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FINANCIAL EFFECTIVENESS AND PRODUCTIVITY OF THE AGRICULTURAL SECTOR IN POLAND

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Abstract

Agriculture is neither the largest nor the most effective segment of the Polish economy. However, since its importance goes beyond purely numerical characteristics, it is justified for the State to support it. What is important in this regard, however, is a kind of balance. These measures cannot be a substitute for initiatives to strengthen its financial efficiency and increase its productivity. The key question therefore becomes to what extent agricultural support through financial instruments improves the performance of this sector of the Polish economy and how neutral it remains for it, while burdening public finances. In view of the above, the purpose of this article is to examine the productivity and financial efficiency of agriculture in Poland using the FADN methodology based on agricultural accounting. The structure of the article has been subordinated to the achievement of the intended research objective. The article starts with an introduction to the issues of financial efficiency and productivity in agriculture. Next, there is a presentation of agriculture and its characteristics as a segment of the Polish economy. Further presented and discussed are the data and methodology used in the study and studies on the productivity and financial efficiency of agriculture in Poland. In the final part of the article, the authors seek to analyse the impact of public transfers on market effects and discuss the modernisation of Polish agriculture and improvement of rural infrastructure. In a sense, the whole analysis closes with a summary containing the most important findings of the studies carried out.

JEL classification: R51[4], Q14[5], Q19[6], D24[7]

Keywords: financial efficiency of agriculture, FADN accounting, agricultural productivity

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[4] R51 Finance in Urban and Rural Economies
[5] Q14 Agricultural Finance
[6] Q19 Agriculture: Other
[7] D24 Production; Cost; Capital; Capital, Total Factor, and Multifactor Productivity; Capacity
[8] FADN (Farm Accountancy Data Network) is a European system for collecting farm accountancy data. The network covers 28 EU Member States and more than 81 000 farms. Farms participate in the FADN on a voluntary basis.

Introduction

The following article is trying to answer two questions:

1) How is agricultural productivity in Poland shaped and to what extent does is depend on the size of the farm?
2) How is the financial efficiency of agriculture in Poland presented in the light of the data collected under the European FADN programme?[8]

Measuring the financial performance of agriculture and its impact on the national economy is not a simple issue. This is mainly due to the fact that the issue of financial efficiency and its efficiency is an extremely complex and at the same time difficult to quantify due to its diversity (Kulawik, 2008). Access to data is also a problem – the reporting systems currently in place in agriculture do not fulfil their task in many respects. Examples include inaccuracies in the data presented, as well as non-taking into account in the analysis of farms with the smallest arena (Misiąg, 2020).

Due to the factors presented above, the article has a chance to shed new light on the financial efficiency and productivity of agriculture in Poland. This issue is extremely important. On the one hand, agriculture in Poland is heavily supplied with financial flows (both direct and indirect) from national and EU funds. On the other hand, the support does not translate sufficiently into the share of agriculture in the national product. Thus, the article has a chance to reopen the discussion on the directions and forms of support for agriculture, and the research findings contained in it may constitute the basis for the assessment and revision of the directions of financial support for this sector of the national economy.

Literature review

The issue of farm productivity is usually studied as a function of its size (Carter, 1984). Research findings are not homogeneous in this respect and the findings based on them do not ensure consistency in the assessment of the relationship between the scale of agricultural activity and its efficiency. According to Bravo-Urety et al. (2007) large farms are more efficient than small ones, especially when operating within limited liability companies or cooperatives. This is because small farms are not able to diversify their incomes as it happens on large farms. We find a similar position in slightly older works. For example, according to Hall and LeVeen (1978), Kumbhakara et al. (1991) and Subala and Kumbhakara (1993), small farms are considered incapable of guaranteeing a good level of productivity because of the theoretical concept that economies of scale do not exist in the primary sector.

The positions of other authors remain in opposition to the views set out above. Bielik & Rajcaniova (2004) or Bojnec & Latruffe, (2007), argue that in small farms run by a single entrepreneur (family farming model) through crop diversification and efficient use of the workforce, it is possible to maximise the productivity of the labour factor while minimising economic and entrepreneurial risks. Hughes (2000), argues that small farmers are more efficient than others due to the better organisation of the factors such as work, capital and investment.

Bielik & Rajcaniova (2004) point to another reason for the higher productivity of small farms, namely the decrease in marginal costs. Latruffe et al. (2004), add a reduction in unemployment arising from employment in small farms, and thus indicate their broader positive impact on the economy on both a micro and macroeconomic scale. These elements, combined with each other, have a positive impact not only on the technical efficiency, but also on the economic efficiency of small farms. Gorton & Davidova (2004) prove that farm performance is influenced by factors such as the form of ownership, the legal status of the farm managers and the level of human capital. Therefore, according to the authors, small family farms are more efficient than large ones because they can be managed in a different way.

This black-and-white approach in analysing the impact of farm size on production efficiency is now increasingly criticised on both empirical and conceptual grounds. The conceptual objections were raised by Kisleva & Peterson (1996). The authors argue that economies of scale are a temporary phenomenon of imbalance that persists only under certain circumstances. As a result, the observed relationship between farm size and productivity may be due to unobserved variables, and the traditional explanation of farm growth as a mechanism for using economies of scale is insufficient to explain the growth of medium-sized farms. Seckler & Young (1978), on the other hand, prove that differences in the way a farm is managed are more important than its size. Thus, what it explains in practice is that today the average size of farms is increasing, and larger farms are more profitable and efficient because of the way in which they are managed rather than the relationship between a farm size and its productivity as such.

Equally important is the question of the financial efficiency of agriculture. In this research area, two points are highlighted:

1) the required rationalisation of the level of employment in agriculture, without which there is no prospect of improving the economic and social sustainability of the agricultural sector in the country (Misiąg et al., 2020),
2) the role of instruments based on financial transfers

from non-agricultural sectors to agriculture.

The financial efficiency of the agricultural sector in Poland requires that these transfers cease to play a dominant role and begin to perform a complementary function. The current system of intrasectoral transfers not only does not produce the intended results, but also poses a burden on more efficient sectors of the economy, reducing their efficiency (Kołodziejczyk, 2020).

Kulawik & Płonka (2013) further show that the subsidy rate, which is the quotient of the single area payment and agricultural production, as well as the subsidy rate at which the single area payment was derived from the family income of the holding, have so far been negatively correlated with the efficiency of agricultural holdings in Poland. That line of argument is supported by the position taken by Czekaj (2008), who has shown that state aid was mainly used by those holdings which had, on average, a higher technical and financial efficiency. This means that support contributes to the polarisation of farms in Poland, as it goes to more efficient farms with greater economic potential. Public support can therefore stimulate competitiveness, but mainly of the strongest farms.

Poczta & Średzińska (2007) express a similar view by demonstrating that agricultural labour productivity, measured by both net added value per full-time total and income from the family farm per fully-employed unpaid person, shows a much higher level on economically stronger farms. Kołoszko-Chomentowska (2006) stresses that income parity in Poland is achieved only by developing farms with a large production scale, being a part of market network.

In the characteristics of the issue under consideration, the significant variation in regional gross value added per agricultural employee, i.e. the measure of the economic efficiency of agriculture (the relationship of labour input to the gross value added effect obtained), must be taken into account. It shows that the provinces with the relatively weakest (least efficient agriculture) , do not bridge the gap in terms of agricultural efficiency, between the best regions. The regions with the least efficient agriculture either maintain a long distance to the most efficient regions in this respect or the distance between them is deepened (Czudec et al., 2017). The relation the economic efficiency of the agricultural labour factor to the efficiency (productivity) of the total labour factor in the economy of the region concerned is also very important. Such values, as the parameter discussed above, indicate a very wide regional variation. In some provinces with relatively weaker economic agriculture, there is also a relatively less efficient economy. As a result, if agricultural labour productivity was to be applied to labour productivity in the economy of the country rather than the region, the disparities between the regions would be even greater. Studies of the relationship between the share of agriculture in gross value added and the pace of economic growth have shown that there is no close link between the rate of economic growth in each region and the economic efficiency of agriculture, expressed by the level of gross value added per employee. Czudec et al. (2017) concluded on this basis that agriculture is not an important enough element of the economic system in the regions to fundamentally influence their growth rate. Moreover, the

Table 1: Land use in Poland 2010-2018

Specification	2010	2013	2015	2016	2017	2018
	km^2					
Total area	312.679,7	312.679,7	312.679,7	312.679,7	312.679,7	312.696,1
Agricultural area	189.309,8	187.701,4	186.828,2	186.207,0	188.101,3	187.764,8
of which: on farms	148.596,5	146.091,6	145.452,7	145.552,7	145.432,8	146.690,2
Forests	92.757,8	93.537,3	93.825,8	93.951,7	94.403,1	94.257,3
of which: on farms	11.443,7	10.331,3	9.343,8	9.343,8	9.440,3	9.359,6
Built-up and urbanised land	15.502,3	16.127,9	16.520,9	16.782,4	17.006,4	17.152,5
Other land	15.109,7	15.313,1	15.504,8	15.738,6	13.168,9	13.521,6
	Total = 100					
Total area	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**
Agricultural area	60,5	60,0	59,8	59,6	60,2	60,0
of which: on farms	47,5	46,7	46,5	46,6	46,5	46,9
Forests	29,7	29,9	30,0	30,0	30,2	30,1
of which: on farms	3,7	3,3	3,0	3,0	3,0	3,0
Built-up and urbanised land	5,0	5,2	5,3	5,4	5,4	5,5
Other land	4,8	4,9	5,0	5,0	4,2	4,3

Source: Data of The Central Office of Surveying and Cartography published by the Central Office of Statistics

relatively excessive involvement of factors of production in agriculture (especially labour and capital) is slowing down the economic growth of the regions rather than taking it on foot.

AGRICULTURE AS A SEGMENT OF THE POLISH ECONOMY

According to data published by the GUS of the Central Office of Surveying and Cartography, agricultural land in Poland occupies about 187.8 thousand. km^2, or about 60% of the total area of the country. For many years, the agricultural area has been decreasing – in 2010-2018 alone there were about 154,5 000 hectares of agricultural land in Poland, while the area of forests increased.

The figures in Table 1 describe the area development status resulting from the surveying records. Status land in this register does not, however, necessarily reflect its actual use. Moreover, according to the so-called new definition of agricultural holding since 2012[9], farms with an area of less than 1 hectare and non-agricultural holdings are not considered to be agricultural holdings[10]. Such an approach means, on the other hand, that land owned by owners with less than 1 hectare of agricultural land is not (with some exceptions[11]) included in the account of agricultural area on agricultural holdings. However, that information does not explain the reasons for the discrepancy between the standard area of agricultural land and the area of that land on agricultural holdings. However, this difference corresponds to 22% of the state of agricultural land (i.e. the area of two medium-sized provinces).

According to the data from Table 2 in Poland, in 2018 there were 1.428.800 farms, the vast majority of which (i.e. about 99.7% of all farms) were private households. The holdings operating in the form of enterprises were significantly larger than individual holdings (their average area was 314,7 ha) and the agricultural area they covered accounted for around 7,8 % of all agricultural area on the holdings.

The area structure shown in Table 3 is dominated by small, low-yield holdings. According to the results of the surveys of farm finances carried out within the FADN network by the Institute of Agricultural Economics and Food Economy, about 700 000, i.e. almost half of the farms operating in Poland, have an annual income of less than 4 000. euro, which at the current exchange rate of the euro corresponds to around PLN 17.7 000 per year, or about PLN 1470 per month.

[9] In Polish law there are several different definitions of an agricultural holding.
[10] ACT of 15 November 1984 on agricultural tax, Article 2. paragraph 1.
[11] Holdings with an area of less than one hectare may be considered as agricultural holdings provided that part of the production of those holdings is intended for sale or if their production exceeds certain physical thresholds, cf. Regulation No1166/2008 of the European Parliament and of the Council of19 November 2008 on the examination of the structure of agricultural holdings and the examination of agricultural production methods and repealing Council Regulation (EEC) No 571/88 (OJ EULNo321of1.12.2008).

Table 2: Farms in Poland 2010-2018

Specification	2010	2013	2015	2016	2017	2018
	Thousand.					
Farms	1.509,1	1.429,0	1.409,6	1.410,7	1.405,7	1.428,8
of which: individual holdings	1.505,0	1.425,4	1.405,5	1.406,6	1.401,8	1.425.1
	km^2					
Area	169.858,1	164.874,8	162.976,6	162.362,0	164.148,3	164.154,6
Agricultural area	148.596,5	146.091,6	145.452,7	145.552,7	145.432,8	146.690,2
Forests	1.144,4	1.033,1	9.343,8	9.343,8	9.440,3	9.359,6
Other land	20.117,2	17.750,1	8.180,1	7.465,5	9.275,2	8.104,8
	Hectares					
Average inn area agricultural sector	11,11	11,17	11,17	11,19	11,42	11,52
of which: agricultural land	10,23	10,42	10,49	10,56	10,65	10,81
agricultural area	9,72	9,90	9,97	10,03	10,12	10,29
Forests	0,75	0,70	0,64	0,63	0,66	0,66

Source: Own study based on data from The Statistical Yearbooks of Agriculture of the Central Office of Statistics

Table 3: Agricultural area in Poland in 2010-2018 by provinces and size of agricultural holdings

Voivodship	Area of holdings							
	Total	0 - 3	3 - 5	5 – 10	10 - 20	20 - 30	30 - 50	50+
	Ha							
Total Poland	**14.669.023**	**903.685**	**988.713**	**2.224.237**	**2.903.153**	**1.517.009**	**1.605.035**	**4.527.193**
Lower Silesian	855.087	41.158	28.851	76.119	99.095	64.465	70.809	474.590
Kuyavian-Pomeranian	1.097.622	23.870	24.647	99.012	217.816	185.961	166.702	379.614
Lublin	1.413.267	102.100	133.282	315.268	300.167	145.684	161.757	255.008
Lubusz	388.070	12.871	10.792	29.216	40.992	28.454	34.231	231.513
Łódź	995.184	64.787	102.258	260.280	262.263	96.731	96.217	112.648
Lesser Poland	557.114	157.829	120.943	112.390	56.409	22.862	25.691	60.991
Masovian	2.148.222	104.156	179.892	516.522	618.346	212.244	228.232	288.832
Opole	488.568	16.870	9.820	31.200	49.529	43.519	61.724	275.904
Subcarpathian	548.548	134.696	97.300	97.723	53.888	25.537	36.564	102.841
Podlaskie	1.072.680	23.491	36.678	133.890	322.115	180.982	167.001	208.522
Pomeranian	750.770	18.110	15.022	64.482	130.272	77.774	83.319	361.790
Silesian	371.897	54.772	43.889	57.935	50.783	28.814	30.191	105.513
Świętokrzyskie	470.743	59.342	86.395	133.238	91.387	34.490	27.636	38.253
Warmian-Masurian	948.701	16.871	18.842	54.508	144.127	99.124	130.772	484.456
Greater Poland	1.737.617	60.112	65.072	205.928	387.297	217.083	205.482	596.643
West Pomeranian	824.934	12.651	15.028	36.524	78.666	53.284	78.707	550.076

Source: Own study on the basis of The Statistical Yearbooks of Agriculture of the Central Office of Statistics

The areas of agricultural holdings in the various provinces shown in Table 4 are highly diversified, with the least fragmented in the provinces where state farms operated on large areas of land until 1990.

Table 4: Average area of agricultural land on agricultural holdings

Voivodship	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	Hectares									
Poland	**10,23**	**10,36**	**10,38**	**10,42**	**10,48**	**10,49**	**10,56**	**10,65**	**10,81**	**10,95**
Lower Silesian	15,72	16,01	16,05	16,01	16,22	16,21	16,3	16,46	16,72	17,10
Kuyavian-Pomeranian	15,01	15,04	15,04	15,14	15,30	15,40	15,51	15,77	16,14	16,43
Lublin	7,40	7,46	7,45	7,50	7,54	7,58	7,65	7,73	7,86	7,93
Lubusz	20,32	20,82	20,78	20,75	20,92	20,94	21,14	21,18	21,52	21,90
Łódź	7,42	7,49	7,52	7,57	7,61	7,62	7,67	7,72	7,84	7,92
Lesser Poland	3,83	3,86	3,88	3,92	3,95	3,98	4,02	4,04	4,10	4,13
Masovian	8,44	8,52	8,50	8,51	8,55	8,52	8,54	8,57	8,68	8,75

Opole	17,83	18,00	17,99	18,12	18,22	18,21	18,3	18,51	18,69	19,02
Subcarpathian	4,47	4,54	4,56	4,60	4,63	4,71	4,73	4,77	4,83	4,90
Podlaskie	12,11	12,22	12,20	12,23	12,24	12,13	12,19	12,27	12,44	12,51
Pomeranian	18,84	19,00	18,94	18,95	19,00	19,02	19,09	19,16	19,42	19,58
Silesian	6,83	7,01	7,14	7,24	7,37	7,42	7,56	7,70	7,85	8,02
Świętokrzyskie	5,42	5,49	5,49	5,53	5,57	5,57	5,63	5,67	5,77	5,82
Warmian-Masurian	22,95	23,07	22,88	22,90	22,92	22,76	22,7	22,79	23,05	23,25
Greater Poland	13,43	13,47	13,41	13,46	13,51	13,43	13,49	13,56	13,74	13,99
West Pomeranian	30,30	30,70	30,67	30,20	30,29	30,00	30,20	30,35	30,78	31,44

Source: Own study based on announcements by the President of the Agency for Development and Modernisation of Agriculture available at: www.arimr.gov.pl/pomoc-krajowa/srednia-powierzchnia-gospodarstwa.html (accessed 14.04.2020)

The number of people working in the agricultural sector has remained at almost the same level for 10 years. With an average annual increase of 1.6% in the national economy and increasing agricultural production, this means a gradual reduction in the share of agricultural workforce in the total number of people working in the national economy, but at the same time, at least statistically, an increase in agricultural labour productivity. The data in Table 4 shows that this fall is visible not only nationally, but also in those provinces where the share of agricultural workforce is much higher than in the whole country. The main reason for the decrease in the number of people working in this segment of the Polish economy is the decrease in the number of farms (as well as their area), whose owners are the largest group working in agriculture. It is also likely that seasonal workers are widely employed ,most of whom are not recorded in any official statistics.

Table 5: Working in agriculture 2010-2018

Content	2010	2013	2015	2016	2017	2018
	Working in the national economy					
	Thousand. People					
Total Poland	**13.778,3**	**13.919,8**	**14.504,3**	**14.964,4**	**15.380,7**	**15.614,9**
	Working in agriculture					
	Thousand. People					
Total Poland	**2.330,0**	**2.329,3**	**2.334,9**	**2.333,4**	**2.332,0**	**2.326,4**
of which:						
Lublin	305,9	305,7	305,8	305,6	305,7	305,4
Lesser Poland	270,7	270,6	270,7	270,5	270,5	270,5
Masovian	298,0	298,4	300,0	300,0	300,0	298,5
Subcarpathian	255,9	255,7	255,8	255,7	255,6	255,5
	Working in the national economy = 100					
Total Poland	**16,9**	**16,7**	**16,1**	**15,6**	**15,2**	**14,9**
of which:						
Lublin	38,5	38,2	37,4	36,9	36,3	35,7
Subcarpathian	32,7	32,3	31,6	30,8	30,0	29,5
Podlaskie	31,2	31,1	30,1	29,5	28,8	28,1
Lower Silesian	8,4	8,2	7,9	7,6	7,4	7,3
Pomeranian	8,3	8,2	7,8	7,4	7,1	7,0
Silesian	6,1	6,1	5,9	5,8	5,7	5,6

Source: Own calculations based on data from the 2011-2019 Labour Statistics Yearbooks

A comparison of data on the number of people working in agriculture with data on the number of agricultural holdings shows that the largest group of agricultural workers is made up of farm owners and family members who help them. However, it should be recalled that official statistics show the number of employees at the end of the year, which means that seasonal workers are not included. Of the four provinces with the highest number of agricultural workers (48.6% of all those working in agriculture in Poland), only the Lublin region is a typical agricultural province. High employment in the Lesser Poland and Subcarpathian voivodships[12] is the result of a large fragmentation of farms in these provinces and difficult management conditions, while in Masovian province a large area of the province and agricultural land is the most essential.

[12] Voivodships in Poland are units of the territorial division. They correspond to NUTS2 in the system of statistical territorial units.

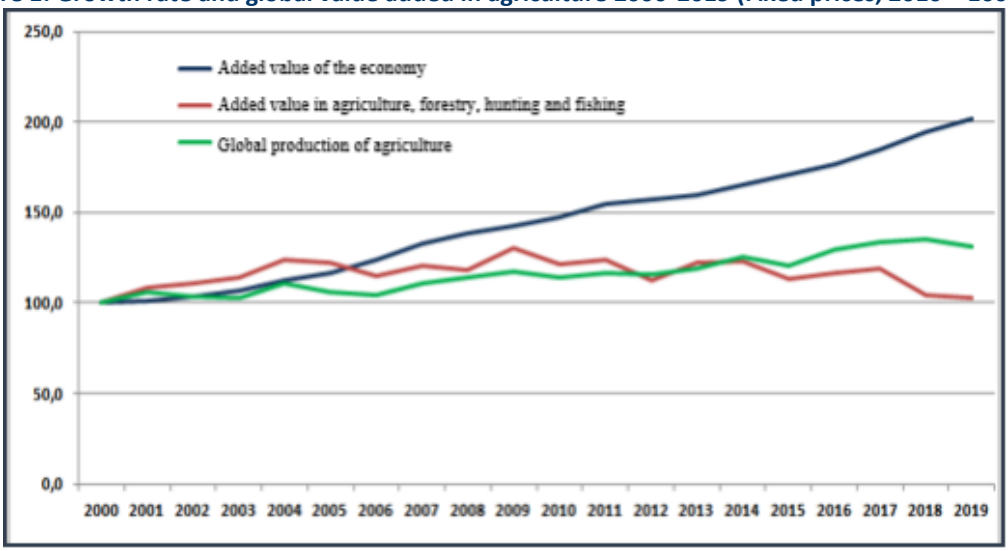
Due to fluctuations in the value of agricultural production originating from changing weather conditions, a reliable picture of the volume and dynamics of this production can only be obtained by analysing the basic volumes over a longer period – here we use the data from 2010-2019, and where possible – from 2000-2019. Between 2000 and 2019, global agricultural production, measured by fixed prices from 2000, increased by 31.4%, giving an average annual increase of around 1.4%, with livestock production growing much faster (2.1% per annum) than crop production (0.6% per annum). This increase has been achieved with the permanently decreasing production of agricultural land (see Table 6).

Table 6: Global production and gross value added in agriculture 2000-2019

Specification	2000	2005	2010	2015	2018	2019
	Fixed prices, year 2000 = 100					
Global agricultural production	100,0	105,9	113,8	120,9	135,5	131,4
Plant production	100,0	98,1	102,4	104,2	115,9	111,4
Livestock production	100,0	113,7	124,5	136,0	153,1	149,7
Final production in agriculture	100,0	115,1	126,2	138,0	156,9	ND
Gross value added in the national economy	100,0	116,5	147,4	171,2	194,6	202,6
of which: agriculture, forestry, hunting and fishing	100,0	121,9	121,5	112,9	108,5	108,1

Source: Own study based on data from The Agricultural Statistics Yearbooks 2010-2019

Figure 1: Growth rate and global value added in agriculture 2000-2019 (Fixed prices, 2010 = 100)



Source: Own study based on The Central Office of Statistics data

The added value in Section A (agriculture, forestry, hunting and fishing), the majority of which is agriculture, reached a level slightly higher in 2019 than in 2000. It should be noted that the increase in gross value added is significantly lower than the increase in output and final production measured by constant (fixed) prices. This signals a significant deterioration in the economic conditions of agricultural management, since there is no reason to believe that the lower dynamics of final production were caused by rapidly increasing indirect costs.

The graph above indicates that the fundamental deterioration in the economic performance of agriculture has strengthened in recent years. As a result of these changes, the share of Section A in the added value of the economy as a whole decreased from 3.3% in 2000 to 2.3% in 2018.

Table 7 data on crop yields and harvests show that the decrease in the share of agricultural added value in the added value of the economy as a whole and the low ratio of the value-added relationship to global output, as well as the low growth rate of crop production, have two main reasons:

1) the worsening of the price ratio of the prices of products sold by farmers to the prices of goods and services purchased for agricultural production,
2) the shrinking of the area where the most important crops are planted.

Table 7: Crop yields and harvests for the period 2000-2019

Specification	2000	2005	2010	2015	2018	2019
	dt from 1 hectare					
Yields						
Total cereals	25,3	32,3	35,6	37,3	34,3	-
of which: wheat	32,3	39,5	43,9	45,7	40,6	43,9
Rye	18,8	24,1	26,8	27,8	24,2	27,2
Rape and agrimonia	21,9	26,3	23,6	28,5	26,1	27,1
Potatoes	194,0	176,0	211,0	210,0	251,0	214,0
Sugar beet	394,0	416,0	483,0	520,0	599,0	575,0
	Thousand of tones					
Collections						
Total cereals	22.341	26.928	27.228	28.003	26.780	28.990
of which: wheat	8.503	8.771	9.408	10.958	9.820	11.012
Rye	4.003	3.404	2.852	2.013	2.167	2.461
Rape and agrimonia	958	1.450	2.229	2.701	2.202	2.373
Potatoes	24.232	10.369	8.188	6.152	7.312	6.482
Sugar beet	13.134	11.912	9.973	9.364	14.303	13.837

Source: Own study based on data from The Agricultural Statistics Yearbooks 2000-2019

Analysis of a data published by the Statistics Poland, shows growing gap between the prices of agricultural products and the prices of goods and services purchased for agriculture – between 2010 and 2018 consumer prices increased by 14.2% and average agricultural production prices by 12.2%, including crop production – by 3.5%. It should be mentioned, however, that 2019 has brought about a very significant increase in the prices of agricultural products.

Gross value added in agriculture increased by 96% between 2000 and 2019, with consumer prices rising by 49.5%. This means that the real value of agricultural income has increased by 1.4% on average per year, at a rate well below the rate of GDP growth in constant prices or real wage growth in the national economy. This clearly increases the income gap between farmers and those working in other sectors of the economy. It should be added that the statistics show quite significant differences between the prices paid to farmers by buying-in undertakings and the prices obtained by farmers in markets.

Agriculture is still dominated by individual farms. From the data in table 8 we can see that individual farm production accounts for more than 88% of global production, but only 80.5% of gross value added, which means that efficiency indicators are worse on individual farms than in large agricultural enterprises. This is undoubtedly

due to the fact that the average area of an individual agricultural holding (around 9.5 hectares in 2018) is 32 times lower than the average area of an agricultural undertaking of more than 314 hectares.

Table 8: Output, intermediate consumption and gross value added of agriculture 2010-2018

Specification		2010	2015	2016	2017	2018
		Total[12]				
Output	A	84.484,2	98.638,3	103.357,0	115.611,7	113.150,7
including individual farms	A	74.573,3	86.586,0	91.469,1	104.350,6	99.739,2
	B	88,3	87,8	88,5	90,3	88,1
Intermediate consumption	A	53.306,9	64.365,6	64.425,6	65.605,8	67.268,0
including individual farms	A	46.674,3	57.116,7	57.416,5	60.380,7	62.779,2
	B	87,6	88,7	89,1	92,0	93,3
Gross value added of agricultural production	A	31.177,3	34.272,7	38.931,4	50.005,9	45.892,8
including individual farms	A	27.899,0	29.469,3	34.052,6	43.969,9	36.960,0
	B	89,5	86,0	87,5	87,9	80,5
		PLN per 1 hectare				
Output		5.686	6.782	7.107	7.908	7.714
including individual farms		5.644	6.539	6.881	7.765	7.374
Intermediate consumption		3.588	4.425	4.430	4.488	4.585
including individual farms		3.533	4.313	4.350	4.493	4.641
Gross value added of agricultural production		2.098	2.325	2.677	3.420	3.129
including individual farms		2.111	2.226	2.561	3.272	2.732

[13] A –PLN 1 million, B – total agriculture = 100

Source: Own study based on FADN data, available on www.fadn.pl (14.06.2020) and https://ec.europa.eu/agriculture/rica/ (14.06.2020)

SOURCE DATA AND RESEARCH CONCEPT

Data on the productivity of Polish agriculture are the source of research carried out under the FADN system[14] of the European system for collecting accounting data from agricultural holdings. This research has been conducted since 1965. The FADN was created in stages, with successive enlargements of the European Union. Liaison agencies are responsible for the implementation of FADN research in each country. In Poland, it is the Institute of Agricultural Economics and Food Economy – The State Research Institute in Warsaw. Farms participate in the FADN on a voluntary basis and their classification for testing is carried out according to two criteria: economic size and agricultural type (Floriańczyk et al., 2019).

The economic size of an agricultural holding is defined in the FADN methodology as the sum of the standard output (SO) obtained from all agricultural activities on the holding. On the other hand, the agricultural type of the holding is determined on the basis of the share of the SO from each agricultural activity in the total SO value of the holding[15], calculated as *the average of five years, the value of production of a specific plant or animal production activity obtained from one hectare or per animal per year, under the region average production conditions* (Goraj & Olewnik, 2016). For the presentation of aggregated data, holdings are divided by their SO into 14, nine or six groups. Farms are distinguished by six groups:

1) very small, for which 4.000 € ≤ SO < 8.000 €,
2) small, for which 8.000 € ≤ SO < 25.000 €,
3) medium, for which €25,000 ≤ SO < €50,000,
4) medium large, for which €50,000 ≤ SO < €100,000,
5) large, for which €100,000 ≤ SO < €500,000,
6) very large, for which SO > 500.000 €.

The agricultural holding's type is determined on the basis of the share of the SO from the various agricultural activities in the creation of the total SO value of the hold-

[13] For example, in 2018, average buying prices were lower than market prices: for wheat by 13.2%, for barley by 12.7%, for pork livestock by 9.5%, for beef livestock by 6.7%, for potatoes by 40.2%, for chicken eggs by 71.8%.

[14] *Farm Accountancy Data Network (FADN).*

[15] If the clearly dominant type of activity cannot be distinguished, the holding shall be classified as mixed.

ing and reflects the direction of its specialisation. Two classification schemes of 14 or eight types are used. The tests for this article use a classification of eight types distinguishing: field crops, horticultural crops, vineyards, permanent crops, dairy cows, herbivores, grain animals[16] and mixed farms, with not a single vineyard in the sample of farms tested in Poland.

The FADN collects data from a sensitive group that describe both the economic and financial situation of agricultural holdings. It is the only such a database that collects data in a uniform manner and farms form a statistically representative sample of commodity farms operating within the European Union. The research sample for the Polish FADN covers 12,220 farms with an SO of more than 4,000 euros. They were selected from a population based on the results of the 2010 Census of Agriculture. This population consisted of 730 883 farms, which means that about 51.4% of the farms operating in 2010 had incomes not exceeding EUR 4 000 per year, or about PLN 1,330 per month. The sample tested under the Polish FADN is representative of the population of farms with an SO greater than 4,000 euros because of the type of holding, the size of the SO, and their location in the provincial

[16]In Polish studies, this type of research distinguishes pig and poultry farms. In statements for the purposes of the FADN, this division shall not be disclosed.

SO greater than 4,000 euros because of the type of holding, the size of the SO, and their location in the provincial system (Florian et al., 2019).

The FADN receives a set of around 1,000 different farm data each year from each of the farms surveyed. It is therefore a very valuable source of information on the functioning of this sphere of the economy. An important problem limiting the possibility of analysing FADN results is the fact that these results are presented to the public only in an aggregated system to the so-called classes and farm types described above. This makes it difficult, for example, to study the relationship between inputs and the economic performance of the farms surveyed.

Due to the exclusion of the smallest holdings, the results of the FADN are not representative of the whole of agriculture but can be considered representative of the part of it which generates commodity production. However, this representativeness is not complete due to the fact that for subsequent years the same 2010 sample structure is adopted, although in fact the structure of agricultural holdings in 2018 differs significantly (both in terms of profitability and farm structure by type of activity) from that recorded in the last agricultural census. The test sample thus selected, and its structure used in these studies are presented in table 9.

Table 9: FADN sample structure in 2018

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	Number of holdings in the sample						
Field crops	500	1.747	1.049	624	309	34	**4.263**
Horticultural crops	5	68	67	71	64	1	**276**
Permanent crops	47	255	106	27	3	–	**438**
Dairy cows	25	514	1.016	779	202	3	**2.539**
Herbivores	114	445	194	77	15	1	**846**
Pigs and poultry	1	83	120	209	233	19	**665**
Mixed farms	310	1.232	902	543	181	25	**3.193**
Time	**1.002**	**4.344**	**3.454**	**2.330**	**1.007**	**83**	**12.220**
	% share						
Field crops	4,1	14,3	8,6	5,1	2,5	0,3	**34,9**
Horticultural crops	0,0	0,6	0,5	0,6	0,5	0,0	**2,3**
Permanent crops	0,4	2,1	0,9	0,2	0,0	–	**3,6**
Dairy cows	0,2	4,2	8,3	6,4	1,7	0,0	**20,8**
Herbivores	0,9	3,6	1,6	0,6	0,1	0,0	**6,9**
Pigs and poultry	0,0	0,7	1,0	1,7	1,9	0,2	**5,4**
Mixed farms	2,5	10,1	7,4	4,4	1,5	0,2	**26,1**
Time	**8,2**	**35,5**	**28,3**	**19,1**	**8,2**	**0,7**	**100,0**

Source: Custom calculations based on data from the FADN database

Tabular data indicate the dominance of small and medium-sized holdings in the test sample. The sample distribution for the "Mixed Farms" type is also characteristic, indicating a clear trend towards a decreasing share of mixed holdings, which account for more than 30% of small farms and only 18% for large farms. Large farms, more than 30% of which are mixed farms, break out of this dependency. This is probably due to the fact that, with a large area of these holdings, units corresponding to different types of holdings can be identified, large enough that they can be efficient in any type of activity – which is not possible on smaller farms.

THE RESULTS OF THE STUDIES AND THEIR DISCUSSION

Table 10 describes the structure of the use of agricultural land. According to its content, three types of farms dominate in Poland: field crops, cow farms and farms with a mixed production profile. Holdings with annual incomes between EUR 4 000 and EUR 8 000, which, in quantitative terms, account for around 8 % of the sample, manage on agricultural land which area represents only 1,8 % of the agricultural land used by all the sample holdings.

Table 10: Land use structure in 2018 by income classes and farm types

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	% share						
Field crops	1,0	6,5	8,5	9,8	14,8	7,9	**48,5**
Horticultural crops	ND	0,1	0,1	0,1	0,2	ND	**0,4**
Permanent crops	ND	0,5	0,4	0,2	ND	ND	**1,1**
Dairy cows	ND	1,5	5,0	6,4	3,6	ND	**16,5**
Herbivores	0,2	1,6	1,4	0,9	0,7	ND	**4,7**
Pigs	ND	0,2	0,4	1,1	1,9	0,5	**4,1**
Mixed farms	0,5	3,7	5,2	5,3	4,7	5,3	**24,8**
Time	**1,8**	**14,0**	**20,9**	**23,7**	**25,8**	**13,8**	**100,0**

Source: Own calculations based on data from the FADN database

Table 11 shows the huge variation in final output produced on farms. The data in this table also show the deteriorating financial situation in agriculture, as for most distinguished income classes the average value of final production per holding is less than the profitability limit for that class set by the fixed income thresholds and the euro exchange rate (1 euro = PLN 4.26) adopted in the FADN reporting for 2018.

Table 11: Final production in 2018 by income classes and farm types

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	PLN per farm						
Field crops	11.943	37.393	88.800	154.079	420.748	1.864.372	**106.497**
Horticultural crops	ND	40.544	97.632	163.358	339.007	ND	**154.323**
Permanent crops	25.745	50.365	127.563	166.159	ND	ND	**73.199**
Dairy cows	6.289	31.034	84.459	188.937	491.538	ND	**137.216**
Herbivores	3.153	12.735	45.507	119.442	101.365	ND	**30.228**
Pigs and poultry	ND	17.553	43.922	92.137	377.053	1.322.198	**208.961**
Mixed farms	6.674	18.552	47.975	100.447	218.061	1.799.811	**64.894**
Time	**9.748**	**29.203**	**74.232**	**146.956**	**377.201**	**1.608.502**	**102.191**

	% share						
Field crops	0,5	5,2	7,5	7,7	10,4	5,1	**36,4**
Horticultural crops	0,0	0,2	0,5	0,9	1,7	0,0	**3,4**
Permanent crops	0,1	1,0	1,1	0,4	0,0	0,0	**2,6**
Dairy cows	0,0	1,3	6,9	11,8	8,0	0,0	**27,9**
Herbivores	0,0	0,5	0,7	0,7	0,1	0,0	**2,0**
Pigs and poultry	0,0	0,1	0,4	1,5	7,0	2,0	**11,1**
Mixed farms	0,2	1,8	3,5	4,4	3,2	3,6	**16,6**
Time	**0,8**	**10,2**	**20,5**	**27,4**	**30,4**	**10,7**	**100,0**

Source: Own calculations based on data from the FADN database

For example, for first-class income converted to a dollar, the income thresholds are about PLN 17,040 and PLN 34,080, and the average value of final production per holding is almost twice as low as the lower threshold. For the sixth income class, the lower income threshold is $2,130,000. and is approximately 32% higher than the average final production per holding in this group. These accounts mean that the holdings included in the relevant income classes on the basis of the results of the agricultural census did not remain in the 'classes allocated' to them. It must be also noted that the share of first-class households in the total value of final production is already ten times lower than the share of that class in the sample size. At the same time, bearing in mind that more than half of all farms operating in Poland have been excluded from the so-called FADN survey field due to their too low income, it turns out that 60% of the lowest-income households generate less than 1% of all final agricultural production. Additionally, it is worth noting that the lack of any financial data on farms excluded from the FADN observation field causes a fairly significant distortion of the picture of the whole of agriculture in Poland.

The Institute for Agricultural Economics and Food Economy does not publish detailed information on the procedures for excluding low-income holdings from the FADN surveys or, more specifically, from the FADN observation box from which the sample of holdings covered by the detailed surveys is drawn. It should be noted, however, that the last agricultural census took place a decade ago, so the data on which the structure of the FADN population is still based may already be very outdated.

Tables 12 and 13 present the relationship of final production and inputs of the main agricultural factors – agricultural area, number of animals reared and labour. Table 12 clearly shows a significantly higher final production per hectare of horticultural holdings than in other types of holdings. The significantly higher financial efficiency of one hectare in dairy cow farming compared to cattle for meat should also be highlighted.

Table 12: Final production from 1 hectare in 2018 by income classes and farm types

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	PLN						
Field crops	1.210,0	1.994,3	2.178,1	1.960,5	1.751,7	1.588,7	**1.863,5**
Horticultural crops	ND	9.630,4	14.860,2	21.868,6	25.858,6	ND	**20.322,3**
Permanent crops	5.772,4	5.474,4	7.166,5	4.923,2	ND	ND	**5.988,6**
Dairy cows	964,6	2.143,2	3.423,6	4.601,5	5.501,9	ND	**4.212,6**
Herbivores	355,5	685,4	1.279,4	2.138,2	464,7	ND	**1.076,6**
Pigs and poultry	ND	1.841,9	2.585,2	3.475,6	9.140,7	9.116,1	**6.700,9**
Mixed farms	832,2	1.225,4	1.657,8	2.035,0	1.662,9	1.689,0	**1.665,4**
Time	**1.109,3**	**1.798,3**	**2.437,2**	**2.874,7**	**2.928,1**	**1.926,6**	**2.484,2**

Source: Own calculations based on data from the FADN database

The highest final production per unit of work[17] is characterised by field crops, cow-rearing for milk and, as a consequence of high productivity in the two types of holdings mentioned above, mixed holdings. Attention is drawn to the very wide variation in labour productivity – in field crops it is eleven times higher than in horticultural farms. The issue why in most types of farms the volume of final production per unit of work decreases with an increase in absolute income would require a more detailed explanation. This dependency does not apply to holdings with incomes of less than EUR 8 000– in all types of holdings, the labour productivity of holdings with an income of up to EUR 8 000 is at least several times lower than that of the next income group. This should be regarded as another argument in favour of the argument of low efficiency of small farms.

Gross value added (GVA) means, in the FADN studies, final production adjusted for the balance of public aid and taxes due in connection with operational activities. GVA can therefore be regarded as the most synthetic measure of income received by holders of agricultural holdings from two sources, from:

1) final production, i.e. excess value of production over intermediate consumption,
2) the balance of transfers between the holding and the public finance sector, i.e. the difference, in agriculture most commonly positive, between the amount of aid (subsidies) received and the taxes paid on income linked to agricultural activities.

A summary of GVA values by income class and farm type is given in Table 14. It can be seen that almost 2/3 of the total GVA is concentrated in the top three income classes, representing 28% of the sample in terms of the number of farms surveyed.

It is worth noting that according to the latest estimates of the Institute of Agricultural Economics and Food Economy, the FADN research excluded a priori, due to too low production, almost 778 thousand farms, or about 51.5% of all farms in Poland. Excluded farms accounted for almost 15% of the agricultural land on farms, and their production accounted for about 7% of the production of all Polish farms. According to the same data, the average area of agricultural land on the excluded farms was around 2,8 hectares and the average annual production was around PLN 6,6 000, of which a significant part was undoubtedly production for intermediate consumption. It seems clear that these holdings could not for the most part be the sole source of livelihood for their owners, and their share of (market) commodity production is minimal.

[17] For FADN, a unit of work is considered to be work of one full-time employed person all year round.

Table 13: Final production per unit of work in 2018 by income class and farm type

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	PLN						
Field crops	595,0	2.707,9	2.077,0	1.416,5	1.291,6	575,6	**8.663,6**
Horticultural crops	ND	97,9	149,4	220,8	303,4	ND	**771,5**
Permanent crops	78,5	489,6	301,0	123,9	ND	ND	**993,1**
Dairy cows	32,0	873,8	1.899,9	1.667,1	559,5	ND	**5.032,3**
Herbivores	141,4	680,9	343,4	147,1	53,9	ND	**1.366,5**
Pigs and poultry	ND	110,4	205,2	388,7	659,4	213,9	**1.577,7**
Mixed farms	393,7	1.921,9	1.587,5	1.080,6	573,8	687,8	**6.245,2**
Time	**1.240,6**	**6.882,3**	**6.563,5**	**5.044,7**	**3.441,5**	**1.477,3**	**24.649,9**

Source: Own calculations based on data from the FADN database

Table 14: Gross value added in 2018 by income class and farm type

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	PLN per farm						
Field crops	24.603	63.258	141.861	253.804	677.585	2.826.518	**172.525**
Horticultural crops	ND	51.320	108.126	173.092	351.714	ND	**164.976**
Permanent crops	30.821	62.396	151.681	213.606	ND	ND	**89.510**
Dairy cows	15.401	56.745	129.562	252.711	604.437	ND	**189.108**
Herbivores	17.553	47.326	103.344	202.662	360.513	ND	**75.795**
Pigs and poultry	ND	29.678	68.484	129.777	432.206	1.495.449	**251.011**
Mixed farms	16.623	40.831	91.158	171.533	375.419	2.834.250	**115.763**
Time	**21.247**	**53.616**	**119.937**	**218.525**	**524.371**	**2.353.872**	**155.567**
	% share						
Field crops	0,6	5,8	7,8	8,3	11,0	5,1	**38,7**
Horticultural crops	ND	0,2	0,4	0,6	1,2	ND	**2,4**
Permanent crops	0,1	0,8	0,8	0,3	ND	ND	**2,1**
Dairy cows	ND	1,5	6,9	10,4	6,4	ND	**25,3**
Herbivores	0,1	1,1	1,1	0,8	0,3	ND	**3,4**
Pigs and poultry	ND	0,1	0,4	1,4	5,3	1,5	**8,8**
Mixed farms	0,3	2,6	4,3	4,9	3,6	3,7	**19,4**
Time	**1,1**	**12,3**	**21,8**	**26,8**	**27,8**	**10,3**	**100,0**

Source: Own calculations based on FADN database data

The final presentation of the analysis of the effectiveness of agricultural functioning in 2018 is provided in table 15, which shows the share of the balance of subsidies and taxes in 2018 in gross value added by income classes and types of farms. The average share of the balance of subsidies and taxes in the total value of GVA is 34.3%, which seems to be quite high, although in the EU-scale the value does not seem shocking.

Table 15: Share of the balance of subsidies and taxes in 2018 in gross value added by income class and farm type

Farm type	Income classes (thousand euro)						
	4-8	8-25	25-50	50-100	100-500	More than 500	Time
	% share						
Field crops	51,5	40,9	37,4	39,3	37,9	34,0	**38,3**
Horticultural crops	ND	21,0	9,7	5,6	3,6	ND	**6,5**
Permanent crops	16,5	19,3	15,9	22,2	ND	ND	**18,2**
Dairy cows	59,2	45,3	34,8	25,2	18,7	ND	**27,4**
Herbivores	82,0	73,1	56,0	41,1	71,9	ND	**60,1**
Pigs and poultry	ND	40,9	35,9	29,0	12,8	11,6	**16,8**
Mixed farms	59,8	54,6	47,4	41,4	41,9	36,5	**43,9**
Time	**54,1**	**45,5**	**38,1**	**32,8**	**28,1**	**31,7**	**34,3**

Source: Own calculations based on data from the FADN database

Reflection needs to be given to the fact that in the least profitable holdings half of the income comes from transfers of public funds, and these transfers have virtually no market effect. This thread requires a slightly broader perspective. Agriculture and rural areas in Poland receive annually, from public funds, support worth tens of billions of PLN, coming from both national public revenues and funds provided to Poland from the Budget of the European Union (Misiąg et al., 2020). Notwithstanding direct transfers of public funds, farmers benefit from the application of specific rules to farmers by reducing, in relation to taxpayers from other segments of the national economy, the financial burden of taxes and compulsory contributions to public bodies financing public social security and health tasks. Nevertheless, agriculture in Poland is experiencing a setback, expressed both in the decrease in the number of farms and the area under cultivation and in the decreasing share of the added value generated in agriculture to the added value of the entire national economy. Most public funds directed to agriculture are aimed at directly increasing incomes and have no impact on either the modernisation of agriculture or the improvement of rural infrastructure. This results in poor efficiency of state aid to agriculture. This efficiency is additionally impaired by the low selectivity of the support instruments used. Adding to this the fact that the state aid scheme for agriculture is not transparent, it is currently difficult to get a full picture of the state of agriculture and a more complete than hereby presented – basis for a fair assessment of the effectiveness of public aid to agriculture in Poland.

Conclusion

Agriculture and rural areas receive public support of tens of billions of zlotys each year, both from national public revenues and from funds provided to Poland from the European Union budget. Apart from direct transfers of public funds, farmers benefit from the application of specific rules by having reduced, in relation to taxpayers from other segments of the national economy, the financial burden of taxes and compulsory contributions to public bodies financing public social security and health tasks.

Despite such intensive financial assistance, agriculture is experiencing a setback, expressed in the decline in the number of agricultural holdings and areas of crops, as well as in the decreasing share of the added value generated in agriculture to the added value of the whole economy.

Kleinhanss et al. (2007) demonstrated that there is a positive relationship between yield and farm size. They have shown that the financial support granted by the Common Agricultural Policy for production specialisation and efficiency has had a positive effect on the sample of farms belonging to the FADN dataset. This specific relationship between economic size and technical efficiency is also highlighted by the studies of Błażejczyk-Majka and colleagues (2011). Undoubtedly, the reason for this situation is the fact that the strategy of financial support for agriculture in Poland is clearly of social nature.

Analysis of the data contained in this study allows to indicate some recommendations that can positively affect the financial efficiency and productivity of the agricultural sector in Poland.

Consideration should be given to the possibility of using the available agricultural monitoring tools to improve the timeliness and accuracy of the information offered by the public statistics system. It would be useful to improve the quality of the records and reporting on agricultural financial support also.

Inappropriate agrarian structure is the cause of low productivity, creates serious income problems for many farm owners, effectively inhibiting the implementation of technological progress. A derivative of the poor area structure is insufficient specialization of farms and consequently low farmers' income. Considering the above, a recommendation should be to combine farms in order to change the very unfavourable agrarian situation. Financial support should depend on the final crop area.

Another conclusion from the research is the fact that, according to the General Office of Geodesy and Cartography, about 4 million hectares of agricultural land are not used in registered farms. It probably belongs to the Agricultural Property Stock of the State Treasury and local governments. Due to this fact it is suggested to consider the possibility of making an inventory of agricultural land other than farms. The current agrarian situation has an impact on the productivity of agriculture and the share of this sector of the economy in GDP.

The presented article has some objective limitations. Firstly, due to the exclusion of the smallest farms, the FADN results are not representative for the entire agriculture, but it can be considered representative for the part that generates commercial production. Secondly, the representativeness is not complete due to the fact that for subsequent years the same (consistent with the state of 2010) sample structure is adopted, although in fact the structure of farms in 2018 already differs significantly - both in terms of profitability and and as for the structure of farms by type of activity, from that which was registered during the last agricultural census. Finally, the way in which the FADN publishes statistical data significantly impedes the formulation of more precise conclusions as

to the effectiveness of agriculture, although it allows for the formulation of some general conclusions that were presented above.

The research results presented in the article will constitute a starting point for further, in-depth analyses focused on the possibility of changes in the current system of public support for agriculture. The research planned by the authors will aim to outline solutions aimed at increasing the effectiveness of the use of public funds (both national and EU funds) for the implementation of the basic objectives of the Common Agricultural Policy.

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