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DOES THE ACTIVITY OF PRODUCER GROUP ORGANIZATIONS IMPROVE THE PRODUCTION OF PIGS?*

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Abstract

There are many works dealing with the activities of small farms, however there is a lack of papers about production and economic performance of small farms associated in producer group organizations. The aim of the study was to compare the production parameters of selected pig producer groups over two years (2010–2011). The basis for the analysis were the results of surveys carried out in 174 individual farms, which were members of 4 groups of pig producers. The study was conducted through direct interviews using a personal questionnaire. The average herd size of sows increased in the next year by 18.5% and the average annual production volume of fatteners by 9.3%. Average meatiness increased from 53.8% to 54.5%. In order to estimate the revenues a model of factors dependent on the farmer was created, expressed as the production of 1 kg of raw material. Three independent variables were introduced into the model: meatiness of fatteners (X_1), the size of produced fatteners (X_2), weight of fatteners (X_3). The model developed in the study was proposed to groups as a tool to measure the efficiency of production and is currently being used by them. The results indicate that the activities of pig producers have a positive effect on production effectiveness and confirms the validity of horizontal integration in agriculture. Managing production in accordance with the statute imposed on the producer group showed a similar quality of produced raw materials, while the average annual sales of fatteners increased, which may contribute to the ability to negotiate purchase prices.

Key words: integration, agricultural producer groups, pigs, production parameters

One of the problems for agriculture in Europe is the highly fragmented farms. Almost 50% of farms in the European Union have an area of less than 2 hectares and they occupy only 2% of the agricultural area of the European Union. On the other hand, 3% of the largest farms (over 100 hectares) occupy 50% of the total agricultural area of the European Union (Eurostat, 2012). Poland has over 1.5 million farms with an area of more than 1 hectare of agricultural land, including about

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0.8 million over 5 hectares, about 0.4 million farms over 10 hectares, of which about 500 thousand farms produce for the market. Most farms specialize in the production of a specific product or group of products, some of them are mixed farms – not specialized (small – up to 5 hectares, self-supply) (Skarżyńska, 2011).

The very low economic organization of agricultural producers is one of the greatest weaknesses of Polish agriculture. Farmers produce high quality agricultural products, but sell them mostly to intermediaries or in a disorganized manner to processing plants or commercial companies. In this market situation, farmers are at a disadvantage because the installments offered are generally small and when setting the prices the negotiating positions are very weak.

Connecting farmers in a group is characteristic for a market economy, indicating the weakness of the individual farm in the system (Lamarche, 1994; Antosik and Koćwin-Podsiadło, 2000; Jóźwiak, 2000). The formation of producer groups among pig producers is very important because of its economic importance and potential opportunities for the development of this direction (Defaix, 1997; Gonet, 1997; Boguta and Siekierski, 2001). Pig production is not closely related to the land, and so the process of concentration and increase in the number of animals can be carried out even in small-area farms.

The existence of such entities facilitates the planning and adapting of production to demand in terms of the range, quality and quantity of production. With the participation of organized groups of producers, the necessary market linkages are formed between producers and buyers, which favors production planning, supply and surer price stability. Planning and management of small-scale farms maintaining pigs must be adapted to the specific conditions of production, taking into account the instability of the market and their own raw material resources (Roessler et al., 2009).

Unfortunately, there are no studies concerning the effectiveness of the operation of producer groups of pigs in the European Union. Analysis of the activities of group effectiveness, understood as the results obtained in production, is justified, especially after the Polish accession to the EU. The opening of borders requires effective coping and problem-solving, such as: cyclical fluctuations, supply, changes in demand or prices for the raw material to be delivered. In order to compete on not only domestic, but also European market, individual producers must produce high-quality raw materials paying attention to the amount supplied to the sale product. Integrated activities will contribute to a high concentration of supply by the producers, enabling a reduction in the price of agricultural products (Urban, 2002; Knoblauch and Kisiel, 2005; Knecht et al., 2007).

Small-scale production farms find it more difficult to meet the quality requirements of the market, compared to producers affiliated to producer groups. Groups with a stable economic position may be an integral part of Europe's social model, because they achieve not only competitive production parameters, but also a high level of awareness and a position on the market. With regard to these issues, and the very small number of studies in this field, our study was designed to carry out a comparative analysis of production parameters of selected pig producer groups over a two-year period.

Material and methods

The research was conducted in four pig producer groups located in the province of Wielkopolska, for years a leading region in modern pig production. The high level of intensity of pig production in the area was the determining factor for choosing producer groups for testing. The Wielkopolska region has more than 16 thousand farms of over 20 hectares in size, about 9 thousand farms specializing in pig production, including about 2 thousand farmers who are members of producer groups (GUS, 2011).

The oldest group was registered in 2004, two in 2006, and the newest in 2009. The number of members in each group during the period amounted to approximately 50.

The research covered the period 2010–2011. Selection of the farms to be included in the study was carried out by a simple random sample method. The farms eligible for the research were specialized in the production of one product (pigs) and in accordance with this specialization belonged to producer groups in the manufacturing sector according to the Act of 15 September 2000.

The basis for the analysis was the results of questionnaire surveys carried out in the individual farms which are members of pig producer groups. Farms to the study were selected by simple random sample method. The numbers of farms in each pig producer group are presented in Table 1.

Table 1. Study sample sizes in each group of pig producers

Producer group	Year	
	2010	2011
I	19	24
II	24	23
III	19	18
IV	24	23
Total	86	88

The study was conducted through direct interviews using a personal questionnaire, which included, in both periods, the level of the following production parameters: average number of sows, average annual sales volume of fatteners, meatiness of fatteners, daily gains, feed conversion per kg of body weight gain, proportion of feed from own production.

Among the farms examined in 2010, the average farm size was approximately 20 ha, while in 2011 this amounted to approximately 23 hectares. The farms in the analyzed period on the maternal side maintained mainly the following breeds: Polish Landrace (PL) – average 82.6% in 2010 and 81.8% in 2011, and Polish Large White (PLW) (12.8% and 14.8%, respectively), a choice which is justified by their productivity (Rekiel et al., 2012; Knecht and Duziński, 2014). In all farms covered by the study sows were inseminated in the same proportions of paternal component in all groups. In the case of the paternal side, more than half of the farms used the semen of

PLW breed boars, the second most widely used option were Duroc×Pietrain (D×P) crossbred boars, which is correlated with production results (Wysokińska and Kondracki, 2014). Farms produced pigs in a closed cycle. Fattening pigs were fed, *ad libitum*, dry feed based on a farm's own production (from cereals produced by farmers, mostly barley, triticale, rye, wheat), supplemented with purchased concentrates. Food intake was tailored to needs according to Polish Swine Nutrition Requirements (1993), with *ad libitum* access to water. Environmental conditions were similar in all tested locations. Farms used mechanical ventilation, with smooth regulation air change depending on the room temperature and stocking density in each pen, and in the chamber. The animals were treated similarly. Zootechnical treatments were standardized in all groups. Animals were maintained in accordance with the principles of animal welfare (Ordinance of the Minister of Agriculture and Rural Development, 2010).

Daily gains (g) during fattening were calculated based on the sum of two weight measurements at the beginning and end of the fattening period divided by the number of days of fattening. The measurements of the animals for the estimation of daily gains were made using the same model of electronic scales, a Mensor WM150P1, in all farms. Feed consumption was calculated based on a controlled amount of feed put into the pen during the fattening period (about 3 months) divided by the number of animals. All the test farms within the group, according to the statute adopted by the organization, slaughtered pigs in the same meat plant where the post-mortem evaluation of meatiness in the carcasses was made according to the SEUROP classification system (by Ultra-Fom 300 (2011/506/EU)).

The value of pork production was converted into €/kg using average exchange rate for the year 2011 from the Polish National Bank. For better illustration, the differences did not include currency fluctuations between the years since pork producer groups operated only in the domestic market, and therefore did not participate directly in currency game on the European market. The difference in exchange rates between 2010 and 2011 was less than 3%, so in addition to the efficiency of calculations, the average rate of the Euro in 2011 was applied.

Results obtained in the study were subjected to statistical analysis using the PASW Statistics 17 EN computer program and in accordance with accepted statistical methods the following factors were calculated for each variable (Ostasiewicz et al., 1998; Górniak and Wachnicki, 2004; Malarska, 2005): arithmetic mean ($\overline{x}$), weighted average ($\overline{x}$), geometric mean ($\overline{x}$) and standard deviation (*s*).

Before conducting appropriate analyses to determine compliance distributions of variables with the normal distribution, the *W* Shapiro-Wilk test was used.

To examine the significance of differences between the mean values of selected indicators of production in producer groups, the one-way analysis of variance (ANOVA) was used separately for 2010 and 2011 in the plan for independent groups.

To verify the assumption of the homogeneity of variance, the Levene test was used (Wilcox, 2003; Malarska, 2005).

In the event of a rejection of the zero hypothesis about the equality of means in groups (significant F test), to assess the significance of the differences found appropriate *post-hoc* tests were applied. When the assumption of variance homogeneity

was met due to uneven group numbers the Tukey-Kramer test was used. To confirm the results the GT2 Hochberg test was used. With data which did not satisfy the assumption of variance homogeneity in comparison with the mean, a modified version of the Tukey-Kramer test was performed, as proposed by Games-Howell, and for confirmation the Tamhane T2 test was used (Games and Howell, 1976).

For the analysis of differences between the mean values of annual sales volumes of fatteners in producer groups, due to the failure by the dependent variable annual sales volume of fatteners, most assumptions made it necessary to conduct ANOVA, i.e. distributions deviate from a normal distribution – strongly positively skewed and leptokurtic, a lack of homogeneity of variances and additionally numerically unequal groups, before performing the appropriate analyses the variable logarithmic transformation was made as a $\log_{10}(x)$. Levels of significance of difference were given conventionally: significant $P \leq 0.05$ and highly significant $P \leq 0.01$.

Similarly, the t-Student test was used in the analysis of economic parameters (value of fattening production and fattening production costs).

To determine the relationships between the various indicators of production, r-Pearson correlation coefficients were calculated between each pair of quantitative variables; this was done separately for data from 2010 and 2011.

Hierarchical multiple regression analysis was conducted in order to describe the impact of various factors on the dependent variables, i.e. the value of the production of 1 kg of raw material. The general equation for multiple regression is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$$

where:

y – predicted dependent variable,

$x_1, x_2, \ldots$ – independent variables (predictors),

$\beta_1, \beta_2, \ldots$ – regression coefficients indicating how the dependent variable value changes when the independent variable changes by one unit.

$$\beta = \frac{\sum_{i=1}^{n} (x_i - \overline{x})(y_i - \overline{y})}{\sum_{i=1}^{n} (x_i - \overline{x})}$$

Results

The average number of sows in 2010 was 11.4 head, while in the following year this increased by 18.5% and amounted to 13.5 head (Figure 1).

In each group the average number of sows increased in 2011, while the smallest increase occurred in group IV (8.7%), which had the most numerous herd of sows in both years (2010: 16.4 head; 2011: 17.8 head). The largest percentage increase within the analyzed indicator was in group III (65.6%), which – among all the study groups – both in 2010 and in 2011, had the smallest average size of herd of sows (5.5 and 9.1 head, respectively).

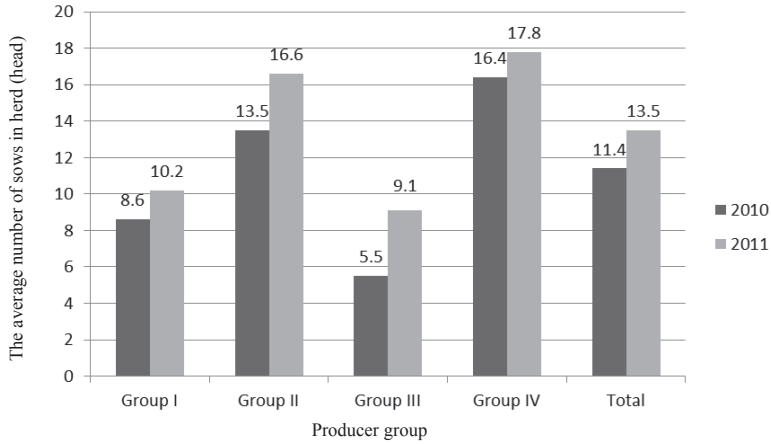


Figure 1. The average number of sows in a herd according to producer group

The average annual production of fatteners in the analyzed farms in 2010 amounted to 243.7 head, and in the next year this increased by 9.3% and amounted to 266.4 head (Figure 2).

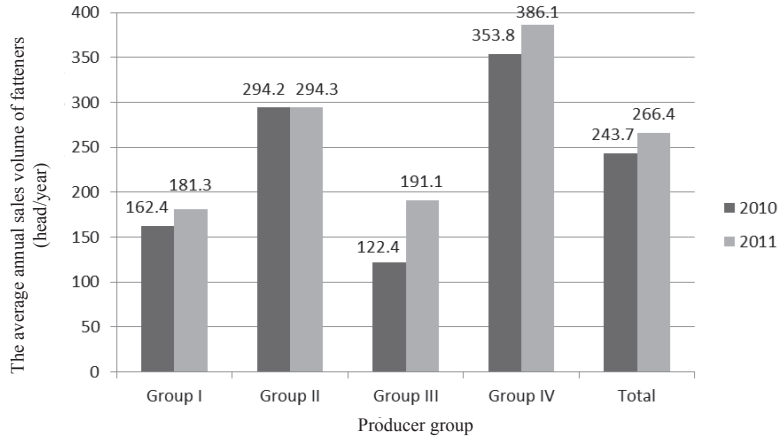
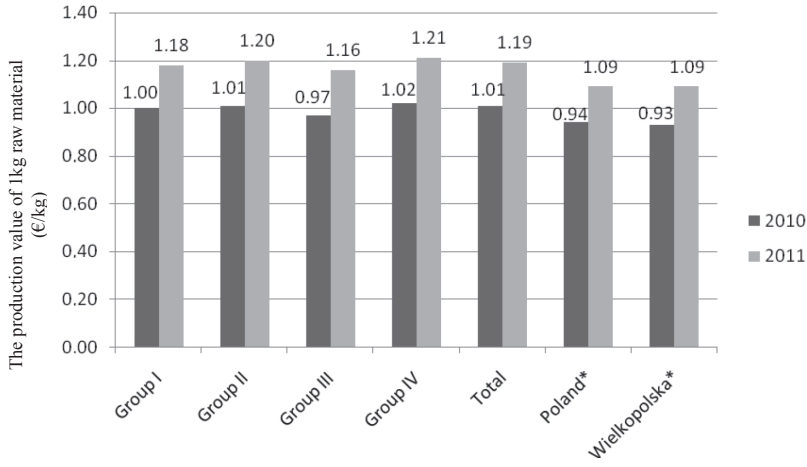


Figure 2. Average annual sales volume of fatteners according to producer group

The largest-scale production was recorded in Group IV. The average production volume in this group was 353.8 head in 2010, and in the following year there was an increase in production by 9.1% to 386.1 head. The lowest average number of fattening pigs per farm in 2010 was sold by the farms in Group III, but in the following year the average production volume increased more than any other group, i.e. by 56.1% to 191.1 head/year/farm.

Most aligned in terms of production in the two analyzed periods was group II. The group produced an average of 294.2 head in 2010 and almost the same in the next year (294.3 head).

Group I – despite an increase of 11.6% year on year – recorded the lowest average annual production volume of all groups (181.3 head).



* data from GUS, 2011

Figure 3. The production value of 1 kg raw material, depending on the producer group, compared to the country and the Wielkopolska region

Figure 3 presents the production of 1 kg raw material, depending on the producer group, compared to the country and the Wielkopolska region. The average procurement price of 1 kg raw material in 2010 was 0.94 €/kg for whole Poland, and 0.93 €/kg for Wielkopolska. The prices were higher in 2011, and were the same, i.e. 1.09 €/kg, thereby increasing by 13.8% and 14.7%, respectively. The highest average prices for 1 kg were achieved by the farms from groups IV (1.21 €/kg) and II (1.20 €/kg), so these groups, in which the average size of the production was the highest (group IV: 353.8 head; group II: 294.2 head), and meatiness parameters were the best (group IV: 54.5%; group II: 54.7%). The highest percentage growth was noted in group III (19.6%) and the lowest in group I (18%). The highest average incomes during the study period were achieved in groups IV and II.

The ANOVA analysis achieved a statistically significant effect for the independent variable (production group) in the case of production parameters: sales volume of fatteners, meatiness of fatteners, daily gains, feed conversion per kg of body weight gain, share of feed from own production (exactly the same dependence, but opposite direction, is in the case of a variable – the feed share of the purchase).

The highest average annual sales volume of fatteners in 2010 was observed in group IV, and amounted to 353.8 head/year, followed by group II – 294.2 head/year, and group I – 162.4 head/year (Table 2).

Table 2. Basic indicators of production – a comparative analysis between the groups

Year	Item			Producer groups				
				I	II	III	IV	Total
2010	Sales volume of fatteners	$\log_{10}$	$\bar{x}$	2.08 aAC	2.37 bC	1.96 A	2.44 BC	2.23
			s	0.32	0.32	0.35	0.30	0.37
	Meatiness of fatteners	%	$\bar{x}$	53.9	54.7 a	51.5 b	54.5 a	53.8
			s	2.1	1.0	4.0	1.8	2.7
	Weight of fatteners	kg	$\bar{x}$	110.6	111.9	113.9	111.6	112.0
			s	3.1	3.8	4.6	3.8	3.9
	Daily gains	g	$\bar{x}$	810.0 a	793.1	720.5 b	780.4	777.3
			s	114.6	93.1	107.2	90.0	107.7
	Feed conversion per kg of body weight gain	kg	$\bar{x}$	3.1 A	2.8 aB	2.7 B	2.6 bB	2.8
			s	0.2	0.2	0.2	0.2	0.2
	Share of feed from own production	%	$\bar{x}$	83.7 A	74.6	67.9 B	77.5	75.9
			s	10.0	18.9	14.4	11.5	15.0
2011	Sales volume of fatteners	$\log_{10}$	$\bar{x}$	2.17 a	2.35	2.16 a	2.47 b	2.29
			s	0.27	0.32	0.34	0.34	0.34
	Meatiness of fatteners	%	$\bar{x}$	54.4	55.1 A	52.6 B	55.5 A	54.5
			s	1.9	1.4	2.7	1.5	2.1
	Weight of fatteners	kg	$\bar{x}$	113.4	112.8	112.5	111.7	112.6
			s	4.3	4.2	4.0	3.5	4.0
	Daily gains	g	$\bar{x}$	800.0	792.2	754.4	760.4	778.3
			s	97.8	70.6	65.5	83.1	82.2
	Feed conversion per kg of body weight gain	kg	$\bar{x}$	3.0 A	2.9 A	2.9 A	2.5 B	2.8
			s	0.3	0.2	0.1	0.1	0.3
	Share of feed from own production	%	$\bar{x}$	82.3	81.1	72.5	79.8	79.3
			s	14.1	15.7	17.2	22.0	17.5

a, b – means in rows with different letters differ significantly ($P<0.05$).
A, B – means in rows with different letters differ highly significantly ($P<0.01$).

The lowest average annual sales volume of fatteners (122.4 head/year) was recorded in group III. The difference in sales volumes (expressed as a logarithm) between groups IV and I, IV and II, and III and II was proved at a highly statistically significant level ($P<0.01$). The difference between the value of the analyzed parameter in groups I and II has been confirmed statistically, at the level of $P<0.05$.

The results of the average sales volume of groups in 2011 were similar to 2010. The highest value of the analyzed parameter was obtained in group IV – 386.1 head/year, group II – 294.3 head/year, group III – 191.1 head/year, and group I – 181.3 head/year. During the analyzed period, statistically significant differences were found between groups I and IV, and IV and III.

Farmers from the three groups (I, III and IV) increased average annual sales volumes in 2011 compared to 2010 (group I by about 18.9 head; group III by about 68.7

head; group IV by about 32.3 head). The average annual sales volumes of fatteners were at a similar level in group II (2010 – 294.2 head/year; 2011 – 294.3 head/year).

The highest average meatiness of fatteners in 2010 was achieved on farms in group II (54.7%) and group IV (54.5%) and lowest in group III (51.5%). The conducted comparisons revealed significant differences ($P<0.05$) between groups II and III, and between groups III and IV.

The year 2011 revealed highly statistically significant differences ($P<0.01$) between groups II and III, and III and IV, with the exception that in 2011 the highest meatiness was characteristic of group IV (55.5%), slightly lower in group II (55.1%), and the smallest – as in the previous year – in group III (52.6%).

Highly significant, positive correlations were observed between the annual sales volume of fatteners and meatiness (2010: $r = 0.51$, $P<0.01$; 2011: $r = 0.47$, $P<0.01$) (Table 3).

Table 3. The correlation matrix between the different indicators of production (separately for 2010 and 2011)

Year	Item	Sales volume of fatteners (head/year)	Meatiness of fatteners (%)	Weight of fatteners (kg)	Daily gains (g)	Feed conversion per kg of body weight gain (kg)	Share of feed from own production (%)
2010	Sales volume of fatteners (head/year)	1	0.51**	−0.10	0.06	−0.20	−0.09
	Meatiness of fatteners (%)	0.51**	1	−0.26*	0.32**	0.16	0.10
	Weight of fatteners (kg)	−0.10	−0.26*	1	−0.09	−0.12	−0.18
	Daily gains (g)	0.06	0.32**	−0.09	1	0.57**	0.22*
	Feed conversion per kg of body weight gain (kg)	−0.20	0.16	−0.12	0.57**	1	0.38**
	Share of feed from own production (%)	−0.09	0.10	−0.18	0.22*	0.38**	1
2011	Sales volume of fatteners (heads/year)	1	0.47**	−0.15	0.08	−0.29**	−0.17
	Meatiness of fatteners (%)	0.47**	1	−0.27*	0.22*	−0.21	−0.10
	Weight of fatteners (kg)	−0.15	−0.27*	1	0.09	0.19	0.17
	Daily gains (g)	0.08	0.22*	0.09	1	0.58**	0.04
	Feed conversion per kg of body weight gain (kg)	−0.29**	−0.21	0.19	0.58**	1	0.08
	Share of feed from own production (%)	−0.17	−0.10	0.17	0.04	0.08	1

* correlation significant at $P<0.05$; ** correlation significant at $P<0.01$.

In both periods, a highly statistically significant strong positive correlation (2010: $r = 0.57$, $P<0.01$; 2011: $r = 0.58$, $P<0.01$) was noted between the feed conversion per kg of body weight gain and daily gains.

Additionally, in 2010 there was a moderate positive correlation between the variables share of feed from own production and the feed conversion per kg of body weight gain ($r = 0.38$, $P<0.01$).

Both in 2010 and in 2011, there was a weak positive correlation (2010: r = 0.32, P<0.01; 2011: r = 0.22, P<0.05) between daily gains and meatiness of fatteners.

In all years there was a weak negative correlation between body weight and meatiness (2010: r = –0.26, P<0.05; 2011: r = –0.27, P<0.05).

A highly significant weak negative correlation (r = –0.29, P<0.01) occurred in 2011 between the annual sales volume of fatteners and the feed conversion per kg of body weight gain.

To describe the influence of individual factors – dependent on pig producers – on the revenues generated, expressed as the production of 1 kg of raw material (revenue from the sale of 1 kg of raw material), a hierarchical multiple regression analysis was conducted. Three independent variables were introduced into the model: meatiness of fatteners (X_1), the size of produced fatteners (X_2), weight of fatteners (X_3). The sequence of inputting factors into the model was dependent on the strength of the correlation with the dependent variable, i.e. first introduced into the model was the independent variable having the greatest impact on the dependent variable.

Multiple regression analysis was performed separately for 2010 and 2011 (Table 4). The analysis showed a significant effect of all three variables in 2010 and two variables in 2011 (an unconfirmed statistically proven impact of the independent variable X_3 – weight of fatteners).

Table 4. The coefficients of the regression equation describing the value of production of 1 kg of raw material

Item	Year	
	2010	2011
X_1 – meatiness of fatteners	0.0479	0.0541
X_2 – the size of produced fatteners	0.0004	0.0002
X_3 – weight of fatteners	–0.0094	---
Intercept	2.407	1.822

Both presented models show that there is a positive correlation between meatiness and the size of production, and the production value; also, in 2010, there was an additional negative correlation with the weight of fatteners. In both periods, the strongest impact on the value of 1 kg of raw material was shown by meatiness (in 2010: *beta* = 0.564; P<0.01; in 2011: *beta* = 0.557; P<0.01). In the case of production size, its impact on the value of 1 kg raw material was less (in 2010: *beta* = 0.353; P<0.01; in 2011: *beta* = 0.254; P<0.01). In 2010, the model for 2010 also had an independent variable (X_3) – weight of fatteners (*beta* = -0.164, P<0.01).

It is worth noting that in 2010 the model was a better fit to the data and accurately described the dependent variable, i.e. the production of 1 kg of raw material: F(3, 82) = 74.267, P<0.01. The value of the adjusted R^2 was 0.721, and so the model explained 72% of the variance of the dependent variable, i.e. the value of 1 kg of raw material.

The model was less precise in 2011: F (2, 85) = 43.941, P<0.01, and explained much less of the variance of the dependent variable. The value of the adjusted R^2

was 0.497 ($P<0.01$), and so the model explained 50% of the variance of the variable, which is about 22% less than in the previous year.

Discussion

The results indicate that the activities of pig producers have a positive effect on the development of production parameters.

Due to the one-sided direction of pig production, the meatiness of carcass carries particular importance. Changes in consumer requirements have led to increased interest in high lean meat content of slaughtered fatteners to the detriment of excessively fat pigs (Krystallis et al., 2009; Knecht et al., 2012).

Increasing meatiness in the carcass of slaughtered fatteners in groups can be regarded as a beneficial aspect of farmers belonging to a group, resulting from the exchange of experience and the coherence of farmers' actions in terms of improving group production technology. Proof of this thesis is comparison of the growth of lean meat content of pigs in producer groups with the growth in the mass population of pigs for Poland and for the Wielkopolska region. The increase in lean meat content in the carcass, during the study period for the mass population of pigs for Poland amounted to 0.4% and for Wielkopolska region 0.5% (ZSRIR, 2011), which represents less than the value of the improvement of the analyzed producer groups (0.7%).

The improvement of the analyzed parameter may also affect the objective quality assessment of delivered animals for slaughter, which is carried out in meat plants, and the results of which affect the income derived from the delivered material. The Polish study conducted by Tereszkiewicz et al. (2001) showed that the best muscled carcasses are derived from raw material in regions with a higher concentration of production and farms specializing in pig breeding.

The ambiguous results in terms of growth and daily feed consumption could result from the use of various types of cereals in diets for fattening pigs. It should be noted that modification of diets directly affects the performance of fattening (Skiba et al., 2012). The cereals used for the preparation of feed were characterized by different food values, which could influence the reduction of daily gains and increased feed consumption. This inference is confirmed by the participation rate of feed from farmers' own production, which increased during the analyzed period.

In European production conditions average daily gains during fattening are in the range of 800 g. Balanced levels of daily gains in the assessed fatteners in groups (over 770 g) are linked to the targeting strategy of the feeding and management process in the pig production groups. Similar results, in the range of 700–900 g/day, were obtained in other studies examining the effects of producer groups of pigs (Borecka, 2004; Knecht and Środoń, 2013).

Changes in animal production have progressed very rapidly over the years. Maintaining the profitability of small-scale farms is possible through effective integration. Guzewicz et al. (2004) noted that there has been an increase in the percentage of specialized farms, and this situation drives the market (especially the prices of cereals).

Introduction of the intensification of livestock production is also intended to meet the growing demand for safe and healthy food and to help improve the living conditions of rural households (Udo et al., 2011).

Taking advantage of the effect of economies of scale, a group of agricultural producers are able to increase their bargaining power, in negotiations with both suppliers and customers (Gołębiowski, 2009). Farms acting alone in the market find it increasingly difficult to meet market requirements, and increase their competitive advantage (Anderson, 2003; Jankowska-Dymet and Piasecka, 2005).

Pig production can provide a relatively large income from work and the rapid turnover of capital (a short production cycle) and definitely has a higher position in the agricultural economy in Poland than is the average for the 27 EU countries (Skarżyńska and Augustyńska-Grzymek, 2001; Skarżyńska, 2011; Eurostat, 2012).

Aligned pig production parameters determine the value of production. In the analysis of total groups in 2010 the average purchase price per kg of raw material (the production value of 1 kg raw material) was higher than the national average (0.07 €), as well as the average in Wielkopolska (0.08 €). In the following year, in all groups, the average purchase price was higher than the average for Poland and the Wielkopolska region (0.10 €). The average price for 1 kg of raw material increased during study periods for total producer groups by 17.8%.

The study conducted by Pepliński (2013) showed that the average prices in Wielkopolska region were 0.93 €/kg and 1.09 €/kg in 2010 and 2011, respectively. However the study of Knecht and Środoń (2013) reported that the average production value per kg was more similar to prices obtained by the Department of Agriculture (ZSRIR, 2011) and were 0.95 €/kg (2010) and 1.12 €/kg (2011).

Szczebiot-Knoblauch (2000) also noted a difference in the amount of unit prices received by producers of pigs (average of 0.08 €/kg). The average prices obtained by group producer were higher by about 0.17 €/kg compared to the average price offered for the non-attached producers in Poland. The average country price may differ depending on the source. However, accepting the highest average domestic prices with the Department of Agriculture (ZSRIR, 2011), 0.96 €/kg in 2010 and 1.13 €/kg in 2011, the analyzed groups were characterized by higher production value of 1 kg raw material, compared to non-attached producers.

The research of Pepliński and Wajszczuk (2003) on 60 piggery farms, showed significant effect of production scale on price per fattener. The lowest prices (1.03 €/kg) were noted for non-integrated producers with production of 200–500 fatteners/year, while the price for producer groups with production on a level of 1000–2000 fatteners was 1.15 €/kg. Almost similar results were reported by Borecka (2004), who studied integration effect on production profitability. Financial benefits from the sale of a fattener by farms integrated in six producer groups in Wielkopolska region ranged between 1.06 €/kg and 1.11 €/kg. The difference in the values was a result of extra amount paid to the base price negotiated by the groups.

The variables for the studied farms presented in models for 2010 and 2011 showed that in 2010 an increase in the meatiness of fatteners by 1% caused an increase in production value of 0.0114 €/kg. In the next year the impact of meatiness was slightly higher: the 1% increase in meatiness caused an increase in the

production value of 0.0129 €/kg. In the year 2010, the size of produced fatteners of 100 heads resulted in an increase in the value of production of around 0.0095 €/kg, and the next year even less, i.e. about 0.0048 €/kg. A kg increase in fatteners body weight in 2010 caused a decline in the value of production of around 0.0022 €/kg, which was consistent with previous years' observations conducted by Jensen et al. (2008). The average price for fatteners in 2010 in Poland was about 132.9 €/100 kg, with lean meat content of 54.8% and carcass mass of 88.4 kg, and for the studied region the values were 125.21 €/100 kg, 54.7% and 89.0 kg, respectively. The year later average country price increased to 151.46 €/100 kg, with lean meat content of 55.4%, and carcass mass decreased to 87.5 kg. During that time higher prices were noted in Wielkopolska region, they were on the level of 150.86 €/100 kg with lean meat content of 55.2% and carcass mass decreasing to 87.9 kg (ZSRIR, 2011). Šprysl et al. (2010) estimated revenues based on a model including meatiness of the carcass and body weight, where every increase of 1% in meatiness generated a revenue growth of approximately 1.5%. In contrast to the results of our own research, these authors found that an improvement in daily gains of 10 g/day generates a revenue increase of 0.0091 €/kg. The differing accuracy of developed models and the size of the variables may have resulted from a much greater price volatility in sales, which were dependent to a greater extent on external factors (e.g., the relationship between cereal prices and prices of pork, fluctuations in supply and demand, exchange rates), not directly related to the amount and quality of the raw materials delivered by producers. The model developed in this study was proposed to groups as a tool to measure the efficiency of production and is currently being used by them.

The limited effectiveness of small producers is often due to a mismatch between program objectives for the organization of production on the farm, which are closely linked to the quality of the initial product (Roessler et al., 2008). The most important factor in terms of the volume of production, according to Krystallis et al. (2009), is still farm size and the number of animals owned. The farms participating in this study all operated in accordance with the statute imposed on such producer groups and showed a similar quality of produced raw materials (meatiness, daily gains, body weight at slaughter) during the period, while the average annual sales of fatteners increased, which may have contributed to their ability to negotiate purchase prices. Price stability during selling while pork prices still remain low in relation to the high cereal prices also inhibits the process of farmers conducting the production of pigs (Donnellan et al., 2012). Individual small-scale farms should combine productive resources in various forms of cooperation and integration (Kukuła, 2007).

The groups of pig producers presented in this study have clearly chosen a strategy of gradually increasing the herd of sows, which in turn affected the annual sales volume of the fatteners. The increase in the number of animals sold is essentially the result of properly conducted reproduction, rearing and fattening (Roessler et al., 2008). Intensification of production may take place only when production groups have existing reserves and they expand awareness of the production, which affects the development of the group. The challenge is to develop multifunctional livestock production systems in terms of not only individual profit but also appropriate care of

animals and the environment (Gibon et al., 1999). The integration of pig producers with similarly organized units, in the context of the vertical integration of processing, could represent a stronger/more effective cooperation between native entities in competitive markets: domestic and foreign.

Summing up, the presented results indicate that horizontal integration of pig producers provides tangible production and economic results, already in a relatively short time of participation. The highest improvement in parameters was observed for meatiness, daily gains and production value of 1 kg raw material. The increase in meatiness during the study period was as high as 0.7%, which in comparison with national and regional trends was definitely the best result. The daily gains remained at a high national level of 780 g, with a large share of feed from own production. The analyzed groups of pig producers achieved higher production value of 1 kg raw material, compared to the average for the country and the Wielkopolska region, irrespective of the study period. The average prices were higher by 0.07 € in 2010 and 0.10 € in 2011. The primary objective of all pig producers is to achieve an increase in profit, which is possible through integrated activities of the producer groups.

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