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FACTORS AFFECTING CHANGES IN THE POPULATION OF SOWS IN POLAND. REGIONAL ANALYSIS

Benedykt Pepliński
Poznan University of Life Sciences

Abstract. Since 2008 there has been a deep crisis in the production of pork in Poland. It has been especially noticeable in the decreasing population of pigs, especially sows. The aim of the article was to analyze the factors affecting changes in the sow population in Poland and in individual voivodeships. The period under investigation ranged from 2001 to 2014. The study was based on the results of a model farm with a semi-closed cycle production system. The farm sold 3836 porkers in 2011. The analysis proved that there was a high correlation between the cost-effectiveness of porker and piglet production and the sow population level at the end of the following year. In individual voivodeships there was low dependence between changes in the sow population and the cost-effectiveness of porker and piglet production. However, there was a high correlation between the average sow population in individual voivodeships and the number of piglets farrowed by one sow per year.

Key words: population of sows, profitability, piglets, regional analysis

INTRODUCTION

Since 2008 there has been a deep recession in the production of pork in Poland. It has been noticeable in a rapid decrease in the pig population [*Pogłowie świń*… 2001–2014]. Although Poland is self-sufficient in meat production, in the case of pork it has been a net importer of pork since 2008 [*Rynek mięsa*... 2009, Kapusta 2015]. The scale of the decrease is so large that this situation will not change soon [Pejsak 2012b, Pepliński 2012, Blicharski and Hammermaister 2013, Szymańska 2014]. In spite of the regressing production, pork production requires special attention due to the culinary traditions in Poland and its importance for the income in Polish agriculture [Gajewczyk et al. 2014].

The general opinion is that the main factor responsible for the decrease in pig population is the worsening relation between the prices of porker and prices of cereals [Pepliński

Corresponding author: Benedykt Pepliński, Department of Management and Law, Poznan University of Life Sciences, Wojska Polskiego 28, 60-637 Poznań, Poland, e-mail: pepliński@up.poznan.pl

2013], i.e. worse cost-effectiveness of production. However, it is necessary to note the fact that the prices of pig carcasses in Poland were usually higher than the average prices in the EU [Blicharski 2011, Knecht and Środoń 2013b]. Poland is one of the countries where the pig population has decreased most in recent years [Stępień 2013]. Apart from that, there has been an unequal decrease in the sow population in individual voivodeships.

Therefore, the aim of the research was to analyze the factors determining changes in the sow population in Poland and in individual voivodeships between 2001 and 2014.

In view of the order of the technological process, we made a research hypothesis that the cost-effectiveness of piglet production has greater influence on the sow population level in Poland than the cost-effectiveness of porker production.

MATERIAL AND METHODS

On average in 2011 the model farm maintained 150 sows, which farrowed 3105 piglets. Additionally, the farm purchased 1190 piglets. In 2011 the farm sold 3836 porkers with an average live weight of 118.7 kg. The choice of a large pig producer, by Polish standards, was caused by the need to show the level of production cost-effectiveness on the farms which are and will be capable of competing on international markets. As results from the study conducted by Ziętara [2012], positive income can only be achieved in a closed cycle on farms breeding 36 sows and selling about 700 porkers. However, there is a rapid increase in the minimum production, which guarantees income for investments. Studies by Pepliński [2005] and Skarżyńska [2011] show that the farms producing several dozen porkers a year generate the costs of production which are about 20% greater than on the farms which produce at least 1000 porkers a year. Therefore, in the long run small entities do not have much prospect for development.

Porker production was a basic commodity product on the farm under analysis. The production technology included feeding the animals with the farm's own forage based on premixes, post-extraction soya and rapeseed meal and, to a lesser extent, on legumes. This is a typical method of feeding pigs in Poland.

In order to obtain comparable results of the cost-effectiveness of porker and piglet production in individual voivodeships we made an economic analysis based on the economic and production results achieved in 2011 by a model farm situated in the south of Wielkopolskie Voivodeship. The analysis was conducted according to the methodology presented by Pepliński et al. [2004]. It had a separate production center for the piglets. The indirect costs of the whole farm was divided in proportion to the value of animal production. The average annual prices of cereals (both owned and purchased by the farm), piglets, porkers and sows in individual voivodeships were adopted for analysis. The costs of cereals were the most important cost, because during the period under analysis they amounted to 31.8–49.0% of the total costs in porker production and to 17.6–27.1% of the total costs in piglet production. In order to calculate the costs of post-extraction meals, premixes, electricity, coal, diesel and human labour we assumed that they had identical prices in all regions of Poland. In order to determine the costs of premixes, forage additives, veterinary care as well as building and machinery depreciation in individual

years, we included selected price variation ratios provided by the Central Statistical Office (GUS) in statistical yearbooks for comparison with 2011.

The Pearson correlation coefficient was applied in order to determine the influence of the cost-effectiveness of porker and piglet production on the population of sows in Poland and in individual voivodeships. There is delayed influence of changes in the cost--effectiveness of production on the population level. Therefore, we compared the profit per unit with changes in the population after one year and after two years. For analysis we assumed the population levels in November of a particular year.

RESULTS

Between 2001 and 2014 there was high spatial diversification in the sales prices of porkers and market prices of piglets in Poland (Fig. 1). As far as porkers are concerned, the difference between the minimum and maximum price in individual voivodeships ranged from 5.9% in 2007 to 17.2% in 2011. During the whole period under analysis the lowest average prices of porkers were noted in Śląskie Voivodeship (4.09 PLN per kg of live weight) and in Lubelskie Voivodeship (4.13 vs 4.19 PLN per kg, which was

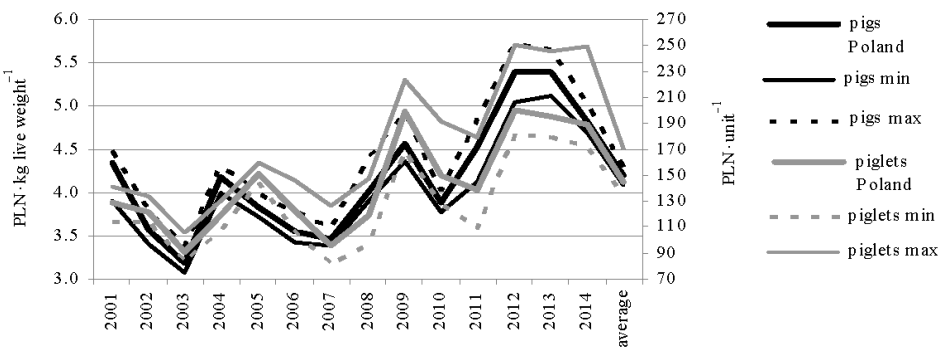

Fig. 1. The prices of porkers and piglets in Poland between 2001 and 2014 (the average values in Poland and the minimum and maximum values in individual voivodeships)

Source: Pepliński [2013] and own study based on *Skup i ceny*... [2014].

the average value in Poland). These voivodeships were also characterised by the most frequent occurrence of the lowest average annual prices in Poland. Farmers in Kujawsko--Pomorskie Voivodeship and in Warmińsko-Mazurskie Voivodeship achieved the highest prices, i.e. 4.28 and 4.26 PLN per kg, respectively. Thus, the difference amounted up to 0.19 PLN per kg, i.e. 4.6%. As far as piglets are concerned, there was much greater spatial diversification in prices. The difference between the maximum and minimum prices in individual voivodeships ranged from 11.8% in 2005 up to 65.0% in 2011. Between 2001 and 2014 farmers in Lubelskie Voivodeship and in Pomorskie Voivodeship achieved the lowest average prices, i.e. 133.9 and 135.4 PLN per piece, respectively. On the other hand, the highest prices were noted in Śląskie Voivodeship (170.5 zlotys per piece) and

Małopolskie Voivodeship (163.6 PLN per piece). The average price in Poland was 144.3 PLN per piece. Thus, the difference amounted up to 29.7 PLN per piece, i.e. up to 27.3%.

The average level of prices in the voivodeships, where the population of pigs exceeded 1 million in 2001, was also diversified. On average the prices in Kujawsko-Pomorskie Voivodeship and Mazowieckie Voivodeship were higher than the average prices in Poland, whereas the prices in Lubelskie Voivodeship, Łódzkie Voivodeship and Wielkopolskie Voivodeship were lower. In all of those voivodeships the prices of piglets were lower than the average prices in Poland. During the whole period under analysis they were 4.0% lower on average. However, between 2008 and 2014 this disproportion increased to 5.2%, which points to the increasing disproportion as compared with the average prices.

The costs of porker production in Poland were characterised by spatial diversification similar to purchase prices. During the whole period under analysis on average they amounted to 4.8%, where the maximum difference reached 11.5% in 2008. As far as piglets are concerned, the differences between individual voivodeships in the level of costs were lower. On average they reached 2.7%, where the maximum difference reached 5.0% in 2008.

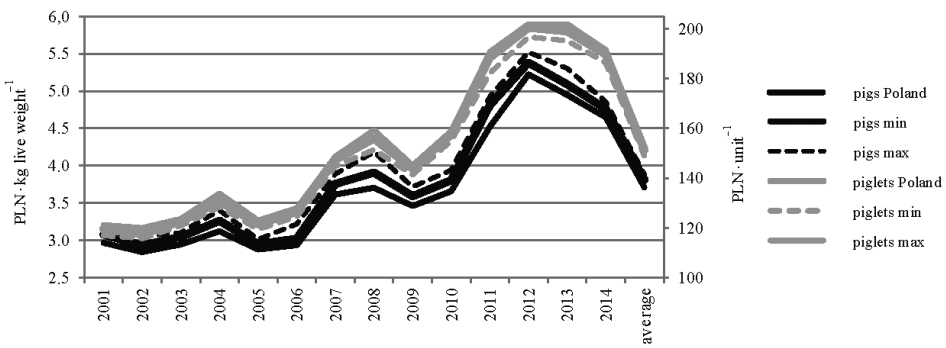

Fig. 2. The costs of porker and piglet production in Poland (on the model farm) between 2001 and 2014 (the average values in Poland and the minimum and maximum values in individual voivodeships)

Source: Pepliński [2013] and own investigations.

Between 2001 and 2014 the lowest average costs of piglet production were noted in Podkarpackie Voivodeship, i.e. 3.71 PLN per kg, whereas the highest costs were noted in neighbouring Małopolskie Voivodeship, i.e. 3.88 PLN per kg. As far as piglets are concerned, the lowest costs were noted in Podkarpackie Voivodeship, i.e. 149 PLN per piece, whereas the highest costs were noted in Mazowieckie Voivodeship, i.e. 153 PLN per piece.

The cost-effectiveness of porker production in Poland is subject to high fluctuations, which is confirmed by the occurrence of pork cycles (Table 1). Between 2001 and 2007 the farm under analysis made an average income of 0.58 PLN per kg, whereas between 2008 and 2014 it was only 0.18 PLN per kg. As the calculations of the trend line revealed, every year the cost-effectiveness level dropped by 0.0686 PLN per kg. The cost-effectiveness of porker production is characterized by great spatial diversification, because

Table 1. The profit from porker production in Poland and voivodeships (on the model farm) between 2001 and 2014 (PLN per kg of live weight)

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2001–2014
Poland	1.27	0.64	0.14	0.92	0.87	0.54	–0.30	0.10	0.97	0.09	–0.29	0.02	0.30	0.06	0.38
Dolnośląskie	1.31	0.71	0.23	1.10	1.04	0.74	–0.25	0.43	0.94	0.08	–0.57	–0.22	0.36	0.02	0.42
Kujawsko-Pomorskie	1.34	0.72	0.21	0.96	0.87	0.60	–0.37	0.10	0.96	0.18	–0.13	0.41	0.61	0.24	0.48
Lubelskie	1.28	0.62	0.04	0.76	0.84	0.49	–0.37	0.05	0.98	0.11	–0.24	0.07	0.20	0.07	0.35
Lubuskie	0.90	0.69	0.16	0.97	0.93	0.55	–0.32	0.11	1.01	0.15	0.21	0.08	0.46	0.01	0.42
Łódzkie	1.28	0.61	0.06	0.73	0.82	0.50	–0.27	–0.06	0.87	0.13	–0.30	–0.03	0.09	–0.01	0.32
Małopolskie	1.17	0.67	0.26	0.84	0.86	0.28	–0.22	–0.20	0.85	0.11	0.04	–0.11	–0.12	–0.13	0.31
Mazowieckie	1.20	0.53	0.13	0.87	0.86	0.55	–0.30	0.06	0.93	0.11	–0.33	0.03	0.24	0.04	0.35
Opolskie	1.41	0.64	0.13	0.75	0.80	0.56	–0.20	0.12	0.92	–0.05	–0.21	0.00	0.13	–0.01	0.36
Podkarpackie	1.31	0.67	0.12	0.86	0.87	0.54	–0.16	0.17	1.04	0.13	0.10	0.09	0.29	0.09	0.44
Podlaskie	1.42	0.77	0.14	0.81	0.93	0.58	–0.32	0.07	0.90	0.00	–0.33	0.06	0.20	0.05	0.38
Pomorskie	1.47	0.85	0.32	1.06	0.92	0.65	–0.20	0.29	1.43	0.14	–0.60	–0.09	0.36	–0.03	0.47
Śląskie	1.26	0.54	0.12	0.72	0.95	0.47	–0.26	–0.03	0.74	–0.09	–0.35	–0.41	–0.15	–0.17	0.24
Świętokrzyskie	1.25	0.56	0.09	0.84	0.99	0.67	–0.14	0.24	1.11	0.21	–0.14	0.09	0.02	–0.11	0.41
Warmińsko-Mazurskie	1.43	0.60	0.13	0.94	0.94	0.59	–0.34	0.20	0.97	0.07	–0.35	0.03	0.26	0.09	0.40
Wielkopolskie	1.19	0.58	0.10	0.90	0.81	0.45	–0.32	–0.01	0.92	0.06	–0.21	0.04	0.34	0.05	0.35
Zachodniopomorskie	1.39	0.74	0.30	1.04	0.94	0.71	–0.17	0.32	1.18	0.16	–0.32	0.18	0.44	0.29	0.51

Source: Pepliński [2013] and own investigations.

the profit level in individual voivodeships fluctuated from 0.23 PLN per kg in 2007 to 0.82 PLN per kg in 2012. The best economic conditions for porker production were noted in Zachodniopomorskie Voivodeship, where the farm under analysis would have earned 0.51 PLN per kg and in Kujawsko-Pomorskie Voivodeship – 0.48 PLN per kg. The worst economic conditions for porker production were noted in Śląskie Voivodeship and in Małopolskie Voivodeship, where the profit would have been 0.24 and 0.31 PLN per kg, respectively.

The structure of the costs of production was predominated by the costs of feeds, which ranged from 57.5% in 2009 to 70.1% in 2007 of all the costs of porker production (it was significantly related with the prices of cereals and feed additives). In 2011 the farm under analysis used wheat (11%), barley (38%), rye (9%), triticale (23%), high protein feeds – post-extraction meals: soya, rapeseed and legume meals (13%), premixes and other additives (6%). Cereals made from 55 to 70% of the costs of feeds and from 33 to 50% of the total costs of porker production. The maximum disproportions in the prices of cereals in individual voivodeships often exceeded 20%. In 2011 triticale in Małopolskie Voivodeship could be purchased at an average price which was 41% lower than in Mazowieckie Voivodeship. Therefore, the level of prices of cereals in individual voivodeships had significant influence on the costs of porker production.

Piglet purchase costs were also important, as they ranged from 7.6% in 2007 to 16.4% in 2009, where the average cost was 11.4%. On average, the share of labour costs in total costs amounted to 7.8% (from 6.7 to 8.9%), whereas the average share of veterinary costs was 4.0% (from 3.0 to 4.7%).

The cost-effectiveness of piglet production is also subject to cyclical fluctuations (Table 2). The results of the farm under analysis in piglet production ranged from –51.63 PLN in 2007 to 54.76 PLN per piece in 2009, where the average loss amounted to 7.1 PLN per piece during the whole period under investigation. There were also considerable disproportions between the voivodeships. The production was the most cost-effective in Śląskie Voivodeship, where during the whole period under analysis the income reached 20 PLN per piece (as many as eight times this voivodeship was characterised by the best economic relations in Poland), and in Małopolskie Voivodeship – 11.9 PLN per piece. The production was the least cost-effective in Lubelskie Voivodeship (–17.6 PLN per piece), in Kujawsko-Pomorskie Voivodeship and in Pomorskie Voivodeship, where the average loss exceeded 15.0 PLN per piece. In this case the prices of piglets were the most decisive to the cost-effectiveness level.

Similarly to porker production, the structure of costs was predominated by the costs of feeds, but their share was much lower and reached the average value of 54% during the period under analysis. It ranged from 48.9% in 2009 to 57.8% in 2012. Labour costs and veterinary costs were more important than in the costs of porker production. Respectively, they reached the average values of 15% (ranging from 13.5% in 2001 to 17.1% in 2009) and 12.1% (ranging from 10% in 2012 to 14% in 2005).

Polish pig production is in deep crisis. This observation can be proved by the fact that the pig population in Poland decreased from 18.13 million pieces in 2007 to 10.99 million pieces in 2013. In 2014 the population increased slightly to 11.7 million pieces only to

Table 2. The profit from piglet production in Poland and voivodeships (on the model farm) between 2001 and 2014 (PLN per piece)

Specification	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2001–2014
Poland	9.1	4.2	–31.3	–11.5	29.1	–3.2	–51.6	–37.2	54.8	–7.8	–49.1	–0.8	–4.0	–0.5	–7.1
Dolnośląskie	–2.3	–0.3	–30.5	–20.2	26.2	1.9	–35.1	–30.7	77.6	–0.8	–42.8	–4.5	8.5	11.1	–3.0
Kujawsko-Pomorskie	6.5	2.7	–38.5	–16.8	28.2	–4.7	–66.7	–61.9	37.9	–5.0	–57.5	–8.4	–14.9	–13.4	–15.2
Lubelskie	7.1	–2.9	–38.3	–16.5	23.2	–20.2	–66.6	–43.3	45.8	–29.5	–63.3	–8.2	–19.3	–13.7	–17.6
Lubuskie	4.4	7.8	–23.7	–8.9	31.6	18.5	–21.1	–47.9	33.7	–2.5	–79.5	–14.3	–3.0	–2.8	–7.7
Łódzkie	11.1	8.3	–32.1	–13.4	35.5	–1.3	–58.3	–49.8	47.4	–11.5	–57.0	–8.5	–8.3	–8.5	–10.5
Małopolskie	20.3	16.6	–17.7	–1.6	39.4	10.0	–27.6	–19.9	79.2	10.0	–24.5	34.4	20.3	28.0	11.9
Mazowieckie	9.5	1.8	–32.8	–16.1	29.0	–5.9	–60.7	–45.4	55.1	–16.8	–68.5	–18.9	–22.1	–20.0	–15.1
Opolskie	–1.0	–1.7	–31.6	–21.1	26.0	–12.8	–64.1	–51.9	65.1	–0.8	–42.0	–19.0	–9.6	–4.3	–12.1
Podkarpackie	16.3	7.9	–26.3	–2.6	30.1	–6.0	–40.5	–25.3	64.6	–6.0	–28.9	28.8	4.1	17.3	2.4
Podlaskie	15.2	6.6	–31.9	–2.2	31.8	1.4	–47.5	–27.5	65.1	–6.3	–60.5	–2.5	4.1	–4.8	–4.2
Pomorskie	2.9	–3.0	–39.3	–20.7	23.1	–6.8	–49.7	–50.0	29.4	7.0	–60.0	–8.6	–18.5	–12.2	–14.7
Śląskie	15.3	12.7	–19.0	–8.6	35.0	14.8	–18.8	–7.5	67.7	34.7	–7.3	51.6	47.4	61.9	20.0
Świętokrzyskie	10.4	2.8	–32.9	–11.1	28.2	–11.5	–55.3	–37.9	64.2	–8.0	–46.9	0.4	–5.8	4.8	–7.0
Warmińsko-Mazurskie	8.8	8.2	–24.0	–8.9	26.7	12.2	–24.1	–22.4	49.1	23.1	–18.4	42.6	2.4	–2.4	5.2
Wielkopolskie	5.7	2.8	–38.3	–14.2	35.6	3.3	–58.1	–51.6	52.6	–13.8	–57.9	–11.3	–3.4	–4.4	–10.9
Zachodniopomorskie	–4.3	–2.5	–35.0	–21.1	29.1	–7.3	–33.9	–34.8	24.7	–12.3	–22.5	–12.4	–1.6	–5.5	–10.0

Source: own investigations.

drop by nearly 0.5 million pieces in December again. In 2001 the pig population in Poland was 17.1 million pieces and in five voivodeships it was greater than 1 million pieces, i.e. in Łódzkie Voivodeship (1.17 million), Lubelskie Voivodeship (1.24 million), Mazowieckie Voivodeship (1.74 million), Kujawsko-Pomorskie Voivodeship (2.11 million) and Wielkopolskie Voivodeship (4.56 million). In 2014 the pig population exceeded 1 million pieces only in Łódzkie Voivodeship (1.01 million), Kujawsko-Pomorskie Voivodeship (1.27 million) and Wielkopolskie Voivodeship (3.96 million). In comparison with 2001 the population dropped by more than a half in five voivodeships, i.e. in Dolnośląskie Voivodeship, Lubelskie Voivodeship, Małopolskie Voivodeship, Podlaskie Voivodeship and Zachodnio-Pomorskie Voivodeship (Fig. 3). Until 2007 Świętokrzyskie Voivodeship was the leader in increasing the population. In comparison with 2001 the population increased by as much as 30%, whereas during the downturn the voivodeship was characterised by the greatest decrease (except Podlaskie Voivodeship). By 2014 the population decreased by as much as 54%, as compared with 2007. The population level was the most stable in Wielkopolskie Voivodeship and in Łódzkie Voivodeship. In comparison with 2001 the pig population in these voivodeships decreased by 13.1 and 13.5%, respectively, whereas in comparison with 2007 it decreased by 24.8 and 26%, respectively.

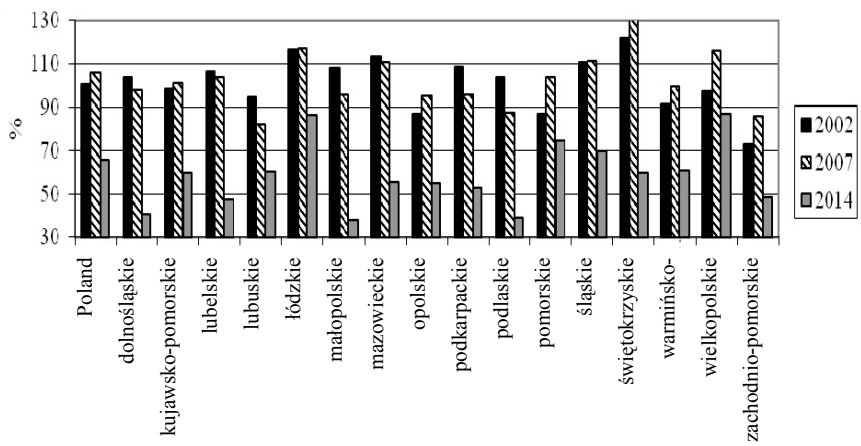

Fig. 3. Variation in the pig population in Poland and voivodeships in November between 2001 and 2014 (2001 = 100%)

Source: Pepliński [2013] and the own study based on *Pogłowie świń wg stanu…* [2014].

The situation in sow population was even more difficult (Fig. 4). In November 2001 there were 1.63 million sows in Poland. In 2006 the population increased by more than 17%, i.e. up to 1.9 million pieces, whereas in 2014 the population decreased to about 0.95 million pieces, which amounted only to 58% of the population in 2001 and 49.6% of the population in 2006. In comparison with 2001 the population dropped by more than 50% in Podlaskie Voivodeship (–63.9%), Zachodniopomorskie Voivodeship (–57.9%), Małopolskie Voivodeship (–55.7%), Mazowieckie Voivodeship (–55.3%), Lubuskie Voivodeship (–53.3%) and Lubelskie Voivodeship (–50.5%). In comparison with 2001

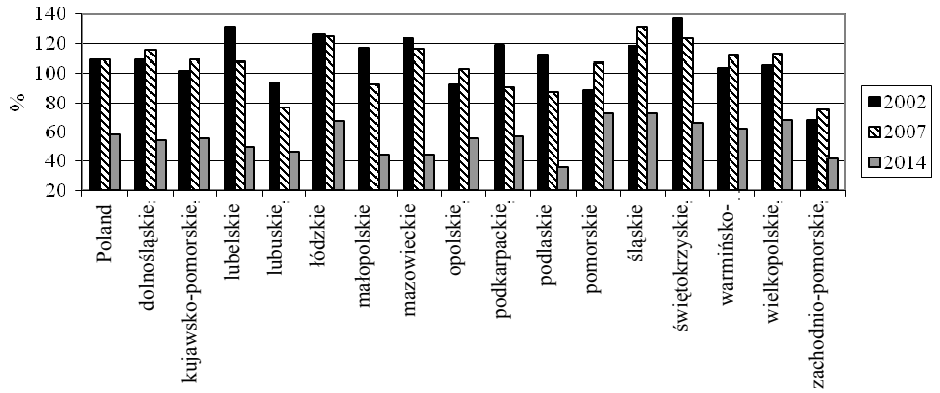

Fig. 4. Variation in the sows population in Poland and voivodeships in November between 2001 and 2014 (2001 = 100%)

Source: Pepliński [2013] and the own study based on *Pogłowie świń wg stanu…* [2014].

the lowest decrease in the sow population was noted in Pomorskie Voivodeship (–27.2%), Silesian Voivodeship (–27.3%), Wielkopolskie Voivodeship (–31.5%) and Łódzkie Voivodeship (–32.4%).

The analysis of correlations between the profit made from porker production in a particular year (n) and the sow population level at the end of the following year (n + 1) for the average national profit and pig population in Poland revealed a high positive correlation of 0.82. However, the correlation with the population level in year n + 2 was lower, as the coefficient amounted to 0.39.

There was a weaker correlation between the profitability of piglet production and the sow population level in the following year (n + 1), i.e. 0.52. However, there was no correlation with the population level in year n + 2 (the correlation coefficient amounted to 0.003). Thus, the research hypothesis was not confirmed. It may have resulted from the fact that most farmers do not divide the technological process into piglet production and fattening of porkers. In consequence, they do not know the costs and cost-effectiveness of piglet production. Therefore, decisions concerning production chiefly depend on the cost-effectiveness of the entire production process.

The analysis of correlation between the cost-effectiveness of porker and piglet production and variation in the sow population level in the following year in individual voivodeships indicated that this dependence was weaker, because the correlation coefficient amounted to 0.49 and 0.23, respectively.

DISCUSSION

The analysis pointed to considerable dependence between the sow population level in Poland and the cost-effectiveness of porker production and to lesser dependence between this level and the cost-effectiveness of piglet production. The lack of cost-effectiveness of porker (profit: 0.06 PLN per kg) and piglet production (profit: –0.5 PLN per piece) in 2014 and worse price relations in the second half of 2014 suggest a further decrease in

the sow population level in 2015. If the cost-effectiveness of porker and piglet production does not improve, their population may drop below 0.9 million in 2016.

The fact that the sow population level greatly depends on the cost-effectiveness of porker production may be caused by the closed production cycle, which is still preferable and predominant on most farms in Poland [Pepliński et al. 2004, Szymańska 2008, 2014, Blicharski and Hammermaister 2013, Knecht and Środoń, 2013a]. The farmers who use the closed production cycle usually do not know the costs of piglet production, so their decisions concerning production are usually based on the cost-effectiveness of porker production.

There was an uneven decrease in the sow population in individual voivodeships. The relatively low values of the coefficients of correlation between the cost-effectiveness of porker and piglet production and the sow population in individual voivodeships in the following year, i.e. 0.49 and 0.23, respectively, point to the fact that other factors are also very important. The low concentration and scale of pig production is one of frequently listed causes of the decrease in the pig population, and in consequence, in the sow population [Pejsak 2012a, Pepliński 2012, Blicharski and Hammermaister 2013]. In 2013 the mean pig population on an average Polish farm was only 41, including 5.7 sows, as compared with 25 pigs, including 4.4 sows in 2002. The increase in the concentration was possible because the number of farms with pigs dropped by more than 60% [*Powszechny spis rolny*… 2003, *Charakterystyka*… 2013]. However, the considerable relative increase in the population is insufficient if we compare the concentration of the population in Poland and in other countries in Europe and on other continents, where the degree of concentration of the population is several times greater and the processes of concentration are much more rapid. For example, between 2003 and 2010 the mean pig population increased by more than 100% in Spain and Denmark, whereas in Italy it increased by more than 400% [Stępień 2014]. Among the five voivodeships, where the sow population dropped by at least 50% between 2006 and 2014, four voivodeships were characterized by the lowest average sow population (in 2002 there were not more than 3.15 sows per farm).

The small scale of production not only made it impossible to achieve the economies of scale but it was also one of the main causes of poor quality of the breeding material, failure to repair the basic herd with sows from breeding herds and in consequence, it resulted in less numerous farrows. It is not cost-effective for small producers to apply modern methods of production and devote their time to handling piglets. Small producers do not have so many possibilities to transfer piglets from bigger to smaller farrows. In consequence, we could see that among the five voivodeships with the largest number of piglets farrowed by one sow (more than 17.8, where the mean number in Poland was 16.7) their sow population was greater than average. These were: Dolnośląskie Voivodeship, Lubuskie Voivodeship, Pomorskie Voivodeship, Wielkopolskie Voivodeship and Zachodnio-Pomorskie Voivodeship. Between 2002 and 2013 sows' fertility decreased in Lubelskie Voivodeship, Małopolskie Voivodeship, Podkarpackie Voivodeship and Świętokrzyskie Voivodeship. These voivodeships were characterised by the lowest concentration of sows on farms (less than 3.5 sows per farm) [*Zwierzęta gospodarskie*… 2003, 2013]. There was a high coefficient of the correlation between the average sow population and the number of piglets farrowed. It amounted to 0.7.

Similarly to the process of herd concentration, improvement in sows' fertility is too slow in Poland, because between 2003 and 2013 the number of piglets from one sow increased only by 1.6 pieces. In view of the fact that the average number of piglets fostered in the EU is 24.3 pieces, whereas in Denmark and the Netherlands it is more than 27 pieces [Blicharski 2011], if fertility continues to improve at this rate, it will take more than 40 years to achieve the current average in the EU. Due to high fixed costs of sows' maintenance (feeds, handling, stands and insemination) and relatively fixed costs of handling farrows in herds of 100 sows the loss resulting from too small numbers of piglets fostered may reach even about 0.1 milion PLN a year. The rapid growth of the number of farms which specialize only in fattening creates the demand for large numbers of piglets. It is estimated that the minimum number of sows in a herd should be 200 to guarantee large, homogenous batches of about 200–300 piglets. There are only about 200 such herds in Poland [Blicharski 2011, Blicharski and Hammermaister 2013]. In consequence, the import of piglets is increasing. According to initial estimates, by December 2014 it exceeded 5 million pieces [*Pogłowie świń*... 2014].

There are also other causes of the decrease in the population of sows and pigs: farmers' poor vocational and specialist education, poor counselling (farmers are usually reserved about consultants from trade companies), little support from the state, which usually supports extensive farming, capital deficit on farms, absence of long-term cooperation between farmers and meat processing companies, high consumption of feeds, low daily growth [Pejsak 2012a, Pepliński et al. 2012, Blicharski, Hammermaister 2013]. Due to the low meat content in porker's meat processing companies try to limit the weight of porkers they purchase. As a result, farmers abandon the most cost-effective fattening of pigs between 110 and 120 kg although in recent years there has been a noticeable increase in the mean weight of porkers sold.

Farmers have rather poor knowledge of economy and organization, which is also a serious barrier to the development of production. It causes difficulties in necessary calculations or makes them impossible. In consequence, most farmers do not know the costs of production, whereas making approximate ad hoc calculations does not usually correspond to reality.

The process of improvement in the situation on the market of pork production in Poland will take a long time and it will require considerable acceleration in the concentration of production, specialization and considerable funds for investments. There are also numerous discussions about producers' horizontal integration, which undoubtedly improves integrated producers' economic results and production [Pepliński et al. 2004, Dziewulski 2012, Szymańska 2012]. However, as far as small producers are concerned, the integration will not meet their expectations, because many small producers will together reach the scale of production equivalent to the scale achieved by larger producers, but the quality and uniformity of piglet batches, for example, will be considerably lower. Extensive farming production, which is predominant on small farms, gives farmers a high potential to switch to organic food production, especially in view of the fact that it is not very difficult to achieve the status of an organic food producer [Bryła 2013]. It may be an alternative trend in the development of some farms, especially due to the fact that there is increasing demand for organic products.

CONCLUSIONS

The analysis proved that:

1. There was a high deference's of cereals, pigs and piglets prices between individual voivodeships.
2. There was a high correlation between the cost-effectiveness of porker and piglet production and the sow population level at the end of the following year and poor correlation in year n + 2.
3. In individual voivodeships there was low dependence between changes in the sow population and the cost-effectiveness of porker and piglet production, so in this case there are another factors differentiating the level of sow population.
4. There was a high correlation between the average sow population in individual voivodeships and the number of piglets farrowed by one sow per year.

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CZYNNIKI WPŁYWAJĄCE NA ZMIANY POGŁOWIA LOCH W POLSCE. ANALIZA REGIONALNA

Streszczenie. Produkcja żywca wieprzowego w Polsce od 2008 roku znajduje się w głębokim kryzysie, czego wyrazem jest spadające pogłowie świń, a szczególnie loch. Celem artykułu jest analiza czynników wpływających na zmiany pogłowia loch w Polsce i w poszczególnych województwach. Badania przeprowadzono za lata 2001–2014 na podstawie wyników produkcyjnych wzorcowego gospodarstwa rolnego produkującego w cyklu półzamkniętym, które w 2011 roku sprzedało 3836 tuczników. Przeprowadzana analiza wykazała dużą korelację opłacalności produkcji tuczników i prosiąt na poziom pogłowia loch na koniec roku następnego. Zmiany pogłowia loch w poszczególnych województwach były w nieznacznym zakresie uzależnione od opłacalności produkcji tuczników i prosiąt. Dużą korelację odnotowano natomiast z przeciętnym pogłowiem macior w poszczególnych województwach i z ilością uzyskiwanych w ciągu roku prosiąt od jednaj maciory.

Słowa kluczowe: pogłowie loch, rentowność, prosięta, analiza regionalna

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