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REGIONAL VARIATION OF MILK PRODUCTION IN POLAND IN THE YEARS 1998–2019[®]

Zróźnicowanie regionalne produkcji mleka w Polsce w latach 1998–2019[®]

Key words: regional variation, milk production, dairy sector, Poland.

The aim of the research was to identify the most important changes that occurred in the Polish dairy sector in the years 1998–2019, in terms of milk production in regional terms. The research included data for the years 1998–2019. The time interval used in the analyses was determined by the administrative reform carried out in 1998 and the availability of regional data on milk production in the Central Statistical Office database. The material used in the study came from unpublished and published Agricultural Statistical Yearbooks for the years 1998–2019. The material for the study also included literature on the subject which contributed to characterizing the definition of a region, indicating the classification of regions occurring in Poland, taking into account the specificity of milk production, and determining the determinants shaping regional differentiation of milk production in Poland. In order to show changes in a regional perspective in the dairy sector the following were analysed: the state of the cow stock, milk production, milk productivity of cows, prices and purchase of milk. Descriptive and cause-effect methods were applied in the presentation of research results. On the basis of performed research analyses and review of literature, it was demonstrated that under conditions of market economy, production of milk was reduced faster in those voivodeships where it is difficult to rationalise production, reduce production costs due to excessive fragmentation or less favourable natural conditions. In consequence, it was observed that the increase in milk production increases more dynamically in voivodeships where natural and economic conditions are favourable for effective milk production, i.e. from the south of Poland to the north.

Słowa kluczowe: regionalizacja, produkcja mleka, sektor mleczarski, Polska.

Celem badań było wyodrębnienie najważniejszych zmian, jakie zaszły w polskim sektorze mleczarskim w latach 1998–2019, pod względem produkcji mleka w ujęciu regionalnym. Badania obejmowały dane za lata 1998–2019. Przedział czasowy wykorzystany w analizach był determinowany reformą administracyjną przeprowadzoną w 1998 roku oraz dostępnością danych w ujęciu regionalnym z zakresu produkcji mleka w bazie Głównego Urzędu Statystycznego. W pracy wykorzystano materiał pochodzący z niepublikowanych oraz publikowanych Roczników Statystycznych Rolnictwa za lata 1998–2019. Materiał do badań obejmował również literaturę przedmiotu, która przyczyniła się do scharakteryzowania definicji regionu, wskazania klasyfikacji regionów występujących w Polsce, z uwzględnieniem specyfiki produkcji mleka oraz określenia determinant kształtujących zróżnicowanie regionalne produkcji mleka w Polsce. W celu ukazania zmian w ujęciu regionalnym w sektorze mleczarskim zbadano: stan pogłowia krów, produkcję mleka, wydajność mleczną krów, ceny i skup mleka. Przy prezentacji wyników badań zastosowano metodę opisową oraz przyczynowo-skutkową. W oparciu o przeprowadzone analizy badawcze oraz przegląd literatury wykazano, że w warunkach gospodarki rynkowej produkcja mleka była ograniczana szybciej w tych województwach, gdzie trudno jest racjonalizować produkcję, obniżać koszty produkcji ze względu na nadmierne rozdrobnienie lub mniej sprzyjające warunki przyrodnicze. W konsekwencji obserwowano, że wzrost produkcji mleka dynamiczniej zwiększa się w województwach, gdzie warunki przyrodnicze oraz gospodarcze są korzystne dla efektywnej produkcji mleka, czyli z południa Polski na północ.

INTRODUCTION

In economic sciences, it is crucial to define a region correctly. In economic terms, a region is understood as „an area with a specific economic specialization, which is a consequence of endo- and exogenous determinants of development” [13, 14]. According to Z. Domański [2] and K. Kuciński [10] the scope of the concept of region should be extended. Resources of

a given area, i.e. local community (social capital), environment and capital can be classified as important criteria of a region’s development. The mentioned criteria were used to develop a classification of development factors, among others in relation to spatial economy [13]. Agriculture (including agribusiness) is an important link of the national economy, which is connected with the concept of an agricultural region,

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defined in the literature as „separate areas having a set of specific features relating to agriculture, differentiating it from other areas”. [1, 13, 14]. Features of a selected agricultural area are connected with types of agricultural holdings which occur in a specific area and with economic and natural criteria occurring in the area. W. Stola and R. Szczęsny [17] distinguished 10 agricultural regions diversified in terms of natural and internal factors of agriculture (types of agricultural holdings and directions of production). Among 10 regions W. Stola and R. Szczęsny [17] distinguished the following agricultural regions occurring in Poland:

- Zachodniopomorski region – with lakeside landscape, with large share of state-owned land, dominated by market and mixed agriculture,
- Masuria region – with lakeside landscape, not very favourable agro-ecological conditions, with a large share of land belonging to the State Treasury, with subsistence agriculture,
- Wielkopolskie-Pomorskie region – with favourable agro-ecological conditions and commodity agriculture of a relatively high level of development,
- Lower Silesia region – with favourable agro-ecological conditions and commodity agriculture on a diversified level of development,
- Central region – with diversified natural conditions and market-oriented to self-supply agriculture,
- Upper Silesia region – with a lot of land devoted to industry and urbanisation,
- North-eastern region – with less favourable natural conditions for agriculture, characterised by agriculture of various types, from traditional to market-oriented,
- Lesser Poland (Małopolska) region – with diverse natural conditions, where small-scale farming prevails and commodity crop production occurs on small areas,
- the Carpathian region – with unfavourable natural conditions, dominated by traditional and semi-subsistence agriculture, while on small areas commercial animal production prevails,

Sudeten region – similar to the Carpathian region in terms of natural conditions. This region has low-intensive and small-scale agriculture [13, 17].

In the literature there can be indicated other divisions of occurring agricultural regions in Poland. An example is the division of Poland into 9 agricultural regions proposed by W. Kamiński [9] (differing from the above-mentioned one), taking the need of food economy planning as the division criterion [13]. Another example of distinguishing agricultural regions in Poland is the division proposed in the publication „Cohesive structural policy of rural and agricultural development”, which was accepted by the Council of Ministers in 1999 [12]. In the adopted document agricultural regions were distinguished due to the agrarian structure and condition of farms. According to this criterion, three macro-regions were indicated, which were additionally divided into sub-regions:

- Macroregion I (the South of Poland) – characterised by the dominance of small farms. In this macro-region two sub-regions (Śląskie and Małopolskie) were indicated,

which are differentiated in terms of the number of jobs for non-agricultural work. According to W. Michna [11], the following provinces can be classified in macroregion I: Podkarpackie, Małopolskie, Śląskie and Świętokrzyskie.

- Macroregion II (north and west of Poland) – within this macroregion large-area farms dominate, which are characterised by underinvestment, disorderly ownership and cereal monoculture. According to W. Michna [11], the following voivodships can be classified in macroregion II: Warmińsko-Mazurskie, Pomorskie, Zachodniopomorskie, Lubuskie, Dolnośląskie, Opolskie.
- Macroregion III (the centre and east of Poland) – within this macroregion there dominate farms with an average area characterised by a weak evolution of changes which await state impulses for production activation as well as structural transformations. W. Michna [11] qualified the following voivodships to macro-region III: Wielkopolskie, Kujawsko-pomorskie, Łódzkie, Mazowieckie, Podlaskie, Lubelskie [1, 11, 13].

The division of Poland into agricultural regions was also proposed by the Institute of Agricultural and Food Economics of the National Research Institute (IERiGŻ-PIB), dividing Poland into four agricultural regions, taking as a criterion for division seven statistical indicators which made it possible to determine production effects of agricultural holdings. These indicators included: the area of arable land in an average individual agricultural holding, the percentage share of permanent grassland in the total arable land, the number of milking cows in an average individual agricultural holding, the total number of pigs in an average individual agricultural holding, cereal yields in the whole agriculture, annual milk production from 1 cow and NPK consumption in kg per 1 ha of total arable land. On the basis of performed analyses of deviations of the indicated indicators it has been determined that lines of division for distinguishing agricultural regions will run along borders of NUTS 2 regions, i.e. voivodships, and each of the regions will cover 4 NUTS 2 regions (i.e. four voivodships each). Thus, in the classification of Polish FADN there are four agricultural regions:

- the Pomerania and Masuria region comprising the Warmińsko-Mazurskie, Pomorskie, Zachodniopomorskie and Lubuskie provinces,
- Wielkopolska and Silesia region comprising the provinces of Kujawsko-Pomorskie, Wielkopolskie, Dolnośląskie and Opolskie,
- the Mazovia and Podlasie region comprising the following provinces Podlaskie, Mazowieckie, Lubelskie and Łódzkie,
- Małopolska and Pogórze region covering the provinces of Świętokrzyskie, Śląskie, Małopolskie and Podkarpackie [13, 20].

The above indicated and described criteria aimed at division of Poland into agricultural regions, as well as functioning divisions of Poland into agricultural regions do not fully exhaust this issue. Various methods of distinguishing agricultural regions indicate application of different approaches, which is connected with variable features of agriculture and various indicators (measures) used in

distinguishing agricultural regions. According to J. Bański [1] there are no coherent and homogeneous agricultural regions with universal features which could be universally accepted by the environment that deals with this issue [13].

In Polish literature on the subject one can distinguish the publication of J. Seremak-Bulge, K. Hryszko, A. Zalewski from 2006 entitled „Regional diversification of dairy farming”. In Polish literature we can distinguish the publication of J. Seremak-Bulge, K. Hryszko, A. Zalewski from 2006 „Regional diversification of dairying” which refers to the subject of regionalisation of cattle farming and milk production. In this publication authors indicate three areas of milk production in Poland, where the criterion of division was conditioned by data on milk purchase at the level of voivodships:

- area I – showing well developed commodity production, with a minimum 70% share of purchases in milk production. Area I includes six voivodships, i.e.: Podlaskie, Kujawsko-pomorskie, Wielkopolskie, Dolnośląskie, Mazowieckie and Opolskie,
- area II – having an average commerciality of milk production, within the range from 40 to 70% of purchase share in milk production. Seven voivodships may be classified in area II, i.e. Lubelskie, Lubuskie, Łódzkie, Pomorskie, Śląskie, Warmińsko-Mazurskie and Zachodniopomorskie,
- area III – having low commerciality of milk production, below 40% share of purchase in milk production. Three provinces - Małopolskie, Podkarpackie and Świętokrzyskie - can be classified in area III [16].

While conducting research on occurring regional changes in milk production in Poland it is crucial to look for an answer to the question: What determinants determine the process of polarization of regions in cattle rearing and milk production concentration? In the new institutional economics the category of specific resources is important, i.e. resources occurring only in a given area and not anywhere else [19]. In order to determine conditions enabling development or stagnation of milk production, also taking into account assumptions of the new institutional economics, A. Parzonko [13] carried out research (using an interview questionnaire) in which he asked employees of communes dealing with agriculture what, in their opinion, conditions milk production in Poland. Conducted research enabled A. Parzonko [13] to distinguish determinants which, according to municipalities employees, contributed to the development of farms specializing in milk production and a category of factors which contributed to stagnation or limitation of milk production in given regions of Poland. To the category of determinants shaping the development of dairy farms A. Parzonko [13], on the basis of conducted research, qualified:

- favourable historical conditions – an example is Podlaskie Voivodship, where milk production is a key activity, as a result of which farms specialising in milk production could undertake investment activities, i.e. building barns for cows using loans. These actions contributed to the development of milk production in Podlaskie Voivodship and in those regions of Poland where historical conditions were also favourable,

- the lack of opportunities for other agricultural or economic activities – in regions of Poland where poor soil quality prevailed, the lack of outlets for agricultural products, the lack of jobs outside of farming contributed to the continuation of milk production by farmers despite the unfavourable economic situation for milk. This phenomenon was visible after the marketisation of the economy, i.e. at the beginning of the 1990s, when a fall in the price of milk at the point of purchase was observed. As a result, there was a decline in the stock of cows, but in some regions in Poland milk production was developed regardless of unfavourable economic conditions,
- support measures on the part of local dairy companies – after the marketisation of the economy, dairy companies took initiatives aimed at increasing milk production in farms specialising in milk production. Actions taken by dairy companies to increase milk production include: providing low interest loans to farmers to buy milk cooling tanks and milking machines, started supplying farmers with udder disinfectants, ointments and balms used to prevent udder diseases, etc., started training among farmers financed by dairies to create awareness among farmers about the importance of animal welfare in agricultural production. Besides, dairy companies introduced price calculation for milk depending on the quality and quantity of milk delivered by the farmer to the dairy, which is still in force today,
- favourable economic situation for milk after Poland's accession to the EU, including the possibility of benefiting from the EU structural funds – Poland's accession to the EU in 2004 made it possible for farms specialising in milk production which carried out commercial milk production to develop their activities using the available financial support from EU funds. Farmers allocated the funds received to modernising their farms and machinery stock, which made it possible to adapt milk production to EU requirements. Further development of milk production was possible due to a favourable economic situation for milk [14].

On the other hand, A. Parzonko [13], on the basis of conducted research, qualified the factors limiting the development of dairy farms as the following:

- unfavourable historical conditions – in regions of Poland, e.g. in the Małopolskie voivodship, where milk production was a secondary activity, unfavourable historical conditions were demonstrated, due to which farms specialising in milk production had limited opportunities to undertake investment activities, which was associated with the small area of such farms and the small fodder area of the farms. These activities contributed to the inhibition of milk production in these regions of Poland,
- increasing quality requirements for purchased milk – in order to meet the growing quality requirements for purchased milk observed in the years 2003–2007, the key task for farmers was to guarantee optimal conditions for keeping cows and storing milk. In order to meet the milk quality requirements of dairy companies, farmers were forced to invest in the purchase of milk cooling tanks. In case of lack of capital and small scale milk production,

investment activities were limited or economically disadvantageous,

- low production potential/low scale of milk production – in the case of small farms which obtain a production volume below the profitability level, the farmer's activity does not provide him with an income enabling him to support his family and accumulate funds for the development of his activity, which, in consequence, may lead to the abandonment of milk production,
- high capital intensity of milk production – in order for holdings specialising in milk production to develop, it is necessary to invest in their activities, which is associated with a high demand for capital. In the period of transformation and preparations related to Poland's accession to the EU, farmers did not have their own funds, while obtaining funds from outside was difficult, which contributed to the reduction of milk production in Poland,
- lack of advice from dairy companies as well as scientists and experts on determining the desired directions for the development of farms specialising in milk production,
- EU structural funds, calculation of direct payments – some programmes introduced by the EU were not favourable to the development of milk production, among others, according to farmers, agri-environmental programmes were not adjusted to the local conditions of milk production, which in consequence limited milk production in those regions of Poland where there were unfavourable natural conditions and a small number of modernised high-yield farms [14].

The aim of the study was to isolate the most important changes that occurred in the Polish dairy sector in 1998–2019 in terms of milk production by region. Due to the important role of the dairy sector in Poland, it was selected purposively.

METHODS AND MATERIALS

The research included data for the years 1998–2019. The time interval used in the analyses was determined by two factors. Firstly, the administrative reform carried out in 1998, which contributed to the functioning of 16 voivodships in Poland. Secondly, availability of regional data on milk production in the Central Statistical Office (GUS) database. The paper uses material from unpublished and published Agricultural Statistical Yearbooks for the years 1998–2019, as well as publications entitled „The physical dimensions of livestock production”. „Physical dimensions of livestock production” for 1998–2019 authored by GUS. The research material also included literature on the subject which contributed to characterizing the definition of a region, indicating the classification of regions occurring in Poland taking into account the specificity of milk production and determining the determinants shaping regional differentiation of milk production in Poland. In order to show regional changes in dairy sector the following issues were examined: state of cow stock, milk production, milk yields of cows, prices and purchase of milk. The paper presents the following research problem: Under conditions of market economy, production of milk was reduced faster in those voivodships where it is

difficult to rationalize production, reduce production costs due to excessive fragmentation or less favourable natural conditions. Descriptive and cause-effect methods were applied in the presentation of research results.

RESULTS AND DISCUSSION

Table 1 presents changes taking place in milk production, stock and milk yield of cows in the years 1998–2019. The length of the period of comparisons included in Table 1 is connected with the availability of data conditioned by the administrative reform carried out in 1998. Based on the data presented in Table 1, it was found that milk production in Poland is regionally differentiated. In the years 1998–2019 milk production in Poland increased by 15%. In regional terms, milk production in 1998–2019 increased in 6 voivodships, which at the same time are characterised by high commoditisation at the level from 15% to 35% (Table 3.19). In the examined period milk production increased in the following provinces: Łódzkie by 11%, Kujawsko-Pomorskie by 43%, Warmińsko-Mazurskie by 51%, Wielkopolskie by 60%, Mazowieckie by 70% and Podlaskie, where milk production increased by 135% (Table 3.19). A decrease in milk production in the analysed period was observed in 10 voivodships, in which the level of decrease ranged from 15% to 79%. Reduction in milk production in the years 1998–2019 was recorded in the following voivodships: Opolskie by 15%, Pomorskie by 17%, Lubelskie by 34%, Dolnośląskie by 46%, Lubuskie by 47%, Zachodniopomorskie by 50%, Śląskie, Świętokrzyskie by 64%, Małopolskie by 65% and Podkarpackie by 79% (Table 1). The structural transformations taking place in agriculture and the dairy industry resulted in 6 voivodships (i.e. Łódzkie, Kujawsko-Pomorskie, Warmińsko-Mazurskie, Wielkopolskie, Mazowieckie and Podlaskie) producing a total of 80% of raw milk production in 2019, and their total share in procurement was 81% (Table 1, Table 3). Changes in milk production are determined, among others, by changes in the number and milk yield of cows [3, 15, 18].

In 1998–2019, there was a 31% reduction in the cow population, with a simultaneous 66% increase in milk yield (Table 1). In all voivodships except Podlaskie and Warmińsko-Mazurskie the cow population was reduced in the analysed years. Only in Podlaskie and Warmińsko-Mazurskie Voivodships, milk production was increased as a result of simultaneous improvement of milk yields (in Podlaskie Voivodship, during the analysed period, milk yields increased by 84%, while in Warmińsko-Mazurskie Voivodship – by 43%), as well as an increase in stock (by 27% in Podlaskie Voivodship, and in Warmińsko-Mazurskie Voivodship – by 2%) (Table 1). In voivodships with high production growth and characterised by high commodity production, the decrease in the cow herd in the analysed period was at the level of approximately 10%, i.e. the Mazowieckie Voivodship, which recorded a decrease in the cow herd by 9%, the Wielkopolskie Voivodship, which recorded a decrease by 12%, and the Kujawsko-Pomorskie Voivodship, which recorded a decrease in the cow herd by 14% (Table 1). In the years 1998–2019, the highest decrease in the cow stock at the level of 57–83% was observed in the provinces with the most fragmented agrarian structure, i.e. in the following provinces: Śląskie by 57%, Lubelskie by 59%, Małopolskie by 69%, Świętokrzyskie

by 72% and Podkarpackie by 83% (Table 1). A decrease in the number of cows in the years 1998–2019 at the level of 36–55% was recorded in the western and northern provinces, where a significant role is played by state-owned farms, i.e. in the following provinces: Łódzkie province a decrease in the number of cows was recorded by 36%, Pomorskie province by 40%, Opolskie province by 44%, Zachodniopomorskie province by 48%, Dolnośląskie province by 55% (Table 3.19). In the analysed period the highest increase in milk yield was recorded in the voivodship: Kujawsko-pomorskie by 73%, Łódzkie by 78%, Wielkopolskie by 80%, Podlaskie by 84% and Mazowieckie by 90%. On the other hand, in the zachodniopomorskie and lubuskie voivodships a decrease in cows' milk yields was recorded in the analysed period, by 5% and 39%, respectively (Table 1).

In order to deepen analyses concerning occurring changes in regional differentiation of milk production, Table 2 presents changes in milk production, stock and milk yields of cows, distinguishing two periods. The first period covered the years 1998-2004, called the pre-accession period, in which changes in milk production related to adaptation to EU requirements were observed. The second period covered the years 2004-2019, called the post-accession period, in which changes in milk production connected with Poland's functioning on the European market were observed. It was shown that in the pre-accession period the region with the strongest regression in cow stock was the south-eastern region of Poland where

a decrease in stock by 40% was recorded (from 45% in the Świętokrzyskie and Podkarpackie Voivodeships to 36% in the Śląskie Voivodeship and 35% in the Małopolskie Voivodeship, with the country average decrease by 21%). On the other hand, the decrease in milk production in the indicated region was observed at the level of 31% (from 39% in Podkarpackie to 25% in Małopolskie), where the average decrease in the country amounted to 6% (Table 2). In the post-accession period the regression in cow rearing and milk production in the south-eastern region of Poland deepened. Cow stock decreased by 51% (in the Podkarpackie voivodeship it decreased by 70%, in the Małopolskie voivodeship by 52%, in the Świętokrzyskie voivodeship by 50%, and in the Śląskie voivodeship by 33%), while on the national scale a decrease in cow stock by 12% was recorded. In the south-eastern region of Poland, both in the pre-accession and post-accession periods, a slight increase in milk yield was observed at the level of 13% in the pre-accession period, while in the post-accession period, at the level of 11% (Table 2). In the post-accession period in the analysed region there was a decrease in production by 45% (in Podkarpackie by 65%, Małopolskie by 54%, Świętokrzyskie by 50%, Śląskie by 12%), while in Poland there was an increase in milk production by 23% (Table 2). A decrease in the stock of cows and milk production, with a slight increase in the milk yield of cows was also recorded in the Lublin Province, where there is an unfavourable area structure of farms specialising in cow rearing and milk production (Table 2). Significant

Table 1. Differentiation of milk production by region in 1998-2019

Tabela 1. Zróżnicowanie produkcji mleka w ujęciu regionalnym w latach 1998-2019

	Milk production [million l].			Total number of cows [in thousands].			Average annual milk yield from 1 cow [in l]		
	1998	2004	2019	1998	2004	2019	1998	2004	2019
POLAND	12229	11477,6	14089,9	3541,7	2796	2461	3491	4082	5803
dolnośląskie	337,4	232,4	180,7	93,9	55,7	42,6	3558	4228	4311
kujawsko-pomorskie	737,9	674,4	1055,1	195,5	160,7	168,6	3800	4178	6561
lubelskie	1230,1	931,9	807,8	344,9	233,4	141,8	3593	3901	5758
lubuskie	159,3	130,8	84,9	35,4	28,9	31,6	4396	4525	2678
łódzkie	991,5	1012,4	1096,4	296,1	235,8	189,3	3309	4152	5898
małopolskie	820,4	614,9	285	262,3	170,2	80,9	3140	3539	3533
mazowieckie	1939,8	2043,7	3301,8	612,8	565,7	558,8	3253	3666	6192
opolskie	327,9	283,6	277,4	75,7	51,2	42,4	4370	5391	6413
podkarpackie	755,8	459,7	160,9	234,1	129,5	38,7	3216	3534	4080
podlaskie	1201,2	1618,2	2822,9	359,3	376,9	457,2	3328	4240	6134
pomorskie	446,1	349,8	371,8	120	78,6	71,6	3873	4463	5119
śląskie	440,9	307	270,2	109,7	70,5	47,4	4133	4558	5714
świętokrzyskie	603,9	432,8	217,7	191,1	105,8	53,4	3329	4006	4071
warmińsko-mazurskie	684,4	853,7	1031,4	196	183	200,4	3522	4708	5050
wielkopolskie	1228,1	1311,5	1963,7	333	305,8	294,2	3735	4259	6760
zachodniopomorskie	324,3	220,8	162,2	81,9	44,3	42,2	4014	4885	3800

Source: Own study based on [4, 5, 6, 7, 8]

Źródło: Opracowanie własne na podstawie [4, 5, 6, 7, 8]

decrease in cow stock and continuing decrease in production in this region is caused, among others, by the occurrence of small area farms which usually keep herds of 1 or 2 cows, which determines low commerciality of milk produced in this region [3, 18]. Additionally, the regression in the number of cows was conditioned by the policy of dairy companies reducing milk purchase from farms with low profitability and having difficulties in guaranteeing high milk quality [3].

In the period of intensive system transformations, the former central-eastern region of Poland, which in the new administrative division subtracted the Podlaskie, Mazowieckie and Warmińsko-Mazurskie Voivodeships, was characterised by the lowest cow stock decline. In the pre-accession period the decrease in the cow stock in that region amounted to 3% (with an increase in the Podlaskie Voivodeship by 5%) (Table 2). The voivodeships which in the pre-accession period showed a low decrease in the cow stock, i.e. below the national average of 21%, were the Wielkopolskie voivodship, where a decrease in the stock by 8% was recorded, the Kujawsko-Pomorskie voivodship with a decrease by 18% and the Łódzkie voivodship with a decrease at the level of 20% (Table 2). In the pre-accession period in the Central-North-Eastern region of Poland there was observed a decrease in the number of cows at the level of 9% and increase in milk yields of cows by 21%, what caused an increase in milk production in that region by 11% (the most in Podlaskie by 35% and in Warmińsko-

Mazurskie by 25%) (Table 2). In the post-accession period in the central north-eastern region of Poland there was an increase in the number of cows by 2% (with the highest increase in the number of cows recorded in Podlaskie Voivodeship by 21%), and production increased by 45% (with the highest increase in milk production recorded in Podlaskie Voivodeship by 74% and Mazowieckie Voivodeship by 62%). In the post-accession period in the analysed region there was also an increase in milk yields by 46.5% (where the highest increase was recorded in the Mazowieckie Voivodship by 69% and in the Wielkopolskie Voivodship by 59%) (Table 2). Dominance of 6 voivodships in milk production in Poland is conditioned by specialisation of farms keeping cows, manifested by a large increase in the share of farms keeping larger and larger herds of cows and obtaining favourable results in improvement of cow herds. This process was possible because in the described region the structure of farms keeping cows according to the area size of the farms was favourable, which made it possible to significantly increase the size of maintained cow herds [3].

In the pre-accession period in the western and north-western region of Poland, which includes the following voivodships: Dolnośląskie, Opolskie, Lubuskie, Zachodniopomorskie and Pomorskie, a decrease in livestock by 34% (from 18% in Lubuskie to 46% in Zachodniopomorskie), and milk production by 23% (from 14% in Opolskie to 32% in Zachodniopomorskie) was recorded. In the final phase of

Table 2. change in milk production, livestock and total cow milk yield by region from 1998 to 2019

Tabela 2. Zmiana produkcji mleka, pogłowia oraz mleczności krów ogółem w ujęciu regionalnym w latach 1998–2019

	Milk production [million l]		Total number of cows [in thousands]		Average annual milk yield from 1 cow [in l]	
	amendment 2004/1998	amendment 2019/2004	amendment 2004/1998	amendment 2019/2004	amendment 2004/1998	amendment 2019/2004
POLAND	0,94	1,23	0,79	0,88	1,17	1,42
dolnośląskie	0,69	0,78	0,59	0,76	1,19	1,02
kujawsko-pomorskie	0,91	1,56	0,82	1,05	1,10	1,57
lubelskie	0,76	0,87	0,68	0,61	1,09	1,48
lubuskie	0,82	0,65	0,82	1,09	1,03	0,59
łódzkie	1,02	1,08	0,80	0,80	1,25	1,42
małopolskie	0,75	0,46	0,65	0,48	1,13	1,00
mazowieckie	1,05	1,62	0,92	0,99	1,13	1,69
opolskie	0,86	0,98	0,68	0,83	1,23	1,19
podkarpackie	0,61	0,35	0,55	0,30	1,10	1,15
podlaskie	1,35	1,74	1,05	1,21	1,27	1,45
pomorskie	0,78	1,06	0,66	0,91	1,15	1,15
śląskie	0,70	0,88	0,64	0,67	1,10	1,25
świętokrzyskie	0,72	0,50	0,55	0,50	1,20	1,02
warmińsko-mazurskie	1,25	1,21	0,93	1,10	1,34	1,07
wielkopolskie	1,07	1,50	0,92	0,96	1,14	1,59
zachodniopomorskie	0,68	0,73	0,54	0,95	1,22	0,78

Source: Own study based on [4, 5, 6, 7, 8]

Źródło: Opracowanie własne na podstawie [4, 5, 6, 7, 8]

the pre-accession period and in the initial phase of the post-accession period a revival was observed in this region in cow rearing, first of all in high-yield farms (usually post-state farms keeping dairy cows), connected with striving to reach the highest possible limits of milk production [3]. As a consequence, in the post-accession period in the western and north-western regions of Poland, along with stabilization of ownership and organizational structure of farms established after liquidation of state farms, the dynamics of decrease in cow stock and milk production decreased significantly [3]. In the post-accession period there was recorded a decrease in cow stock by 9% (from 5% in the West Pomeranian Province to 24% in the Lower Silesian Province), and in milk production by 16% (from 2% in the Opole Province to 35% in the Lubusz Province) (Table 2). The decrease in milk production was determined by the decrease in milk production in self-supplied holdings and those which fall out of the dynamically shrinking group of commercial farms (milk suppliers to dairy companies) [3].

Changes occurring in the prices of purchased milk also had an important impact on the course of regionalisation of milk production in Poland. Table 3 presents changes in the purchase of milk and milk purchase prices in the years 1999–2019. The time interval 1999–2019 was adopted as the research period, which was conditioned by the availability of data in the GUS database. In the years 1999–2019 an increase in the purchase of milk in Poland by 82% was observed. The changes in the purchase of milk in the examined period took place dynamically in the central – north-eastern region of Poland, which was connected with dynamic development of milk production in that region. In the Zachodniopomorskie and Małopolskie voivodships, a decrease in milk purchase was recorded in the analysed period, by 8% and 22% respectively (Table 3). Along with changes in milk procurement, changes in milk procurement prices were recorded in the years 1999–2019. The highest increase in milk procurement prices in the analysed period was recorded in Podlaskie Province where the procurement price of cow's milk for 1 l of milk in 2019

Table 3. Changes in the purchase of milk [in thousand l] and in the purchase prices of cow's milk [in PLN per 1 hl] by regions in the years 1999-2019

Tabela 3. Zmiany skupu mleka [w tys. l] oraz cen skupu mleka krowiego [w zł za 1 hl] w ujęciu regionalnym w latach 1999-2019

	1999		2004		2019		change in milk collection 2019/1999	change in milk prices 2019/1999
	milk procurement [in thousand l]*	purchase price of cow's milk [in PLN per 1 hl]	milk procurement [in thousand l]*	purchase price of cow's milk [in PLN per 1 hl]	milk procurement [in thousand l]*	purchase price of cow's milk [in PLN per 1 hl]		
POLAND	6486415	61	7 770 084	87	11827566	139	1,82	2,28
dolnośląskie	143085,4	63	164 872	87	164734	139	1,15	2,21
kujawsko-pomorskie	446195	60	549 112	86	830018	133	1,86	2,21
lubelskie	552595,8	60	583 967	80	573439	140	1,04	2,33
lubuskie	75129,6	62	87 480	89	77894	139	1,04	2,24
łódzkie	653272	59	698 440	84	845414	127	1,29	2,15
małopolskie	172578,9	60	161 860	73	134941	124	0,78	2,06
mazowieckie	1190618	59	1 515 510	85	2581097	138	2,17	2,35
opolskie	171936	68	198 656	90	260802	139	1,52	2,04
podkarpackie	113283,5	53	126 651	71	119080	134	1,05	2,53
podlaskie	1033975,4	66	1 506 846	99	2605126	147	2,52	2,22
pomorskie	184062,4	59	196 972	85	329074	140	1,79	2,38
śląskie	167249,4	61	175 545	81	252784	138	1,51	2,26
świętokrzyskie	171266,2	54	172 666	76	179851	130	1,05	2,40
warmińsko-mazurskie	482361,6	58	510 021	91	926048	145	1,92	2,50
wielkopolskie	782562,5	63	981 312	87	1814626	137	2,32	2,18
zachodniopomorskie	145728,8	59	139 368	91	133690	140	0,92	2,38

* milk procurement [in thousand l] was calculated by multiplying the procurement of cow's milk per 1 sensitive head [in litres] and the total cow's population expressed [in thousands].

Source: Own study based on [4, 5, 6, 7, 8]

Źródło: Opracowanie własne na podstawie [4, 5, 6, 7, 8]

amounted to 1.47 PLN and was by 122% higher than the price offered in procurement in 1999 (0.66 PLN/l) (Table 3). High prices offered in Podlaskie Voivodeship for cow's milk purchase in the analysed period were conditioned by good financial and economic situation of large dairy enterprises located, in this voivodeship, high quality of milk produced by farmers and relatively large scale of production [15].

SUMMARY

On the basis of review of the literature on the subject and performed research analysis in the scope of determining changes in the Polish dairy sector taking place in the years 1998-2019 in the regional aspect of milk production in Poland it was stated that:

- Dynamic development of milk production was observed in the central-northeastern region of Poland, to which 6 voivodships were classified, i.e. Podlaskie, Warmińsko-Mazurskie, Mazowieckie, Wielkopolskie, Kujawsko-Pomorskie and Łódzkie. The factors determining the production growth in this region included: favourable natural conditions, agrarian structure, tradition and agricultural culture, which contributed to the concentration of herds and production of cheap roughage.
- On the other hand, the south-eastern region of Poland, which includes the Podkarpackie, Świętokrzyskie, Śląskie and Małopolskie voivodships, in the analysed period was characterised by the highest decrease in production, which was related to the fragmented agrarian structure, as well as the mountainous relief of this region.
- In the western and north-western region of Poland, which includes Dolnośląskie, Opolskie, Lubuskie and Zachodniopomorskie voivodships, a decrease in production was also observed, which was a consequence of the lack of tradition in dairy cattle farming, while farms owned by legal persons, which were established on the basis of bankrupt state farms, continued to limit animal production, running mainly zero-inventory farms. Besides, the western and north-western region of Poland dominates in crop production [15, 18].

On the basis of the above analyses and the literature review, it was shown that under the conditions of market economy, milk production was reduced faster in those voivodships where it is difficult to rationalise production, reduce production costs due to excessive fragmentation or less favourable natural conditions. Consequently, it was observed that the growth of milk production increases more dynamically in provinces

where natural and economic conditions are favourable for effective milk production, i.e. from the south of Poland to the north [15, 18].

PODSUMOWANIE

W oparciu o przegląd literatury przedmiotu oraz przeprowadzone analizy badawcze w zakresie określenia zachodzących w polskim sektorze mleczarskim w latach 1998–2019 zmian w ujęciu regionalnym w zakresie produkcji mleka w Polsce stwierdzono, że:

- dynamiczny rozwój produkcji mleka obserwowany był w regionie centralno-północno-wschodnim Polski, do którego zakwalifikowano 6 województw, tj. podlaskie, warmińsko-mazurskie, mazowieckie, wielkopolskie, kujawsko-pomorskie i łódzkie. Do czynników determinujących wzrost produkcji w tym regionie zakwalifikowano: korzystne warunki przyrodnicze, strukturę agrarną, tradycję oraz kulturę rolną, co przyczyniło się do koncentracji stad oraz produkcji tanich pasz objętościowych.
- Region południowo-wschodni Polski, do którego można zaliczyć województwo: podkarpackie, świętokrzyskie, śląskie i małopolskie w analizowanym okresie cechował się najwyższym spadkiem produkcji, co było związane z rozdrobnioną strukturą agrarną, a także górskim ukształtowaniem tego regionu.
- W regionie zachodnim i północno-zachodnim Polski, do którego zaliczono województwo: dolnośląskie, opolskie, lubuskie, zachodniopomorskie i lubuskie, również obserwowano spadek produkcji, co było konsekwencją braku tradycji chowu bydła mlecznego, zaś gospodarstwa należące do osób prawnych, które powstały w oparciu o upadłe gospodarstwa państwowe nadal ograniczają produkcję zwierzęcą, prowadząc przede wszystkim gospodarstwa bezinwentarzowe. Poza tym region zachodni i północno-zachodni Polski dominuje w produkcji roślinnej [15, 18].

W oparciu o powyższe analizy oraz przegląd literatury wykazano, że w warunkach gospodarki rynkowej produkcja mleka była ograniczana szybciej w tych województwach, gdzie trudno jest racjonalizować produkcję, obniżać koszty produkcji ze względu na nadmierne rozdrobnienie lub mniej sprzyjające warunki przyrodnicze. W konsekwencji obserwowano, że wzrost produkcji mleka dynamiczniej zwiększa się w województwach, gdzie warunki przyrodnicze oraz gospodarcze są korzystne dla efektywnej produkcji mleka, czyli z południa Polski na północ [15,18].

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