017/2007	109,0	59,1	69,1	72,7	58,4

Source: own studies based on FADN data

The sum of fixed and current assets reduced by long-term and short-term liabilities gives the capital of farms (Figure 2). Its value on dairy farms increased in 2007-2017 by 190%.

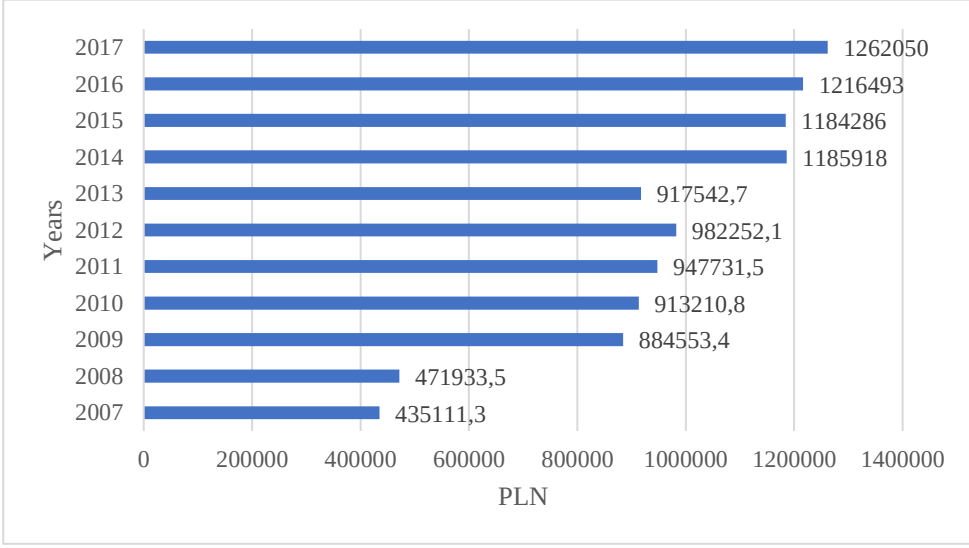

Figure 2. Equity of dairy farms

Source: own studies based on FADN data

7.5. Investments in dairy farms

Investments are one of the strategies of dairy farms. Their aim is to increase the competitive potential of farms. Investments carried out in dairy farms allow for their modernization and their adaptation to EU standards (Pietrzak 2014). As a result of the investments carried out, production costs are reduced, production capacity improved, as well as changes in supply and sales (Sierpińska and Jachna 1997). Moreover, the implemented investments in dairy farms contribute to the introduction of new technologies and improvement of milk quality and animal welfare (Bewley 2010). The benefits of the investments also include improved labor productivity, keeping farms in good condition, greater implementation of technology and increased herd of animals (Pouch and Trouré 2018).

Generally, according to the FADN methodology, investments are divided into gross and net investments. Net investments are gross investments minus depreciation. The highest value was observed for gross investments, the value of which increased from PLN 29,827.47 in 2007 to PLN 48,587 in 2017 (63%). Dairy farms invest in machinery, buildings and structures, animals and land (Table 12). In the conditions of strong market competition, investing is a necessary activity to stay on the market.

Table 12. Investment value (PLN)

Year	Gross investment	Net investment	Subsidies to investment
2007	29827,5	11843,6	1413,3
2008	24898,6	3661,8	1756,2
2009	30081,1	6384,7	1646,4
2010	32529,6	8167,8	2239,1
2011	38089,6	12708,9	2373,4
2012	43649,7	17250,0	2507,7
2013	28049,5	2242,5	2275,0
2014	41962,5	8730,5	3440,1
2015	33546,7	-1068,7	2806,9
2016	26550,6	-8832,9	2749,4
2017	48587,2	12812,1	2507,6
Changes 2017/2007	62,9	8,2	77,4

Source: own studies based on FADN data

7.6. Operating subsidies

With the accession to the EU, Polish agriculture was included in the instruments of the common agricultural policy. These include various measures targeting farms to modernize them and improve their competitiveness. These activities are not only a kind of financial aid, but also an incentive to conduct investments (Malak-Rawlikowska et al. 2007). The broad support included financial aid, consulting, training, and access to means of production (Dries and Swinnen 2004).

One of the most important instruments are direct payments. Dairy farm owners can benefit from operating subsidies, agri-environmental subsidies, subsidies for less favored areas and other subsidies for rural development. Among them, subsidies to operating activities constitute the greatest value.

One of the problems in the functioning of dairy farms is environmental pollution. Dairy farms produce large amounts of organic fertilizers and gases. The Common Agricultural Policy (CAP) provides financial support for more environmentally friendly agriculture (Cederberg and Mattsson 2000).

An important group of payments are payments to less-favored areas. Under Polish conditions, they cover a large part of the country. Farmers can apply for agri-environmental subsidies aimed at preserving the values of the natural environment. As emphasized by Czyżewski et al. (2019), agri-environmental payments contribute to the sustainable development of agriculture. The smallest group in terms of value were other subsidies for rural development.

Table 13 presents the subsidies obtained by dairy farms in Poland.

Table 13. Subsidies (PLN)

Year	Subsidies for operating activities	Agri-environmental subsidies	Subsidies for less-favored areas	Other subsidies for rural development
2007	16262,9	951,9	2147,9	657,4
2008	25139,9	1619,9	3286,1	581,7
2009	27689,6	1765,1	3166,5	557,5
2010	30420,9	2197,9	3141,6	468,0
2011	29562,3	2143,8	2971,5	691,5
2012	28703,6	2089,6	2801,5	690,8
2013	29220,4	2575,7	2816,5	155,2
2014	31158,6	2594,0	3103,7	263,9
2015	32143,5	1564,5	3015,8	1462,3
2016	61219,9	1464,8	3099,1	619,4
2017	45236,7	1313,8	3093,4	816,2
Changes 2017/2007	178,2	38,0	44,0	24,2

Source: own studies based on FADN data

7.7. Investment subsidies

Farmers can obtain subsidies for their investments. They play an important role not only in the modernization of farms and enterprises and their modernization, but also in the functioning of the capital market (Mojsoska and Gerasimoski 2012).

Among all subsidies, the largest value is that of subsidies for the purchase / overhaul of machinery and equipment. Under these subsidies, farmers can obtain non-returnable aid amounting to 50% of eligible purchase costs.

The second important group are subsidies under the program facilitating the start of young farmers. In the meaning of the provisions applicable to these subsidies, a young farmer is a person under 40 years of age.

The next group consisted of subsidies for buildings or major renovation of buildings. These investments improve animal welfare and facilitate milking and feeding (Table 14).

Table 14. Investment subsideis (PLN)

Year	Subsidies for the purchase of agricultural land	Subsidies for the establishment of permanent crops	Grants for the construction / renovation of drainage	Subsidies for construction / major renovation of buildings	Subsidies under the program to facilitate the start of young farmers	Subsidies for the purchase / major renovation of machinery and equipment
2007	0,0	0,0	0,0	0,0	0,0	0,0
2008	0,0	0,0	0,0	0,0	0,0	0,0
2009	0,0	0,0	0,0	256,9	58,5	6249,2
2010	0,0	0,0	0,0	646,1	42,3	5883,2
2011	0,0	0,0	0,0	141,2	639,1	1434,7
2012	8,4	0,0	0,0	165,5	623,0	9325,7
2013	0,0	0,0	6,7	360,9	81,7	3072,2
2014	4,9	19,6	0,0	193,4	210,0	3052,3
2015	101,3	0,0	0,0	308,6	1419,0	3846,0
2016	0,0	0,0	0,0	0,0	0,0	34,2
2017	0,0	0,0	0,0	0,0	0,0	0,0

Source: own studies based on FADN data

7.8. Summary and conclusion

The dairy farms recorded the development in case of farm area, organization and production. Such a situation was the results of increasing competitiveness of Polish dairy farms.

Almost all characteristics of dairy farms increased. The milk yield of cows increased in the analyzed period from 3,984.5 kg / cow to 4,931.6 kg / cow. This is due to the selection of more efficient animal breeds and a better feeding system.

The equity value on dairy farms increased in 2007-2017 by 190%. Such results can be the effect of investment which increased the value of machinery. Moreover, the value of land increased in the period as the results of increased demand for land not only from agriculture but also from non-agricultural sectors.

The investment value increased in the period under study. Such a situation is the effect of utilization of public support from the EU. The EU is increasing the competitiveness of dairy farms by different tools, for example subsidies and Rural Development Program.

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8

DEVELOPMENT DIRECTIONS OF DAIRY FARMS IN POLAND[5]

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8.1. Introduction

The Polish dairy industry has undergone many changes in recent times. They were related to the transformation of the economic system, European integration, and globalization processes (Pietrzak and Roman 2014). As a result of European integration and opening to the single market, the Polish dairy sector had to make the necessary investments to improve its competitiveness. The number of dairy enterprises decreased from 292 in 2004 to 163 in 2019 (i.e. a decrease of 44.2%). In turn, employment in enterprises decreased from 42,913 in 2004 to 39,949 in 2019 (i.e. a decrease by 23.2%).

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The number of milk producers has also decreased. Farms with a small number of cows liquidated production, and milk yield increased after Poland's integration with the EU (Milk market 2004-2019).

Studies in the literature show that the situation on the milk market depends on many factors, which can be divided into exogenous (external) and endogenous (internal). These factors are interrelated, and it is difficult to capture the influence of only one variable, which makes it the resultant of many factors (Klusek 2003).

There are exogenous and endogenous factors shaping investments in dairy farms.

Exogenous-external factors are (Kusz 2018):

- Demographic conditions (growth of the world's population, industrialization and urbanization).
- Environmental conditions (scarcity and degradation of natural resources, cultural changes, increasing social pressure on environmental protection and protection of rural areas).
- Socio-cultural conditions resulting from demographic factors (system of values, preferences of buyers' behavior, level of use of adaptability, openness to technical innovations).
- Economic conditions (the rate of economic growth, the level of people's income, the level of prices, prices of production factors and their relations, inflation, unemployment, economic situation, the level of interest rates, tax tariffs, exchange rates, international trade, the situation of public finances).
- Technological factors: new scientific discoveries, public spending on research and development in agriculture, availability of new technologies).
- Institutional conditions (organizations, regulatory norms).
- Processes of globalization.

Endogenous-internal factors are (Kusz 2018):

- Resources and relations of production factors (land, labor and capital resources),
- Applied production technologies,
- Human capital,
- Financial situation and the level of obtained income,

– The relation of the farmer's family to the farm or organizational culture in the case of farms with hired labor,
– The degree of connection with the environment.

8.2. Aim and method of research

The main aim of the research was to evaluate the development of dairy farms in Poland.

The achievement of the main goal was possible because of the following specific goals:

– Getting to know the size of investments in dairy farms,
– Recognition of types of investments in dairy farms,
– Assessment of changes that occurred as a result of the investments carried out,
– Knowing the income of the researched farms.

The surveys were conducted in 293 dairy farms all over the country. The selection of farms was deliberate, and the researched farms had to meet the following criteria:

– Keeping dairy cows,
– Farmer's consent to conduct the survey,
– Investments implemented in 2004-2019.

Farms were divided into four groups depending on the number of cows on the farm (Table 1): 20 or less cows (60 farms -20,5%), 21-40 cows (115 farms-39.2%), 41-60 cows (58 farms-19.8%) and more than 60 cows (60 farms-20.5%).

Table 1. Number of cows in a farm

Number of cows	Number of farms	%
20 or less	60	20,5
21-40	115	39,2
41-60	58	19,8
More than 60	60	20,5
Total	293	100,0

Source: calculations based on own research (n = 293)

The geographic scope of the research covered dairy farms that carried out investments in the years 2004-2019 in the following voivodeships: Podlaskie, Mazowieckie, Wielkopolskie, Warmińsko-Mazurskie, Kujawsko-Pomorskie and Pomorskie.

8.3. Research results and discussion

The average land area of farms increased with the increase in the number of cows on the farm and was the highest in entities with over 60 cows (Table 2). When analyzing the changes in the land area of the researched farms in 2019 compared to 2014, it can be concluded that the largest changes were in farms with 41 to 60 cows. The average farm area in these farms increased by 51%, and the area of arable land by 40.6%. In turn, the area of permanent grasslands increased the most in 2019 compared to 2014 on farms with the number of cows from 21 to 40 (25.9%) and from 41 to 60 cows (24.9%). Farms with the smallest number of cows reduced the area of arable land in 2019 compared to 2014 by 4.5%; in farms with 21 to 40 cows by 5.3%. The average area of agricultural holdings in 2019 increased by 16.9% compared to 2014.

The presented research proves the progressive concentration of production on dairy farms. Poland has good natural conditions for breeding and breeding dairy cows. However, according to Roman (2017), it was the Common Agricultural Policy (CAP) and the policy of Polish governments that had the greatest impact on improving the situation in the dairy sector.

Table 2. Area of researched farms depending on the number of cows

Number of cows	Average farmland		Arable land [ha]		Permament grasslands [ha]	
	2014	2019	2014	2019	2014	2019
20 or less	27,08	28,20	17,38	16,60	9,7	11,6
21-40	34,5	37,0	20,60	19,5	13,9	17,5
41-60	44,9	67,8	24,40	42,2	20,5	25,6
More than 60	145,3	161,1	108,0	116,10	37,3	45,0
Average	62,90	73,50	42,6	59,9	20,4	24,9

Source: calculations based on own research (n = 293)

The research shows that the average number of cows increased from 44 to 53 in 2019 compared to 2014, and the number of calves increased from 30 to 36 (Table 3). When analyzing the changes that took place on dairy farms, taking into account the number of cows and calves, it should be stated that they were the largest in farms with the largest number of cows (increase by 24.7%), and the smallest in entities with the number of cows up to 20 (7.21 %).

The conducted research shows the progressive concentration of rearing and breeding of dairy cows. The increase in the number of cows takes place on the largest farms. It is from farms keeping a large number of cows that most of the milk purchased in Poland comes from. The concentration of milk production is the result of an increase in the quality requirements of dairies and the requirements of the common market (Seremak-Bulge 2005).

Table 3. Average number of milking cows and calves

Cows' number	Average number of milking		Average number of calves	
	2014	2019	2014	2019
20 or less	14	15	11	12
21-40	27	31	17	19
41-60	43	50	27	35
More than 60	93	116	65	76
Average	44	53	30	36

Source: calculations based on own research (n = 293)

The research shows that the number of cows on a farm impacted milk yield, which was the highest in farms with over 60 cows (8054.3 liters / cow). The lowest productivity observed in farms with the least number of cows (Table 4).

Comparing the results obtained from own research with the averages for Poland, it should be stated that they exceeded the national data. The average milk yield of cows in 2019 in Poland was (6,348 liters / head), and in cowsheds under control (8,530 l / head). The research shows that farms with up to 20 cows achieved performance similar to the national average.

The increase in milk yield of cows proves biological progress and the implementation of technical and organizational changes (Roman 2017). Also Ziętara and Adamski (2014) claim that the observed increase in milk yield of cows in Poland after accession to the EU is the result of not only the selection of cows but also changes in production technology.

Table 4. Milk yield of cows in the researched farms depending on the number of cows

Number of cows	Milk yield of cows in the researched farms depending on the number of cows [PLN]
20 or less	6049,5
21-40	7215,6
41-60	7661,2
60 and more	8054,3

Source: calculations based on own research (n = 293)

Investments are an important factor in the development of farms and the improvement of their competitiveness (Table 5). There are many definitions of investment in the literature on the subject. The most general was presented by Hirshleifer (1965), according to which it is a renunciation of current consumption in order to achieve future benefits. Research shows that the value of investment in machinery increased with the increase in the number of cows on the farm. The most frequently purchased farms in the surveyed farms were new tractors, balers, slurry tankers, seeders, trailers and others. Therefore, they were specialized machines that facilitate both plant and animal production as well as logistic processes on farms.

In addition to machinery, dairy farms must invest in upgrading fixed assets, animal welfare and environmental protection while increasing production levels to meet market competition. This direction of investments took place in many European Union countries, which was the result of the requirements related to integration (Bórawski and Pawlewicz 2006; Sass 2009).

Table 5. The value of investments in machines depending on the number of cows

Number of cows	The value of investments in machines depending on the number of cows [PLN]
20 or less	121561,7
21-40	252440,0
41-60	382823,1
60 and more	619587,6

Source: calculations based on own research (n = 293)

The key group of investments was the purchase of land (Table 6). Owing to such investments, farms increase the acreage and production volume. The research shows that the value was the highest in the group with the largest number of cows.

The implemented investments in dairy farms improve the efficiency of management, the level of modernity and the exchange of decapitalized production assets (Kusz 2018). The increase in investment outlays in Polish agriculture after accession to the EU was the result of greater availability of funds, easier access to solutions, direct payments, higher sanitary and epidemic standards for animals, environmental protection, and food safety and quality related to consumer requirements (Kusz 2009). Due to these and other factors, the value of investment outlays in agriculture increased from PLN 2,398,000. PLN in 2005 to 5,303.9 thousand. PLN in 2015 (Statistical Yearbook of Agriculture 2016).

Table 6. Value of land investment depending on the number of cows

Number of cows	Value of land investment depending on the number of cows [PLN]
20 or less	121561,7
21-40	252440,0
41-60	382823,1
60 and more	619587,6

Source: calculations based on own research (n = 293)

Another group of investments are investments in livestock, which allow for the reconstruction of the running and livestock (Table 7). They enable the introduction of new and more efficient animal breeds to farms. Generally, farmers purchase calf heifers which are used to repair their

livestock. The research shows that the value of the investment was the highest in the group with the largest number of cows and amounted to PLN 15,347.7. Taking into account the average price of a calf heifer of 7-10 thousand. PLN 15 347.7 means the purchase of an average of two calf heifers on farms with the largest number of cows.

The investments made are a key factor for the development of dairy farms in Poland. According to Bień (2008), the benefits of investments may have an economic, social and organizational dimension. The effects of the implemented investments will be observable in the longer term (Bień 2008). According to Ziętara and Adamski (2014), investments in dairy farms may increase the use of the production potential and the production of milk and live cattle, which may translate into increased exports of these products. In addition, the introduced investments in dairy farms may lead to an improvement in production capacity, production structure, farm profitability, improvement of the dairy industry's competitiveness and mitigation of differences in the sector's development (Kulawski 2016).

Table 7. Value of investments in animals depending on the number of cows on the farm

Number of cows	Value of investments in animals depending on the number of cows on the farm [PLN]
20 or less	2380,0
21-40	5078,8
41-60	4675,9
60 and more	15347,7

Source: calculations based on own research (n = 293)

Holding investments may benefit from financial support. Most often it is the Rural Development Program (RDP) in 2007-2014 and 2015-2020. The research shows that the value of co-financing (state aid) increased with the increase in the number of cows on the farm (Table 8). In addition to the RDP, there were many regulations on the milk market, including milk quotas, export subsidies, EU intervention stocks that influenced the situation and investments that were eventually liquidated (Grochowska 2017). In addition, the support system for dairy farms related to greening, redistribution of subsidies and subsidies to cattle and cows additionally positively affects the economic situation of farms and

the possibility of implementing investments (Kołoszyc and Świtłyk 2015).

Table 8. The amount of co-financing for investments depending on the number of cows on the farm

Number of cows	The amount of co-financing for investments depending on the number of cows on the farm [PLN]
20 or less	84720,2
21-40	141639,9
41-60	187032,6
60 and more	244304,8

Source: calculations based on own research (n = 293)

With the collected information, it was possible to estimate the value of production and income in the researched dairy farms (Table 9). The results of this research data confirm previous analyzes. In general, farms with the largest number of cows had the highest production and income.

The increase in production on dairy farms is the result of good natural conditions in Poland, the concentration of herds, the production of cheap feed on the farm and the agrarian structure (Seremak-Bulge 2005).

Milk production is mainly influenced by such elements as the level of investments, resources, prices and costs (Śmigla 2014). The functioning of dairy farms determines their spatial distribution in different regions, economic value, and the efficiency of milk production. Dairy farms, due to the growing costs of means of production and increasing labor costs, increase the level of production (Adamski 2014).

Table 9. Total production in the researched farms depending on the number of cows

Number of cows	Animal production [PLN]		Plant production [PLN]	
	2014	2019	2014	2019
20 or less	135494,1	171780,5	93463,6	96194,3
21-40	283096,3	367930,4	144452,5	142542,2
41-60	456012,5	620230,6	479364,2	492189,3
60 and more	916701,8	1557695,0	928285,1	1018752,0

Source: calculations based on own research (n = 293)

Income is the most important category. Farmers spend their income on the development and functioning of the farm and to cover the

household needs of the family. Its value increased with the increase in the number of cows on the farm and was the highest in 2019 (PLN 563434.4). On the other hand, when analyzing the increase in family farm income depending on the number of cows in 2019 compared to 2014 (Table 10). It should be stated that it increased most in the group of entities with the largest number of cows (43.5%), to 20 %), then from 21 to 40 cows (18.45) and from 41 to 60 cows (12.8%).

The conducted research shows that the economic situation of the surveyed dairy farms improved in all groups in 2019 compared to 2014. After accession to the EU, the most important factors influencing farm income include: direct payments, faster income growth than costs and farm management skills by farmers and the use of CAP instruments (Bórawski 2013).

Table 10. Income from family farms

Number of cows	Income [PLN]	
	2014	2019
20 or less	53575,0	70673,0
21-40	162383,7	192383,7
41-60	217367,1	245162,0
60 and more	392577,9	563434,4

Source: calculations based on own research (n = 293)

8.4. Summary and conclusions

Changes in the surveyed farms were the result of actions taken by their owners, who increased the land area of farms in order to obtain their own feed and reduce production costs (Bórawski 2013). Increasing the land area of farms enables the improvement of economic and environmental performance. Activities undertaken by farmers aimed at increasing the land area in relation to the number of animals allowed for the implementation of the concept of sustainable development, greater environmental protection and the emission of less pollutants into the environment (Guth and Smędzik-Ambroży 2017).

Poland's accession to the EU had a positive effect on investments. Research by Grochowska (2015) shows that after accession to the EU,

Polish farmers invested mainly in machinery and equipment (36.5%), means of transport (28.2%), land purchase (10%) and buildings (3.4%). It should therefore be stated that the structure of investments in the researched farms was similar to the structure in Poland overall. The level of implemented investments was related to the increased scale of cow rearing.

In the case of dairy farms, the improvement in the economic situation in Poland compared to farms in other countries was the result of the cost advantage associated with lower opportunity costs of production factors (labor, land and capital) (Kołoszyc 2013). However, according to Sompolska-Rzechuła and Świtłyk (2016), the internal factors influencing the value of income of dairy farms, the area of agricultural land and the number of dairy cows are all important.

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9

THE ROLE OF INVESTMENTS AND TECHNICAL PROGRESS IN THE MODERNIZATION PROCESS OF MILK FARMS IN POLAND[6]

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9.1. Introduction

For nearly two decades, Polish agriculture has undergone rapid changes, which were possible thanks to economic growth, and above all thanks to the support of the European Union. At that time, funds from the Sectoral Operational Program – Agriculture were launched. For the years 2007-2013, the Rural Development Program for farmers was prepared, which helped EU agriculture to modernize. The process of modernizing Polish agriculture was started. The condition of utility rooms

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was improved and farms were equipped with new machines and tractors. Access to the programs assumed the implementation of the objectives included in the priority axes, which are the economic, environmental, and social axes. In the next budget period, 2014-2020, the focus was on supporting the competitiveness of farms, mainly through the modernization of agriculture. The support was estimated at EUR 13.6 billion, of which EUR 2.5 billion will be allocated to the modernization of farms. The common agricultural policy of the EU is faced with the challenge of eliminating the imperfections that occur. Support aimed at increasing the efficiency of Polish agriculture is important from the point of view of maintaining human resources in agricultural activity, but primarily to ensure food security (Wicki and Pietrzykowski 2018).

Due to the growing competition on the international market, it is necessary to increase the quality of the goods and services offered. In order to improve the competitiveness of Polish agriculture, it is necessary to have modern technical facilities. Therefore, it is up to farms to introduce continuous changes leading to their modernization, i.e., transformations that result in progressive actions (Babuchowska and Marks-Bielska 2012).

Dairy cattle rearing is one of the dominant agricultural activities in Poland. This is due to the high demand for milk and dairy products in our country. Milk is a foundational food. Although milk as a finished product and a raw material for the production of other dairy products, there is considerable competition on the market. As a result, farms are faced with the need to adapt to market requirements. To improve the economic situation, dairy farms in Poland have achieved greater specialization and concentration of production (Czułowska and Abramczuk 2016).

Data from the Central Statistical Office of Poland from 2015 show the largest concentration of cows breeding and milk production was in Mazowsze and Podlasie. The smallest number of dairy farms were located in Małopolska and Pogórze. Farms based on the rearing of dairy cows are the foundation of the dairy product supply chain. "In Poland, the food chain can be divided into several main branches, e.g., milk and dairy products, meat, cereals, sugar, potatoes, oils, vegetables and fruit" (Sznajder 2008).

However, it is important that farms contributing to the creation of the value of a given product are the first link in the food supply chain (Czułowska and Abramczuk 2016).

9.2. Aim and methodology

The aim of the research was to obtain information about the investments made in the farms that were researched and the changes that have taken place in the technical equipment of dairy farms in Poland.

The subject of the work is technical equipment of selected dairy farms. In addition, important issues are also investments in farms, production costs, and the presentation of the changes taking place.

The research concerned changes that have occurred in farms in Poland in recent years. The research was conducted using questionnaires addressed to the owners of 373 farms. The time scope of the research covered the years 2014-2020. The questions dealt with milk production, animal husbandry, buildings, machines and general conditions on the farm. In addition, the survey provided information on farm investments and the use of funds from the Rural Development Program.

9.3. Characteristics of surveyed farms

The breeding of dairy animals in our country has a long tradition of agricultural production. This is influenced, among others, by favorable natural conditions and a strong work force. Poland is in fourth place in the ranking of EU milk producers. Germany is the leader in production, however, the member states are quite diverse (Będzikowska 2015).

For comparison, in 2010, there were 89.8 thousand of dairy farms in Poland. Germany had 425.8 thousand, and the Netherlands 19.8 thousand. The average herd of cows in Poland consisted of 6 cows, in Germany 46 and in the Netherlands 75. Whether milk production would bring the expected profits depends on the price received, as well as the scale and costs of milk production. The production scale consists of: "the size of the farm, the number of cows and their unit capacity, which translates into annual production." To make it possible to profit from milk production, agricultural calculations should be used. Thanks to them, the

costs and effects of production are calculated. Such calculations address what activities are profitable, for what quantities and with what method. Both actual and predicted data are used for these measurements (Będzikowska 2015).

The table 1 below presents the stock of dairy cows in the researched farms. 20.5% of the respondents had 20 cows and less. From 21-40 cows were owned by 39.2% of the surveyed farmers. This is the largest number of farms. Herds of 60 cows and more were on 20.5% of the farms studied.

Table 1. Characteristics of surveyed farms

Number of cows	%
20 or less	20,5
21-40	39,2
41-60	19,8
61 or more	20,5
Total	100,0

Source: own elaborations on the basis of surveyed farms

Figure 1 shows the milk production obtained in the researched farms. The highest number of liters of milk per cow (8054.3 liters) was obtained on farms with 60 or more cows. This reflects the modernity and efficiency ot these farms.

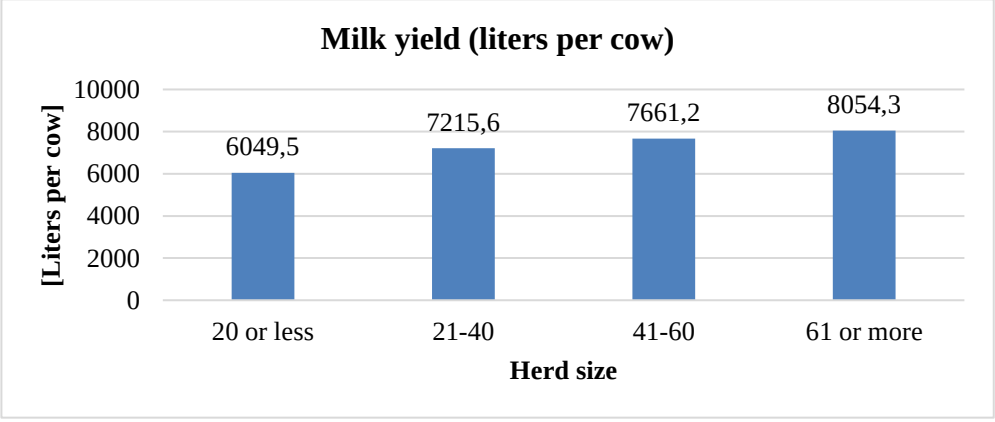

Figure 1. Milk yield from 1 cow

Source: own elaborations on the basis of surveyed farms

In 2015, milk quotas were ended, which increased competition in the dairy market, and consequently meant a reduction in milk purchase prices. As a result, farms with low production costs have the greatest chances of survival (Marzec and Pisulewski 2003).

It turns out that the variable cost incurred by dairy farmers depends on the prices of materials. On the other hand, the prices of feed and livestock are less important. Dairy farms in Poland are characterized by low-cost effectiveness. For an increase in efficiency, a large amount of work and time is necessary (Będzikowska 2015).

The dairy industry plays a huge role in the Polish economy in terms of social, environmental, and economic terms. It is one of the most important sectors of the food economy. It is an important element of the country's economic system due to the importance of milk in the commercial structure of agriculture, amounting to 19.4%. The demand for milk on the internal market is lower than the scale of its production. For this reason, a large part is intended for export. The production of milk is inextricably linked with the production of beef cattle. Farms that keep dairy cattle provide a significant proportion of the calves for fattening and cows for slaughter. Dairy farming also plays an important social role. This is because approximately 240 thousand farms live are in dairy, half of which also sell milk for dairy processing. This is an essential part of domestic food production, thanks to which approximately 33 thousand people are employed. Dairy cattle farming contributes to the expansion of biodiversity in agricultural production. This is due to the efficient use of grassland and increasing the demand for fodder from arable land. The generally understood natural environment benefits from this activity. Its conduct contributes to the occurrence of a by-product in the form of natural fertilizers. They are a valuable tool used to fertilize the soil and meet the objectives of sustainable agricultural production. Dairy farming also consumes a lot of water, which is related to the need to implement new technologies that consume less water. In recent years, the dairy sector has undergone major structural changes and modernization. They were related to processes aimed at meeting stricter hygienic conditions and adjusting the production and breeding of dairy cattle to the EU market regulations. The years 2017-18 saw an increase in the number of cows by 2,214 thousand head, and an increase in milk yield to 6,000 l./head.

The number of cows in the barns that are subjected to the milk performance inspection has increased. They constitute the "basis for the transmission of genetic progress" that serves the purpose of commodity production. In 2018, there were as many as 816 thousand head of the evaluated pieces, constituting 37% of the total and 8,150 kg./head in terms of milk yield (Kowalski and Kowalczyk, 2019).

9.4. Value of investments in dairy farm

The Common Agricultural Policy and the membership of Poland in the EU contribute to the development of agriculture, which is visible especially through the improvement technical equipment of farms. According to the research carried out in 2013-2014 by R. Rudnicki, 139.6 thousand projects were carried out, including applications with a total value of PLN 9.1 billion in connection with the processes of improving the technical condition of agriculture. At that time, farms were adjusted to the guidelines dictated by the EU, technical infrastructure was modernized (Rudnicki and Wiśniewski 2016).

The Rural Development Program for 2014-2020 was formed to apply European Union regulations. The regulations of the European Parliament and the EU Council of 2013 were mainly used. The aim of this program was to increase the level of competitiveness of agriculture, to use natural resources in a sustainable manner, and to develop rural areas in a sustainable manner.

One priority contained in the Program is to increase the profitability of farms, but also to popularize risk management in agriculture. An important goal is to protect ecosystems and give them strength, but also to popularize the development of farms in areas belonging to the village (https://www.gov.pl/web/rolnictwo/-program-rozkieta-obszarow - wiejskich-2014-2020- prow-2014-2020).

The program aims to improve the profitability of farms through investing in fixed assets, but also involvement in economic development and farm activities (Rural Development Program for 2014-2020).

Figure 2 shows the investments incurred for the purchase of machines and devices in the researched farms. The highest outlays are

incurred by farms with 60 or more cows. It is worth noting that these modern farms invest all their capital in the development of the farm.

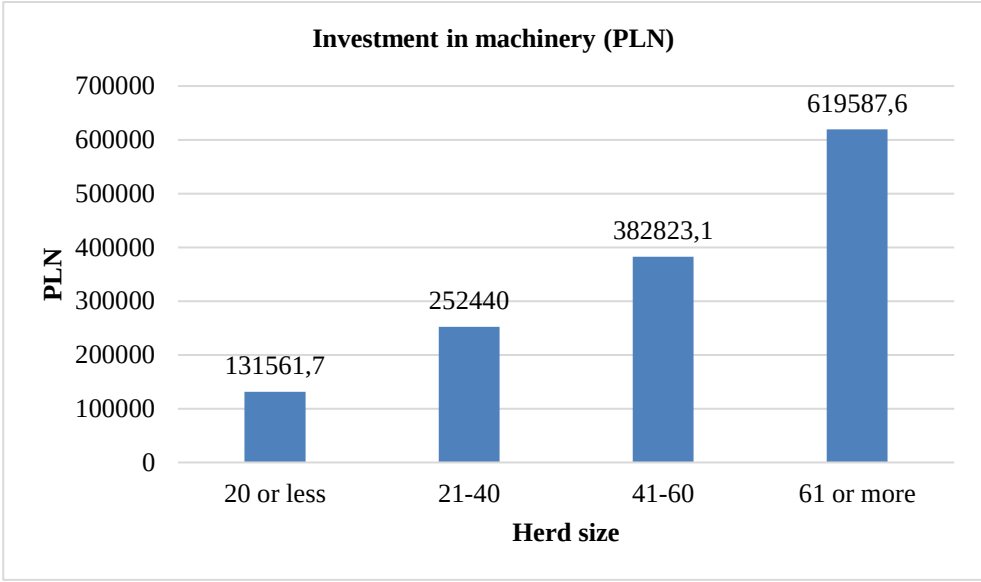

Figure 2. Value of investments for the purchase of machines
Source: own elaborations on the basis of surveyed farms

Data obtained from agricultural censuses of 2002 and 2010 were also used to analyze the development of farms with regard to their equipment with tractors, machines or other agricultural devices. As part of running a dairy farm, elements of agricultural mechanization are used: tractors, machines for harvesting grains and green fodder, collecting trailers and collecting presses, as well as general-purpose machines, e.g., cultivators, fertilizer spreaders, field tractor sprayers or mowers. tractor. In addition, dairy farms must be equipped with machines for animal production, such as tube milking machines and tank coolers (Rudnicki and Wiśniewski 2016).

One of the most basic agricultural machines is the tractor, which is the most frequently used equipment. Thanks to Poland's accession to the EU, many operational programs were introduced, which increased the possibilities of purchasing new agricultural machines. Since 2002, the number of brand new tractors has almost doubled. The years 2002-2010 saw an increase in the number of tractors in farms in Poland 101 thou.

pieces. At the same time, a decrease in the number of tractors was noticed in the following voivodeships: Opolskie, Dolnośląskie, Śląskie and Zachodniopomorskie. However, there were more tractors in the Podlaskie, Lubelskie, Warmińsko-Mazurskie and Mazowieckie voivodships (Rudnicki and Wiśniewski 2016). When it comes to machines used on livestock farms, in particular cows' rearing, we can mention pipeline milking machines and cooling tanks. It should be emphasized that the efficiency of milk production is influenced by the installation of modern milking equipment. According to the discussed analysis, until 2010 in our country there was an increase of 37 thousand machines for livestock production (Rudnicki and Wiśniewski 2016).

Devices intended for milking and storing milk are selected according to the housing system, herd size, milk yield of cows, and how often the milk is collected. Two systems of keeping dairy cows can be distinguished: stall and free stall. In the first animal, a separate stall is provided for feeding and resting, as well as for milking the cow. The free-standing system assumes feeding the cows in the corridor, which is called the forage area, and separate stalls or group stalls are used to rest. In addition, there are separate so-called milking parlors. The devices used for milking cows include: can milking machines and pipeline milking machines, which are intended for a tethered barn. The mechanism of the canister milking machine consists of collecting the milk in the can, after which it goes to the cooler, and the pipeline milking machine transports the milk through pipelines to the cooler. “Milking machines are characterized by low costs in terms of purchase, assembly and operation. However, they do require the transport of heavy bubbles to the cooler. Due to this fact, they are intended mainly for farms with up to 30 dairy cows. In turn, pipeline milking machines are less demanding, which are installed after minor changes to the barn. The solution for obtaining milk without having to milk the cows twice a day by the farmer are milking robots, the main advantage of which is milking automation. They contribute to the increase in milk yield of cows, as milking takes place several times a day. It can be used in an intensively fed herd (Muzalewski 2015). However, they are very expensive.

Figure 3 shows capital invested in farmland and grassland. The value of the land owned is PLN 244,304.8. Farms with 20 and fewer

cows have the least land. The estimated value invested in the land is 84 720.2 PLN.

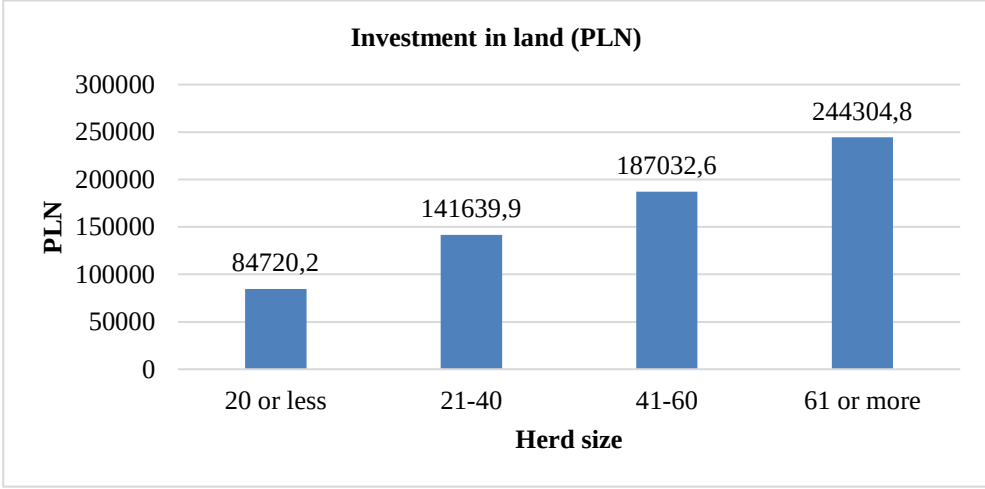

Figure 3. Capital invested in farmland and grassland
Source: own elaborations on the basis of surveyed farms

The buildings that must necessarily be equipped with a dairy farm are primarily cattle-breeding barns. For cattle breeding and milk production to be possible, the requirements for having large areas must be met. Dairy production and its infrastructure have constantly improved. If the buildings make it impossible to change the animal housing system, then they are modernized to at least ensure animal welfare as much as possible. Directly next to the building there must be a fenced area for livestock runs. It is necessary to ensure good sanitary conditions and a properly hardened and sewerage area. An important issue related to livestock buildings is the width of communication routes, as well as doors and gates, taking into account the dimensions of primarily animals. The rooms should be adequately lit with uniform lighting intensity. To ensure adequate weight gain and the expected milk yield of cows, windows are used, as well as lighting elements on the ceiling to obtain more natural light. Livestock buildings must have an efficient ventilation system that can provide well-designed natural ventilation. If it is insufficient, then it is necessary to install mechanical ventilation (Nowak 2013).

Figure 4 shows the money invested in the purchase of animals. The highest outlays for the purchase of animals are incurred by farms with

60 or more cows. They amount to 15 347.7 thousand PLN. The lowest amounts for the purchase of animals are on farms with 20 or fewer cows. They amount to approx. 2400 thousand PLN.

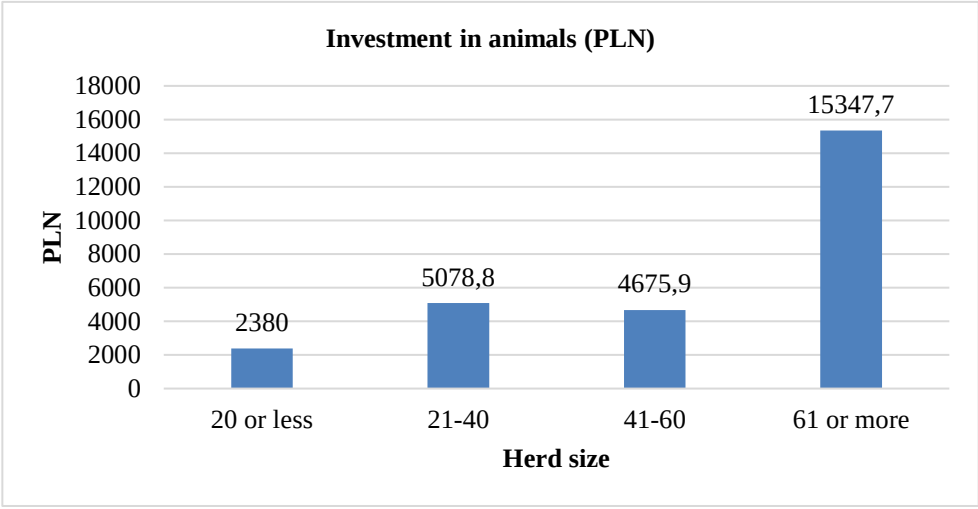

Figure 4. Money invested in the purchase of animals

Source: own elaborations on the basis of surveyed farms

In order for milk and dairy products suitable for consumption to be safely produced and, it is necessary to implement good practices by the producer. They also have an impact on ensuring an adequate economic and social level of dairy farms. Due to the activities of milk producers in the food production business, it is important that the quality and safety of milk are at the highest level. Therefore, good practices must meet the highest expectations of the food industry and consumers. They are a guarantee that the milk comes from healthy animals and in a manner that meets all appropriate standards (FAO 2011).

The main goal of good practices on dairy farms is "safe, high-quality milk obtained from healthy animals using practices that are appropriate from an animal welfare point of view, from a social perspective".

Good practice consists of the following elements: "animal health, milking hygiene, nutrition, animal welfare, the environment, and social and economic management." The basis of proper milk production is the health of animals and taking care of an effective system of their health protection. It is necessary to ensure proper hygienic conditions of devices and equipment intended for obtaining and storing milk. It is also

important to feed and water the animals, which must be safe and of adequate quality. Animal welfare is an equally important issue, i.e., compliance with the principles of the five freedoms, which are as follows: animals should be free from: "thirst, hunger and malnutrition, discomfort, suffering, trauma and disease, from fear, and to be free to behave normally "(FAO 2011).

Increased management efficiency may result in the allocation of financial resources to purchase new means of production. Obtaining a competitive advantage and maximum labor consumption is possible by providing the farm with sustainable means of production. Consumers force farmers to actively make investments due to their increased needs. Farmers have to protect the environment and constantly improve the conditions in which animals live. The opportunity to invest means the farmer must obtain capital. Farmers do not have easy access to loans, therefore they cannot make such large investments as they would wish (Kusz 2013).

Figure 5 shows subsidies to investments according to the size of the herd. The highest subsidies are granted to farms with 60 or more cows. They are at the level of 244304.8 thousand PLN. Farms keeping 20 or fewer cows receive the smallest subsidies. They amounted to 84 720.2 thousand PLN.

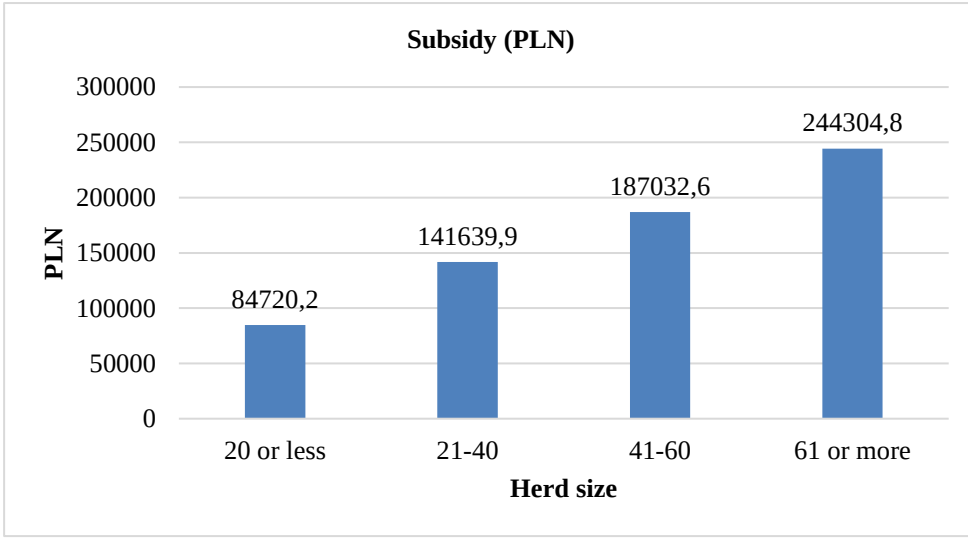

Figure 5. Subsidies to investments according to the size of the herd

Source: own elaborations on the basis of surveyed farms

There are many factors that play a role in changing processes on dairy farms, both present and future. One of the most important are political issues, which are usually complex, diverse, and subject to change. Additionally, milk production is influenced by national and international regulations. One of them is the so-called milk package valid until the end of 2020. According to its assumptions, the bargaining power of milk producers was to be strengthened by the introduction of collective bargaining for milk deliveries, for which binding formal contracts are made. In addition, a requirement has been introduced to send information related to the amount of purchased milk with a monthly distribution by purchasing entities to the state authorities, which will improve the transparency of milk production in Europe. According to Andrzej Parzonko, such solutions will only slightly stabilize the milk market in the EU (Parzonko 2013).

Taking a closer look at the dairy sector brings conclusions in the form of elaborating the needs of investment activities related to market interventions. In order to prevent a threat to the functioning of dairy farms, it is necessary, inter alia, to planning and organizing production in such a way as to be adapted to the demand, taking into account quality and quantity, achieving optimal production costs and stable prices. In addition, it is important that farms strengthen their bargaining position along the supply chain. The hosts must invest "in buildings and structures used in milk production: livestock buildings, milking equipment and robots, milk cooling tanks, devices for the preparation and distribution of fodder, warehouses and silos for fodder, agricultural machinery halls and chemical storage facilities for maintaining standards hygienic and veterinary as well as yield-generating agents". In addition, it is important to conduct investments related to innovative machines that are used to grow plants for the production of concentrated and bulky fodder. Such machines include: "cultivators, seeders, machines for the care of permanent grassland, harvesters, machines for cleaning and drying, and means of transport". In addition, an important issue is also investments in agricultural machinery, thanks to which the soil will be organically fertilized while increasing the level of humus, and investments in environmentally friendly machinery and equipment (Kowalski and Kowalczyk 2019).

9.5. Summary and conclusions

Investing in machinery, equipment and agricultural tractors enables the farmer to turn them around flexibly. Machines and tractors are movable elements of farm equipment, so in the event of financial problems, the farmer may receive at least a part of the invested money.

The conducted research shows that farmers with 60 and more cows make higher investment outlays. The research showed that farmers made changes in the supply of cattle to their farms. The changes also concerned the constructed buildings and the purchased machinery and equipment necessary for the rearing of dairy cattle.

Farm development depends on many factors. Opportunities, but also barriers appear in the form of aid programs addressed to farmers, but also in relations between the farmer and other entities with which cooperation in running a farm is necessary. The effect is the level of running the farm and the benefits achieved. The farmer cooperates with recipients for the sale of produce and suppliers of production means. In addition, farmers attach great importance to cost calculation to make their production profitable. The costs incurred must be proportionate to the expected profits. The help of an advisor may be helpful in this case. Farmers who want to develop their farms also use aid programs to improve their farms.

Not without significance are the problems that modern farmers have when they want to implement the started investments. Complex procedures and many months of investment implementation do not encourage farmers to spend their time on unprofitable activities. A modern farmer must show great self-denial in order to implement his investment plans.

The multiplicity of procedures necessary to apply in order to apply for EU funds requires knowledge of the law, but also persistence in striving to fulfill their own plans. All farmers indicated that the prices of fertilizers and feeds are high. Therefore, when running a farm and wanting to improve it, it is necessary to evaluate the benefits in relation to the costs incurred and to conduct close cooperation with many entities.

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10

THE ROLE OF SUPPLIERS OF PRODUCTION MEANS AND RECIPIENTS OF MILK IN THE DEVELOPMENT OF DAIRY FARMS[7]

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10.1. Introduction

The efficiency of milk production depends on many factors. One of the most important is logistics, which can be defined as the management of storage and handling activities that enable the flow of products from their origins to their places of consumption (Baran et al., 2010). Logistics has, among other things, a great influence on the quality and profitability of work. The intensively developing market enables entrepreneurs to be innovative and creative. Visible changes take place in the logistics of production and procurement, warehouses, inventory management, as well as in distribution logistics. We observe the dynamic improvement of the supply chain system and their application to customer needs. All branches of logistics – supply, production, and distribution –

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should be interconnected in such a way that meet customer requirements, and hence sales, the most important goal (Dyczkowska 2012). For many years, service and trade companies and international corporations have been interested in logistics. It is clearly visible in many popular science and scientific publications devoted to logistics. For several years we have observed an increase in interest in logistics among farms, including dairy farms. Farmers are increasingly focusing on improving the compatibility of all branches of their production (Klepacki 2016). They try to make all stages of the production chain more interdependent. A farm's logistic system depends, among other things, on its size, specialization and production structure. It can be very simple or very complex (Kuboń 2007).

Logistics on dairy farms is a complex process that allows the farmer to properly dispose of his capital, as well as plan his time and work in advance. One of the most important pillars is supply logistics. It affects the efficient functioning of farms. Another important element is production logistics. It is responsible for the appropriate adjustment of the sown area to the number of dairy cattle. The third type is distribution logistics. Its main task is to constantly control the quality of the raw material, which allows it to meet the growing expectations of consumers, including hygiene, purity, and health benefits of milk (Szymańska et al. 2018). From 2005 to 2017, a significant increase in milk production of almost 12% was observed, despite the decreasing number of cows, which shows that the changes are bringing the intended effects.

10.2. Aim and method

The main aim of the research was to evaluate logistic activities on dairy farms. The specific goals are:

- recognition of supply and distribution logistics;
- introduction of machines to improve the logistics of supply and distribution;
- assessment of investments in the researched farms.

The time scope of the research covered 2019.

The research material consisted of data obtained in own research carried out on 373 farms involved in milk production.

The selection of farms for the research was purposeful. The basis for the selection was:

– the farmer's willingness to answer the survey questions,
– making investments on the farm.

In this paper, the results of the survey were analyzed. The respondents answered questions about the logistic processes of supplying their farms, the production processes of the raw material, which is milk, as well as the processes of its distribution. The questionnaire mainly covered issues related to the expenses incurred at each stage of the farmer's work. For greater comparative possibilities, the respondents also answered many basic issues. They contained, inter alia, information on the size of the farm, stock levels, and methods of keeping and breeding cows.

10.3. Factors influencing the choice of suppliers of means of production

Supply logistics aims to use existing opportunities. It coordinates the flow of goods and information in order to provide the company with materials used for production or for trade. Its activities go beyond the reach of the enterprise, sometimes even outside the country (Dyczkowska 2012).

The conducted research shows that dairy farmers cooperate with many suppliers and purchase inputs on the market. As a result, supply logistics has developed, which has a very large impact on the efficient functioning of the farm (Szymańska et al. 2018). Its main task is to provide maximum protection of all material needs at the lowest possible cost. First of all, it is about ensuring the availability of raw materials, products and materials that allow the farm to be ready for production (Wojciechowski 1999). Agricultural means of production include: plant protection chemicals, agricultural machinery, organic, mineral and natural fertilizers, as well as certified seed. The broadly understood market for services, for example mechanization, transport or veterinary services,

should also be considered when it comes to supplying dairy farms. An additional aspect is the energy needed to work and maintain production (Kuziemska et al. 2016). Table 1 presents the factors having an impact on the choice of suppliers of means of production.

Table 1. Factors influencing the choice of suppliers of means of production? (on a scale of 1-5)

Factors	Points
High quality	4,11
Competitive price	4,18
Products' differentiation	3,77
Known mark	3,61
The attractiveness of the packaging	2,85
A wide range of assortment	3,64
Ecological features	3,29
Constant cooperation	3,72
Favorable distance	3,71
The best price for the goods	3,99
The best quality of goods	4,05
Timely deliveries	3,87
Supplier monopoly	3,17
Knowledge of suppliers	3,57
Other	1,49

Source: elaborations made on own research

10.4. Nature of cooperation with suppliers

Two main purchased goods are concentrates and concentrated feed. The surveyed farmers evaluated the nature of cooperation with suppliers (Table 2). Most of them pointed out that they take into account their own and supplier's conditions. More than 30% of farmers accepted the terms of delivery. Only 8% dictated terms.

Table 2. Nature of cooperation with suppliers

Specification	%
We accept the terms of delivery	32,70
We take into account our own and supplier's conditions	62,16
We dictate our terms	7,57

Source: elaborations made on own research

Farmers sometimes refuse to accept (42,3%). Some of them decide to refuse accept goods for various reasons, for example defective goods (30,27%) and lack of timeliness (23,51%). No information on sustainability for use was the reason for 8% of farmers. Majority of farmers do not refuse to accept the goods (Table 3).

Table 3. Reasons for refusing to accept the goods in the opinion of the respondents

Specification	%
No refusal to accept the goods	55,40
Refusal to accept the goods:	42,43
Lack of timeliness	23,51
Lack of the ordered quantity	11,35
Defective goods	30,27
No information on suitability for use	7,84

Source: elaborations made on own research

Production logistics is designed to ensure the flow of information and materials throughout the entire production process. Its main tasks are control, organization and planning of the flow of raw materials, materials, cooperative elements, and parts during the entire production process (Dyczkowska 2012).

Farmers as an active supplier chain members sometimes change suppliers (Table 4). The reasons for this actions are following: bad attitude towards customer (56,75%), untimely (55,67%) and high price of goods (55,13%).

Table 4. Reasons for changing supplier

Specification	%
Untimely	55,67
Bad attitude towards the customer	56,75
Not an interesting offer	45,13
High price	55,13

Source: elaborations based on own research

10.5. Products sales channels

Distribution is the last stage in the logistics chain. Its aim is to provide a product that meets the expectations and needs of buyers in the right place and time. Through the distribution channels, the entire process of movement of goods from producers to customers takes place. Distribution channels are not limited to intermediary links, but also involve companies that participate in the flow of goods and services from producers to the final recipient. One of the most important roles of distribution logistics arises from the principle of modern logistics. It states the need to shorten and accelerate all processes as much as possible at each stage of distribution with the required quality of customer service. The biggest problem of these processes is the time-consuming nature that results from the distance between the producer's location and the consumer's location. Distribution logistics combines all processes and flows that occur in the field of sales and delivery into one management system. Its main goal is to minimize sales costs with the optimal satisfaction of customer needs (Dyczkowska 2012).

Table 5 presents the product sales channels.

Table 5. Product sales channels

Specification	%
Directly on the farm	48,92
For processing	43,24
Sale to intermediaries	23,78
At marketplaces	7,30
To wholesalers	7,84

Source: own elaborations based on own research

When trading milk, it is very important to maintain its high quality. The requirements of retail chains and consumers regarding the purity, hygiene and health benefits of milk grow constantly. They require ensuring food safety and its adequate quality (Kobus and Kmiecik 2006). The accession to the European Union required improvement of the raw material quality. The milk producers had to make many of the necessary investments in terms of milking as well as milk storage in order to comply with its regulations. Table 6 shows the factors determining the choice of recipients of agricultural products.

Table 6. Factors determining the choice of the recipient of agricultural products

Specification	Points*
Timeliness of receipt	3,95
Good prices	4,09
Possibility to pick up a large batch	3,89
Known mark	3,46
Knowing the recipient	3,74
A positive experience	3,85
Good opinion about the recipient	3,86
Constant cooperation	3,84
Favorable distance	3,58
Customer monopoly	3,07

* the farmers evaluated the factors in 1-5 points, where 5 is the most important
Source: elaborations based on own survey

Farms now focus more on the proper development of the distribution of their milk. First of all, it concerns obtaining the highest possible customer satisfaction, reducing transport costs or limiting the activities of competitors (Pawlewicz and Gotkiewicz 2012). Producers of this milk claim that they sell mainly to dairy cooperatives. This proves that the link of farms with processing is developing, which, in turn, guarantees the cooperatives an uninterrupted supply of milk (Karwat-Woźniak 2013).

10.6. Summary and conclusions

We conclude from the research that a small few farmers sell products to restaurant at markets, to wholesalers, or on request directly to the customer. This means that producers are reluctant to undertake their own milk sales activities. The development of distribution logistics also depends on cooperation with other farmers. Hence horizontal integration develops.

Producers most often sell milk to dairy cooperatives, establishing long-term cooperation. Thanks to this, they are provided with a market and regular raw material pick-ups, usually every two days. This results in reduced milk storage costs. Companies that purchase milk most often look for farms with large production, which can provide batches of raw milk of consistent quality. When setting prices, dairy cooperatives do not only consider the market situation. Therefore, manufacturers are mainly guided by the price offered and the favorable distance when selecting the recipient. Other aspects are secondary to them.

An important element in distribution logistics is the maintenance of constant milk production throughout the year. Research shows that it is easier to achieve by farms more open to new investments that focus on milk production. Not only does this make it possible to obtain a higher price of milk, but also allows the farmer to take advantage of specific subsidies.

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11

MOTIVES AND FINANCIAL SOURCES OF INVESTMENTS IN DAIRY FARMS[8]

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11.1. Introduction

Dairy farms are an important economic sector. Considering all food products, dairy products have a significant link of functional food. This is due to the fact that dairy products are characterized by health-promoting features- a unique origin and a specific composition of milk (Świderski et al. 2018). Production and processing of dairy products contribute to both a strong economy and a healthy populations.

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According to statistical data, in 2019, the production of cow's milk in Poland amounted to 14,089.9 million liters. Compared to 2018, it increased by 322.1 million liters (2.3%) The average annual milk yield per cow was 5803 liters and increased by 56 liters(1.0%), compared to 2018. Individual farms produced 13,172.0 million liters of milk (2.5%) more than in the previous year representing 93.5% of the total national production. In 2019, milk production per 1 ha of agricultural land was 959 liters compared to 939 liters in 2018, a 2.1% increase (GUS 2019a). The number of dairy cows in December 2019 was 2,403.7 thousand head (GUS 2019b).

The greatest amount of milk in Poland is produced by Mazowieckie and Podlaskie voivodships comprising 44% of the total milk supply in the country (Milk market 2020). In December 2019, the average number of dairy cows per 100 ha of UAA was 14.7 head. The largest number of cows were located in the voivodships specializing in milk production – Podlaskie (39.2 head) and Mazowieckie (25.2 head). The lowest milk production is shown in the Podkarpackie, Lubelskie, Śląskie and Łódzkie voivodships (Milk market 2020).

In 2019, raw material supplies to the dairy industry increased by 2.1%. The production of liquid milk, including consumption milk and milk for secondary processing, decreased by 1.3%. The production of condensed milk and cream decreased by 6.8%, while the production of milk powder increased by only 0.6% (Milk market 2020). The production of butter and milk fats increased by 3.4%, including butter with a milk fat content of 80-85% (4.5% increase). The production of curd cheeses increased by 2.1%, and the production of rennet-ripened cheeses by 0.9%. In 2018, the balance consumption of milk, including milk intended for dairy products, without milk converted into butter, on a per capita was 224 liters about 2.8% higher than in the previous year (Milk market 2020).

The dairy sector is also very important in the European Union. The main milk producers are Germany, France, Great Britain, the Netherlands, Italy, and Poland, which together produce almost 70% of the milk produced in the European Union (Milk market 2020). World milk production in 2019 increased by 1.4%, to about 852 million tons, where 81% of production was cow's milk. In 2019, the purchase prices of raw milk

in Poland slightly increased. According to the data, the average price was 1.35 PLN / l and was 0.5% higher than in 2018.

In 2019, an increase in purchase price was recorded in twelve voivodships, and a decrease in price in four. The highest increase in price was recorded in the voivodships where the purchase price of milk is among the lowest in the country: Łódzkie (by 3.5%), Świętokrzyskie (by 1.8%) and Małopolskie (by 1.2%). A drop in price was registered in two voivodships that specialize in milk production, namely in Warmińsko-Mazurskie (by 1.7%) and Podlaskie (0.1%). In the first quarter of 2020, the average purchase price of raw milk in Poland was 1.37 PLN / l and was 1.3% lower than in 2019 (Milk market 2020).

11.2. Aim and method

The aim of the research was to assess the opinions of owners of specific farms on the factors determining investment activity in the process of modernization of given dairy farms. Within the main objective, the following specific objectives were defined:

- Assess the sources of financing for investment activities;
- Determine the most important motives behind the investment activity.

In this paper, the diagnostic survey method was chosen as the research method, which is "a way of gathering knowledge about structural and functional attributes and the dynamics of social phenomena, opinions and views of selected communities, the intensification and directions of development of specific phenomena and any other institutionally located phenomena" (Pilch and Bauman 2007). The research tool is a questionnaire, the answers are provided by the respondents.

The research was carried out throughout the country on a group of 383 dairy farms which made investments in their businesses. The surveyed participants are divided into four groups depending on the size of the investment (PLN thousand) into:

- Less than PLN 300 thousand – 151 farms,
- PLN 300.1-600 thousand – 104 farms,

– PLN 600.1-900 thousand – 52 farms,
– Greater than 900 thousand PLN – 76 farms.

Purposeful selection was used in the research. The basis for qualifying the farm for the study was the investment made in 2007-2019 and the farmer's willingness to participate in the study.

11.3. Investments in economic theory

Investments are the main determinant of the growth and development of an economic entity. Investments affect the modernization of production processes, increasing the production scale and increasing the amount of commodity produced (Józwiak and Kagan 2008). The amount of investment depends on the income that a farm can achieve (Orłowska 2013). Moreover, an important aspect impacting farms was Poland's accession to the European Union, which took place on May 1, 2004. After that, all EU funds contributed to the increase in income and intensified investment activities (Poczta 2008). Activities related to investments in farms are dependent on many factors, including macroeconomic variables, market conditions, budget and financial situation of farms (Bórawski 2014).

Investments in a farm are divided into two categories:

1. Replacement investments – renewal of worn-out assets and replacement of worn-out fixed assets;
2. Development investments – improvement of the farm's efficiency, increasing the owned fixed assets (Zając 2012).

The development of enterprises is carried out with many kinds of investment outlays. Investments lead to an increase in the value of the unit, improve the entity's competitiveness, as well as increase production capacity, leading to an increase in sales and an increase in farm income (Szafraniec-Siluta and Zawadzka 2017).

According to the Central Statistical Office, "investment outlays are financial or material expenditures aimed at creating new fixed assets or improving existing tangible assets" (GUS 2020a) through reconstruction, extension, reconstruction or modernization of existing tangible assets, as well as expenditure on the so-called first investment equipment

(Rogowski 2004). Investment outlays are divided into outlays for fixed assets and other outlays. Outlays for fixed assets are outlays on:

- Buildings and structures (including buildings and premises as well as civil and water engineering structures), including, inter alia, construction and assembly works, design and cost estimate documentation;
- Equipment, technical devices and tools (including instruments, movables and equipment);
- Means of transport;
- Other, ie: detailed drainage, costs incurred when purchasing land and used fixed assets, livestock (primary herd) and long-term plantings, as well as interest on credits and investment loans for the period of investment implementation (GUS 2018).

The remaining outlays are outlays on the so-called first equipment of the investment and other costs related to the implementation of the investment. These outlays do not increase the value of fixed assets (GUS 2018).

Investments in agriculture in macroeconomic terms started as a kind of breakthrough in Polish agriculture with entry into the European Union. Closely tied with the integration with the European Union, critical issues arose in the agricultural and rural sectors for maintaining high GDP activity and properly implementing macroeconomic policies.

The factor of economic growth is, therefore, capital growth, an increase in the number and quality of the workforce and the improvement of the potential for using these resources, which is also evidenced by an increase in profitability in the enterprise sector (Molo 2013). The stage of socio-economic growth in each country is the main criterion for the proper dynamization of the agricultural economy. The higher the level of development, the more profitable the situation to intensify agriculture (Tomczak 2000).

Incorporating Poland into the Common Agricultural Policy, changed the profitability and investment outlays of Polish agriculture significantly. Then, as a consequence, Polish farms benefited from subsidies aimed at the Common Agricultural Policy of the European Union (EU CAP). The investment measures implemented by farmers determine

their development and competitive position. All investment activities are relatively dependent on the underlying financing, as well as their availability and universality. In this respect, the best known form of investment is the farm's own funds (Baraniak 2017).

11.4. Results and discussion

The macroeconomic situation is very important because in the absence of favorable conditions, effective and comprehensive restructuring of agriculture, as well as economic development of rural areas becomes an abstraction (Mrówczyńska-Kamińska 2008). The macroeconomic dimension of investments in the economy integrates with two important things, namely investments being a source of capital condensation are the cause of economic growth (supply side), in a short time investment result in economic growth – GDP as one of the superior links of the total demand (demand side). The long-term impact of investments causes the intensification of productivity and work efficiency.

The importance of agriculture in generating GDP and employment in economically highly developed countries decreased to 1.4%. In Poland, however, the impact of agriculture was positive with agriculture's share of GDP creation at 3%, and within the agri-food sector – 10% (MRiRW 2019). These relationships are also affected by the activity in rural areas, including depopulation. These events took place despite a huge increase in agricultural production, the fundamental elements of which were converted into means of production of industrial origin and biological evolution, modern varieties of plants and animal breeds (MRiRW 2019). In order for agriculture to continue to have a positive impact on GDP, investment or re-investment in farms is needed.

In this research, farmers were asked about their motives for investment activity. The information contained in Table 1 shows that the most numerous motives indicated were the increase in agricultural income and the increase in the scale of production. For, farms where the value of investments was in the range of 300.1-600 thousand PLN, motives for investment were improvement of the organization (88.46%) and increase in agricultural income (87.50%).

Table 1. Motives for starting investment activities

Motives for investment	Investment value [thoudand PLN]			
	Less than 300	300,1-600	600,1-900	Greater than 900
Increase in production scale	88,08	87,50	92,31	92,11
Increase in agricultural income	86,09	87,50	88,46	89,47
Change in the direction of production	13,24	18,27	17,31	6,58
Launching new production to diversify	16,56	23,08	17,31	17,11
Improving the quality of production	70,20	85,58	76,92	84,21
Possibility of refining products	45,69	48,08	50,00	51,13
Lowering production costs	68,87	77,88	63,43	78,94
Improving the organization of production	69,54	88,46	69,23	82,89
Adaptation of the production profile to market requirements	56,29	74,04	69,23	71,05
Legal conditions	37,75	42,31	44,23	36,84

Source: own elaborations based on research (n=383)

Compared to other European countries, the Polish economy is distinguished by an uninterrupted, relatively high growth rate. According to the data of the International Monetary Fund, Poland's Gross Domestic Product (GDP) increased by 4.0% in real terms and reached USD 565.85 billion at the end of the year (GUS 2020b). According to the data of the International Monetary Fund, the Polish economy ranks 22nd in the world in terms of GDP.

Data from the current research project with dairy farm owners indicated the sources of financing the investment. The research shows that the majority of dairy farm owners used their own resources and EU subsidies to implement their investment. The second highest source was EU loans and subsidies. Own funds and credit were ranked third (Table 2).

The dominant factor influencing the level of GDP is internal demand – investment and consumption demand. Even with higher investment outlays, agricultural productivity is increasing. The result is an increasing degree of automation and a lower intensity of human involvement in agricultural activities (MRiRW 2019). In 2019, over 1.4 million farms used 14.7 million ha and had 10.0 million large livestock. As a result of the increase in plant production (by approx. 12%) as well as

livestock production (by approx. 3%), the global agricultural production increased by 7% in current prices (GUS 2020c).

Table 2. Sources of financing for planned investments of surveyed farmers depending on the amount of financial support (%)

Investment sources	Investment value [thousand PLN]			
	Less than 300	300,1-600	600,1-900	Gerater than 900
With own resources and EU subsidies	50,33	56,73	51,92	56,58
With an EU loan and subsidy	23,18	27,88	23,08	32,89
With my own funds and credit (I have exhausted my EU funds limit),	8,61	14,42	15,38	19,74
With only own resources	15,23	16,35	9,61	19,74
Only on credit	2,65	-	1,92	2,63
Leasing	3,31	-	3,84	3,95

Source: own elaborations based on research (n=383)

11.5. Endogenous investment conditions

Endogenous conditions are related to the productivity of agriculture, mainly with the level of supply as a means of production, the scale of innovation, fixed assets at ones's disposal, as well as the ability to fund investment activities from one's own resources (Kusz and Gędek 2012).

Land is a specific production factor for agriculture. Its value is subject to soil quality and climate, which determines its productivity (Bezat-Jarzębowska and Rembisz 2015). The overriding internal conditions include the following five areas:

- labor productivity in agriculture, the added value per employee, employment in agriculture expressed as a percentage of the total number of employees,
- the size and structure of farms,
- the amount of agricultural income per employee in agriculture,
- production scale, and
- the share of sales in production – commodity production (Bezat-Jarzębowska and Rembisz 2015).

Endogenous conditions, determined by the producer, have a predominant influence on building the productivity (Rembisz 2006). In certain geographic locations, success in the market largely depends on internal forces (Gołębiewska 2008).

This signals a particularly important role of the internal potential of a given enterprise, taking into account first of all production resources, which affect the amount of income obtained (Poczta et al. 2009).

Nowadays, more and more often one can come across the thesis that the development of agriculture depends to a lesser extent on the internal substrate than on external conditions (Walenia 2009).

Investments provide the desired level of technological equipment, which determines the value of the gross margin in given farms (Kocira 2008). The property, relevance and number of fixed assets determine production capacity. For both maintaining or expanding production capacity, it is desirable to make investment outlays. Through investments, depleted fixed assets are reconstructed, and increased investments expand assets. Investment activities are based on deliberate, thoughtful and intentional use of large financial resources for durable goods (Czubak and Mikołakczyk 2012).

Investment expenditures have definite goals as part of an investment action plan. When initiating an investment action plan, the main factor becomes the farm's ability to make changes, and to achieve a specific investment goal. The indirect goal of investments may be to preserve the quality and quantity of fixed assets. Consequently, good investment plans can increase both income and profits. One example of investment strategy in agriculture is the investment in land which is a primary production factor.

Investments in mechanization are particularly related to the situation in agriculture and to the level of income for farmers with their own farms (Wójcicki 2014). Poland's accession to the European Union improved the position of farmers due to the introduction of the Common Agricultural Policy. In addition, it also contributed to the initiation of some financial support processes for agriculture by launching agri-environmental programs (Jucherski and Król 2013).

Price volatility makes the investment in agricultural equipment difficult to analyze. Constant or average prices should be used to assess the value of specific investment outlays. (Pawlak 2016).

11.6. Summary and conclusion

Farm owners who are actively managing the farm can benefit from investment support programs. The level of investment activities was directly related to current production capacity. Funds from the European Union were helpful for new investments; however some investment decisions were directly related to the availability and form of support available in subsidies and other aid programs. The progress of farms is related to the internal knowledge of production, technology, and marketing, in addition to the principles of the Common Agricultural Policy of the European Union with availability of aid programs. The increase in farm resources provides the opportunity to increase the scale of production, as well as providing for improvement of production processes and animal welfare.

Investments improved the efficiency and competitiveness of farms. The dominant reason for conducting investment activities is the conviction that in the future the income will be much higher than the investment costs incurred. The main motivation for the investment were striving to increase agricultural income and increase the scale of production.

The implemented investments were mainly for modernization and development, with the goals of reducing costs, increasing production capacity and stabilizing the market. Owner equity was used for investment, together with funds obtained from European Union funds. Farm owners with small land areas felt apprehensive about high investments on farms due to the high risk of failure with low profitability of production and high market volatility. Therefore, the investments undertaken in agricultural holdings are very diverse. Most of the surveyed farmers consider the lack of the necessary equity capital and difficulties in obtaining loans as significant barriers to undertaking investment activities.

In spite of everything, the overriding source of investment financing are own funds. Nowadays, investments in agriculture are an absolute necessity. Investment activities save labor and increase the level of

organization. You should carefully and reliably adjust your production potential and production costs to be able to compete in the market in the best possible way.

Investment in agriculture in necessary for continued profitability and viability. Strategic use of investments to adjust production potential and costs to be competitive in the market is necessary. The most common source of funding for investment was “own funds” combined with EU funds.

Farmer dissatisfaction with the functioning of the information system for obtaining EU funds may limit investment opportunity.

Farmers should focus primarily on investments that ensure an increase in the quantity and quality of the farm's commercial production. Each investment should be adapted to the scale and direction of production. Proper diagnosis of factors influencing the stability of agricultural income reduces the risk and contributes to efficient management and development of the farm, especially when making new investments.

On the website of the Central Statistical Office, data values are quoted in current prices, but does not take into account increasing prices. Therefore, it is required to estimate the value of investment outlays in average prices in the years covered by the analysis (Pawlak 2016). An important premise for investing in fixed assets in agriculture is their high degree of wear. In 2018, it was 77.1% (GUS 2019c).

Data for 2019 for capital expenditures, when broken down by expenditure typed showed that 43.5% were buildings and structures, 27.4% were equipment, technical devices and tools and, only 15.4% were allocated to means of transport. According to the data, a total of 1,491,679 agricultural tractors were purchased in Poland, including 226,133 in the Mazowieckie voivodship (GUS 2019c).

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12

EXOGENOUS FACTORS IN THE MODERNIZATION OF DAIRY FARMS[9]

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12.1. Introduction

Supporting agriculture and rural development is an important part of both the state policy and the policy of the European Union. An important objective of the Common Agricultural Policy and Rural Development is the modernization of the agricultural sector, including the modernization of agricultural holdings. In the sphere of economic and social policy, modernization is associated with restructuring and investments (Czyżewski et al. 2008; Wasilewska 2009).

Modernization is a symbol of the entire catalog of various types of social changes, where society moves along a certain scale of progress

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and achieves higher and higher levels of development. Modernization takes place in all historical periods, and an example of modernization is the departure of man from caves and the erection of the first shelters, replacement of carts with cars or replacement of typewriters with computers (Sztompka 2005).

Another meaning of modernization is related to the transformations in the political, social, cultural and mental spheres that continued in the West from the 16th to the 20th centuries. The result of these transformations was the development of capitalism, democracy, industry, urbanization, bureaucracy, rationalization, or the spread of individualism and motivation to achieve results, as well as the glorification of reason and science. In this context, modernization meant taking actions aimed at bringing modernity, reaching a specific, historically located institutional and organizational syndrome, which refers to the evolution of society from traditional and pre-technical to a modern society equipped with machine technologies. Modernization at that time was also characterized by secular and rational attitudes with a diverse social structure (O'Connell 1976).

Another meaning of the word modernization is used to express the actions taken by poorly developed and backward societies to match the world's most developed countries that coexisted with them in the same historical period (Wasilewska 2009).

The aim of this research was to assess the factors shaping investment in dairy farms. Particular attention has been focused on:

– Assessment of barriers to investment activity,
– Learning about investment plans.

We collected the data from a group of 383 dairy farms which made investments. The surveyed participants is divided into four groups depending on the size of the investment (PLN thousand):

– less than 300 thousand PLN – 151 farms,
– 300,1-600 thousand PLN – 104 farms,
– 600,1-900 thousand PLN – 52 farms,
– greater than 900 thousand PLN – 76 farms.

Purposeful selection was used in the research. The basis for qualifying the farm for the study was the investment made in 2007-2019 and the farmer's willingness to participate in the study.

12.2. The importance of modernization in the development of agriculture

Modernization means "modernizing enterprises by introducing new technologies, equipment and devices, means of transport, or modern work organization." (https://encyklopedia.pwn.pl/haslo/modernizacja; 3942539.html; 02/03/2020, 17:00).

According to the Economic and Agricultural Encyclopedia (1984), modernization of agriculture is a process of improving the existing fixed means of production, aimed at optimizing production processes by increasing the efficiency of human resources, while reducing their burden, and by increasing production efficiency and improving the quality of production, as well as by reduction of production costs.

Often the term modernization is associated with the term restructuring (Kusz 2018), but according to Woś (1999), these words are not identical in meaning. Modernization of farms is the replacement of the old production resource with a new one, which in turn results in better production quality and higher labor productivity, improving the efficiency of farming. On the other hand, restructuring is a change in the internal structure of an economic entity. In an agricultural holding, restructuring includes a change in the structure of production resources (which should be understood as a change in both the relationship between production factors and a change in ownership relations between individual production factors), and a change in the production structure and management method, as well as changes in the location of the farm in the market structure.

According to Klepacki (2005), restructuring means changes in the company's potential, changes in production technology and organization, or changes in relation to the environment, as well as changes in management and organizational structures designed to adapt the enterprise and organization to the requirements of the market economy.

Wójcicki (1997) also defines the modernization process and the restructuring process separately. The author believes that the

modernization of farms is carried out by introducing new techniques and work organization to the farm. This should be equated with the introduction of new technologies for obtaining agricultural raw materials and food products, taking into account the rational use of owned and acquired fixed assets. Restructuring, in turn, according to the author, is the changes taking place in the production structure and agrarian structure of farms and agricultural enterprises, including changes in employment in rural areas and agriculture.

According to Kusz (2018), both the modernization process and the restructuring process have a positive effects on increasing the competitive position of a farm. According to the author, changes resulting from the modernization process may translate into a change in the organization of a farm, and this in turn leads to the restructuring of the economic entity. The restructuring process often requires modernization of the production resources held. Therefore, the modernization and restructuring processes may simultaneously take place on the farm.

Modernization is aimed at adapting enterprises and entire economies to the current challenges that arise in their environment. These are constant, dynamic changes, allowing for participation in the benefits resulting from development. Entities in which the modernization process does not take place are marginalized (Zieliński 2014).

According to Zieliński (2014), in order for agriculture and rural areas to progress, the modernization process should be continuous. The creation and application of new technologies in agriculture is an important element that distinguishes modern agriculture from traditional agriculture.

There have been positive changes in agriculture in many developed countries. The introduction of new techniques and production technologies has led to an increase in the level of production and an improvement in the quality of manufactured products, as well as a decrease in the demand for human labor and improvement of working conditions. Another beneficial effect of progress in agriculture was less negative impact of agricultural production on the natural environment and reduced economic risk (Kim and Chavas 2003).

According to Runowski (2018), a distinction is made between progress in many areas, such as: progress in the biological area, which is

associated with the improvement of desired traits in plants and animals (including those obtained through genetic modification) and progress in the technical area, which mainly concerns changes in means of production and methods of obtaining them. Technical progress should be understood in the technical and production sense, which includes energy progress, mechanical progress, engineering and construction progress, engineering and water progress, and IT (Inteligent Technologies) progress. The author also mentions progress in the technological area, which is associated with new methods of production and new production technologies, progress in the organizational area, associated with changes in the organization of a farm and production organization, and progress in the socio-economic area, the scope of which includes social relations, agricultural system, etc.

The effect of progress in agriculture is the reduction of unit production costs and an increase in production potential (Reisch and Zeddies 1995).

According to Sroka (2010), it is very difficult to identify the role of a single factor in the development of agriculture, because all factors synergistically affect development and are related to each other. The level of agricultural development is the result of the influence of many factors in various directions (Klusek 2003).

According to Kusz (2018), the process of modernization of agriculture, including farms producing cow's milk, is influenced by many factors that can be divided into: exogenous (external) and endogenous (internal) factors. According to the author, exogenous (external) factors affect either directly or indirectly the changes taking place in agriculture. They can be divided into several groups, which are: demographic factors, environmental factors, socio-cultural factors, economic factors, technological factors, institutional factors, and the globalization process. Exogenous factors can also be divided into those that affect the demand and supply of food products. Market factors influencing demand are more important in causing changes in agriculture than those influencing supply. From the point of view of achieving positive changes in agriculture, it is advantageous to have balance.

12.3. Exogenous and endogenous factors of agricultural modernization

All investment activities carried out by farmers depend on the range of external – exogenous and internal – endogenous factors (Kusz and Gędek 2015). The exogenous factors determining the investment activity of farmers include:

- Demand for manufactured raw materials;
- Consumer preferences;
- Projected and current price levels of goods and services;
- Supply conditions, in particular the level of costs incurred, availability of factors of production, labor resources, materials and raw materials, machinery and equipment;
- Current and expected economic situation by farmers;
- Situation in a given sector of the economy;
- Geographic conditions;
- Demographic and social conditions;
- Resources in the national economy;
- System solutions (financial, economic, institutional);
- Economic policy, especially agricultural policy;
- Fiscal policy;
- Monetary policy;
- System of investment reliefs and subsidies;
- Level of inflation which determines the costs of obtaining capital;
- Level of interest rates;
- Functioning organizations or financial institutions;
- Degree of openness of the economy to international connections;
- Legal regulations;
- Barriers to international trade;
- Requirements for environmental protection or animal welfare;
- Demands from environmental groups;
- Other factors, such as rapid technical progress (Kusz et al. 2012).

Kołodziejczyk (2008) also points out that the modernization of farms is influenced by many external (exogenous) and internal

(endogenous) factors. The author includes among the exogenous factors: "eg. state policy, the Common Agricultural Policy and other institutions closely related to the functioning of farms and the condition of material and intellectual infrastructure ", while the endogenous factors were identified by factors originating from within the farm itself like land, human and capital resources.

The endogenous (internal) factors of agricultural modernization relate mainly to the production potential. Internal factors mentioned most often in the literature are: human capital, the level of obtained income and financial situation, organizational culture or attitude to the farm of the farmer's family, relationship between production factors and their resources, applied production technologies and the degree of connection with the environment in the case of legal persons with hired labor (Kusz 2018).

The endogenous investment factors include:

- Productive potential (size, mobility, productivity and profitability of own resources);
- Degree of consumption of fixed assets;
- Economic and financial situation of farms;
- Adaptation of the enterprise to high volatility of the environment;
- Organization and management system;
- Scale of modern manufacturing techniques used;
- Knowledge of the farm managers;
- Age of the farm managers;
- Other (own predispositions) (Kasprzak-Czelej 2013).

Poland's accession to the EU forced dairy farms to adapt to many requirements for the production of cow's milk with high quality parameters. The quality requirements for good raw cow's milk resulted from the consumer's demand for high-quality dairy products and a very strong competition on the milk market (Salamończyk et al. 2013).

In Poland, farms specializing in the production of cow's milk have undergone a wide range of restructuring and modernization processes, which can be divided into three periods. The first period is 1990-1995; the second period is 1995-2003; and the beginning of the third period started in 2004. In the years 1990-1995, farms producing cow's milk

underwent an adaptation process to the conditions of the market economy. During 1995-2003, dairy farms adapted to the requirements related to Poland's integration with the European Union and to the requirements related to the liberalization of world trade, the range of agricultural and agricultural products, and food products resulting from the end of the GATT Uruguay Round. Starting with Poland's accession to the European Union in 2004, a continuous process of adaptation to the changing market conditions, resulting from integration with the European Union, changes in the Common Agricultural Policy and ever stronger competition on the community and world markets began (Seremak-Bulge et al. 2015). As the author points out, the Polish dairy industry in the mid-1990s was one of the most fragmented in Europe. During this period, there were on average 2.6 cows in the herd. Almost 70% of farms had 1-2 cows, which constituted 37.5% of the national population. Milk produced at that time significantly differed from the European Union standards in terms of hygienic quality. For example, in 1998 only 15% of purchased milk met the criteria of the "Extra" class ("Extra" class is the content of up to 100,000 microorganisms and no more than 400,000 somatic cells in 1 ml of milk according to EU hygiene standards).

Dairies in Poland implemented a pricing policy focused on producing high-quality milk. The need to adapt to the hygiene and veterinary standards of the European Union before Poland's accession to the European Union was one of the factors accelerating the process of concentrating raw milk supply in larger farms and improving milk quality. Along with the rapid process of concentrating the milk marketed in larger farms, production efficiency and technological progress also improved.

The need to improve milk quality and production led to the creation of groups of large and medium-sized farms creating a good raw material base for the dairy industry. In 2013, compared to 2004, milk production increased by 6.6% (to 12.6 billion kg) nationally, due to an increase in milk yield per cow of almost 27% (to 5244 kg), despite a decrease in the number of cows by 15.4% and a decrease in the number of farms by almost 56%. In Poland, the number of suppliers in 2014 was 137 thousand, which was 56% lower than in 2004. The average annual volume of milk delivered from a farm was 73 tons and was almost three times higher than in 2004. In 2014, 10.6 million tons of raw milk were

supplied to the dairy industry, an amount that was 68% higher than in 1995.

Investments were an important factor having a positive impact on the increase in milk production and concentration of farms. Price policies were of secondary importance. In the first period of economic transformation, farms did not have adequate capital resources for the modernization of the raw material base.

Dairy cooperatives assisted farmers in purchasing supplies and equipment for breeding cows and cooling milk by granting loans repaid with milk deliveries (Smoleński and Seremak-Bulge 1994).

In addition, national budget funds were targeted for modernization of farms producing milk under the "Sectoral Restructuring and Modernization of Dairy BR / 01" and "Sectoral Dairy Program BR / 15". From the "Industry Dairy Restructuring and Modernization Program BR / 01", farms specializing in the production of cow's milk could obtain support for investments in 1994-2000, and from the "Industry Dairy Program BR / 15" in 2000-2007. In December 1997, the European Union introduced an embargo on dairy products from Poland due to the fact that raw milk did not meet the hygienic and veterinary standards. The embargo on products and the prospect of integration with the EU accelerated activities of the dairy sector to improve milk quality, and the state administration also made improving milk quality a priority. The In 1998, the "extra" class was introduced to assess the quality of raw milk, which corresponded to EU veterinary standards. In order to support the process of obtaining the largest possible amount of high-quality raw milk in Poland, a surcharge was introduced to the purchase price of "extra" class milk. The amount of subsidies to raw milk in the "extra" class in 2002-2003 amounted to PLN 542 million. In farms specializing in the production of cow's milk, thanks to the implemented aid programs, significant modernization progress was made, which resulted in the share of milk in the "extra" class at the level of 70% in 2002, and in 2003 at the level of 81.4% (Seremak-Bulge et al. 2015).

12.4. Specialization of dairy farms

Starting in 2002, the process of modernization of dairy farms in Poland was implemented with the use of EU funds under the SAPARD programs, the Sectoral Operational Program (SOP) and the Rural Development Program (RDP). In the years 2004-2013, PLN 5 billion was allocated to investments in dairy farms under the RDP. More than PLN 24 billion was paid for investments related to adjustments to meet the European Union standards under RDP 2004-2006, of which 93% was paid for the construction of panels and slurry tanks, while PLN 26 billion was paid under RDP 2007-2013. Another PLN 24 billion. was intended for the purchase of equipment and machinery (Seremak-Bulge et al. 2015).

Currently in order for a dairy farm to be able to produce and sell cow's milk, the farm is obliged to comply with the legal provisions in national and EU regulations regarding sanitation and hygienic conditions, animal welfare and the environment.

In the area of sanitation and hygienic conditions required for the production of cow's milk, farms specializing in the production of cow's milk must meet the conditions of the Act of December 16, 2005 on animal products (Journal of Laws of 2006, No. 17, item 127, as amended), which directly refers, to Regulation (EC) No. 853/2004 of the European Parliament and of the Council of 29 April 2004 with specific hygiene rules for food of animal origin (Journal of Laws of the EU, L 139 of April 30, 2004, p. 55).

The animals owned by farms specializing in the production of cow's milk are also subject to the Act of August 21, 1997 for the protection of animals (Journal of Laws 1997, No. 111, item 724, as amended), which means that they must be kept on a farm in conditions not worse than those described in the Regulation of the Minister of Agriculture and Rural Development of 28 June 2010 on the minimum conditions for keeping farm animal species other than those for which protection standards have been defined in the European Union regulations (Journal of Laws 2010, 116, item 778, as amended) and the Ordinance of the Minister of Agriculture and Rural Development of February 15, 2010 on the requirements and procedures for keeping farm animal species for which

protection standards have been defined in European Union regulations (Journal U. 2010 No. 56 item 344 as amended).

In addition, livestock must be marked and registered in accordance with the Act of 2 April 2004 on the animal identification and registration system (Journal of Laws of 2004, No. 91, item 872, as amended).

In the entire process of producing high-quality milk on farms, animal nutrition is very important. Therefore, the farm requires the acquisition and storage of feed from its own farm and the use of feed for feeding animals produced in accordance with the requirements of the Act of 22 July 2006 on feed (Journal of Laws 2006 No. 144 item 1045 as amended), referring to the EU law contained in many legal acts, including in particular Regulation (EC) No. 183/2005 of the European Parliament and the Council of 12 January 2005 with requirements for feed hygiene (OJ L 35 of 08.02.2005, p. 1).

The production of cow's milk on the farm is closely related to the rearing of youngstock and the maintenance of a herd of dairy cattle which results in the production of manure, a valuable fertilizer of natural origin used in crop production, which is the basic animal feed base (Czekała 2015).

On the one hand, natural fertilizers are highly valued in crop production, but if not used carefully, they can pose a threat to the environment. In addition to natural fertilizers, a number chemicals may be used in crop production, including mineral fertilizers and various types of substances supporting the cultivation of plants, the use of which, if not properly used, may also have a negative impact on the condition of the natural environment (Walczak et al. 2012).

Therefore, farms specializing in milk production are obliged to store and use fertilizers, including those of natural origin, in accordance with the Act of July 10, 2007 on fertilization and fertilization (Journal of Laws of 2007, No. 147, item 1033, as amended) and the Act of 20 July 2017 Water Law (Journal of Laws of 2017, item 1566, as amended). The provisions of the Water Law Act additionally regulate the entire subject related to the use of surface and groundwater, their protection and management, which is also related to agricultural production carried out on farms specializing in the production of cow's milk. Rules and regulations

that must be complied with for milk production and dairy farming are extensive.

12.5. Research results

The owners of dairy farms identified barriers that hinder investment activity. The research showed that greatest barrier was the lack of necessary equity capital (Table 1). It should be noted that only in the group of farms whose investment value was in the range of 600.1-900 thousand indicated that the greatest barrier was the complicated procedures of applying for EU funding.

Farmers also reported barriers of high interest rates on loans and lengthy procedures for obtaining approval for investments. This barrier particularly affects farms suffering from lack on necessary capital to conduct the investment. The loans and credits are too expensive for many farmers and their difficult economic situation limits the use of credits.

Another strict barrier to the investment processes in dairy farms are the complicated procedures for applying for EU funds. This barrier particularly affects farmers who are not able to fill in all necessary documents.

Polish dairy farmers are also afraid of agricultural policy and its uncertainty. The common agricultural policy of the European Union places particular emphasis on the development of agriculture and rural areas. So farmers should not be afraid and take advantage of the opportunities it creates.

Polish dairy farms have lower profitability compared to other farmers from EU member states. These differences result from a smaller scale of production, greater fragmentation of dairy farms, lower milk yield of cows and worse development prospects.

Dairy farmers in Poland have also difficulties in achieving good advice. The development of dairy farms requires constant contacts between farmers and advisers who offer various types of advice, e.g. investment, agricultural, technological and others. Obtaining such aid requires constant cooperation with advisers who help farmers in developing their farms.

Table 1. Barriers to investment activity depending on the amount of financial support (%)

Barrier	Investment [thousand PLN]			
	Less than 300	300,1-600	600,1-900	Greater than 900
No necessary equity capital	64,90	67,31	63,46	64,47
Difficulties in obtaining loans	41,06	38,46	36,54	26,31
High interest rates on loans	56,95	67,31	63,46	61,84
Lengthy procedures for obtaining approval for an investment	58,94	68,30	63,46	72,37
Complicated procedures for applying for EU funds	62,91	62,50	73,08	59,21
Lack of advice and practical models	31,79	26,92	15,38	22,37
Information system not functioning satisfactorily	30,46	43,27	30,77	39,47
Too much risk of failure	41,06	56,73	40,38	44,74
Low production profitability	45,69	54,81	34,62	60,53
Uncertainty about agricultural policy	57,62	69,23	57,69	59,21

Source: data from own research

The owners of dairy farms had investment plans (Table 2). The purchase of land was the most common investment across all groups of dairy farms. In many regions of Poland, farmers have problems with purchasing land because of its shortages. In Poland, the land is very often passed down from generation to generation in families. Moreover, farmers are reluctant to sell land, seeing it as an investment of capital. The sale of land from the resources of the National Agricultural Support Center is decreasing year by year, which is the amount of the dwindling land resources.

On farms where the investment value was in the range of 300.1-600 and 600.1-900 thousand PLN, the construction of livestock buildings was the next highest investment, whereas. By investing in buildings, farmers improve the hygienic conditions of animals and their welfare, and install milking machines and devices for storing and cooling milk. In addition, modern barns are equipped with sewage systems to store the slurry, which protects the natural environment.

In farms with the lowest and the highest value of investments, the purchase of a tractor and equipment was the next highest investment. Investments of this kind are very beneficial because they enable the

introduction of more mechanization in the economy. Thanks to these investments, dairy farm owners become more independent in field work and hire less workforce, which is becoming more and more difficult in the Polish countryside.

Table 2. Further investment plans of the surveyed farmers depending on the amount of financial support (%)

Investment plans purchases	Investment value [thousand PLN]			
	Less than 300	300,1-600	600,1-900	Greater than 900
Land	47,02	49,04	61,54	68,42
House building / apartment	17,22	13,46	19,23	23,68
Livestock buildings – cowshed, juniper, calf, other	28,48	33,65	36,54	34,21
Construction of farm buildings	14,57	20,19	23,08	21,05
Tractor/equipment	31,12	29,81	36,54	44,74
Devices	18,54	15,38	21,11	21,05
Car	14,57	14,42	11,54	17,11

Source: data from own research

12.6. Summary and conclusion

The development of dairy farms is closely linked to the investment process. The investment activity of dairy farmers depends on many different factors and is limited by barriers. Our research demonstrate that the most important barrier to the investment process is the complicated procedures of applying for the EU funds. Such barrier is the effect of complicated procedures of filling documents, realization the investment process and refunding money. Polish farmers have to carry out the investment and after that they can apply for money refunding. They can only claim a refund of 50% of the investment costs.

Other important barrier to the investment id dairy farms is the lack of capital. This barrier particularly affects poorer farmers and those who have small-scale farms who cannot afford to carry out the investment on their own. They have to take loans and credits which are expensive.

The largest percentage of farmers indicated land purchase as the most important investment plan in the future. The largest percentage of farmers indicated land purchase as the most important investment plan

in the future. This plan may be difficult for many farmers to implement due to the lack of agricultural land for sale in their region. There is currently a hunger for land in Poland and many farmers, although they would like to expand their business and buy land, cannot do it.

Other investment plans are closely related to the production of milk, enlargement of the herd of animals or the purchase of new machinery and equipment for farms. It should be noted that these investments can be implemented on dairy farms and the barriers are rather small.

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13

PERSPECTIVES FOR THE DEVELOPMENT OF ORGANIC DAIRY FARMS IN POLAND

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13.1. Introduction

Enhancing environmental and food security requires a shift in agricultural production systems towards sustainable agriculture which ensures more efficient use of natural resources (Huhtanen 2010). Organic farming is an agricultural production system that respects the principles of sustainable management to the greatest extent (Cooper et al. 2010; Jespersen et al. 2017).

This system combines the most environmentally beneficial practices, a high degree of biodiversity, conservation of natural resources and high animal welfare standards. Animals kept under the organic farming system must be fed with organic fodder, preferably from the same farm, and provided with sufficient space and access to outdoor areas (Meemken and Qaim 2018). The International Federation of Organic Agriculture Movements (IFOAM) defines organic farming as a set of

specific farming concepts, in line with soil, plant and animal requirements, the overall objective of which is to produce high-quality food, while maintaining the biological balance of the environment as far as possible. The basic principles of organic farming as defined by IFOAM include, among others: closed-loop management in order to maintain long-term soil fertility, preservation of animal welfare and provision of living conditions for the animals compatible with their physiological needs and humane principles (Arbenz et al 2016).

Globally, organic farming legislation is evolving, influenced by the expectations of organic sector participants and by developments in knowledge and innovation that increase the applicability of acceptable methods and measures in the sector. The European Union has created a broad legal framework for a growing number of agricultural producers and a financial support system for organic farming. On the one hand, the introduced regulations on organic farming have contributed to its institutionalisation and increased transparency in the organic food market, while the system of financial support for organic farming has fostered an increased interest among farmers in this production system.

The level of development of organic agriculture varies spatially. The continents with the largest share of the world's areas under organic maintenance are: Australia, Europe and South America (Runowski 2009). The size and importance of organic milk production is also spatially varied. Europe and North America are in the lead. The main producers of organic milk in Europe are: Germany, Austria, Great Britain, France and Denmark.

Cow's milk production is one of the most important branches of agricultural production in the world. The dairy sector also plays an important role in the economy of the European Union, and in the EU member states there is a strong emphasis on the quality of the raw material and on animal welfare, i.e. keeping animals in a way which ensures appropriate living conditions (Bórawski et al. 2020; Babuchowska 2020). The main problem of cattle farming is the negative impact of this branch of production on the environment, as indicated by many researchers, which is particularly high on farms with a high level of production intensity (Soltanali et al. 2015; Gulseven and Wohlgenant 2017; Bórawski et al 2020). At the same time, the level of public awareness of the negative

effects of agricultural intensification on health, quality of life and the environment is growing. As a consequence of the changes, both the interest of farmers in the organic production system (Brodzińska 2010) and the interest of consumers in organic food are increasing (Łuczka-Bakuła 2005).

13.2. Research objective and methods

The aim of the research is to diagnose the nature and direction of changes in organic dairy farming system in a global, European and national context and to understand their economic and social determinants. The nature of these changes is not unambiguous and the development of organic farming, especially in EU member states, including dairy farming, is largely determined by the subsidy system for organic farming. This was analysed in detail on the example of Poland.

The analyses used source data mainly from studies of foreign institutions on organic farming, such as the Research Institute of Organic Agriculture (FiBL), published in The World of Organic Agriculture – Statistics & Emerging Trends, and the International Federation of Organic Agricultural Movements (IFOAM). Both institutions are the primary source of statistics on organic farming worldwide. The latest data published in 2020 includes information on organic agriculture from 2018. The analyses on organic farming in Poland were based on data from the Commercial Quality Inspection of Agricultural and Food Products (IJHARS), as well as the Ministry of Agriculture and Rural Development (MARD), the Agency for Restructuring and Modernisation of Agriculture (ARMA).

13.3. Organic milk production in a global and European framework

According to the latest OECD-FAO projections, world milk production will grow at an average annual rate of 1.6% between 2020 and 2029, reaching 997 million tonnes in 2029. In 2029, it is estimated that Asian countries, particularly India and Pakistan, will produce more than 30% of the world's milk volume. In contrast, the highest productivity is

achieved by cows in North America, where the share of the production model based on pasture feeding is small and the mode of production in specialised farms is focused on high yields. The dairy cow population in both the United States and Canada is expected to remain similar to current levels over the next ten years, with production growth based on further productivity gains. In New Zealand, by contrast, the production system is mainly grazing-based, thus land availability and increasing environmental requirements will be the limiting factors for further growth in milk production. Strong growth in milk production can also be expected in Africa, mainly due to an increase in the size of low-yielding herds. According to OECD-FAO analysts, milk production in the world's second largest milk producer after India, the European Union, will grow at a lower rate than the world average. Moreover, it is in the EU that the share of organic milk production is expected to increase.

In 2018, there were 2 796.4 thousand organic farms worldwide, with the highest number of organic farms in Asia and Africa. In contrast, the highest annual growth rate was recorded in EU countries (by 7.14%), while a significant decrease in the number of organic farms in 2018 compared to 2017 was recorded in South America (Table 1).

Table 1. Number of organic producers by continent in 2018

Continent	2017	2018	Dynamics
Europe (incl. EU)	397 146,00	418 610,00	105,40%
	305 394,00	327 222,00	107,14%
Africa	806 877,00	788 858,00	97,76%
Asia	1 231 159,00	1 317 023,00	106,97%
South America	460 443,00	227 608,97	49,43%
North America	22 966,00	23 957,00	104,31%
Australia and Oceania	26 750,00	20 859,00	77,98%
World	2 944 909,00	2 796 404,97	94,96%

Source: own study based on data from FiBL

Among the 28 EU member states, the highest number of organic farms in 2018 was recorded in Italy (69 317 farms), followed by France (41 632 farms) and Spain (39 505). On the other hand, the highest average UAA on organic farms was recorded in Slovakia (430.49 ha), the

UK (129.06 ha) and Czech Republic (117.13 ha). The average organic farm size in the EU is 42.14 ha, while the smallest average area of organic farms are in Malta (2.48 ha), Cyprus (4.82 ha) and Slovenia (12.80 ha) (Table 2).

Organic cow's milk production in the EU in 2018 totalled 5 761 thousand tonnes. This production was mainly concentrated in Germany – 1 117 thousand tonnes (19.4% of EU production), France – 909 thousand tonnes (15.8% of EU production), Denmark – 685 thousand tonnes (11.9% of EU production) and Austria 635 thousand tonnes (11.0% of EU production) (Table 2).

Table 2. Number of producers, organic agricultural area, average organic farm area and amount of cow's milk produced in EU countries in 2018

EU country	Number of producers	Area in thous. ha	Average area per producer	Volume of organic cow's milk in tonnes
Austria	25795	637,8	24,73	635751
Belgium	2264	89,0	39,32	120077
Bulgaria	6471	162,3	25,09	5280
Croatia	4374	103,2	23,59	3094
Cyprus	1249	6,0	4,82	3706
Czech Republic	4601	538,9	117,13	33433
Denmark	3637	256,7	70,58	635751
Estonia	1948	2060,6	106,05	7386
Finland	5129	297,4	57,99	71028
France	41632	2035,0	48,88	909336
Germany	31713	1521,3	47,97	1117821
Greece	29594	492,6	16,65	75722
Hungary	3929	209,4	53,29	4721
Ireland	1725	118,7	68,81	17791
Italy	69317	1958,0	28,25	448184
Latvia	4178	280,4	67,11	94327
Lithuania	2476	239,7	96,81	68133
Luxembourg	103	5,8	56,14	3772
Malta	19	0,05	2,48	0
Netherlands	1696	57,9	34,14	293681
Poland	19224	484,7	25,21	26773
Portugal	5213	213,1	40,88	
Romania	7908	326,3	41,26	28062
Slovakia	439	188,9	430,49	25998
Slovenia	3738	47,8	12,80	7187
Spain	39505	2246,5	56,87	42006
Switzerland	5801	608,8	104,94	464970
UK	3544	457,4	129,06	564
Sum	**327 222**	**13 790,4**	**42,14**	**5144554**

Source: own study based on EUROSTAT data

13.4. Organic cow's milk production in Poland

The dynamic development of organic farming in Poland, especially after agriculture was covered by financial support under the CAP, has significantly increased the interest in organic production methods and organic processing. According to data from the Commercial Quality Inspection of Agricultural and Food Products (IJHARS), in 2018 the number of organic farms with a certificate or in the process of obtaining a certificate amounted to 19,207, compared to only 3,705 farms in 2004 (IJHARS 2007-2018). However, it is important to note that the highest number of organic farms in Poland (27 093) was in 2013. Since 2014, however, the number of organic farms has been decreasing, even though Poland is considered a country with friendly conditions for organic production due to its environmental conditions. Organic farming is one of the branches of agriculture in which we can successfully compete with other countries and produce high quality food. This is supported by the relatively clean environment, uncontaminated soils and the structure of agriculture (Szymona 2012).

Analysing the number of registered organic cattle farmers in Poland, a downward trend can be observed between 2010 and 2018. In 2010, the number of organic cattle producers was 4 187, while in the following years a downward trend was observed, the exception being 2012 with a slight year-on-year increase. In 2018, there were 1 305 organic cattle farms, representing only 31.2% of the holdings with organic herds in year 2010 (Figure 1).

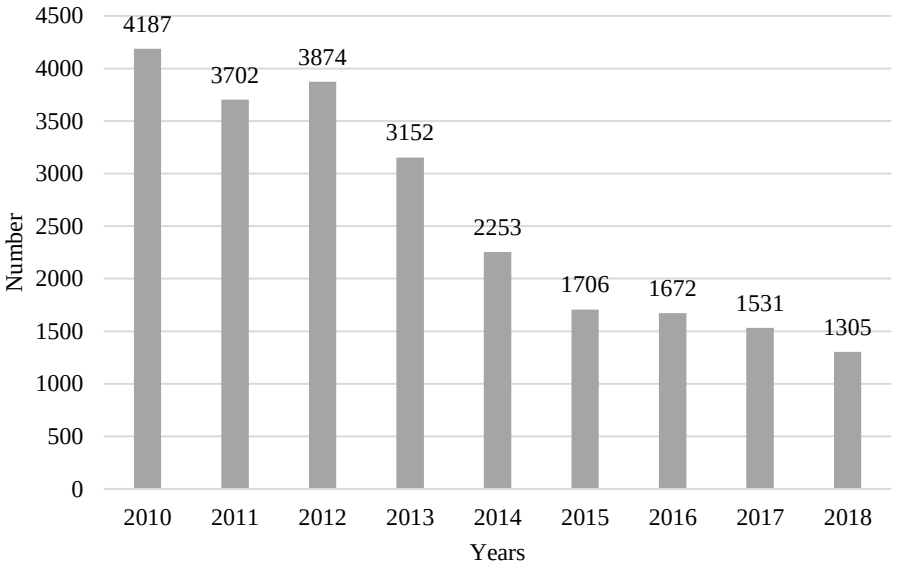

Figure 1. Organic cattle farms in Poland 2010-2018
Source: own study based on IJHARS data.

The analysis of changes in the stock of cattle kept in the organic farming system according to the direction of use, in the case of dairy cows, shows a general downward trend since 2010, while in the case of beef cattle this the same trend started in 2012. It is also worth highlighting the predominance of beef cattle over dairy cows between 2011 and 2013. On the other hand, in the new RDP 2014-2020 programming period, with a general downward trend, a clear predominance in the population of dairy cows over beef cattle kept under the organic farming system is evident. With the dairy cow herd in 2018 accounting for only 46.6%of the 2010 herd (Figure 2).

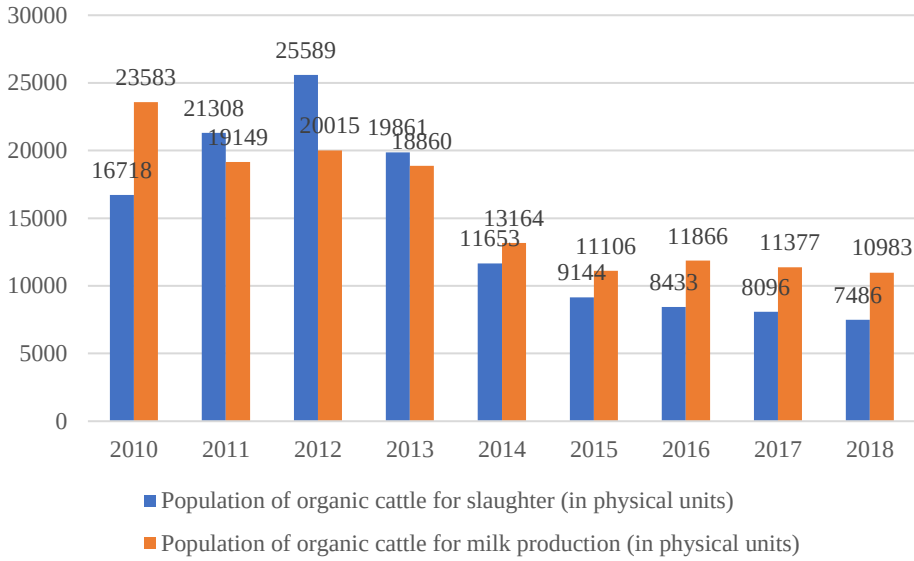

Figure 2. Population of organic cattle in Poland, 2010-2018, for slaughter and for milk production (in physical units)
Source: own study based IJHARS data

Analysing the population of dairy cows kept under organic farming system in individual voivodeships in 2018, it can be seen that the highest number of dairy cows in this system was kept in the voivodeships of małopolskie (2 002), zachodniopomorskie (1 800), podkarpackie (1 332), pomorskie (1 106) and mazowieckie (1 047) (Table 3).

Table 3. Dairy cow population and quantity of milk produced (hectolitres) by voivodeship in 2018

Voivodeship	Dairy cow population (physical units)	Volume of organic milk collected (hectolitres)	Average volume of organic milk marketed per cow (litres)	Estimated volume of organic milk sales %
małopolskie	2002	51643,23	2579,6	44,9
podkarpackie	1332	38193,20	2867,4	49,9
mazowieckie	1047	29759,00	2842,3	49,5
warmińsko-mazurskie	871	22342,0	2565,1	44,6
świętokrzyskie	516	12754,00	2471,7	43,0
podlaskie	597	18530,83	3104,0	54,0
zachodnio-pomorskie	1800	40630,00	2257,2	39,3
dolnośląskie	607	8592,31	1415,5	24,6
pomorskie	1106	16853,6	1523,8	26,5
lubelskie	248	2610,0	1052,4	18,3
lubuskie	303	170,00	56,1	1,0
kujawsko-pomorskie	239	8560,00	3581,6	62,3
wielkopolskie	149	205,00	137,6	2,4
śląskie	45	445,00	988,9	17,2
łódzkie	73	1793,00	2456,2	42,7
opolskie	48	0,00	0,0	0,0

Source: own study based IJHARS data

In Poland, a total of 253,000 hectolitres of milk were obtained from dairy cows kept under organic farming system in 2018. The available data shows that the highest milk production was recorded in the voivodeships with the largest dairy cow population, namely małopolskie with 51.6 thousand hectolitres, zachodniopomorskie with 40.6 thousand hectolitres, podkarpackie with 38.1 thousand hectolitres and mazowieckie with 29.8 thousand hectolitres. In 2018, the average annual milk yield per 1 cow was 5 747 litres and therefore, assuming the yield of dairy cows at this level, the sales volume of milk, obtained from cows kept under organic farming system, was estimated as an organic product. The calculations show that in three voivodeships, opolskie, lubuskie and wielkopolskie, milk obtained from cows kept under the organic farming system was almost entirely marketed as milk from conventional production. In four voivodeships the share of milk sold as organic was only 10-

30% of the total milk from cows kept under the organic farming system, in seven voivodeships it was 30-50% and only in two voivodeships (podlaskie and kujawsko-pomorskie) it exceeded 50% (Figure 3).

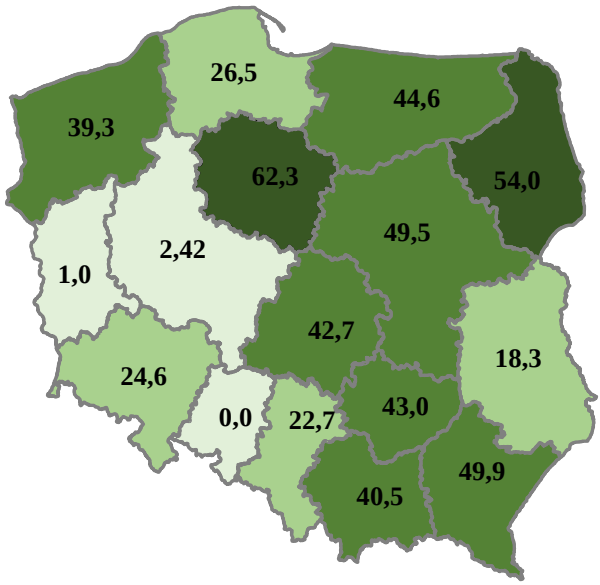

Figure 3. Level of organic milk production and sales by voivodeships (% of sales)
Source: own study based on IJHARS data

It is also worth pointing out that in recent years the production of organic cow's milk in Poland has remained stable at around 250 thousand hectolitres. In the years 2010-2012 the production was between 376 and 395 thousand hectolitres, thus this is a significant decrease in the volume of organic milk production.

The situation was similar in the number of organic milk processors. In 2009-2010, 4-5 entities were involved in milk processing, in 2012 their number increased to 17, and in 2014, 6 processors were active in this field, which together produced a total of only 1 093 tonnes of milk products and cheese (IJHARS 2008-2014). According to IJHARS these trends are a consequence of difficulties in selling organic products by agricultural producers to processors and result in them being marketed

as non-organic food. Therefore the most important barrier to development is the sale of milk and putting it into organic rather than conventional marketing. In turn, organic processors do not obtain enough quantities of raw materials for processing and thus significantly reduce their production volume or abandon it altogether. Although the environmental conditions for organic dairy farming do not essentially differ from those of conventional farming, the more expensive and more difficult organic production under domestic conditions still faces the barrier of low profitability.

13.5. Economic efficiency of organic dairy farming

The development of organic milk production is closely linked to its profitability, as well as its competitiveness in relation to other production systems. On the one hand, profitability depends on the costs incurred in production, while on the other hand, it is determined by the income obtained from the sale of raw materials or organic products. Organic livestock production reduces the scale of sales and the monetary value of commodity production, because its productivity is lower, which generates higher unit production costs (Runowski 2007; Malaga-Tobola 2011).

Milk production according to organic principles, just like conventional production, to be economically efficient, must consist of minimising production costs and maximising revenue. There are many factors determining the economic efficiency of milk production. The most important of these include milk yield per cow and milk price. Agricultural producers, who obtain milk by organic methods, expect higher prices. It is worth noting that the prices of raw materials and organic products in the world are up to 85% higher than the prices of conventional milk. In Germany, Belgium, the Czech Republic and Poland the price per kg of organic milk is about 12.5 eurocents or 36% higher than the price of conventional milk. The comparison in figure 4 shows that the price ratio of organic to conventional milk is higher from about 22% (Austria) to 46% (Belgium). In Poland, therefore, it is not the price of organic milk that limits the development of this line of production but, as already mentioned, the limited possibilities for its sale.

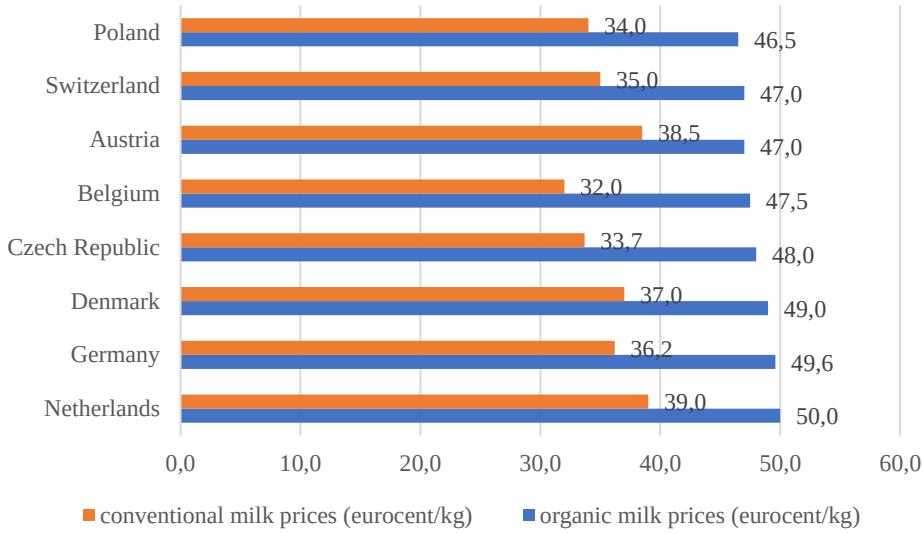

Figure 4. Comparison of organic and conventional milk prices in selected EU countries

Source: own study based on Puppel et al, 2018, p. 4.

Another determinant of the economic efficiency of organic milk production is the scale of production, which depends primarily on the number of cows in the herd, because as the scale increases, the production costs decrease. An important constraint on the increase in the scale of organic milk production is the size of the possessed fodder base, because organic cattle farming mainly involves the use of fodder from the farm (Jankowska-Huflejt and Prokopowicz 2011). The high proportion of permanent grassland on the farm determines the potential for development of this line of production and provides an opportunity to reduce feed costs.

An important influence on the economic efficiency of organic dairy farming is the appropriate choice of breed. On these farms, milk production should not be carried out using high-production breeds of cattle with high nutritional requirements, but breeds that guarantee better adaptation of animals to local environmental conditions. Native breeds are characterised by better adaptation to less favourable environmental conditions, better utilisation of lower quality fodder as well as higher

fertility. Improved animal health is particularly important in organic farming, as there are restrictions on the use of drugs. Therefore, higher cow health means lower herd failure rates and therefore lower herd renovation costs, which translate into a positive economic effect.

The results of analyses conducted on the basis of FADN data indicate that organic milk production is profitable, as 1 PLN of the incurred inputs generated an income of 1.45 PLN. In contrast, in the case of grassland animals, a loss was recorded (Juchniewicz and Nachtman 2020). It is also worth noting that it was the organic farms keeping dairy cows that obtained the highest average economic size (32162.0 euro), but also in these farms the highest own labour input was recorded.

Table 4. Selected production data by type of undertaken organic agricultural production

Specification	Units	Field crops	Permanent crops	Dairy cows	Herbivore animals	Mixed
Economic size	euro	18472,8	21190,6	**32162,0**	19207,9	14812,3
Total labour input	AWU	1,983	2,203	1,932	1,544	1,491
Own labour input	hours	3 146	2 456	**4 336**	3 519	3 168

AWU- paid labour input, expressed in full-time equivalents (annual work unit)
Source: own study based on Standard Results 2018…2020

There is a widespread belief that cows kept under organic farming system are not able to compete with conventionally managed dairy farmers due to the small scale of production and the requirements on fodder quality (Borecka and Szumiec 2013; Walczak and Szewczyk 2013; Komorowska 2016). And although the system of subsidies for organic production can be as high as 1500-1882 PLN (orchard crops), subsidies for permanent grassland are only 535 PLN, and for fodder crops on arable land they are 658-926 PLN. This support certainly improves the economic efficiency of milk production in the organic system, but it certainly does not determine it, because it is a very labour-intensive direction of production.

13.6. Summary

Milk production under organic farming system can provide an opportunity to improve the income situation of some farms, especially those producing on a smaller scale but with a large area of grassland. Studies have shown that support in the form of subsidies for organic farming is important and the main barrier to the development of organic dairy farming is the limited possibilities to sell milk as a certified product, i.e. at a higher price than milk from conventional production. The estimated production of organic milk sold as milk from conventional production varies from about 48% in kujawsko-pomorskie voivodeship to almost 100% in opolskie, lubuskie and wielkopolskie voivodeships. The lack of possibility to sell milk as a certified product significantly limits the development possibilities of organic dairy farms.

The lower competitiveness of organic farms compared to conventional farms results from the smaller scale of production and the lower milk yield per cow. Therefore, it can be improved both by concentrating production and increasing the unit milk yield of cows and by consolidating organic dairy farms to obtain a larger batch of uniform product (raw material) and a higher price for the milk sold.

In conclusion, organic cow's milk production is limited by the lack of an integrator, which could be either dairies already in operation once their organic milk processing lines are in place or groups of organic milk producers. Linking organic milk producers to processing and distribution will create a sustainable basis for the development of this line of production. The example of Poland shows that a system of subsidising organic farming without a link to the market does not support the sustainability of organic farms.

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14

LEGAL AND ECONOMIC ASPECTS OF THE DEVELOPMENT OF DIARY COOPERATIVES IN POLAND[10]

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14.1. Introduction

Dairy production in the EU and in Poland is a basic branch of agricultural production (Wasilewski and Chmielewska 2006). It constitutes about a 20% share of agricultural commodity production, and a 15%

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share of consumer spending on food, a 14% share of sales and an 11% share of exports (Pietrzak 2010).

In Poland, individual farms supply milk to dairy processors. The number of suppliers and processors of milk has decreased recently. These changes show the increased concentration of processors. Moreover, the dairy product market is saturated, which forces dairy enterprises to be innovative (Chądrzyński 2014).

The development of the dairy sector depends heavily on the dairy cooperatives and their financial condition. The good economic situation of these enterprises may result from a number of factors, including export opportunities for milk and dairy products. Also, the availability of large and high quality raw milk is also a key factor.

Polish dairy cooperatives are developing dynamically. The consolidation of dairy enterprises allows them to obtain greater economies of scale in processing and the sale of dairy products. Due to the increased scale of production, unit costs decrease.

Dairy cooperatives function organizationally like traditional enterprises. They are responsible for controlling the entire supply chain for dairy products. Recently, there has been a trend toward more integration of dairy cooperatives with farmers supplying raw milk.

14.2. Aim and methods

The goal of the research was to learn about the legal and economic aspects of the functioning of dairy cooperatives in Poland. As part of the main objective, the following specific objectives were implemented:

- assess changes in the number of dairy cooperatives in Poland,
- learning about the economic situation of dairy cooperatives,
- assess the financial liquidity of dairy cooperatives.

The source of the information used in the work were the materials of the Institute of Agricultural and Food Economics-National Research Institute in Warsaw.

In order to present the research results, tabular, graphic and descriptive methods were used. A trend analysis was used in the interpretation.

14.3. Legal aspect of dairy cooperatives development

The history of the Polish dairy cooperative goes back to the partitions and the period before the First World War (Dworniak and Pietrzak 2014). After the Second World War, dairy cooperatives were subject to national regulations. On the other hand, after integration with the EU, dairy cooperatives had to adjust the organization, production and quality to EU standards (Chmielewska 2007).

The vast majority of milk processing enterprises operate in the form of dairy cooperatives. The most important features of the cooperative as entities were set out in the Act of September 16, 1982 and in the light of the applicable law are as follows:

- is a voluntary and self-governing association with an unlimited number of members and a floating share fund (U S T AWA z dnia 16 września 1982 r.),
- conducts economic activity, as well as social and educational and other activities, guided by the needs of its members and social interest,
- dairy cooperatives cooperate with farmers and thus participate in the integration of the entire dairy sector in Poland,
- the establishment of a cooperative is conditioned by an entry in the register of cooperatives kept by district courts (U S T AWA z dnia 16 września 1982 r.),
- when making decisions, each member has one vote, regardless of the number of shares held, so the majority of people decides, not the capital majority, while the member participates in the profits of the cooperative depending on the number of shares,
- members of the cooperative are divided into founding members and other members, founders become members of the cooperative by submitting a declaration of will, others must submit a declaration. Moreover, to obtain a decision on admission, which is taken by the

competent body of the cooperative (U S T AWA z dnia 16 września 1982 r.),

– members – founders adopt and sign the statute, which should include: the name of the cooperative, seat and area of operation, purpose and object of its activity, amount of the entry fee, amount and number of shares, rights and obligations of members, rules of convening general meetings, methods of dividing the balance sheet surplus and covering losses. Their functioning depends to a large extent on the members of the cooperative (Suchoń 2013).

Despite their specific characteristics, dairy cooperatives function like other entities on the market, striving to obtain a surplus of revenues over costs, i.e. profit (Zuba and Zuba 2011). The most important features of the cooperative as entities are:

– cooperative bodies: general meeting, supervisory board, management board, removal of groups of members,
– the general meeting is the highest body of the cooperative, which is made up of all members of the cooperative, it is a legislative body deciding on key matters of the cooperative,
– the supervisory board is a body established to control and supervise the day-to-day activities of the management board and individual organizational units of the cooperative, and economic plans and programs of cooperative activities, approves the organizational structure of the cooperative (U S T AWA z dnia 16 września 1982 r.),
– the management board is a body representing the cooperative outside and managing the day-to-day activities of the cooperative, it consists of at least three members of the cooperative, including the president and his deputy, elected by the supervisory board or the general meeting, depending on the provisions of the articles of association,
– meetings of member groups take place in cooperatives, where the statute, due to the number of members, delegates the function of the general meeting to the meeting of representatives, electing and dismissing representatives at the meeting of representatives, sometimes electing a member or members of the supervisory board, performs the opinion-giving function (U S T AWA z dnia 16 września 1982 r.).

Polish dairy cooperatives are considered to be one of the most dynamically developing industries, which is related to the effectiveness of innovative activities (Zakrzewska 2016).

According to Suchoń (2013), the functioning of Polish dairy cooperatives is also subject to other regulations, such as:

- the Act of 20 April 2004 on the organization of the milk and dairy products market (Tekst jednolity Dz.U. z 2009, Nr 11, poz. 65.6), kodeks cywilny (Dz. U. Nr 16, poz. 93 ze zm. 7),
- the Act of September 15, 2000 on groups of agricultural producers and their associations (Dz.U. Nr 88, poz. 983 ze zm. 8),
- tax-related act of 12 January 1991 on local taxes and fees (Tekst jedn. Dz.U. z 2006, Nr 121, poz. 844 z ze zm.),
- the Act of February 15, 1992 on corporate income tax (Tekst jedn. Dz.U z 2000, Nr 54, poz. 654 ze zm.),
- Act of November 15, 1984 on agricultural tax (Tekst jedn. Dz.U. z 2006, Nr 36, poz. 969 ze zm.),
- or EU legislation (Rozporządzenie Rady (WE) nr 1698/2005 z 20 września 2005 r. w sprawie wsparcia rozwoju obszarów wiejskich przez Europejski Fundusz Rolny na rzecz Rozwoju Obszarów Wiejskich (Dz.U.UE.L.05.277.1 ze zm.).

In the Polish divisibility of dairy products, organizational forms and nomenclature also changed (Nowak 2013). It is worth mentioning the National Agreement of Dairy Cooperatives established in 1991 and the change of its name to the National Association of Dairy Cooperatives, the Audit Union, which took place on September 4, 1998 (www.mleczarstwaopolskie.pl).

14.4. Economic aspects of the functioning of dairy cooperatives

The number of dairies dealing with milk processing decreased from 177 enterprises in 2015 to 163 in 2019 (i.e. a decrease by 8%). The recorded decrease in the number of dairy enterprises results from a number of factors. One of them are mergers and acquisitions in the dairy industry (Figure 1). Smaller dairy companies are taken over by others with

more capital. There is a consolidation of dairy cooperatives, which helps to improve efficiency (Pietrzak 2007).

Another reason for the reduction in the number of dairy enterprises is the collapse of unprofitable entities. Another premise may be the general situation on the market, which is very volatile. The financial crises of 2009, the elimination of milk quotas for farmers and the Covid-19 pandemic caused temporary crises in the milk market. Supply chains in the milk market were disrupted. A financial problem arose related to difficulties in obtaining capital for the development of enterprises and difficulties in obtaining human resources for work. Covid-19 disease has created resource difficulties among dairy farm owners. In the Polish countryside, the phenomenon of the lack of hands to work can be observed more and more often. The analyzed trend was clearly decreasing.

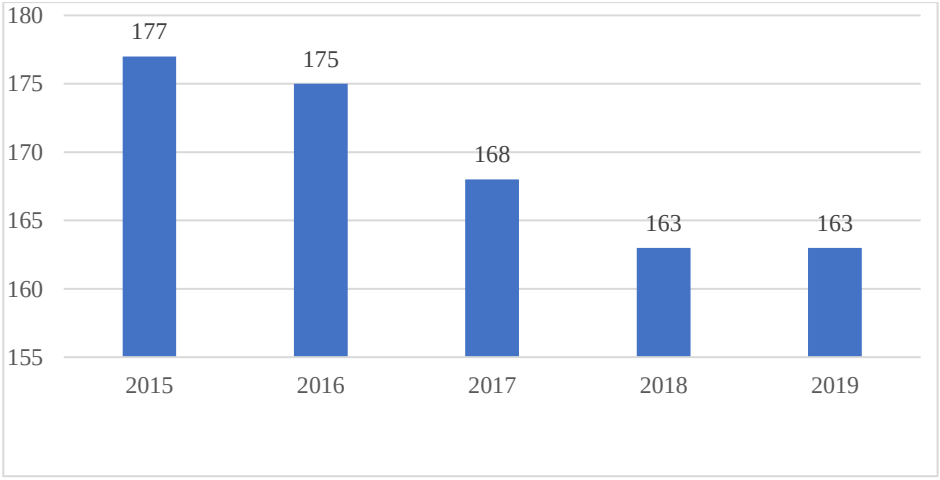

Figure 1. Number of dairy cooperatives in Poland
Source: milk market data IERiGŻ-PIB

Figure 2 shows changes in the number of people employed in dairies. In 2019, the number of people employed in dairy enterprises increased to 32,949 people compared to 2015 – 32,238 people (an increase by 2.2%). The reason for the increase in the number of people employed in dairies is the increase in the scale of production, concentration of enterprises and increased production and foreign trade in milk and dairy products. The analyzed trend can be described as an upward trend. The

demand for the labor factor in dairy enterprises is related to the demand for the enterprise's products. The development of the production scale, higher sales on the domestic, EU and global markets shapes the demand for the labor factor in dairy cooperatives. Polish dairy plants are still fragmented and located in small towns. The potential weakness of these entities is their chance because they constitute the labor market. Moreover, the location in small towns is also an opportunity to acquire well-qualified human capital who knows the issues of dairy production (Nowak 2013).

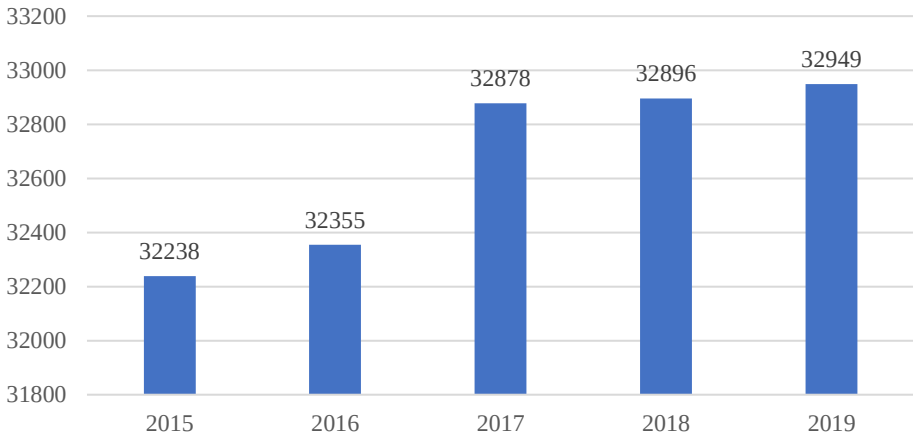

Figure 2. Employed number in dairy cooperatives
Source: milk market data IERiGŻ-PIB

The value of sales in dairy enterprises increased in 2019 (PLN 34,746 million) compared to 2015 (PLN 26,915 million). The increase in the value of sales in dairy enterprises results from the increase in turnover on the Polish milk market. In the analyzed period, the trend was clearly increasing.

Gross profit also increased in 2015-2019. However, in 2016 the value of the dairy's gross profit was PLN 666.9 million. In total, in 2019, compared to 2015, the gross profit increased by nearly 38% (Table 1).

Current financial liquidity represents the ability to meet current liabilities. It is calculated as the ratio of current assets to short-term liabilities. According to literature sources, the value of this indicator should exceed 1.2 points, ie 120%. A drop below this level indicates a problem

with meeting current liabilities. In 2015-2019, the current liquidity ratio exceeded 1.2, which indicates a good economic situation of enterprises. Moreover, asset rotation enables the use of funds involved in generating profits (Zuba and Zuba 2014).

Profitability is an important aspect of the evaluation of the functioning of the dairy industry. The data presented in Table 2 shows that the share of profitable companies remains high, which is a good indication of the assets used. The share of profitable companies in the sector's revenues will be presented even better, which is a positive sign of resource management.

The investment rate, which remains at a high level, plays an important role in the development of dairy cooperatives. This result positively proves investments carried out in dairy enterprises.

Table 1. Economic situation of dairy cooperatives

Specification	2015	2016	2017	2018	2019
Sale value (PLN million)	26 915	27 632	33 668	33 168	34 746
Financial costs in% of revenues	0,35	0,40	0,40	0,32	0,33
Gross profit for dairies (PLN million)	451	666,9	642,4	526,4	621,1
Current liquidity ratio	1,41	1,61	1,67	1,62	1,59
Profitability ratio in% of revenues					
Gross profit	1,66	2,39	2,33	1,57	1,77
Net profit	1,31	1,95	1,89	1,28	1,36
Accumulation of capital	3,57	4,14	3,72	3,23	3,27
Gross margin	4,27	4,97	4,55	3,84	4,01
Share of profitable companies (%)					
In the total number of companies	70,6	82,9	74,4	68,7	68,1
In the revenues of the sector	84,5	94,2	86,9	85,5	90,8
Investing rate	1,35	1,40	1,67	1,35	1,45
Share of direct exports in sales value (%)	15,2	15,7	16,6	16,7	18,4
The share of dairy in the sales value of the food industry	12,3	12,1	12,9	12,6	12,3

Source: milk market data IERiGŻ-PIB

The export of milk and dairy products determines the development of enterprises. It should be noted that after the accession to the EU, there was an increase in exports and imports of dairy products produced in

Polish dairy cooperatives. This result positively proves that Polish dairy companies took advantage of the benefits appearing on the common market.

The share of dairy in the sales value of the food industry remains satisfactorily above 12%.

14.5. Conclusions

Over the last decade, there has been a decrease in the number of dairy enterprises, which is evidence of their consolidation and improved efficiency. Small dairy companies are taken over by larger ones. Such activities are the result of increasing the scale of milk processing, implemented investments and closer cooperation between enterprises and farmers.

The economic situation of dairy enterprises significantly improved in 2015-2019 in terms of sales value and gross profit. In 2015-2019, the sales value increased by 22.5%, and the gross profit increased by 38%. It can therefore be concluded that the integration with the EU and the increase in sales and exports contributed to the improvement of the competitiveness of the dairy sector.

Dairy cooperatives are characterized by correct liquidity ratios, which indicates their ability to settle current liabilities. In the analyzed period, the current liquidity ratios were at a high level. Such a situation could be the result of shaping proper relations between current assets and short-term liabilities.

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15

DETERMINANTS OF THE PROCESS OF SHAPING PURCHASING DECISIONS ON THE DAIRY PRODUCTS MARKET IN HOUSEHOLDS OF YOUNG PEOPLE

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15.1. Introduction

The dairy market is one of the most dynamically developing markets for food products, and milk and dairy products are widely consumed by consumers (Bórawski et al. 2021). They are valued not only for their taste, but also for their special nutritional and preventive properties. This market has a great development potential. The main factor determining this development is demand, both on the domestic and international markets. The consumption of milk in Poland has been growing successively for 14 years. According to GUS data published on October 30, 2020, the balance consumption of cow's milk, including milk intended for products without raw material processed into butter, reached the level of 225 liters per capita (https://stat.gov.pl/obszary-tematyczne/ceny-handel/ceny/ceny-produktow-rolnych-w-styczniu-2020-roku,4,93.html).

The increase in the general level of milk consumption in Poland in recent years occurred in the conditions of good economic conditions on

the international market and in the conditions of real prices of dairy products in relation to food in general, including in particular meat and meat products. Factors stimulating the increase in consumption were, among others: the continued good income situation of the population, related to the increase in wages and the implementation of the government program "Family 500+" and the change in the consumption model, in which animal protein products have an increasing share. (www.agropolska.pl/produkcja-zwierzeca/bydlo/polacy-pija-coraz-wiecej-mleka,1536.html). In Poland, the consumption of milk and its products per capita, however, is still lower than in most Western European countries.

Looking at the milk market from the point of view of the current situation in the environment of enterprises, it should be stated that, starting from spring 2020, the domestic dairy industry was characterized by a relatively high dynamics of development, despite the recession in the global, EU and national economy, the main reason of which was the pandemic caused by COVID-19. It is expected that in the near future, however, the upward trend in balance milk consumption may be halted, which may result in a progressive recession in the national economy, as well as deterioration of the situation on the labor market, a decrease in consumer income and restrictions on the movement of the population. As a consequence, households will be forced to reduce expenditure on food, including dairy products.

The introduction of restrictions on economic activity in the HoReCa channel in the spring and autumn of 2020 resulted in a decrease in the demand for food products, including products for secondary processing and food preparation. (Milk Market 2020). It is also expected that in 2021 the domestic milk market will continue to be influenced by further economic recession, which will be a consequence of subsequent waves of the COVID-19 pandemic. *(Users/uzytkownik/ Downloads/snqjmpt4g1h8hbhi9vidje4t84_mleko_59_20-net.pdf).*

Despite the huge variety of dairy products and milk processing companies, there are still opportunities for further development of this segment on the domestic market. In such a situation, it becomes extremely important for entrepreneurs to get to know the consumer, his needs, preferences and criteria that guide him when choosing specific

products. Because the purchase of dairy products can be influenced by various factors, including: economic, psychological, but also social and marketing factors, etc. In order to function and be successful on the market, a company should look at its products through the eyes of buyers. It is also necessary to constantly evaluate and analyze the offer of enterprises and its continuous improvement. Nowadays, a manufacturer, in order to be able to compete effectively on the market, is forced to encourage consumers to buy through various forms of promotion. In addition, the market situation forces producers to diversify their product offer more and more, and to introduce various innovations to the market, both of a product and marketing nature (Meimankulova et al. 2018). One of the main directions of market changes, including changes in the commercial strategies of enterprises is to modernize the existing distribution channels, as well as to launch new ones with the use of modern sales techniques.

Although the conditions influencing consumer behavior in the dairy products market were the subject of many studies also by the author of this study, the factors influencing purchasing decisions are constantly changing. Therefore, research on this problem should be repeated and updated on an ongoing basis, so that enterprises can efficiently adapt their offer to the current purchasing preferences.

15.2. Research objectives and methodology

The aim of this study was an attempt to define the elements determining the purchasing behavior of consumers on the milk and milk products market.

The study, thanks to the conducted empirical research, was aimed at finding answers to research questions and an indication of:

- What factors are young buyers guided by in their everyday purchasing decisions on the dairy products market?
- What is the assortment structure of food products purchased by consumers?
- Defining the role of the brand and marketing activities carried out by enterprises in purchasing decisions.

– Defining the perception of product and marketing innovations and their impact on the purchasing process as well as the speed of their acceptance.
– Determining how the concept of quality is perceived and its impact on the purchase of dairy products.

679 respondents took part in the study, of which, after an initial selection from the obtained research material, responses obtained from 664 people were submitted for further analysis. The selection of the research sample was deliberate. The main selection criterion was the respondents' declaration of regular purchase and consumption of dairy products in households. Another criterion was the specific age range of the respondents, namely getting to know the opinions of young people on the subject of the survey. The group of young people was aged 18-39. The research tool was a standardized questionnaire, which consisted of closed questions, both single and multiple choice, and it was fully anonymous. The obtained results made it possible to draw conclusions and compare them with the general market trends taking place in the analyzed sector. Moreover, they were compared with the results of research published by other authors dealing with related issues.

The study population was 69% female and 31% male. The most numerous group among the respondents were people aged up to 25 (84%), the respondents aged 25-39 were 16%. Taking into account the level of education, more than half of the respondents (55%) were people with higher education, 34% had secondary education, and 11% had vocational education. The respondents living in the countryside accounted for 21% of the respondents, 34% of the respondents represented a city with over 500,000 inhabitants. residents. Among the opinion makers, 18% stated that they lived in the city from 20,000 to 100,000. residents. Inhabitants of cities from 100,000 to 500,000 19% of the respondents were residents, while the least numerous group, 8%, were people living in cities with up to 20,000 people. The most numerous group were schoolchildren/students who constituted 68% of the respondents.

More than half of the respondents, i.e. 58%, declared that their monthly income is between PLN 1,000 and PLN 3,000/person/month. 28% of respondents indicated that their income is below PLN

1,000/person/month. On the other hand, the smallest number, because 14% of respondents, defined their net income at the amount above PLN 3,000/person/month.

15.3. Research results and discussion

Among the respondents, 33% declared that they eat dairy products even several times a day (these were mostly female people). 29% consume them several times a week. Slightly less, because 27% chose the answer once a day, and 5% of the respondents stated that they eat dairy products once a week. Only 3% of the respondents chose the answer once a month and less often. The same number of people only buy dairy products for other family members, but do not consume them regularly. The obtained results show that dairy products play a significant role in the daily diet of the respondents.

According to the research, it was women who more often than men declared to make a purchase decision, and also showed a greater frequency of consumption of dairy products, especially due to their pro-health and dietary values. Taking into account the criteria differentiating consumers' attitudes towards the features of purchased dairy products, it can be concluded that it is women who attach more importance to the various features of food products taken into account during the product selection (purchase) process (Ubrežiová, Iveta, et al 2019). They buy them, as a rule, not only for themselves, but also for other members of households with which they live together. Thus, they very often impose the type of products consumed on a daily basis, thus taking on a specific role of the "household leader" and following the current market trends. As Szwacka-Mokrzycka points out, this may be the result of women's experience and greater knowledge of food products (Szwacka-Mokrzycka and Kociszewski 2013), because it is women who relatively more often shop for food (Boaitey and Kota 2020).

Analyzing the responses as to the frequency and type of assortment of the groups of dairy products purchased, it can be concluded that the surveyed consumers most often bought traditional milk (most often UHT containing more than 2% fat) (75%) and various types of yoghurts

(67%). Consumption of products from the group of yoghurts and various types of milk delicatessen, such as breakfast cheese or drinking yoghurts, was more often declared by people aged 18-25 (53%), most often singles or still living in shared households with parents (Walli and Trail 2005). The most frequently consumed highly processed products in this age group were natural products without additives, and products enriched with various types of additives, such as fruit, muesli, or with the addition of breakfast cereals, etc. Of the respondents, 47% of women declared regular consumption of probiotic products, believing in their pro-health and dietary properties (Timon 2020) (Avila 2020). However, they were more often acquired by middle-aged women, i.e. 25-39 years of age (74%), the rest were declarations of younger women (up to 25 years of age). Men did not see the need to consume this type of products, being skeptical as to the essence of their pro-health impact (Wajs and Stobnicka 2020). Only 13% of them reported incidental purchase of these products, very often as a result of persuasion by their partners. The importance of respondents is also growing regarding the purchase of organic products (27%), as well as lactose-free products (13%).

A large proportion of the respondents (64%) declared that they usually buy products such as: cream, butter, cottage cheese, and processed cheese several times a month or less frequently during larger purchases made for the whole family. In the case of buttermilk, kefir and blue cheese, more than half of the respondents declared that they buy and eat them incidentally. Products such as natural kefir or natural or flavored buttermilk are eaten more often in the summer, e.g. to quench thirst, or as a supplement to the daily diet with dairy products during a break at work on hot days, when the demand for other food products decreases. When it comes to yellow cheese, more than 40% of respondents answered that they buy it once a week, and only 7% of people said that they did not buy it at all, most often they were people from the oldest part of the study group and people who declared food and dietary intolerances associated with this product.

It is also worth noting that in recent years there has been a growing tendency to supplement and gradually replace traditional animal dairy products with artificial plant milk and its products. More and more often you hear about people who give up drinking cow's milk for various

reasons, e.g. lactose intolerance, allergy to cow's milk protein, veganism, or simply the desire to diversify their diet (Silva and Libeiro 2020). This process is also an expression of a specific development of the fashion for vegetarianism or veganism, especially among young people (Mann and Reluca 2020). For those who choose a dairy-free diet, the food market offers many milk substitutes in the form of plant-based drinks that are lactose-free and cholesterol-free. Beverages obtained from plants vary in taste, color and properties depending on what they are prepared from. The most frequently purchased milk substitutes include: rice, almond, soy and coconut milk. This situation is undoubtedly a threat to the traditional processing of animal milk and to the entire dairy industry, not only in Poland but also around the world. About 7% of respondents declared that they are gradually inclined to switch to this type of diet and supplement traditional dairy products with vegetable protein products..

The responses of the respondents surveyed by the author also reflect the generally prevailing trends in the consumption of dairy products in recent years on the domestic market, published in mass statistics (https://www.portalspozywczy.pl/mleko/wiadomosci/roznice-w-wielkosci-spozycia-produktow-dairy-in-dependence-on-income, 178491.html). However, yoghurts and other dairy desserts are still underestimated products in the purchase and consumption process and, unfortunately, still represent a low share in the purchasing basket of a standard household in Poland (Woźnialis and Wilk 2020).

Looking at the results of the research from the point of view of the amount spent on purchases of dairy products, a significant relationship can be observed between the type (product category) and frequency of purchases of dairy products and the income of the respondents. 39% of people with an income above PLN 3,000/person/month declared that they spend over PLN 60 a week on this type of products, compared to people with lower incomes because there were more than half of them. The highest-earning group of respondents most often declared purchasing brand-name highly processed products as well as organic dairy products and probiotic products. People with an income of PLN 1,000-3,000/person/month declared that they usually buy dairy products for PLN 31-40/month (approx. 30%). Most often they were mid-priced products with a predominance of products necessary for the daily

functioning of their household, such as: milk, butter, grain cheese, processed cheese or cottage cheese. On the other hand, products such as organic products or more expensive yoghurts and dairy products were purchased by this group much less frequently. The amount of up to PLN 20 was most often chosen by the respondents with the lowest income. This may be due to the fact that due to limited income, these farms are forced to act more rationally, and therefore they make more thoughtful purchases and purchase the cheapest and rather non-brand products (most often private labels of retail chains). These farms are limited to basic types of products, such as whole milk, cottage cheese, cheaper butter or a milk-fat mix. On the other hand, more processed products or delicatessen dairy products in this group of buyers are rather incidental purchases.

As many as 55% of the respondents mentioned super- and hypermarkets as their preferred place of purchase due to the rich and varied assortment offer. Then there were discount stores (15%). Of the respondents, only 4% stated that they shop for dairy products in local stores, and 3% obtained their supplies in sponsored stores (Kusz and Kilar 2020), if, of course, there was such a possibility in their place of residence. On the other hand, the importance of making everyday purchases via the Internet is growing today (23%), given the circumstances in which the research was conducted (COVID 19) (Grashuis et al. 2020). This type of shopping became particularly important in the early stages of the pandemic and the general panic among consumers for fear of direct contact with other people, or even avoiding such contact. In addition, it should be remembered that the study involved young people in most large cities for whom this type of shopping is not a problem. It should be presumed that in the present situation the tendency to make this type of shopping will continue (Seth 2020) due to the ease and possibility of making them without leaving home and wasting time on traditional shopping.

As already mentioned above, purchases of the vast majority of dairy products are routine purchases due to their high frequency, as well as their relatively low unit value and the universality of physiological needs satisfied in this way. The conducted research shows that consumers very often decide to eat dairy products due to the fact that, according to them, it is a food that is convenient to use (eat) (Figure 1). Most of these products are suitable for direct consumption, without the need to

put effort into preparing them before consumption. Therefore, these products can be eaten freely regardless of the buyer's location (44%). Many of the respondents buy dairy products out of a habit they learn from family homes (42%), and this process is in many cases closely related to the current model of their household functioning, based in many cases on an easily digestible diet, also in line with the current market trends created by incl. nutritionists and opinion leaders or celebrities. A large part of the respondents stated that they are not able to replace these products with other food products in the process of preparing everyday meals (26%), and the consumption of these products was declared due to their values which are necessary for the proper functioning of the body and due to the wealth of these products. the nutrients they provide (25%). Their undisputed pro-health and dietary values (24%) also turned out to be important for consumers. This fact is particularly important in households where children live (therefore these products are an indispensable element of a diet rich in calcium), as well as in households of people running the so-called "healthy lifestyle". In these farms, the consumption of the vast majority of "light" or "fit" products was declared".

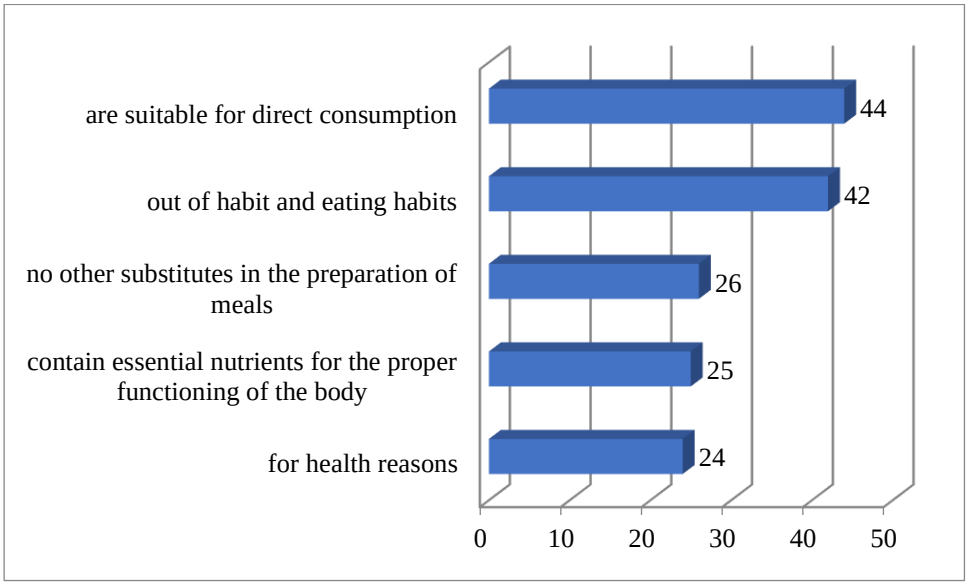

Figure 1. Reasons for consuming dairy products (%)
Source: own elaboration

The research also shows that the most important in the process of selecting a specific type of dairy product are, apart from the above-mentioned factors (you can say technical), also their functional and quality values, such as taste, smell, texture, color (80%), and an important factor in making the decision to purchase a dairy product also turned out to be the use-by date (64%) due to the fact that, as is well known, these products are perishable. Almost half (45%) of the respondents stated that long-term purchasing habits related to loyalty to the same brand also had a large influence on their decisions. It manifests itself in a wide range of products related to the purchased products within the same brand. Another factor that should be taken into account in the process of selecting a specific product is the ratio of the price of a given product to the prices of competing brands (38%) within the same product category (Figure 2).

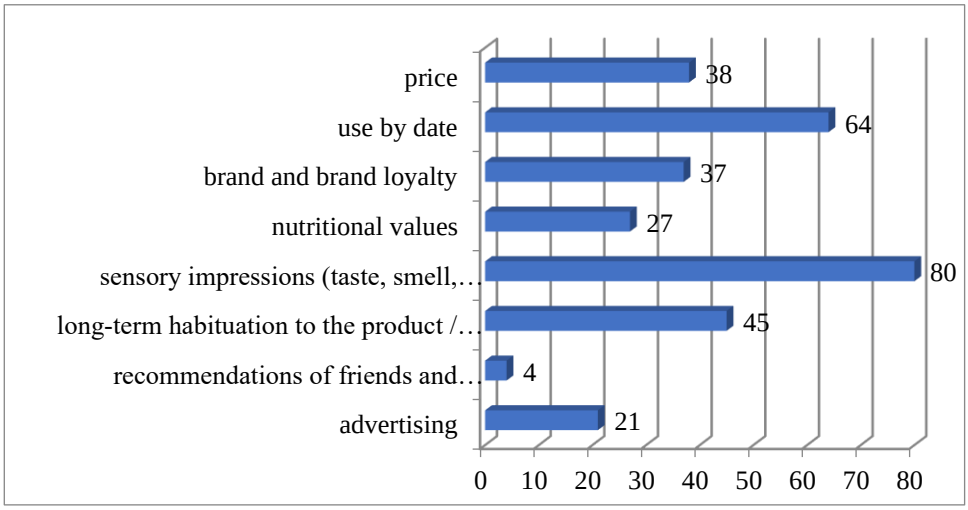

Figure 2. Influence of selected factors on the process of selecting a dairy product (%)

Source: own elaboration

In addition to utility stimuli, marketing factors can also be important selection factors. One of them is the aforementioned trust in the brand (manufacturer) and the elements conditioning this trust (attachment), which is reflected in the long-term loyalty of consumers to the manufacturer and its products. The study shows that the importance of the brand for consumers varied. 37% of respondents stated that this factor is very important in the purchasing process, and in the case of 42%

of respondents it is significant. For 17% of respondents, the brand is of negligible importance, while for 4% it has no importance at all in the purchasing process.

Therefore, the study attempted to clarify what the respondents associate a branded product with. Most of the respondents answered that the brand of a dairy product is closely related to a specific price (60%) and a specific (i.e. acceptable in many respects) quality of the products of a given brand preferred by consumers (57%). For 29% of respondents, the satisfaction of using is extremely important, and for 20% the sense of security of the purchased product and the comfort of its use. 9% of respondents take into account the opinion of friends about a given product brand, while 6% suggest the prestige resulting from the purchase and use of a given product brand (Figure 3).

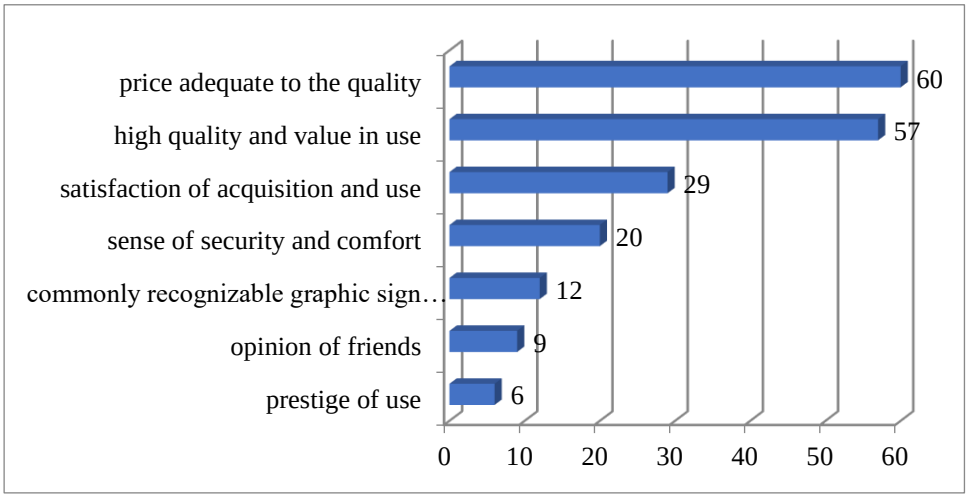

Figure 3. Features of branded dairy products (%)
Source: own elaboration

The respondents were also asked to choose up to four brands of dairy products that they most willingly buy. The first place (67%) was taken by Piątnica, famous mainly for cottage cheese and cream. Mlekovita (44%) came in second, offering a wide range of products. Mlekpol (33%) and Danone (32%) also turned out to be eagerly purchased brands. 28% of respondents preferred the Hochland brand. 15% of respondents declared that Krasnystaw is the brand they eagerly purchase. Other less significant brands accounted for 8% of declarations.

Fixing the brand in the minds of buyers usually reflects the great involvement of producers in all kinds of promotional activities. Advertising is one of the forms of promotion by which enterprises communicate with the client by providing him with valuable messages (e.g. place, time of promotion, launch of a new product, reminder of an existing product brand, etc.). Research shows that advertising has an impact on making purchasing decisions, but not as clear as one might expect, taking into account the age of the population under study. Among the respondents, 41% even declared that they do not take dairy product advertising into account in the purchasing process, and in the case of as many as 38% of the respondents, it has little influence. Advertising significantly influences the purchase of dairy products in 21% of respondents. Such an answer was given especially by the youngest among the respondents.

If we compare the above research results with others, it turns out that e.g. in the studies conducted by Jąder (2014), taste was considered the most important factor influencing the choice of dairy products, and advertising was considered the least important factor. Ziarno and Hauzer (2009) listed the expiry date, price and name of the producer as the most important purchasing factors. On the other hand, in the publication of Kudełka and Marzec (2004), half of the respondents placed the use-by date (durability) in the first place in the hierarchy of factors influencing the purchase of dairy products.

The respondents were also asked about the most common forms of promotion of dairy products. Television advertising was ranked first (62%). Commercial and promotional newspapers (49%) and price promotions (46%) were listed successively. For 18% of respondents, promotional packaging was a common form of promotion, and for 15% – tasting. 14% said they noticed such advertisements on billboards and 13% on the Internet. Only 4% declared that they most often see such advertisements in the press (Figure 4).

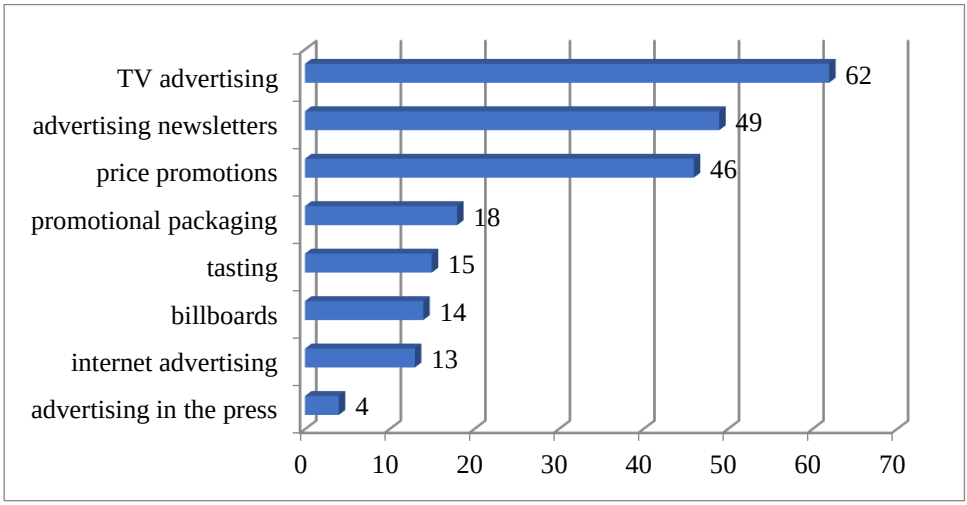

Figure 4. Basic forms of promotion of food products perceived by consumers

Source: own elaboration

The directions of development and diversification of the dairy products market result from the consumption trends mentioned in the theoretical part of the study, as well as from the current needs and preferences of consumers. Apart from traditional dairy products, the consumption of which is deeply rooted in the daily diet of many households, there are also completely new or significantly changed products on the market, referred to as innovative. The innovativeness of such products may be perceived in various ways by consumers (Naspetti 2021). Therefore, the survey asked consumers about the features of an innovative dairy product. Over 60% of respondents stated that such a product has a new taste (new, natural additives), and according to 39% of respondents, that it has an additional pro-health effect (extending the functional features of products, often reflecting contemporary nutritional trends). According to 24% of respondents, an important feature of the new product is the reduced fat content or better use of its culinary possibilities (21%). In the opinion of 16% of respondents, an innovative product should necessarily have a new, more recognizable packaging and a new design.

The research presented in the publication by Bierzuńska (Bierzuńska et al. 2016) shows that the innovativeness of dairy products was associated by consumers mainly with the new appearance of the product

(52.1%), with a new taste (10.7%) and increased health (5.8%). For others, the new product was characterized by a new and/or better culinary use as well as better hygienic quality (0.8%). There was also the answer that it is a product completely different from dairy products already available on the market (28,9%).

One of the important elements taken into account when purchasing dairy products is the broadly understood quality of these products, as well as the way it is understood (defined) by buyers. Product quality according to the management approach is perceived as the level of product excellence and thus its ability to meet the consumer's needs. The quality of the product largely determines whether the buyer will purchase a given product or not, and in many cases also proves the creation of the brand image. The respondents, when asked about the quality of dairy products available on the Polish market, assessed it very highly. This answer was given by 42% of the respondents, and 38% of the respondents assessed the quality as high. Only 10% of the respondents stated that dairy products on the domestic market are of average quality.

The quality level of manufactured goods may be confirmed by certified quality assurance systems held by enterprises. The analysis of the empirical data obtained suggests, however, that more than half of the respondents, regardless of their education, do not pay attention to the information whether the producer has certificates confirming the use of quality and safety management systems in the production process of dairy products (HACCP, ISO 22000 etc.). For 16% of respondents, such a declaration is of little importance, while for 6% of respondents it does not matter at all. 19% of respondents declared that information about certificates confirming the use of quality management systems is of great importance to them, and 13% of respondents that it is very important. Therefore, it should be presumed that the surveyed respondents, when assessing the level of purchased food products, make this assessment in terms of organoleptic, taste and functional sensations, and not in terms of standardization elements (holding a quality certificate).

15.4. Summary and conclusion

Consuming dairy products and making choices when buying them is a phenomenon conditioned by many factors, both external and internal. Systematic observation of changes in consumer behavior is extremely important from the perspective of adjusting the offer of enterprises to the diverse requirements of buyers.

The analysis of the conducted survey relating to consumer behavior on the dairy products market allowed for the formulation of the following statements and conclusions:

1) Dairy products are widely consumed by respondents with the majority consuming them several times a day, once a day or several times a week.
2) Among the dairy products, the most popular among the respondents are milk and yoghurt. On the other hand, the least frequently purchased dairy products are buttermilk, kefir, blue cheese and dairy desserts. The respondents buy these products mainly in super- and hypermarkets, which offer a wide range.
3) Taking into account the financial situation of the respondents, it was found that people with higher monthly income spend more on the purchase of more processed and more expensive dairy products than less wealthy people who act more rationally and make informed purchases.
4) The purchasing decisions of dairy consumers are mostly routine decisions due to the high frequency of purchasing this type of product. The main reason for consuming dairy products is that they are suitable for direct consumption and from the point of view of long-term habits of the respondents.
5) In the hierarchy of factors determining the purchase of dairy products, the most important were sensory impressions and the use-by date. The barrier to the purchase of such products is the high price and short shelf life.
6) The brand of a dairy product plays an important role for the respondents in the selection process, albeit diversified for various reasons. More than half of them declare that the brand is very important and of great importance. When choosing a specific brand, respondents take into account the price and high quality guaranteed by a specific brand.

7) The vast majority of respondents do not pay attention to advertisements for dairy products, and thus believe that they have little or no influence on their purchasing decisions. Despite the declared lack of visible influence on the purchasing decisions of advertisements, the respondents unintentionally notice them mainly on television, commercial and promotional newspapers and on the occasion of various price promotions.
8) The respondents are satisfied with the quality of Polish dairy products offered on the market.
9) Most of the respondents associate an innovative dairy product with a new taste and an additional pro-health effect. The respondents are willing to buy new products, but mainly after they have been tried and recommended by friends.
10) Almost half of the respondents do not pay attention to the information about the certificates held by the manufacturer, confirming the use of quality and safety management systems in the production process of dairy products (HACCP, ISO, etc.).

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