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CONDITIONS OF CHANGES IN THE REGIONAL SPECIALIZATION OF ANIMAL PRODUCTION IN POLAND

Elżbieta Jadwiga Szymańska[1]✉, Robert Mroczek[2], Agnieszka Tłuczak[3]

[1] Warsaw University of Life Sciences – SGGW, Poland
[2] Institute of Agricultural and Food Economics National Research Institute, Poland
[3] University of Opole, Poland

ABSTRACT

Aim: The study aimed to identify regional specialization and changes in competitiveness in the field of animal production in Poland. **Methods:** The analysis covered statistical data of the Central Statistical Office from 2010–2021 on a national scale and in individual voivodeships. The study used a comparative analysis of animal production in regional terms. In order to determine the specialization of the region and to analyze changes in competitiveness over time, the classic method of Shift-Share Analysis (SSA) was used. **Results:** Major changes are taking place in Poland in the stock of farm animals and the production of animals for slaughter. In the years 2010–2021, the pig stock decreased drastically, and the stock of cattle, especially for fattening and poultry, increased. Changes in livestock stock contributed to an increase in beef cattle and poultry production and a decrease in the production of live pigs. **Conclusions:** There is specialization in Poland, and the concentration of production of the most important livestock species in individual voivodeships is increasing. Specialization and concentration processes allow for more effective use of farm resources and greater competitiveness of regions. However, the accelerating concentration of production may threaten the sustainable development of agriculture and negatively affect the natural environment. Therefore, further research on the impact of specialization and concentration of animal production on food security and the natural environment is recommended.

Key words: production, region, concentration, pigs, beef cattle, poultry, competitiveness
JEL codes: Q12, O18, R11

INTRODUCTION

In Poland, animal production is of great importance in the system, guaranteeing the country's food security. It is one of the most important divisions in the total agricultural commodity production structure, although its share has decreased in recent years. Meat production fluctuates over time due to the size and structure of meat consumption, livestock purchase prices, and the retail prices of meat and meat products [Bąk-Filipek 2011].

Animal production in Poland is regionally differentiated. Internal conditions influence changes in agriculture, including natural-environmental, organizational-economic, and external conditions [Pepliński 2019]. Natural and environmental conditions determine agricultural land use and primarily affect the

Elżbieta Jadwiga Szymańska, https://orcid.org/0000-0001-7686-1243; Robert Mroczek, https://orcid.org/0000-0003-2238-3885; Agnieszka Tłuczak, https://orcid.org/0000-0001-6217-8822;

✉elzbieta_szymanska@sggw.edu.pl

quantity and quality of plant feed supplied. In turn, economic and organizational conditions affect the profitability of production. The regionally diversified livestock population is also significantly affected by the agrarian structure and labor resources, which determine the choice of a more or less labor-intensive type of rearing [Dziewulska 1994].

Historical conditions, as well as traditions and experience in running individual lines of production, shape the structure of farms and also play an important role in the regional differentiation of animal production. The competitive environment is also important (for example, successful production by neighboring farms) and the institutional environment, i.e., efficiently functioning organizations in the agricultural environment that support agricultural producers [Olszańska 2017].

Changes taking place in Polish agriculture, including animal production, are significantly influenced by external conditions shaped by the Common Agricultural Policy (CAP), the World Trade Organization (WTO), and capital, raw material, and product markets [Kopiński 2015]. After Poland's integration with the EU, financial support for agricultural production under various aid programs has increased. Apart from direct payments from the 1st pillar of the CAP for the livestock production sector, the most significant funds were allocated to the measure "Investments in a farm" under SAPARD, then from the SOP "Agriculture" in 2004-2006 and the measure "Modernization of farms" in RDP 2007-2013 [Szymańska 2006, Bułkowska 2011].

The process of concentration of animal breeding is one of the key factors influencing the reduction of unit production costs. It affects the profitability and competitiveness of a given production. In general, the processes of concentration of animal production are intensifying, which results in the deepening of regional diversification of animal production. Some regions become leaders in a given production, while others are marginalized [Strijker 2008, Rybicki 2009, Leeuwen et al. 2010, Bartova and Konyova 2015, Ragkos et al. 2015, Tłuczak 2018].

The specialization and concentration of production contribute to the increase in regional competitiveness. Łaźniewska and Gorynia [2012] defined regional competitiveness as the sustainable ability to compete with other regions, ensuring sustainable economic development. The regional dimension of competitiveness consists of two essential elements: interregional differentiation and market size. In the area of agriculture, Kołodziejczak [2010] defined regional competitiveness as the ability of a region to use its environmental, social, economic, and social institutional resources to achieve and maintain a competitive position in the country's market in terms of the contribution of its agriculture to the national economy. Competitiveness is, therefore, the ability of farms and regions to achieve success and gain an advantage over other entities (regions) fighting to earn their place in the market [Meyers and Ziółkowska 2013, Józwiak 2014]. In agricultural and economic-agricultural sciences, competitiveness is treated as the pursuit of reducing production costs and improving the efficiency of using production potential [Józwiak 2011].

The consequences of changes in animal production are multi-faceted and multi-dimensional, affecting changes in the state of the environment. In animal production, the organization of production is extensive (specialization) with a simultaneous increase in its intensity (concentration), which may result in an increase in environmental pressure in areas with a high concentration of animal production, leading, among others, to the deterioration of the quality of surface and groundwater [Fotyma et al. 2010, Kołodziejczak 2020].

In recent years, the deepening of regional diversification of agriculture has been observed as a result of strongly occurring processes of production concentration and polarization, resulting from the desire to improve the profitability of farming [Ziętara 2009]. Due to the importance of changes in the regional diversification of animal production, the study attempts to explain the reasons for the spatial diversification of individual animal species and the changes taking place in this respect. The aim of the study was to identify regional specialization and changes in the level of competitiveness in the field of animal production in Poland.

METHODS AND DATA SOURCES

The analysis covered the statistical data of the Central Statistical Office from 2010-2021 on a national and individual voivodeship scale. In the study, a compara-

tive analysis was made using tabular and graphical summaries. In order to determine the specialization of the region and to analyze changes in competitiveness over time, the classic method of shift-share analysis (SSA) was used. It was described by Dunn [1960] and then by Perloff et al. [1960]. The classic shift-share equation for variable increments takes the form:

$$x^*_{ri} - x_{ri} = x_{ri}\, tx_{..} + x_{ri}\,(tx_{.i} - tx_{..}) + x_{ri}\,(tx_{ri} - tx_{.i}) \quad (1)$$

where:

$$tx_{..} = \frac{\sum_{r=1}^{R}\sum_{i=1}^{S}(x^*_{ri} - x_{ri})}{\sum_{r=1}^{R}\sum_{i=1}^{S}x_{ri}};\ tx_{.i} = \frac{\sum_{r=1}^{R}(x^*_{ri} - x_{ri})}{\sum_{r=1}^{R}x_{ri}};$$

$$tx_{ri} = \frac{x^*_{ri} - x_{ri}}{x_{ri}}$$

x^*_{ri} – observations of the analyzed variable X in the r-th region and i-th group of the cross-sectional division in the final period,

x_{ri} – observations of the analyzed variable X in the r-th region and i-th group of the cross-sectional division in the initial period;

In the following years, the indicated equation was modified and improved by other authors, e.g., Houston [1967], Berzeg [1978], Fothergill and Gudgin [1979], Stevens and Moore [1980], and Arcelus [1984].

By dividing both sides of equation by (1) sides by *x*ri, the relationship between the growth rates was obtained:

$$tx_{ri} = tx_{..} + (tx_{.i} - tx_{..}) + (tx_{ri} - tx_{.i}) \quad (2)$$

The use of SSA analysis allows the decomposition of the total change of a localized variable into three components [Suchecki 2010, Trzpiot et al., 2013, Tłuczak 2016]:

$tx_{..}$ – national (global) regional growth factor;

$tx_{.i} - tx_{..}$ – sectoral (structural) factor of regional growth;

$tx_{ri} - tx_{.i}$ – local (geographical, competitive, differentiating) growth factor in the i-th sector of the r-th region.

In 1972, Esteban-Marquillas [1972] proposed introducing a new element into equation (1), the so-called homothetic variable:

$$\hat{x}_{ri} = x_{ri}\,\frac{x_{r.}}{x_{..}} \quad (3)$$

Equation (1), after modification byEsteban-Marquillas, took the form:

$$x^*_{ri} - x_{ri} = x_{ri}\, tx_{..} + x_{ri}\,(tx_{.i} - tx_{..}) + \hat{x}_{ri}\,(tx_{ri} - tx_{.i}) + (x_{ri} - \hat{x}_{ri})(tx_{ri} - tx_{.i}) \quad (4)$$

The homothetic variable introduced by Esteban-Marquillas determines the level of the i-th variant of the phenomenon that the r-th object would have if the structure of the phenomenon in this object were identical to the national structure, and it results from the relationship between the position of competitiveness and the effect of structural changes. In addition, replacing the value of x_{ri} with the effect of changes in the position of competitiveness cleared the impact of local structural changes [Herzog and Olsen 2006]. The remaining, unexplained part of the actual changes in the phenomenon is called the allocation effect:

$$a_{ri} = (x_{ri} - \hat{x}_{ri})(tx_{ri} - tx_{.i}) \quad (5)$$

The component of the allocation effect a_{ri} indicates the specialization of the rth object in the sense of concentration in those variants of the phenomenon $(x_{ri} - \hat{x}_{ri})$ in which it is the most competitive $(tx_{ri} - tx_{.i})$. The value $\hat{x}_{ri}(tx_{ri} - tx_{.i})$ is considered an indicator of the competitive advantage (or gap) of the ith sector in the rth region in relation to the reference area [Ray 1990].

The component $x_{ri}(tx_{ri} - tx_{.i}) + (x_{ri} - \hat{x}_{.i})\ (tx_{ri} - tx_{.i})$ is positively related to agricultural production in a given sector when a given agricultural sector develops faster than the entire agricultural production and the region specializes in a given sector [Woźniak, 2010].

It is possible that the region's specialization does not occur in the initial year $(x_{ri} - \hat{x}_{.i} < 0)$, and then that specialization occurs in the final year of the analysis $(x_{ri} - \hat{x}_{.i} > 0)$.

The allocation effect will take positive values in regions specializing in sectors where the growth rate is higher than the national growth rate, and vice versa. If the region's growth rate is lower than on the national scale, then the allocation effect takes negative values. In such a situation, it cannot be said that the region is the specialization of the studied phenomenon. (Table 1). The higher the value of the allocation effect for the entire region, the better the examined phenomenon is distributed between the analyzed ones. If there is no specialization in a given region, the allocation effect is zero, and the region does not benefit from competitive advantages [Suchecki, 2010].

In the analysis of the structure of animal production for all voivodeships, Poland was taken as the reference

Table 1. Characteristics of allocation effects

Specification	Sign a_{ri}	The sign of the components of the allocation effect	
		specialization	competitiveness
		$x_{ri} - \hat{x}_{ri}$	$tx_{ri} - tx_{.i}$
Specialization of the facility to the disadvantage of competitiveness	–	+	–
Lack of specialization of the facility to the disadvantage of competitiveness	+	–	–
Lack of specialization of the facility for the benefit of competitiveness	–	–	+
Specialization of the facility for the benefit of competitiveness	+	+	+

Source: [Suchecki 2010].

area, and the comparison was made in relation to the level of development of animal production throughout the country. The analyses considered the volume of livestock production in tonnes in individual voivodeships (r = 1, …, 16) in a structural breakdown by livestock species (i =1, …, 3; pork, beef and veal, and poultry, respectively).

RESULTS AND DISCUSSION

In the years 2010–2021, there were significant changes in the number of the most important livestock. The pig stock decreased by 27.6% to about 11 million heads, mainly as a result of the spread of ASF [Szymańska and Dziwulski, 2022] and the low profitability of production. The number of cattle increased by 11.5% to 6.4 million heads, with the number of cows decreasing by 9.7% to 2.4 million heads, and the number of other cattle increased by 29.6% to 4.0 million heads, which may indicate a greater interest of farmers in rearing beef cattle (Table 2).

In the years 2010–2021, the poultry stock increased by 33% to approximately 190 million units, while the number of chickens increased by 28.8% to 168.6 million units, turkeys by 107.1% to 15.3 million units, ducks by 97.3% to 5.3 million units, and the geese

Table 2. The population of selected species of animals for slaughter in Poland in 2010 and 2021

Specification	2010	2021	Changes 2021/2010 (%)
	Thousands of animals		
Pigs[a]	15,244	11,033	–27.6
Cattle[a], including:	5,742	6,401	11.5
• cows	2,646	2,389	–9.7
• other cattle	3,096	4,012	29.6
Poultry[b], including:	142,460	190,028	33.4
• chicken/poultry[c]	130,959	168,629	28.8
• geese	1,463	892	–39.0
• turkeys	7,366	15,256	107.1
• ducks	2,672	5,271	97.3

a. state in June; b as at the end of the year; c laying hens, chicken broilers.

Source: own study based on [GUS 2022c].

herd decreased by 39% to about 0.9 million units. The short production cycle in poultry livestock compared to pigs, and even more so with beef livestock, means that in the face of avian influenza, outbreaks of which have also been recorded in Poland in recent years, it is possible to rebuild its number relatively quickly, and thus the size of poultry meat production.

Due to changes in livestock stock in 2010–2021, the production of animals for slaughter in Poland increased by 34% (from 5205 to 6973 thousand tonnes), growing at a rate of 2.7% per year (Fig. 1).

This increase resulted primarily from the rapid increase in poultry production, the volume of which increased by almost 77% to 3,478,000 tonnes (the average annual increase in production amounted to 5.3%). Beef cattle production (including calves) increased by 39.2% to 1,080 thousand tonnes, which means it grew annually by 3.0%. In turn, the pro-

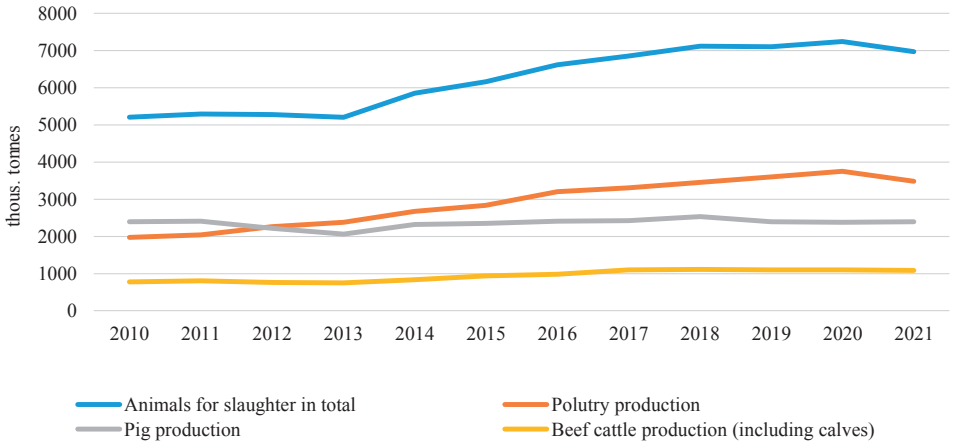

Figure 1. Production of animals for slaughter in Poland in 2010–2021 (in thousands of tonnes of live weight)
Source: own study based on [GUS 2011, 2015, 2022c].

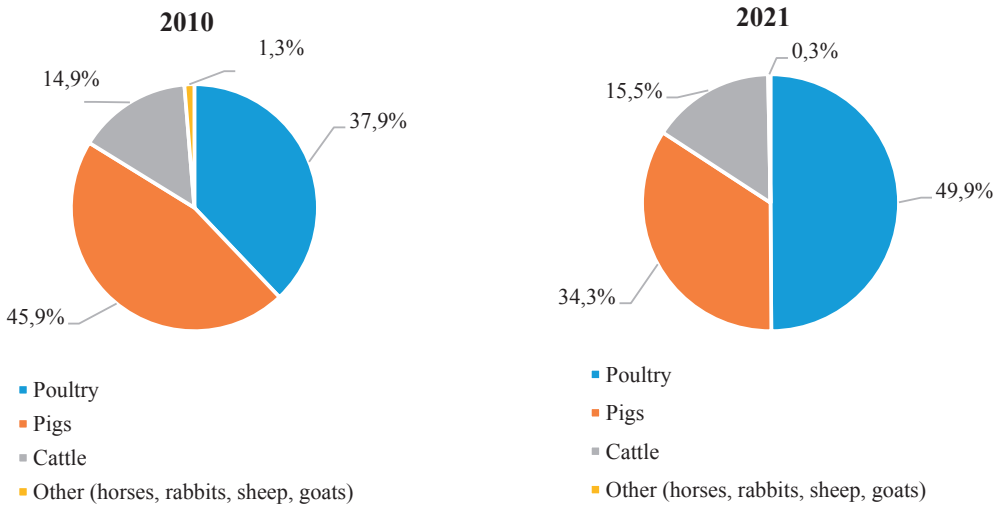

Fig. 2. The share of individual livestock species in the production of animals for slaughter in Poland
Source: own study based on [GUS 2022c].

duction of pigs for slaughter remained at a similar level of approx. 2,390 thousand tonnes. However, it was characterized by large fluctuations in the analyzed period. In the years 2010–2021, the share of live poultry production in total livestock increased to 49.9% (i.e., by 12.0 p.p.) and by 11.6 p.p. The percentage of pig production decreased to 34.3%. This was due to several factors, such as ASF, large fluctuations in purchase prices, lack of profitability of production, and liquidation of pig production, especially in small farms. In 2010, according to the data of the General Agricultural Census [GUS 2022a], there were 388.5 thousand farms in Poland engaged in pig farming, while in 2020, only 85.1 thousand. In turn, slightly, by 0.6 p.p., the share of live beef and veal increased to 15.5%, and by 1.0 p.p., other slaughtered animals, i.e., horses, rabbits, sheep, and goats, decreased to 0.3%. (Fig. 2). Poultry has become the leader in producing animals for slaughter in Poland, with approximately 60% of its production exported.

In the years 2010–2021, in the regional system (voivodeships), the production of animals for slaughter increased in eleven of them and decreased in five (i.e., in Dolnośląskie, Lubelskie, Małopolskie, Opolskie, and Podkarpackie), (Table 3).

The fastest increase in the production of animals for slaughter took place in the Mazowieckie voivodeship, where production grew by 8.1% annually and in 2021, it reached the level of about 1.7 million tonnes, and its "driving force" was primarily the rapid development of the production of poultry for slaughter. At the same time, the productivity of animals for slaughter in this voivodeship per 1 ha of UAA was the highest and amounted to 857.4 kg. The Wielkopolskie voivodeship

Table 3. Production of animals for slaughter in Poland in 2010 and 2021

Specification	2010			2021			Change 2021 2010 (% annually)
	Production (thousand tonnes in live weight)	Share (%)	Production of animals for slaughter (kg/1 ha of UAA)	Production (thousand tonnes in live weight)	Share (%)	Production of animals for slaughter (kg/1 ha of UAA)	
Poland	**5 205.4**	**100.0**	**335.8**	**6 972.6**	**100.0**	**466.3**	**2.7**
Voivodeship:							
Dolnośląskie	131.4	2.5	135.8	83.5	1.2	91.4	–4.0
Kujawsko-pomorskie	421.6	8.1	387.7	466.0	6.7	441.6	0.9
Lubelskie	314.2	6.0	221.8	268.1	3.8	193.7	–1.4
Lubuskie	138.9	2.7	308.0	166.2	2.4	374.4	1.6
Łódzkie	421.8	8.1	420.0	560.1	8.0	570.8	2.6
Małopolskie	179.4	3.5	270.5	118.0	1.7	211.6	–3.7
Mazowieckie	725.4	13.9	359.7	1.701.9	24.4	857.4	8.1
Opolskie	159.4	3.1	307.3	142.7	2.0	275.2	–1.0
Podkarpackie	119.8	2.3	172.8	57.9	0.8	101.1	–6.4
Podlaskie	292.2	5.6	273.0	390.5	5.6	355.0	2.7
Pomorskie	281.6	5.4	348.7	414.4	6.0	535.9	3.6
Śląskie	180.9	3.5	398.0	247.6	3.6	634.5	2.9
Świętokrzyskie	138.5	2.7	251.7	178.9	2.6	358.2	2.4
Warmińsko-Mazurskie	350.2	6.7	331.7	422.9	6.1	394.1	1.7
Wielkopolskie	1.129.6	21.7	631.1	1.388.3	19.9	781.3	1.9
Zachodniopomorskie	220.5	4.2	230.8	365.6	5.2	393.9	4.7

Source: own study based on [GUS 2011, 2022].

took second place, producing 1388 thousand tonnes of livestock (781.3 kg/1 ha of UAA). These two voivodeships accounted for 3,090,000 tonnes of animals for slaughter, which means over a 44% share in total animals for slaughter. Voivodeships with a significant share in animals for slaughter in Poland also include Łódzkie, Kujawsko-Pomorskie, Warmińsko-Mazurskie, Pomorskie, Podlaskie and Zachodniopomorskie voivodeship with production from 365.6 to 560.1 thousand tonnes of animals for slaughter.

Among the voivodeships, specialization in the production of animals for slaughter is progressing, resulting from many factors, including the size and structure of agricultural land. Pig production, which has declined for years, is dominated by the Wielkopolskie voivodeship, where 653.9 thousand tonnes were produced in 2021, accounting for 27.3% of the domestic output. Mazowieckie voivodeship (395,000 tonnes) came second place, followed by Łódzkie (295,000 tonnes), Pomorskie (268,000 tonnes), and Kujawsko-Pomorskie (222,000 tonnes). In these five voivodeships, pig production accounted for 76.5% of the national output.

In the analyzed period, in the voivodeships with the highest pig production, there was an increase in its production, with the fastest increase in production recorded in the Mazowieckie and Pomorskie voivodeships (the growth rate was 4.2 and 4.1% per year, respectively) (Table 4). In voivodeships with the lowest pig production, its reduction was observed, as exemplified by, among others: Dolnośląskie, Lubelskie, and Podkarpackie voivodeships.

The classic link between pig production, and even more so beef cattle production, with the appropriate utilized agricultural area (UAA) or permanent grassland as its fodder base, is currently losing its impor-

Table 4. Pig production in Poland in 2010 and 2021 (thousand tonnes)

Specification	2010	2021	Change 2021 2010 (% annually)
	thousand tonnes		
Poland	**2 388.2**	**2 395.3**	**0.0**
Voivodeship:			
Dolnośląskie	46.3	11.9	–11.6
Kujawsko-pomorskie	256.1	221.8	–1.3
Lubelskie	161.6	105.3	–3.8
Lubuskie	37.1	14.0	–8.5
Łódzkie	226.4	294.7	2.4
Małopolskie	69.0	25.0	–8.8
Mazowieckie	252.4	395.1	4.2
Opolskie	87.6	68.8	–2.2
Podkarpackie	50.8	25.8	–6.0
Podlaskie	97.4	75.7	–2.3
Pomorskie	172.4	267.9	4.1
Śląskie	58.2	33.8	–4.8
Świętokrzyskie	57.8	38.8	–3.6
Warmińsko-Mazurskie	113.3	131.6	1.4
Wielkopolskie	621.0	653.9	0.5
Zachodniopomorskie	80.8	31.2	–8.3

Source: own study based on [GUS 2011, 2022b].

Table 5. Beef cattle production (including calves) in Poland in 2010 and 2021 (in thousands of tonnes)

Specification	2010	2021	Change 2021/2010 (% annually)
	thousand tonnes		
Poland	**798.2**	**1 079.8**	**2.8**
Voivodeship:			
Dolnośląskie	17.7	11.9	–3.5
Kujawsko-pomorskie	46.9	73.2	4.1
Lubelskie	55.8	47.8	–1.4
Lubuskie	6.6	6.2	–0.6
Łódzkie	64.6	131.5	6.7
Małopolskie	60.1	53.1	–1.1
Mazowieckie	138.4	187.7	2.8
Opolskie	15.9	15.4	–0.3
Podkarpackie	19.1	11.0	–4.9
Podlaskie	107.5	119.4	1.0
Pomorskie	25.4	35.7	3.1
Śląskie	27.9	50.4	5.5
Świętokrzyskie	10.3	49.0	15.2
Warmińsko-Mazurskie	31.0	53.0	5.0
Wielkopolskie	138.6	222.3	4.4
Zachodniopomorskie	12.4	12.2	–0.1

Source: own study based on [Rocznik Statystyczny Rolnictwa, 2011; Rocznik Statystyczny Rolnictwa, 2022].

tance. In the pig fattening outlay system, it is enough for the agricultural producer to own (have) only the facility (pig house), and feed and piglets come from outside (from the operator). Similarly, poultry production, which is usually characterized by high intensity, has a loose connection with the land. In turn, the cattle grazing system can differ from extensive, based primarily on grassland, semi-intensive, and intensive.

In the years 2010-2021, beef cattle production in Poland increased in nine and decreased in seven voivodeships. Beef cattle production is dominated by four voivodeships, i.e., Wielkopolskie (222,000 tonnes), Mazowieckie (188,000 tonnes), Łódzkie (132,000 tonnes), and Podlaskie (119,000 tonnes) (Table 5), and the total share in beef cattle production in 2021 amounted to 61.2%.

Beef cattle breeding is developing the fastest in the Świętokrzyskie Voivodeship (at a rate of 15.2% per year) and in Łódzkie (6.7% per year). In these voivodeships, in the years 2010–2021, beef cattle production increased nearly five times (to 49.0 thousand tonnes) and more than two times (to 131.5 thousand tonnes), respectively. Poland is the largest producer of poultry meat in the European Union. The leader in domestic poultry production is the Mazowieckie voivodeship. In 2021, it accounted for almost 33.0% of production, i.e., 1,115.5 thousand tonnes, and the production growth rate in the period under review was the fastest in the country and amounted to 11.8%. Wielkopolskie voivodeship came second (511 thousand tonnes), followed by: Zachodniopomorskie, Warmińsko-Mazurskie, Podlaskie, and Kujawsko-Pomorskie voivodeship with production from 170.6 to 322.1 thousand tonnes (Table 6). In the analyzed period, poultry production decreased only in three voivodeships, i.e., Podkarpackie, Małopolskie, and Dolnośląskie.

Changes in animal production in individual voivodeships in 2010–2021 resulted mainly from

Table 6. Poultry production in Poland in 2010 and 2021 (thousand tonnes)

Specification	2010	2021	Change 2021/2010 (% annually)
	thousand tonnes		
Poland	**1 971.2**	**3 478.2**	**5.3**
Voivodeship:			
Dolnośląskie	65.3	59.4	–0.9
Kujawsko-pomorskie	117.1	170.6	3.5
Lubelskie	92.5	114.2	1.9
Lubuskie	94.8	146.1	4.0
Łódzkie	129.6	133.4	0.3
Małopolskie	43.9	38.6	–1.2
Mazowieckie	326.4	1 115.5	11.8
Opolskie	55.8	58.2	0.4
Podkarpackie	45.7	17.9	–8.2
Podlaskie	80.1	193.5	8.3
Pomorskie	83.3	110.3	2.6
Śląskie	91.2	158.6	5.2
Świętokrzyskie	46.0	90.6	6.4
Warmińsko-Mazurskie	205.3	238.2	1.4
Wielkopolskie	367.2	511.0	3.0
Zachodniopomorskie	127.0	322.1	8.8

Source: own study based on [Rocznik Statystyczny Rolnictwa 2011, 2022b].

changes in the profitability of production, requirements for animal welfare and environmental protection, and the occurrence of infectious diseases among farm animals. Live pig production is characterized by high fragmentation, increasing specialization in fattening, and high dependence on imported piglets from Denmark. A high level of vertical integration and large poultry meat exports to foreign markets distinguishes live poultry production. In turn, beef production most often complements milk production on farms and is characterized by high exports.

The next stage of the research aimed at determining the competitive advantages (gaps) in individual voivodeships in relation to the others in terms of the production of a particular livestock species. When analyzing the value of the second component of the allocation effect – competitiveness, the differentiation of voivodeships was demonstrated. In Figure 3, those voivodeships where the component "competitiveness" has negative values are marked in white. Positive values (black) characterize those voivodeships where there are competitive advantages in producing a given livestock species. In the case of pig production, the voivodeships located in the border area are characterized by competitive gaps. Only in the Pomorskie, Warmińsko-Mazurskie, Mazowieckie, Łódzkie, and Wielkopolskie voivodeships were the most significant increases in the volume of animal production recorded in the analyzed period.

In the case of poultry production, four voivodeships: Zachodniopomorskie, Podlaskie, Mazowieckie, and Świętokrzyskie, used their competitive advantages and increased the production volume more than twice. However, in the Mazowieckie voivodeship, poultry production increased by 200% between 2010 and 2021. The situation in the beef and veal market is more diversified. Half of the voivodeships in central Poland take advantage of their competitive position in the market and draw benefits from it. On the other

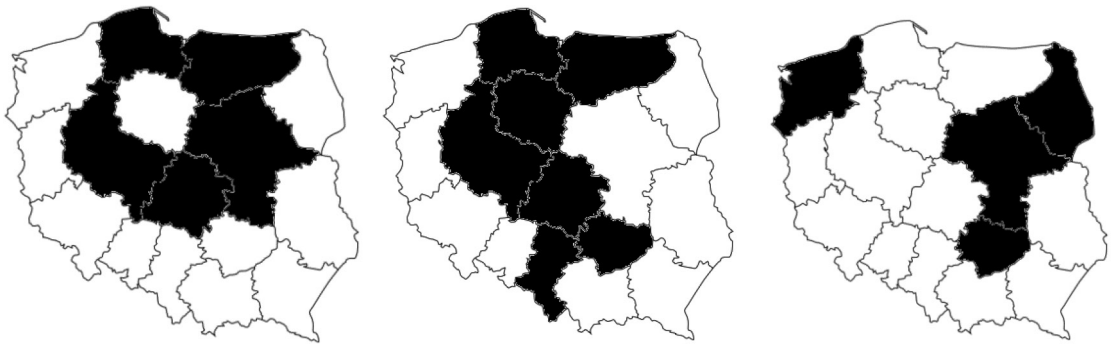

Fig.3. Element of the allocation effect "competitiveness" for production of animals
Source: own study.

hand, there are competitive gaps in the voivodeships from the border belt of eastern Poland and western Poland. However, a separate analysis of both components of the allocation effect does not provide complete information on the specialization and competitiveness of voivodeships in livestock production in Poland in the years 2010–2021. Considering both components of the allocation effect at the same time, there is a significant variation in the value of the allocation effect in all three analyzed species of livestock (Table 7).

In the conducted analysis, it is not possible to indicate voivodeships that would be characterized by a positive value of the allocation effect in terms of all livestock species. The voivodeships where the allocation effect is positive are those that specialize in producing a given livestock species and benefit from competitiveness. However, such a situation does not occur in the case of live poultry for the Łódzkie, Podkarpackie, Pomorskie, and Warmińsko-Mazurskie voivodeships. Regarding live pigs, the Podkarpackie and Pomorskie voivodeships are specialized, and there are no competitive gaps.

One of the ways to improve the effects of agricultural production is specialization and the use of competitiveness gaps. The increase in the specialization of production leads to an increase in its profitability and competitiveness [Dziwulski 2012, Tłuczak 2018], but it can also increase the management risk and threat to the environment [Józwiak and Juźwiak 2007]. The processes of concentration and specialization in animal production translate into the structure and inten-

Table 7. Allocation effect (a_{ir}) of animals for slaughter in Poland in 2010–2021

Voivodeship	Pig production	Beef cattle production	Poultry production
Dolnośląskie	–	+	+
Kujawsko-pomorskie	–	+	+
Lubelskie	–	–	+
Lubuskie	–	–	+
Łódzkie	–	+	–
Małopolskie	–	+	+
Mazowieckie	–	–	+
Opolskie	–	+	+
Podkarpackie	+	+	–
Podlaskie	–	–	+
Pomorskie	+	–	–
Śląskie	–	+	+
Świętokrzyskie	–	+	+
Warmińsko-mazurskie	–	+	–
Wielkopolskie	–	+	+
Zachodniopomorskie	–	–	+

Source: own study.

sity of plant production [Kopiński 2014]. Proper use of competitive advantages in the form of quality and price [Szczepaniak 2007, Ziętara 2014] will translate into an increase in the income of agricultural producers in the future [Sielska and Rembisz 2015].

SUMMARY AND CONCLUSIONS

Major changes are taking place in the structure of the livestock population in Poland. In the years 2010–2021, the pig stock decreased dramatically, mainly due to the presence of ASF, low profitability of production, and high price volatility. On the other hand, the stock of poultry, especially chicken, increased due to the increase in consumption and export of this animal species. Similarly, the stock of cattle, especially those intended for fattening, increased. In turn, the number of dairy cows decreased due to the abolition of milk quotas in 2015. Changes in the stock of farm animals contributed to the increase in production of animals for slaughter – from 5205 to 6973 thousand tonnes of live weight. In its structure, the share of poultry increased from 37.9% to 49.9% and of cattle from 14.9 to 15.5%. In turn, the share of pigs decreased by 11.7 p.p.

1. Specialization in the production of animals for slaughter is progressing among the voivodeships, which results, among others, from the size and structure of utilized agricultural areas. Five voivodeships play the most significant role in producing pigs: Wielkopolskie, Mazowieckie, Łódzkie Pomorskie, and Kujawsko-Pomorskie. In these five voivodeships, in 2021, pig production accounted for 76.5% of the national production. Beef cattle production is dominated by the Wielkopolskie, Mazowieckie, Łódzkie, and Podlaskie voivodeships. Together, in 2021, these voivodeships produced 61.2% of beef cattle. However, cattle breeding developed the fastest in Świętokrzyskie and Łódzkie voivodeships. On the other hand, the leader in domestic poultry production is the Mazowieckie voivodeship, followed by the Wielkopolskie, Zachodniopomorskie, Warmińsko-Mazurskie, Podlaskie, and Kujawsko-Pomorskie voivodeships.
2. A positive value of the allocation effect characterizes voivodeships that specialize in producing a given animal species. The production dynamics are higher in these voivodeships than the national ones. In the Dolnośląskie, Kujawsko-Pomorskie, Małopolskie, Opolskie, Śląskie, Świętokrzyskie, and Wielkopolskie voivodeships, due to the specialization of the production of beef cattle and poultry, the breeding of these animal species is concentrated. At the same time, both the specialization and concentration of production in these voivodeships translate into the use of competitive advantages by them. Thanks to this, agricultural producers can obtain higher income. Specialization and concentration of pig production were recorded in the Pomorskie and Podkarpackie voivodeships.
3. The data shows that in Poland, there is a specialization and concentration of animal production in individual voivodeships, which allows for the effective use of farm resources and greater competitiveness of regions. In voivodeships with higher specialization and concentration, the dynamics of live pig, beef or poultry production are higher than the national dynamics. However, accelerating production concentration may threaten agriculture's sustainable development and environmental protection. Therefore, further research on the impact of animal production on food security and the environment is recommended. A particular limitation in developing production concentration is the European Green Deal strategy implemented by the European Commission, which significantly emphasizes supporting organic farming and shortening supply chains in the agri-food sector. The search for alternative solutions in animal production is an important challenge for its development in Poland and the EU.

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WARUNKI ZMIAN W REGIONALNEJ SPECJALIZACJI PRODUKCJI ZWIERZĘCEJ W POLSCE

STRESZCZENIE

Cel: Celem opracowania było rozpoznanie regionalnej specjalizacji oraz zmian poziomu konkurencyjności w zakresie produkcji zwierzęcej w Polsce. **Metody:** Analizą objęto dane statystyczne Głównego Urzędu Statystycznego z lat 2010–2021 w skali kraju i w poszczególnych województwach. W badaniach zastosowano analizę porównawczą w zakresie produkcji zwierzęcej w ujęciu regionalnym. W celu określenia specjalizacji regionu oraz analizy zmian konkurencyjności w czasie zastosowano klasyczną metodę analizy przesunięć

udziałów – Shift Share Analysis (SSA). **Wyniki:** W Polsce zachodzą duże zmiany w pogłowiu zwierząt gospodarskich i produkcji żywca rzeźnego. W latach 2010–2021 drastycznie spadło pogłowie trzody chlewnej a zwiększyło się pogłowie bydła, zwłaszcza przeznaczonego do opasu oraz drobiu. Zmiany pogłowia zwierząt gospodarskich przyczyniły się do wzrostu produkcji żywca wołowego i drobiowego oraz spadku produkcji żywca wieprzowego. **Wnioski:** W Polsce występuje specjalizacja i coraz bardziej zwiększa się koncentracja produkcji najważniejszych gatunków zwierząt gospodarskich w poszczególnych województwach. Procesy specjalizacji i koncentracji pozwalają na efektywniejsze wykorzystanie zasobów gospodarstw rolnych i większą konkurencyjność regionów. Przyspieszająca koncentracja produkcji może jednak zagrozić zrównoważonemu rozwojowi rolnictwa i negatywnie wpływać na środowiska naturalne. Wskazane są zatem dalsze badania nad wpływem specjalizacji i koncentracji produkcji zwierzęcej na bezpieczeństwo żywnościowe oraz środowisko naturalne**.**

Słowa kluczowe: produkcja, region, koncentracja, trzoda chlewna, bydło mięsne, drób, konkurencyjność