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SMALL DAIRY FARMS – PERSPECTIVE OF INCOME AFTER 2015

Summary

The article concerns the problems of profitability of dairy farms, which according to classification of the Central Statistical Office, belong to the group of very small and small farms. Analysis of production and economic situation covers the years 2015-2020 and takes into account the changes in the regulations in terms of direct support for farms. Data from 94 farms, characterised by high specialisation in the production of milk, were used for the purpose. The study takes into account the volatility of milk prices and milk yield of cows this, in turn, allowed to achieve distribution of agricultural income in each year of the analysis. The results show that small dairy farms in the coming period can expect an increase in farm income, but their level in half of the farms will not exceed the income parity. The risk of negative agricultural income refers to a small number of farms and the occurrence of this phenomenon is unlikely.

Key words: small dairy farms, income, production risk, direct support, milk yield, production and economic situation, volatility of milk prices, milk quota, greening

Introduction

Significant fragmentation of farms is one of the features of the Polish agriculture, which results from historical events linked to both policy and economic factors. The data of the Central Statistical Office (Polish: *Główny Urząd Statystyczny, GUS*) show a drop in the number of small farms in Poland. This is largely due to agricultural policy encouraging farmers to extend production scale, which leads to concentration and specialisation and, consequently, it should increase competitiveness of farms in the global market. However, despite enormous financial resources allocated to development of farms, the rate of structural changes in the European agriculture is not as fast as expected (von Braun 2005).

The definitions of a small farm are varied and follow from different criteria of their selection from the overall population of farms. The most often used criteria are as follows: utilised agricultural area per farm, number of animals, number of people employed on a farm, share of production for self-supply, etc. (von Braun 2005; Zegar 2012). It should be noted that farms recognised as small in one country, in other countries could be classified as medium-sized or large. Most of the criteria to select small farms are determined by the production size of a farm; hence, economic size is increasingly more often used as a measure of farm size. In Poland, very small and small farms are farms whose sum of standard output for all agricultural activities of a given farm ranges from EUR 2 thousand to EUR 25 thousand (Współczynniki... 2014). This is also a measure of farm size used by the Central Statistical Office. According to data for 2013, the group of very small and small farms (SO at EUR 2-25 thousand) in Poland included ca. 842 thousand farms, which accounted for ca. 60% of the total of Polish farms. These farms hire over 60% of the total of people employed on farms. Small farms dominate in most of agricultural types and one of their characteristics is specialisation in milk production (72% of farms). Therefore, changes in the system regulating milk production in the EU are an important issue also for small farms. Farmers treat the liquidation of the quota system, which is one of the most important elements of the reform, as both an opportunity and a threat. According to research results, liquidation of milk quota can result in an increase in milk production and a drop in prices, but the scale of these changes will be different in different regions (Helming and Berkum 2008; Patton et al. 2008; Baer-Nawrocka and Kiryluk-Dryjska 2010; Świtłyk and Wilczyński 2012). Another element, adding up to the concerns of farmers, is the reform of the Common Agricultural Policy applicable as of 2015. The reform is to facilitate the achievement of long-term objectives of the European agriculture: viable food production, sustainable management of natural resources and climate action, and balanced territorial development (European Commission Overview 2013). The most important changes directly influencing farms can include the modified system of direct support, which takes into account the environmental aspects of agricultural production. Analysis of the impact of new instruments of agricultural policy conducted by the European Commission, point to an expected growth in agricultural income, but in the new EU Member States it will be probably higher than in the so-called EU-15 countries. According to the European Commission, this will be influenced by favourable price cycle for meat, dairy and plant products manufactured at farms (European Commission, Prospects for agricultural... 2014). Literature broadly analyses the impact of the new component of economic support on the implementation of agricultural practices beneficial for the climate and theenvironment, i.e. the so-called greening payments. Results of the research indicate that unfavourable results of regulations linked to greening will affect a small group of farms, mainly, these

with highly simplified production structure and no EFA (Ecological Focus Area), i.e. the largest farms, especially the crop and pig holdings (Czekaj et al. 2014; Kołoszycz and Wilczyński 2014, 2015). At the same time, it is indicated that the income of cattle farms can increase by 2020 (Kulawik 2014). Research on the effects of introduction of the redistributive payment (the so-called payment for the first hectares) demonstrates that they will affect the growth in income of small farms, which rather keep the level of current profitability (Balmann and Sahrbacher 2014). Hungarian research shows that redistributive payments will also have no impact on the structural changes in farms (Potori et al. 2014). According to experts, this payment, targeted mainly at small farms, will fail to solve their basic problems (Poczta 2010).

The above research concerns the situation of small farms to a limited extent. Given the significant share of small and very small farms in milk production in Poland, authors decided to analyse more closely the effects of changes in the level of payments and new requirements related thereto as well as effects of unplanned phenomena or phenomena beyond the possibilities of farmer's direct impact, i.e. price changes and performance. The research aims at assessment of the situation of Polish small dairy farmers up to 2020. The detailed objectives in the paper cover assessment of the new system of operational payments in the context of income of small farmers and possibilities of achieving income parity for the income.

Research material and method

Empirical research was based on the Polish FADN (Farm Accountancy Data Network) system data for 2009-2012. The analysis covered holdings specialising in dairy cattle rearing (Type 45). Taking into account the assumed objective of the paper, the data used hereunder represent farms classified by economic size as group 1 and 2, i.e. very small and small. According to the data from the Central Statistical Office for 2013, there were ca. 256 thousand holdings of such economic size in Poland (ca. 72% of all farms rearing cows). Another criterion defining the level of holding specialisation was the share of milk production value in the total output of a farm. The research covered farms where this share was equal to or higher than 50% of total output. This enabled to define the impact of price changes and productivity on holdings specialising in milk production, thereby minimising the impact of other lines of production on the agricultural income. The group of analysed objects included 94 holdings. Additionally, it was divided into three subgroups by volume of milk produced per farm in 2012 – up to 40 thousand kg, from 40 to 60 thousand kg and over 60 thousand kg of milk. Table 1 presents the most important features and organisational parameters of groups of farms.

Table 1

Basic parameters of analysed groups of farms in 2012

Parameters	Measurement unit	Entire group	Groups of farms		
			<40 thousand kg	40-60 thousand kg	>60 thousand kg
Number of farms	units	94	27	32	35
Population of dairy cows	LU	12	9	12	15
Milk yield	kg per cow	4,572	3,663	4,380	5,449
Stocking density	LU per 100 ha of UAA	193	179	198	200
UAA	ha	15.62	13.77	15.55	17.10
Share of leased land in UAA	%	25	21	25	27
Total labour input	AWU	1.74	1.66	1.78	1.76
Share of hired labour input	%	0.21	0.36	0.25	0.06
Share of milk production in total output	%	64	55	64	72
Average value of capital per 1 cow	PLN thousand per LU	25.8	23.5	25.3	27.1

Source: own compilation based on the FADN data.

Data analysis shows a positive correlation between resources and production results. It is clear that along with an increase in the farm area there is a growth in production specialisation and intensification. Hired labour input is one of the parameters departing from general regularities, as its share dropped along with an increase in farm size.

A calculation model was built to determine the future economic situation of farms. The model enables deterministic and stochastic determination of the production and economic results of holdings in a nine-year period. The model makes many assumptions and uses additional non-FADN empirical data. The reference year for the research was 2012, for subsequent years of the analysis indices of changes in production and economic data were used. In 2013-2014, the general statistics were used as basis to determine the formation of yields (unit productivity) and prices for outputs and inputs. The projections of product and input prices for subsequent years take into account the forecasts of the OECD--FAO, the World Bank and the European Commission (OECD-FAO Agricultural Outlook 2014; World Bank Commodity Market Outlook 2015; European Commission Prospects 2014). The research assumes an increase in milk yield of cows. For the researched farms, the average milk yield of cows was lower than the average yield in the country, which gives grounds for an assumption that

farms have some unused production potential. Data analysis shows that in 2009--2012 for 38 out of 94 researched farms (40%) a growth in the number of cows was accompanied by a drop in milk yield or an increase in case of reduction in the number of cows. Thus, expiry of the milk quota system will eliminate the basic barrier to milk production growth of farms. However, it needs to be remembered that basic farm resources and the so-called environmental regulations (e.g. cross-compliance requirements) will continue to restrict production. Bearing the above in mind, the growth in milk yield of cows on farms was made dependent on the level of yield in the reference year, i.e. 2012, and on such grounds growth gradation was assumed: for cows with yield below 5 thousand kg the growth amounted to 2% per year, for cows from 5 to 6 thousand kg – 1.5%, and above 6 thousand kg – 1% per year. Increase in milk yield was linked to changes in fodder consumption (costs of feeding) at farms.

The analysis of the economic situation of farms in 2015-2020 considers changes in the agricultural policy. Direct support in the analysed farms consisted of:

– single area payment scheme,
– greening payment,
– additional (redistributive) payment,
– coupled payment (to cattle and cows).

The research does not consider payments for young farmers. The analysis of amounts of payments for farms forecasted for 2015 shows that no holding can be exempt from the control of standards and requirements of the cross-compliance principle and greening practices, i.e. all farms are excluded from the system of payments for small farms (sum of all payments for farms exceeds the amount of EUR 1,250). Analysis of data on the utilised agricultural area and on the cropping system indicates that all researched holdings will be covered by payments for agricultural practices beneficial for the climate and the environment (greening), without changes to the cropping structure. The new system of direct payments provides for additional support to all farms – to lands eligible for single area payment scheme, ranging from 3.01 ha to 30 ha (maximum area covered by support per farm is 27 ha). This is the so-called redistributive payment targeted, mainly, at the group of small and medium-sized holdings, which do not generate benefits on account of production scale but have chances for durable development. Coupled payments should foster keeping the current production level at farms. The support covers selected sectors of crop production, e.g. protein crops, sugar beets, starch potatoes, and sectors of livestock production, e.g. cattle and cows. Payments to cattle covered animals, regardless of sex, up to 2 years old and living on farms that rear from 3 to 30 heads of young cattle. A farmer will get the payment per each head of young cattle in a herd (a maximum of 30 heads per farm can be covered by payments), if the farmer takes on an obligation to keep the animals on the farm for a fixed period of time. Additionally, each farm having from 3 to 30 cows aged above 2 will have the possibility to apply for payments to cows.

Given the restrictions of the deterministic model, which considers a small number of combinations of variables with *a priori* adopted probabilities, and the fact that the obtained results reflect the possible effects for farms in points, it was decided to apply stochastic stimulation method using the Monte Carlo method for the purpose. Random character assigned to selected input data allowed for determination of possible results for farms. The stochastic methods enable simultaneous analysis of the impact of many random variables on the obtained results. However, during the simulation of economic results at the level of the entire holding, the losses of one production branch are offset by another, which is in a better situation; therefore, too large number of random variables hinders sensitivity analysis. In the research, the number of variables is limited to only few, most often two or three. Milk price is the basic random variable for dairy farms, and the selection of other variables depends on the research objective (El Benni and Finger 2013; Shalloo et al. 2004; McDonald et al. 2013; Neyhard et al. 2013). Prices and yields (unit productivity) of products manufactured by a farm were most often taken as independent variables in the Polish research of the economic situation of farms in the future, which considered the random character of selected variables (Kaczocha et al. 2003; Majewski et al. 2007; Kołoszycz and Wilczyński 2015; Sulewski and Czekaj 2015). This paper takes milk prices and milk yield of cows as random variables. The volatility of milk prices was estimated on the basis of historical data of the Central Statistical Office for 2004-2013. The research assumes growth in the milk yield of cows and considers the possibility of its fluctuations under the impact of production intensification and health problems of cows and cow feeding errors, etc., often occurring alongside the above (coefficient of variation at the level of 10%). Given trade liberalisation in the agricultural market and departure from production limits in the European market, it was assumed that by 2015 the growth in volatility of milk prices will amount to 1.15% per year, which in 2020 will result in a cumulated volatility at the level of 7%.

To make comparisons over time, the paper uses the expected value of agricultural income and its amount per total labour input (AWU) and per 100 kg of milk. The expected value of income *E(Dr)* was calculated as follows:

$$E(D_r) = \sum_{i=1}^{n} E(P_z) + P_r + P_p + D_o - Z_p - A - K_{cz}$$

where:

$\sum_{i=1}^{n} E(P_z)$ – stands for the sum of expected value of production from i-th activities under livestock production branch,

P_r – crop production value,

P_p – value of other production in the economy,
D_o – payments to operating activities,
Z_p – indirect consumption,
A – amortisation,
K_{cz} – costs of external factors.

The formula does not consider payments to investment activities given the lack of information on the plans to make investments at a farm and because of different sources of investment financing; hence, setting up one-fits-all solution would be a far-fetched simplification.

The expected value of livestock production on farms was calculated as follows:

$$E(P_z) = E(S_m) + S_z + S_{ppz}$$

where:
$E(S_m)$ – stands for the expected value of returns on sales of milk (calculated as a product of the number of cows and their yield and milk prices),
S_z – returns on sales of cattle,
S_{ppz} – other returns on sales of livestock production.

The research does not assume a correlation between milk price and production on farms, which followed mainly from two reasons – important according to the authors. Firstly, milk price forecasts developed by the World Bank, the OECD and the European Commission were based on fluctuations in production volume worldwide (milk production growth in Europe after liquidation of quota system), therefore, temporary price drop is expected. Secondly, milk production growth as a result of better productivity of farms (especially, when the analysis covers farms of small production potential) will most likely not affect the milk prices in the market.

To determine the distribution of income on a family farm in the future, a Monte Carlo method simulation was applied which uses the @Risk 6.0 software. Ten thousand iterations were conducted for each farm, which allowed precise determination of the distribution of agricultural income probability for the analysed farms.

Results

Agricultural income showed a clear positive link to the amount of milk produced on farms (Fig. 1); Pearson's correlation coefficient calculated for variables in 2012 amounted to 0.64. Although the holdings belonged to a group of the

same economic size, they were characterised by a significant variability of production and economic results.

In 2015-2020, the expected values of agricultural income for all farms were higher than agricultural income in 2012. This was influenced, mainly, by higher than in 2012 milk prices, but also a growth in the level of operating payments for farms. The share of payments in the agricultural income continued to be the highest for farms of the lowest production potential in all years of the analysis. Payments in this group of farms accounted for more than $^3/_4$ of the agricultural income. Holdings producing milk on a greater scale had a lower share of payments in the agricultural income, but it was still nearly half of the obtained income.

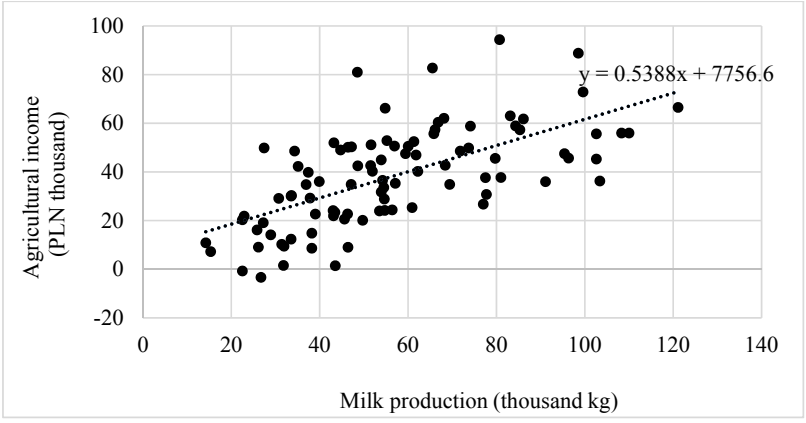

Fig. 1. Milk production versus agricultural income in 2012
Source: own calculations.

Analysis of distribution of the expected value of agricultural income shows that the share of farms, which can achieve a negative agricultural income, did not exceed 15% for farms producing up to 40 thousand kg of milk and 9% for farms producing more than 60 thousand. However, such an event is not very likely (below 5% in all groups of farms). It is clear that there is a growth in disproportions in the obtained agricultural income between the analysed groups of farms. In 2012, the difference was at the level of ca. PLN 16 thousand, in 2015 and 2017 it grew to ca. PLN 20 thousand and in 2020 it reached the level of PLN 23 thousand.

Table 2

Agricultural income in 2012 and the expected value of agricultural income in farm groups in 2015-2020

Farm groups	Parameters	2012	2015	2017	2020
<40 thousand kg	Average	21,342	33,532	34,077	34,689
	SD	14,810	14,300	14,946	15,119
	Min.	-3,283	10,251	11,522	12,071
	Max.	49,880	62,805	65,708	66,431
	Share of payments in agricultural income	74%	85%	84%	77%
	Share of farms showing risk of negative agricultural income	7%	11%	15%	11%
	Risk of negative agricultural income	-	<5%	<5%	<5%
40-60 thousand kg	Average	37,609	54,954	56,598	58,904
	SD	16,722	17,619	18,454	18,211
	Min.	1,477	19,808	18,188	20,812
	Max.	81,070	91,147	97,404	97,893
	Share of payments in agricultural income	45%	54%	53%	47%
	Share of farms showing risk of negative agricultural income	0%	0%	6%	3%
	Risk of negative agricultural income	-	0%	<5%	5%
>60 thousand kg	Average	53,377	73,810	75,030	80,974
	SD	15,559	19,521	19,957	21,413
	Min.	26,769	19,896	17,787	19,822
	Max.	94,398	104,748	104,708	111,719
	Share of payments in agricultural income	34%	48%	48%	41%
	Share of farms showing risk of negative agricultural income	0%	9%	9%	9%
	Risk of negative agricultural income	-	<5%	<5%	<5%

Source: own calculations.

Agricultural income showed no link to own labour inputs on farms (Fig. 2). The Pearson's correlation coefficient calculated for these variables in 2012 amounted to 0.02. Given the information value, income parity of agricultural holdings was analysed.

Fig. 2. Own labour inputs versus agricultural income in 2012

Source: own calculations.

Table 3

Agricultural income and expected value of income per own labour inputs on a farm by farm groups in 2012-2020 (PLN/AWU)

Farm groups	Parameters	2012	2015	2017	2020
<40 thousand kg	Average	13,433	21,387	21,920	22,323
	SD	9,962	11,136	11,536	11,706
	Min.	-1,642	4,801	5,445	5,842
	Max.	37,106	46,184	48,202	48,915
	Share of farms below the income parity	93%	81%	85%	88%
40-60 thousand kg	Average	23,593	33,567	34,499	35,984
	SD	14,590	14,970	15,196	16,160
	Min.	690	9,948	9,209	10,442
	Max.	81,591	87,633	88,338	97,576
	Share of farms below the income parity	78%	50%	56%	65%
>60 thousand kg	Average	30,959	43,046	43,609	47,183
	SD	10,342	13,676	14,216	15,740
	Min.	14,727	12,276	11,005	12,166
	Max.	60,017	69,218	70,112	78,258
	Share of farms below the income parity	51%	23%	23%	26%

Source: own calculations.

Table 4

Agricultural income and the expected value of agricultural income, less operating payments, per 100 kg of milk by farm groups in 2012-2020 (PLN/100 kg of milk)

Farm groups	Parameters	2012	2015	2017	2020
<40 thousand kg	Average	15	23	26	33
	SD	53	43	45	45
	Min.	-153	-115	-113	-105
	Max.	107	83	90	98
	Share of farms showing risk of negative agricultural income	33%	41%	41%	33%
	Risk of negative agricultural income	-	5-100%	5-100%	35-100%
40-60 thousand kg	Average	40	48	52	61
	SD	27	25	26	26
	Min.	-25	-9	-11	-3
	Max.	92	106	112	120
	Share of farms showing risk of negative agricultural income	6%	9%	9%	6%
	Risk of negative agricultural income	-	5-70%	5-75%	5-55%
>60 thousand kg	Average	43	49	51	61
	SD	20	23	24	25
	Min.	6	-9	-10	-5
	Max.	95	83	89	105
	Share of farms showing risk of negative agricultural income	9%	9%	9%	9%
	Risk of negative agricultural income	-	45-70%	40-75%	20-60%

Source: own calculations.

Income parity was determined as the relation of agricultural income to the average annual net remuneration in the national economy. The research takes account of remuneration growth in the national economy, in line with the assumed model of pay growth for farms (3.5% per year). Despite a clear growth in income per labour input in 2015-2020, only few farms noting the lowest production potential will achieve income parity (only 19% of farms in 2015 and 12% in 2020). Along with a growth in milk production, the percentage of such farms will also grow.

In the group of farms producing from 40 to 60 thousand kg of milk in 2015, half will achieve the forecasted level of annual net remuneration in the economy, however, by 2020 the share of such farms will drop as a result of forecasted faster rate of remuneration growth in the national economy than income growth on farms from the group. The highest growth in the share of farms obtaining income parity was noted in the group of farms having the highest production potential.

Deducting operating payments from the agricultural income was to enable assessment of the ability of farms to achieve agricultural income without support, at assumed volatility of milk yield and prices. The obtained results are characterised by volatility, both inside groups, and within farms. The greatest income volatility is typical of farms noting the lowest milk production. In 2015 and 2017, for over 40% of farms from this group the noted average expected value of agricultural income was negative, in 2020 the percentage of such farms dropped to 33%. Definitely lower volatility and similar level of expected value of income is characteristic of two other groups of farms, where the risk of negative income affects the same number of farms, but the likelihood of its occurrence is slightly higher for farms producing over 60 thousand kg of milk.

Conclusions

The research held allowed for determination of the future economic situation of small dairy farms in 2015-2020. The data show that these farms, in the coming period, can expect a growth in agricultural income. Operating payments will have a clear impact on the improvement of economic results of farms. The projected system of support in selected areas, e.g. linked to the so-called greening, redistribution of payments or payments to cattle and cows, prefers small farms setting a lower and upper limit of the number of animals and area of a farm eligible for a defined support or releasing from agricultural practices. Other sources of better economic situation of farms can include the use of their production potential through a growth in milk yield of cows and forecasted growth in milk prices.

Research results indicate that the risk of negative agricultural income, at the projected level of support, refers to a small number of farms and occurrence of the phenomenon is rather unlikely. Without the system of direct support the group of the smallest farms is the most sensitive to volatility of milk price and milk yield of cows. In the other groups, most of the farms will reach a positive agricultural income.

Special attention should be devoted to the achievement of income parity by farms. Based on the conducted analysis it can be concluded that despite increased support, around half of farms will not reach the income parity, this refers mainly to the smallest farms. Such situation can incline farmers to search for additional sources of income outside of a farm or it can result in resignation from more labour-intensive operations (e.g. milk production) to the advantage of other activities, and in extreme cases it can lead to resignation form agricultural activity.

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Abstrakt

Artykuł poświęcony został problematyce dochodowości gospodarstw mlecznych, które zgodnie z klasyfikacją GUS należą do grupy gospodarstw bardzo małych i małych. Analiza ich sytuacji produkcyjno-ekonomicznej obejmowała lata 2015-2020 i uwzględniono w niej zmiany regulacji w zakresie wsparcia bezpośredniego gospodarstw rolnych. W tym celu wykorzys-

tano dane z 94 gospodarstw, charakteryzujących się wysoką specjalizacją w produkcji mleka. W badaniach uwzględniono zmienność cen mleka oraz wydajności mlecznej krów, co w konsekwencji pozwoliło na uzyskanie rozkładu dochodu rolniczego w każdym roku analizy. Wyniki wskazują, że małe gospodarstwa mleczne w nadchodzącym okresie mogą spodziewać się wzrostu dochodu rolniczego, jednak jego poziom nie przekroczy parytetu dochodu w połowie z nich. Ryzyko ujemnego dochodu rolniczego dotyczy niewielkiej liczby gospodarstw a wystąpienie tego zjawiska jest mało prawdopodobne.

Słowa kluczowe: małe gospodarstwa mleczne, dochód, ryzyko produkcji, wsparcie bezpośrednie, wydajność mleczna, sytuacja produkcyjno-ekonomiczna, zmienność cen mleka, kwoty mleczne, zazielenienie