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TOMASZ ROKICKI, ALEKSANDRA PERKOWSKA, PAULINA ZIÓŁKOWSKA

Warsaw University of Life Sciences – SGGW, Poland

CHANGES IN THE CONCENTRATION OF ANIMAL PRODUCTION IN POLAND

Key words: animal population, animal production, livestock production, milk, voivodships

ABSTRACT. The main purpose of the paper was to present changes in the concentration level of individual animal production in Poland. All Polish voivodships were selected for research purposefully. The research period concerned the years 2005-2019. The source of material was the literature on the subject and data from the Central Statistical Office. For the analysis and presentation of materials, descriptive, tabular and graphic methods as well as dynamics based on a constant basis, the Gini concentration factor and concentration analysis using the Lorenz curve were used. Specialization in animal production was found in several voivodships, such as Mazowieckie and Wielkopolskie. There were also voivodships focused on a given type of animal production, like Podlaskie on milk production. The concentration of animal production increased, which meant an even greater concentration of activities in several voivodships. The exception was sheep production, for which a decrease in the concentration of the sheep population and lamb production was noted. A reduction in the concentration of production also occurred in the production of veal meat. It should be noted that, as a rule, the dominant voivodships in given animal production increased the number of animals and the production of products obtained from these groups of farm animals the most.

INTRODUCTION

Agricultural production has specific features that result in the fact that it is more concentrated in certain areas and less so in others. These features include [Heijman et al. 1997, Gębska, Filipiak 2006, Olson 2004]:

– large dependence and diversity of climatic and soil conditions,
– seasonality of production,
– production cyclicality,
– mutual dependence linking some agricultural products with others.

Individual activities compete with each other for limited resources, e.g. animals for feed. They are also very diverse. It is caused by many conditions in the field of agricultural production [Kay et al. 1994, Olson 2010]. It is also necessary to mention the very large spatial dispersion of agricultural activities, due to the nature of production. There is a great variation in this area in individual countries and regions. Agricultural activity is often multidirectional, with a high share of own labor force and the large economic diversification of farms. There

are also strong social and cultural links between farms and local communities [Kowalczyk, Sobiecki 2011]. Agriculture is seen as a primary branch of the economy that creates products for processing other departments. The development of agriculture in individual countries is affected by domestic demand and an increase in turnover in foreign trade in agricultural products and, on the supply side, access to financial resources supporting agricultural production and rural areas [Trostle 2010, Florey 2012, Grochowska 2012].

The process of concentrating animal husbandry is one of the key factors affecting the reduction of the unit cost of production. It also affects the profitability and competitiveness of a given production. In general, the processes of animal production concentration are intensifying, which causes the deepening of regional diversity of animal production. Some regions become leading in a given production, while others are marginalized. In addition, given regions specialize in specific production [Strijker 2008, Leeuwen et al. 2010, Bartova, Konyova 2015, Ragkos et al. 2015, Tłuczak 2019].

MATERIAL AND METHODS

The aim of the study was to present changes in the concentration level of individual animal production in Poland. The specific objectives were to determine the importance of individual animal production in Polish voivodships, show trends and present the level of production concentration in voivodships and changes in this respect. The paper presents a hypothesis according to which the level of animal production concentration in Poland increased in several voivodships. All Polish voivodships were selected for research purposefully. The research period concerned the years 2005-2019. The source of the material was the literature on the subject as well as data from the Central Statistical Office. For the analysis and presentation of materials, descriptive, tabular and graphic methods, dynamics based on a constant basis, the Gini concentration factor as well as concentration analysis using the Lorenz curve were used.

RESULTS AND DISCUSSION

The population of individual groups of farm animals in Poland has changed. At the same time, there were inequalities in the distribution of these animals in individual voivodships. Such differences are natural and result from the conditions and specialization in production. In 2019, the largest animal population was maintained: for cattle in the Mazowieckie, Wielkopolskie and Podlaskie voivodships, for pigs in the Wielkopolskie, Mazowieckie and Łódzkie voivodships, for poultry in the Wielkopolskie, Mazowieckie and Łódzkie voivodships, for sheep in the Małopolskie, Podlaskie and Wielkopolskie voivodships (Table 1). This list shows voivodships specializing in given production and indicates large disparities between areas.

The Gini coefficient was used to determine the population concentration of individual groups of farm animals in voivodships in relation to other voivodships. The data concerned two years, i.e. 2005 and 2019, and the number of observations was 16. The Gini coefficient was calculated from the sample and was estimated. The results of the calculations are

Table 1. Animal population in voivodships in 2019

Voivodships	Animal population in thousands of pieces			
	cattle	swine	poultry	sheep
Dolnośląskie	104.83	184.79	6,827.29	11.99
Kujawsko-Pomorskie	516.92	1,097.98	11,156.19	9.11
Lubelskie	389.09	459.32	10,409.21	17.58
Lubuskie	82.41	126.41	6,942.74	7.46
Łódzkie	491.04	1,180.47	14,112.35	15.51
Małopolskie	169.03	135.92	4,863.12	79.34
Mazowieckie	1,163.46	1,245.86	35,884.41	7.36
Opolskie	125.34	317.29	5,004.83	2.14
Podkarpackie	70.00	134.82	4,736.44	15.49
Podlaskie	1,017.61	337.12	13,827.33	26.33
Pomorskie	219.07	759.59	6,308.20	13.67
Śląskie	128.53	203.98	8,244.25	10.37
Świętokrzyskie	158.27	196.87	6,265.75	5.32
Warmińsko-Mazurskie	473.04	558.55	8,926.56	15.78
Wielkopolskie	1,042.11	4,020.80	45,569.26	22.89
Zachodniopomorskie	110.83	255.70	11,967.84	7.39
Poland	6,261.58	11,215.46	201,045.77	267.73

Source: own elaboration on the basis of Statistics Poland

Table 2. Gini coefficients for the population of individual farm animals in 2005-2019

Parameters	Gini coefficient in years			
	2005		2019	
	from sample	estimated	from sample	estimated
Cattle population	0.4035	0.4305	0.4751	0.5068
Pig population	0.4424	0.4719	0.5512	0.5879
Poultry population	0.3248	0.3464	0.3906	0.4166
Sheep population	0.4888	0.5214	0.4204	0.4484

Source: own elaboration on the basis of Statistics Poland

presented in Table 2. Results close to 1 signify a high concentration, while close to 0 stand for no concentration. In 2005-2019, the concentration of all animals in several voivodships, except sheep, increased to a high level. The sheep population was small, so small changes could significantly affect the concentration level. An increase in the concentration of the pig population resulted from the inhibition of production in regions affected by ASF (African swine fever). A greater concentration in the production of cattle and poultry resulted from the resignation of small farms from keeping animals and the growing scale of production in the case of developing farms. A high concentration of the animal population and diversity occurring in voivodships was presented by means

of Lorenz concentration curves (Figure 1). In 2019, the highest concentration was found for cattle and pigs, and the lowest for poultry.

In the years 2005-2019, there were major changes in the animal population. The cattle population increased by 16%, the most in the Wielkopolskie and Podlaskie voivodships, which also kept most of these animals (Table 3). The decreases concerned voivodships with the least cattle. The pig population in Poland has decreased by 40%, the most in eastern voivodships, i.e. Małopolskie, Lubelskie, Podlaskie, Podkarpackie. The reason was ASF disease and competition from producers from Western European countries, such as Denmark and Germany. The total poultry population increased in the years 2005-2019 by 61%, most in the Podlaskie, Warmińsko-Mazurskie and Zachodniopomorskie voivodships, in which the number of kept animals doubled or tripled. The population only dropped in the Małopolskie and Podkarpackie voivodships. The increase in stock required investment in the construction of appropriate buildings for housing and fattening these animals. The sheep population has fallen by 16%. There were voivodships with large increases in the population of these animals, but also with large decreases, and the dynamics were affected by the small initial state of the population.

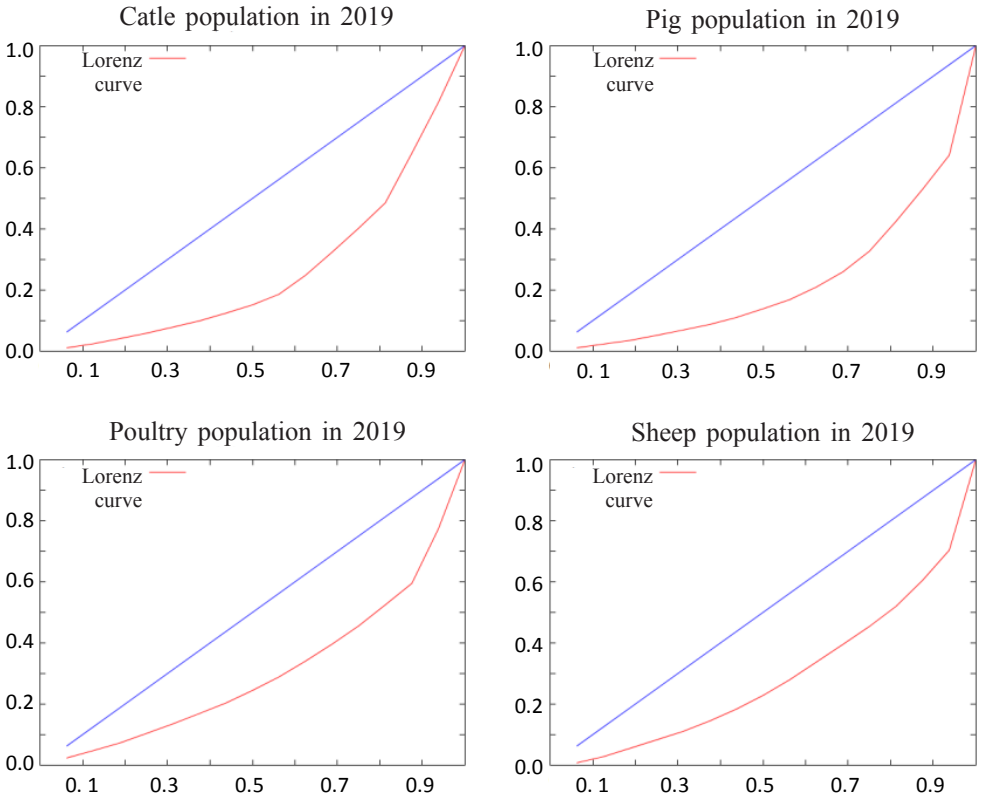

Figure 1. The Lorenz concentration curve for the livestock population in voivodships of Poland in 2019

Source: own elaboration

Table 3. Dynamics of changes in the animal population in voivodships in 2005-2019 (2005 = 100)

Voivodships	Dynamics of animal population changes in 2005-2019			
	cattle	swine	poultry	sheep
Dolnośląskie	91.45	40.43	106.10	143.42
Kujawsko-Pomorskie	127.74	50.41	158.83	33.19
Lubelskie	93.86	33.97	180.52	76.46
Lubuskie	126.90	52.59	154.65	232.09
Łódzkie	114.85	84.98	136.28	76.85
Małopolskie	63.62	25.81	97.25	86.38
Mazowieckie	123.91	60.31	200.32	76.24
Opolskie	101.63	40.80	128.30	117.55
Podkarpackie	38.63	38.35	97.67	102.85
Podlaskie	137.43	37.64	284.71	101.47
Pomorskie	125.33	70.84	126.90	119.36
Śląskie	100.07	46.09	122.55	49.96
Świętokrzyskie	82.66	41.71	103.79	132.93
Warmińsko-Mazurskie	123.59	59.91	242.96	183.93
Wielkopolskie	142.63	79.62	164.76	55.78
Zachodniopomorskie	109.86	50.33	220.98	139.48
Poland	116.28	59.94	160.74	84.28

Source: own elaboration on the basis of Statistics Poland

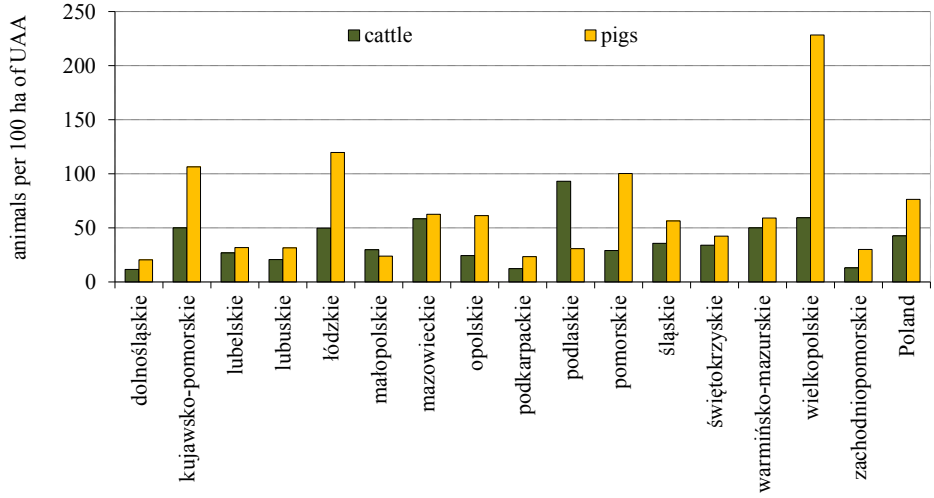

Figure 2. Intensity of cattle and pigs in Polish voivodships in 2019

Source: own elaboration on the basis of Statistics Poland

The concentration of animal production in individual voivodships can also be demonstrated by stocking density per 100 ha UR (Figure 2). Important groups of animals include cattle and pigs. In 2019, the largest number of cattle per 100 ha UR was in the Podlaskie (93), Wielkopolskie and Mazowieckie (59 each) voivodships. At the same time, they were voivodships with the largest number of these animals. The largest number of pigs was in the following voivodships: Wielkopolskie (229), Łódzkie (120) and Kujawsko-Pomorskie (106). Again, these were the areas with the largest population.

The factor determining the importance of a given animal production is the volume of products obtained. For animals, meat is an important product (expressed in live weight). In the case of cows, milk is also obtained, and in the case of hens – eggs. In 2018, most live beef was produced in the Wielkopolskie and Mazowieckie voivodships, veal meat in the Mazowieckie and Podlaskie voivodships. Beef came from raising meat cows and the sale of defective animals. In turn, calves (male, but also female not intended for further breeding) were supplied by dairy farms. The Wielkopolskie and Kujawsko-Pomorskie voivodships dominated in the production of live pigs, lambs in the Lubelskie and Podlaskie

Table 4. Animal production in voivodships in 2018

Voivodships	Production of livestock tonnes					Cow milk production in thous. tonnes	Chicken egg production in thous. pieces
	beef	veal	pork	lamb	poultry		
Dolnośląskie	21,837	75	25,736	105	96,243	188	510,853
Kujawsko-Pomorskie	87,507	142	294,544	270	166,304	1,079	405,802
Lubelskie	53,271	157	184,100	429	100,918	800	388,746
Lubuskie	8,388	53	27,031	6	130,070	111	232,187
Łódzkie	130,825	179	264,294	105	145,746	1,060	511,975
Małopolskie	41,419	182	54,245	413	61,002	324	579,907
Mazowieckie	214,478	847	277,158	300	1,001,520	3,113	2,381,842
Opolskie	13,864	39	74,906	22	57,565	299	182,983
Podkarpackie	8,586	185	45,500	117	47,212	185	375,462
Podlaskie	107,786	549	102,902	419	154,032	2,918	305,912
Pomorskie	35,962	63	253,719	322	136,134	374	416,740
Śląskie	42,467	37	56,705	99	176,121	261	396,440
Świętokrzyskie	66,810	87	79,611	64	73,411	243	299,340
Warmińsko-Mazurskie	34,001	462	142,424	134	253,806	1,168	203,736
Wielkopolskie	227,705	204	603,603	170	667,388	1,892	4,326,552
Zachodniopomorskie	11,660	79	43,183	46	184,206	156	295,792
Poland	1,106,566	3,340	2,529,661	3,021	3,451,678	14,171	11,814,269

Source: own elaboration on the basis of Statistics Poland

voivodships, while poultry livestock in the Mazowieckie and Wielkopolskie voivodships. Production was quite strongly correlated with animal population. The weight of the animals sold was also of great importance, as in sheep production, where lambs weighing 20 kg but also 40 kg were sold. The highest milk production was achieved in the Mazowieckie and Podlaskie voivodships, while egg production most definitely in the Mazowieckie Voivodship. Farms specializing in milk and egg production were important.

Table 5. Gini coefficients for the production of individual farm animals in 2005-2019

Parameters	Gini coefficient in years			
	2005		2018	
	from sample	estimated	from sample	estimated
Beef production	0.4207	0.4487	0.4970	0.5301
Veal production	0.5379	0.5738	0.4888	0.5214
Pork production	0.4265	0.4549	0.4681	0.4993
Poultry production	0.3664	0.3908	0.4767	0.5085
Lamb production	0.4837	0.5159	0.4202	0.4482
Cow's milk production	0.4176	0.4455	0.5290	0.5642
Chicken eggs production	0.4273	0.4558	0.5204	0.5551

Source: own elaboration on the basis of Statistics Poland

In most cases, the level of animal production concentration increased in several voivodships (Table 5). The decrease only concerned the production of veal and lamb. The reason may be the purchase of calves from farmers specializing in milk production and farm specialization for fattening. Another direction was the export of live calves to other EU countries, e.g. to Italy. In the case of lamb, the decrease in concentration was also due to a similar trend for the sheep population. The high concentration of animal production and diversity occurring in voivodships was also presented using Lorenz concentration curves (Figure 3). In 2018, the production of cow's milk and chicken eggs was the most concentrated, and lamb meat the least.

Changes in the volume of animal production were different for individual product groups (Table 6). In 2005-2018, beef production increased in Poland by 85%, and the fastest in the Pomorskie and Świętokrzyskie voivodships, where the volume doubled. In the case of veal, there were declines everywhere, because the production of this meat in 2018 accounted for only 5% of the volume from 2005. Pork production was maintained, while a large increase was recorded in the Pomorskie (by 161%) and Warmińsko-Mazurskie (by 26%) voivodships. Lamb meat production in 2018 accounted for only 60% of the volume from 2005. Nevertheless, there were areas where it increased several times, such as the Świętokrzyskie and Kujawsko-Pomorskie voivodships. Poland has become a leader in the production of poultry meat, as evidenced by an increase of 138%, the largest in the Pomorskie and Mazowieckie voivodships. Cow›s milk production increased by 19%, most in the Podlaskie voivodship (by 74%), then in the Kujawsko-Pomorskie, Warmińsko-Mazurskie, Wielkopolskie and Mazowieckie voivodships (about 40% each). Egg production increased by 23%, mostly in the Wielkopolskie and Mazowieckie voivodships.

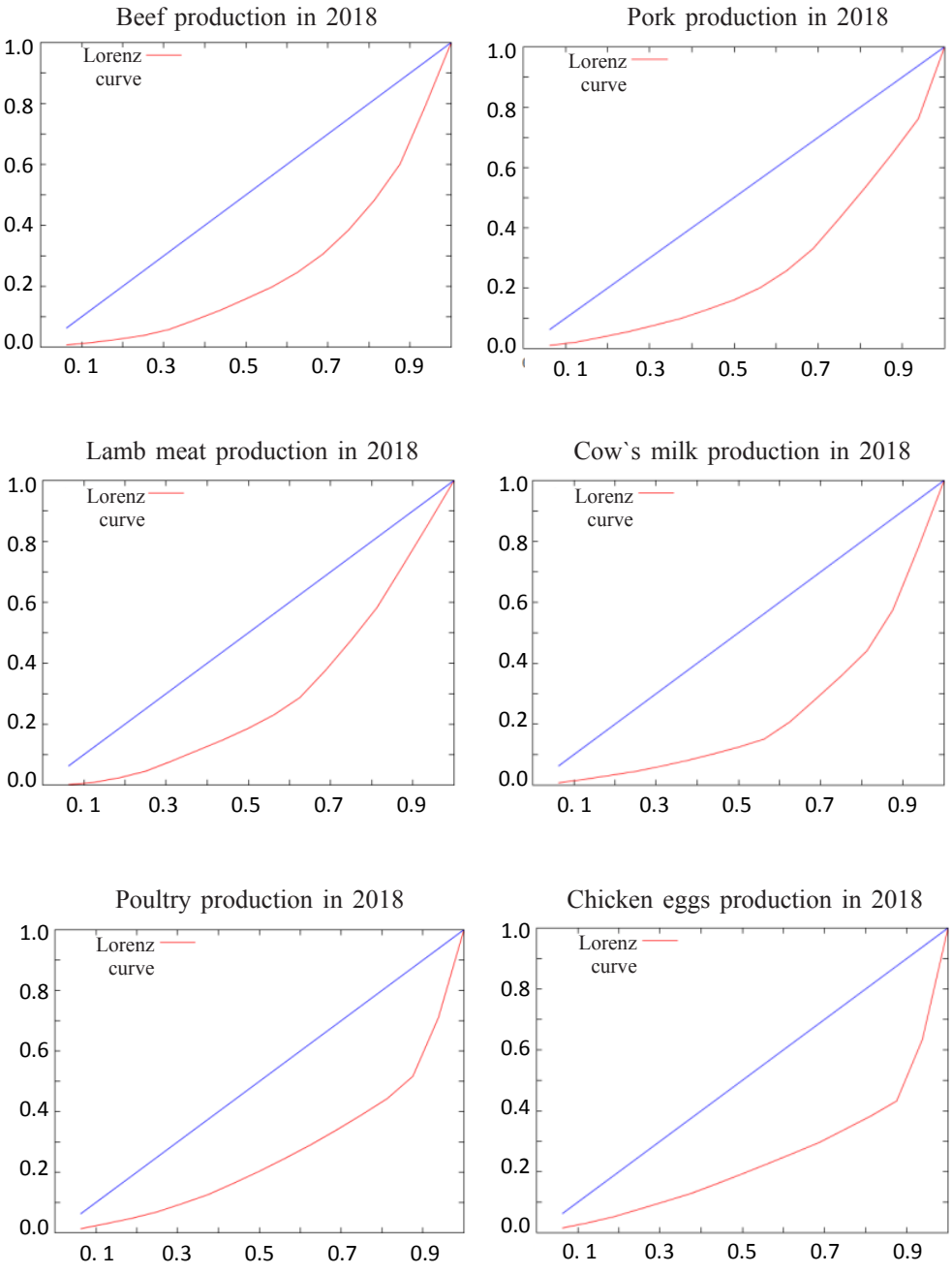

Figure 3. The Lorenz concentration curve for the parameters of animal production in Polish voivodships in 2018

Source: own elaboration

Table 6. Dynamics of production changes in voivodships in 2005-2018 (year 2005 = 100)

Voivodships	Dynamics of changes in the livestock production					Dynamics of changes in cow's milk production	Dynamics of changes in chicken egg production
	beef	veal	pork	lamb	poultry		
Dolnośląskie	159.22	18.84	41.09	35.84	133.55	76.11	86.77
Kujawsko-Pomorskie	173.26	7.20	110.55	275.51	181.55	139.77	85.29
Lubelskie	138.26	2.30	109.85	65.20	163.41	75.19	86.51
Lubuskie	133.65	31.18	66.87	120.00	172.86	82.84	97.14
Łódzkie	210.81	3.18	100.79	29.49	104.37	97.61	90.31
Małopolskie	117.40	3.34	66.20	36.78	108.02	61.36	92.58
Mazowieckie	240.81	5.80	97.81	135.75	472.30	137.99	152.69
Opolskie	102.87	9.68	94.32	52.38	152.22	97.08	83.77
Podkarpackie	47.34	2.79	77.33	61.26	98.55	38.95	97.16
Podlaskie	192.68	5.52	88.85	93.53	247.50	174.21	133.72
Pomorskie	366.06	12.52	261.13	92.00	778.35	116.88	93.17
Śląskie	236.23	4.56	72.97	44.39	338.59	94.57	73.61
Świętokrzyskie	317.92	3.58	110.77	711.11	245.97	63.45	150.63
Warmińsko-Mazurskie	107.80	14.21	125.60	69.07	166.95	139.88	136.73
Wielkopolskie	192.14	10.71	89.22	22.70	260.73	138.71	165.47
Zachodniopomorskie	69.69	13.41	51.00	44.66	209.58	78.00	84.01
Poland	184.87	5.43	99.59	59.67	237.71	118.85	122.55

Source: own elaboration on the basis of Statistics Poland

In Jerzy Kopiński›s research [2014, 2016] for the years 2000-2012, the cow population decreased, but milk yield increased. Since 2007, there has been a decline in pig production, which has resulted in reduced concentration and specialization. Regions that strengthened their importance in the production of milk (Podlaskie) and pork (Wielkopolskie) were also indicated. Differences between voivodships to a lesser extent refer to habitat and natural conditions, and are mainly due to the different level of organization and intensity of agricultural production. In this respect, these differences have deepened quite significantly [Kopiński, Matyka 2016]. Similar results were obtained in research by Agnieszka Tłuczak [2015] for 2004-2014, Mariusz Matyka et al. [2016] for 2000-2014. As indicated by Jerzy Kopiński [2009], Marek Wigier [2013], Jan Kuś and Mariusz Matyka [2014a, 2014b], Franciszek Kapusta [2015], the concentration and specialization of production is necessary for economic and organizational reasons. At the heart of this is increased productivity, better economic conditions and easier sales of agricultural products. Unfortunately, these processes are also associated with increased agricultural pressure on the environment.

CONCLUSIONS

In the years 2005-2019, there were changes in the concentration of animal production in Poland. These were years related to Poland's functioning on the EU market, which is subject to many regulations. In most cases, the concentration of livestock groups in several voivodships increased. The exception was the sheep population, for which a lower concentration factor was achieved in 2019 than in 2005. The increase in concentration generally meant increasing disparities and strengthening specialization in a given animal production of dominant voivodships. These included the most agriculturally developed areas of Poland, such as the Mazowieckie and Wielkopolskie voivodships. There were also specializations in specific production, like the Podlaskie Voivodship in milk production.

In the case of testing the concentration of live cattle production from individual groups of animals as well as milk and eggs, similar regularities as for population were found. The concentration of production in several dominant voivodships increased. The hypothesis presented in the paper was confirmed, apart from the production of lamb and veal, which were subject to other trends. Lamb production was quite marginal and quite dispersed. In the case of veal, the direction of calf use has changed. The composition of dominant voivodships in a given production was similar to that of the population. Concentration processes will take place in the following years and the trends initiated will be maintained. However, the change will be quite slow.

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ZMIANY W KONCENTRACJI PRODUKCJI ZWIERZĘCEJ W POLSCE

Słowa kluczowe: pogłowie zwierząt, produkcja zwierzęca, produkcja żywca, mleko, województwa

ABSTRAKT

Głównym celem artykułu jest przedstawienie zmian w poziomie koncentracji poszczególnych produkcji zwierzęcych w Polsce. W sposób celowy wybrano do badań wszystkie województwa Polski. Okres badań dotyczył lat 2005-2019. Źródłem danych była literatura przedmiotu i dane GUS. Do analizy i prezentacji materiałów zastosowano metody opisową, tabelaryczną, graficzną, a także wskaźniki dynamiki o podstawie stałej, współczynnik koncentracji Giniego, analizę koncentracji za pomocą krzywej Lorenza. Stwierdzono występowanie specjalizacji w produkcji zwierzęcej w kilku województwach, m.in. w mazowieckim i wielkopolskim. Były też województwa nastawione na dany rodzaj produkcji zwierzęcej przy produkcji mleka (podlaskie). Koncentracja produkcji zwierzęcej zwiększyła się, co oznaczało jeszcze większe skupianie działalności w kilku województwach. Wyjątkiem była produkcja owczarska, dla której zanotowano zmniejszenie koncentracji pogłowia owiec i produkcji mięsa jagnięcego. Zmniejszenie koncentracji produkcji wystąpiło również przy produkcji mięsa cielęcego. Należy zauważyć, że z reguły województwa dominujące w danej produkcji zwierzęcej, najbardziej zwiększały pogłowie zwierząt i wytwarzanie produktów uzyskiwanych od tych grup zwierząt gospodarskich.

AUTHORS

TOMASZ ROKICKI, PHD
ORCID: 0000-0003-3356-2643
Warsaw University of Life Sciences – SGGW
Department of Logistics
166 Nowoursynowska St., 02-787 Warsaw, Poland

ALEKSANDRA PERKOWSKA, MSC
ORCID: 0000-0002-7059-0689
Warsaw University of Life Sciences – SGGW
Department of Logistics
166 Nowoursynowska St., 02-787 Warsaw, Poland

PAULINA ZIÓŁKOWSKA, MSC
ORCID: 0000-0001-9140-8228
Warsaw University of Life Sciences – SGGW
Department of Logistics
166 Nowoursynowska St., 02-787 Warsaw, Poland