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Sustainable Intensification vs. Farms` Economic Outcomes – the case of Poland

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Abstract
The concept of agriculture intensification, in traditional terms, is understood as a process of increasing inputs of work units and/or industrial means of production in order to increase production per unit of agricultural land or animal. Having regard to the greater human pressure to natural environment, there is the need of sustainable intensification implementation. Sustainable intensification concerns agricultural productivity increase, simultaneously reducing agriculture negative impact on ecosystem.

Sustainable intensification can be understood in two different ways. The first one refers to inputs minimization, mainly industrial inputs, although such practices may result in reduction of economic outcomes. The second approach is based on the use of agrobiological processes in factor productivity improvement. In this case, of particular importance is the farmer`s extensive knowledge, which translates to the quality of agri-environmental practices, as well as the use of environmentally friendly traditional and modern production technologies.

The purpose of the article is economic assessment of farms in Poland, diversified in the scope of sustainable intensification process. This process was evaluated on the basis of soil fertility data, namely balance of soil organic matter. Farm Accountancy Data Network was used (2004, 2015).

Keywords: sustainable intensification, soil fertility, soil organic matter balance, economic outcomes, farms` sustainability, Farm Accountancy Data Network, Poland

1. Introduction

The concept of intensification in agriculture in traditional terms is understood as a process of increasing inputs of work units and/or industrial means of production in order to increase production per unit of agricultural land or animal (Woś et al., 1979, Harasim, 2006). Intensification of agriculture in Poland comes down to the increased quantity and better use of technical means in agriculture and improved knowledge and skills of farmers (Woś et al., 1979). Generally, the intensification process is associated with the increased consumption of mineral fertilisers and other industrial means for agricultural production (The Montpellier Panel, 2013). Intensification is associated with the increased productivity (efficiency). The productivity can be improved by the increased production, decreased inputs or simultaneous change in the production and inputs. The higher efficiency takes place not only when we achieve more production units from one unit of all inputs, but also by applying new combinations of inputs and technology (Cook et al., 2015, DEFRA, 2012).

Intensification of production is associated with an increased level of production specialisation on farms, as well as frequent separation of directions of the agricultural

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production – the crop production from the livestock production (Zimny, 2014). In case of farms taking up specialisation activities in the field of the livestock production, there is a problem with the proper disposal of surplus manure. On the other hand, farms geared towards the crop production must look for additional non-farm sources of fertilisers. Progressive intensification and specialisation in agriculture are considered typical industrialisation processes, which are often contrary to the sustainable development strategy (Zegar, 2012).

In approaching the issue of the productivity in a conventional manner, it is identified with performance of the crop and livestock production, however, such an approach may be confusing. An excessive focus on the supply should be considered limited, and often means ignoring equally important issues such as access to food and food system management (Cook, et al., 2015). An approach to the productivity, in particular in rural areas, requires a much broader perspective than the purely market aspect (Shiva 1989). The justification is the multifunctionality of agriculture, where apart from providing market goods, it also provides goods which are unvalued (often also unseen) by the market (environmental services, landscape, cultural heritage) (McIntyre et al., 2009).

The issue of sustainable intensification has been introduced due to a need to seek production solutions in agriculture fitting in the concept of sustainable development. Sustainable intensification consists in selecting such agricultural science and zootechnical procedures aimed at improving productivity, which take into account the triad of sustainability goals (Ripoll-Bosch et al., 2012, Buckwell et al., 2014). The postulate of sustainable intensification talks about a need to improve the productivity while minimising and reducing the environmental impact of agriculture. On the one hand, these solutions (practices) should protect the reserves in the natural environment, support the natural circulation of nutrients, protect the soil against erosion and degradation and water resources from pollution. On the other hand, these practices should provide the sufficient productivity of agriculture. Particularly important is to respect specific limits that define sustainable intensification, so that it does not become a tool to promote high-cost agriculture and to create a policy having a negative impact on local conditions (Cook et al., 2015).

Sustainable intensification means a simultaneous improvement in the productivity and environmental management in agricultural land. Sustainable intensification gears the farmer towards such land management so as to obtain a better balance between food production and the environment. It should be considered in two aspects, namely, static and dynamic. The first one takes into account the level of intensity and sustainability, while the other corresponds to the intensification and sustainability process (Buckwell et al., 2014).

Sustainable intensification refers directly to the way of land use and soil quality. The soil quality, along with climate, create a natural basis for the soil production capacity, i.e. soil fertility. The yielding capacity determines also the economic efficiency of inputs made into the soil, i.e. economic efficiency of the process intensification (Woś et. al., 1979, p. 180). In the context of sustainable intensification, exceptionally relevant is the adoption of the most important soil parameters as determinants of a possibility to maintain natural processes and production capacity (Blum et al., 2015). Solutions fitting in sustainable intensification should be sought in agricultural science practices ensuring the maintenance of the soil production potential ultimate increase in soil fertility, which translates into greater possibilities of carbon sequestration.

The purpose of the article is economic assessment of farms in Poland, diversified in the scope of implementation of sustainable intensification process. This process was evaluated on the basis of soil fertility data, namely balance of soil organic matter.

2. Research method

The soil quality can be assessed through various parameters, and one of them is the value of the soil organic matter balance. This indicator has been used to assess farms in terms of implementing sustainable intensification (formula 1). This balance is derived from crop rotation and fertilisation in the farm, determined by the soil richness and type. The positive balance attests to the soil enrichment with humus by disintegration of soil organic matter which guarantees the right provision of grown plants with nutrients throughout the growing season, and thus their appropriate productivity. On the other hand, the negative balance means the loss of organic matter results in the soil degradation and the loss of its fertility, in particular, when such balance has persisted for several years. The effect of degradation is the release of large amounts of minerals, including nitrogen, which leads to pollution of groundwater and surface water (Kuś, Kopiński, 2012), as well as the untapped production potential of crops[1].

Formula 1. Balance of soil organic matter

$$SOMB = \frac{(x_i \times r_i) + (x_j \times r_j) + (y \times r_1) + (z \times r_2)}{\sum_{i=1}^{n} x_i}$$

where:

SOMB	soil organic matter (t/ha),
x_i	area of reproductive crop species (ha); $i = 1, 2, 3, \dots, n$,
x_j	area of depredating crop species (ha); $j = 1, 2, 3, \dots, n$,
y	natural fertilizers – manure (tons),
z	organic fertilizers – straw (tons),
r_i	reproduction rate of crop species (tons),
rj	degradation rate of crop species (tons),
r_1	reproduction rate of natural fertilizers/manure (tons),
r_2	reproduction rate of organic fertilizers/straw (tons).

Source: [Wrzaszcz, et. al. 2015].

The balance of soil organic matter was the basis of farms` division into four groups. The study was based on a panel of farms covered by the FADN system (Farm Accountancy Data Network) and keeping agricultural accounting on a continued basis in

[1] Cf. also (Wrzaszcz et al., 2014, Wrzaszcz et al., 2015).

the years 2004 and 2015. This farms` panel consisted of 4 thousand farms with arable land cultivation. Farms` analysis in the defined period has allowed to recognize the scale of the phenomenon of sustainable intensification in agriculture and changes in this scope. Within the panel of the farms, four groups of farms were distinguished, namely: constantly sustainable, constantly not sustainable, withdrawn farms, progressive farms. These groups may be treated of sets of farms differing in terms of implementation of sustainable intensification process.

The group of **constantly sustainable (CS) farms** was formed by farms which in the analysed years were characterised by sustainable intensification (SI). These farms were characterised by the positive soil organic matter balance, which proved the process of increasing its fertility and crop productivity.

The group of **constantly not sustainable (CNS) farms** was composed of farms being opposite to constantly sustainable farms, and the soil organic matter balance in these units had negative values. In these farms, the soil degradation process took place, thus, the process of diminishing its productivity was taking place.

The next two groups were formed by such farms whose soil organic matter balance has changed. There were **withdrawn farms (WS)** – those were farms in which the positive outcome has changed to negative one, i.e., improving productivity by means sustainable intensification was discontinued. The analysis also covered **progressive farms (PS)**, i.e. farms opposite to withdrawn farms, as in those units the negative balance has changed to positive one, in other words, they entered the process of sustainable intensification of agricultural production.

Farms have been assessed in terms of their **economic sustainability**, using indicators of productivity and profitability of production factors[2]. The productivity of production factors is the basic element of farms` economic efficiency. It is defined as a ratio of a single output and a single input. It may refer to the individual factors of agricultural production (land, labour and capital) and also to those factors in general. Its level may result from increasing production (maximising outputs) or reducing costs (minimising inputs). The profitability of the factors of production, on the other hand, is the basic output indicator of the agricultural activity, indicating the size of income earned from the input unit. Farm income is a basic economic objective of the farmer's activity and is an important determinant of the life standard of a farming family, hence it may be an important indicator of the economic sustainability (Wrzaszcz, Zegar, 2014). The size of income illustrates the level of remuneration for involving own factors of production in the farm's operations and for risk taken by the farm holder during the accounting year.

In order to analyse the farms` economic sustainability, the following indicators were used: Land Productivity (Total Output, TO/Agricultural Land; Gross Farm Income, GFI /Agricultural Land), Labour Productivity (Total Output, TO/Annual Work Unit, AWU; Gross Farm Income, GFI/AWU); Land Profitability (Family Farm Income, FFI/Agricultural Land), Labour Profitability (FFI/Family Work Unit, FWU)[3].

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[2] All value categories were presented in current prices.

[3] *The Total Output of a farm represents the basic economic and production category that indicates the economic result of farming. It is the outcome of the sum of the value of crop and livestock production and other activities.

3. Research results

The population of farms keeping agricultural accounts, both in 2004 and 2015, was dominated by sustainable farms which were characterised by the reproduction of organic matter (SI, Fig. 1). In the analysed period, the number of farms contributing to the soil degradation slightly decreased (not SI), indicating the desired direction of organisational changes.

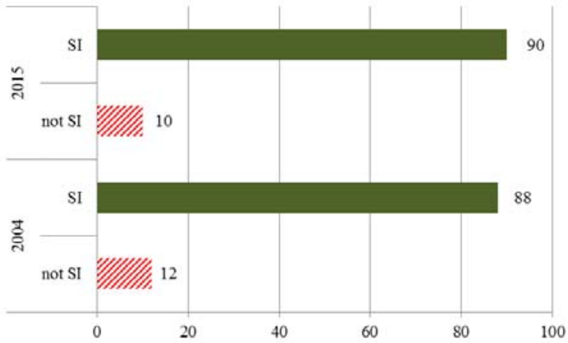

Figure 1. Farms` parentage according to sustainable intensification process in 2004 and 2015. Source: Prepared on the basis of 2004 and 2015 FADN data.

The basic characteristics of the analysed farms are shown in Table 1. In 2015, an average farm had an area of 38 ha of agricultural area and generated the economic outcomes at the level of EUR 21 thousand. Since 2004, FADN farms have been developing dynamically, significantly increasing their production potential (including their area and headage[4]), as well as the standard output. These developments contributed to the improved production and economic outcomes. The value of the crop and livestock production accounted for close to 50% each. An additional factor determining economic outcomes in the analysed period were subsidies related to the functioning of farms. The better economic situation of farms in 2015 was also reflected in their economic investments that led to the reproduction of fixed assets.

*Gross Farm Income is the result of difference of Total Output and the Total Intermediate Consumption (Total specific costs – including inputs produced on the holding – and overheads arising from production in the accounting year), adjusted for the outcome of the balance of current subsidies and taxes. This value indirectly makes it possible to verify the impact of farming efficiency measured by the level of costs and subsidies.

*Family Farm Income is the primary economic goal of farmer's activity and it is an essential determinant of a farmer family living standard, and hence it may be an important indicator of farm efficiency in agriculture.

*1 AWU (Annual Work Unit) is equivalent to full-time own and paid labour, i.e. 2,120 hours of work a year.

*1 FWU (Family Work Unit) is the equivalent of a full-time labour of a farming family member.

[4] The headage of animals has been expressed in Livestock Units (LU), where 1 LU is a standard unit of farm animals weighing 500 kg.

The characteristics of a farm with the reproduction of organic matter (SI) was similar to that of average farms (Table 1). In their case, a slightly greater share in creating the value of agricultural production was that of the livestock production. Also, in these farms the stocking density index had higher values.

A different group was formed by unsustainable farms, degrading organic matter (not SI). Those were farms slightly smaller, with higher labour inputs, and also with the smaller scale livestock production when compared to average farms (2015). The very low stocking density on unsustainable farms made it impossible to maintain the proper soil productivity. The production potential and organisation of those farms translated into their far lower economic outcomes when compared to the other. In their case, the crop production accounted for as much as 88% of the total farm production (2015). It should be stressed that the specialisation of those farms towards the crop production provided them with comparable income to average farms, which also resulted from the significant transfer of subsidies (mostly coupled), as well as their cost advantages in terms of the intermediate consumption.

Taking into account the organisation of farms in 2004 and 2015, it may be concluded that 83% of analysed farms were constantly sustainable (CS), i.e., they were characterised by the reproduction of organic matter (Fig. 2). The opposite group of farms, so-called constantly not sustainable farms (CNS) accounted for 5%. In their case, undertaken agricultural practices consistently were leading to the soil degradation. On the other hand, some farms were reorganised, which significantly changed their economic outcomes.

Table 1. Farms` characteristics and outcomes (an average/farm) according to sustainable intensification implementation in 2004 and 2015

No.	Specification	Total		2015/ 2004 %	SI		2015/ 2004 %	not SI		2015/ 2004 %
		2004	2015		2004	2015		2004	2015	
1	Farms` number	3 908	3 908	x	3 426	3 518	2.7	482	390	-19.1
2	Agricultural land, AL (ha)	31.04	37.48	20.8	30.66	37.77	23.2	33.70	34.86	3.4
3	Labour (AWU)	2.01	2.02	0.3	1.96	1.99	1.3	2.38	2.31	-2.8
4	Livestock (LU)	27.01	31.19	15.5	29.78	33.98	14.1	7.29	6.01	-17.6
5	Livestock/AL (LU/ha)	0.87	0.83	-4.4	0.97	0.90	-7.4	0.22	0.17	-20.3
6	Standard Output (thous. €)	43.82	50.90	16.2	44.01	51.70	17.5	42.46	43.72	3.0
7	Total output (thous. €)	40.3	66.24	64.4	40.63	67.69	66.6	37.97	53.13	39.9
8	- Crop production (%)	46.66	49.24	#	41.77	45.87	#	83.85	87.91	#
9	- Livestock production (%)	52.42	50.01	#	57.35	53.38	#	14.99	11.27	#
10	- Other production (%)	0.92	0.75	#	0.88	0.75	#	1.16	0.82	#
11	Gross farm income (thous. €)	18.72	32.75	74.9	18.50	32.67	76.6	20.26	33.40	64.8
12	Family farm income (thous. €)	11.91	21.40	79.7	11.93	21.40	79.4	11.77	21.43	82.1
13	Gross investment (thous. €)	5.41	11.34	109.6	5.11	11.76	130.1	7.55	7.57	0.3
14	Net investment (thous. €)	0.52	2.56	396.0	0.26	2.89	1 001	2.32	-0.45	#

Source: Prepared on the basis of 2004 and 2015 FADN data.

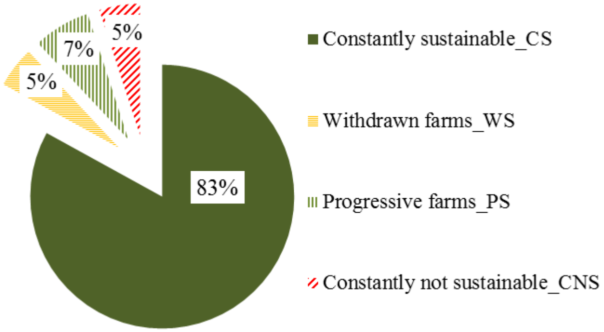

Figure 2. Farms` parentage according to sustainable intensification process implementation in the period of 2004-2015. Source: Prepared on the basis of 2004 and 2015 FADN data.

Constantly sustainable farms dynamically improved their production potential, including the area of land used, as well as the animal headage (Table 2). The environmentally safe stocking density at the level 1 LU/ha was maintained there. The production value of these farms was composed of the comparable value of the crop production and that of the livestock production, which indicates their internal balancing (significant coverage of the feed and fertiliser demand and possibility of reducing the purchasing costs of industrial means for agricultural production). The outcomes of those farms significantly improved, also as a result of the subsidy absorption. They were also characterised by the extended reproduction of fixed assets.

The analysed groups of farms differ in terms of their production potential, organisation and outcomes, as well as the direction and speed of changes taking place therein. The growth in the agricultural area of **withdrawn farms** was definitely higher when compared to constantly sustainable farms, and accompanied by a decline in the animal headage and stocking density. These changes resulted in the lower value and growth rate of the production which in 80% was created by the crop production (2015). The stream of subsidies and relatively lower costs of intermediate consumption in those units affected the high growth rate of economic outcomes, although their level did not come up to the values assigned to constantly sustainable farms.

Constantly not sustainable farms were characterised by the very low animal headage, which in addition was gradually decreasing, providing even the minimum stocking density at the level of 0.1 LU/ha (2015). Narrow specialisation of these farms (with the 90% share of the crop production value) ensured the production value, as well as its positive growth rate comparable to that which took place in case of constantly sustainable farms. Focusing on the crop production allowed also to obtain high external support in a form of subsidies. The effect of the production changes was much higher income (EUR 25,000, 2015), which doubled over the analysed period (also due to cost advantages), surpassing by far farms implementing sustainable intensification practices.

Progressive farms are farms which are the largest in terms of their area, when compared to the other analysed groups, diversifying the agricultural production. In these farms, the animal headage significantly increased in the analysed the period, resulting in the increased share of the livestock production from 18 to 25% in the total production value of the farm. The economic and production outcomes of those farms were comparable to those corresponding to constantly sustainable farms, though their growth rate was more favourable. These figures confirm the economic validity for implementing agricultural environmental-friendly practices. Noteworthy is the high value of investments made in these farms, which was dictated by the increased scale of the livestock production.

Table 2. Farms` characteristics and outcomes (an average/farm) according to sustainable intensification implementation

No.	Specification	CS		2015/ 2004 %	WS		2015/ 2004 %	CNS		2015/ 2004 %	PS		2015/ 2004 %
		2004	2015		2004	2015		2004	2015		2004	2015	
1	Farms` number	3 235	3 235	x	191	191	0.0	199	199	0.0	283	283	0.0
2	Agricultural land, AL (ha)	30.9	37.3	20.7	26.3	34.8	32.4	28.5	34.9	22.6	37.4	42.9	14.7
3	Labour (AWU)	1.96	1.97	0.4	1.96	2.02	3.4	2.53	2.59	2.5	2.27	2.19	-3.7
4	Livestock (LU)	30.6	35.8	16.8	15.3	7.4	-51.5	5.4	4.6	-13.3	8.7	13.4	54.4
5	Livestock/AL. (LU/ha)	0.99	0.96	-3.2	0.58	0.21	-63.4	0.19	0.13	-29.3	0.23	0.31	34.6
6	Standard Output (thous. €)	44.68	52.08	16.6	32.76	37.77	15.3	41.74	49.43	18.4	42.96	47.32	10.1
7	Total output (thous. €)	41.29	67.90	64.4	29.47	42.65	44.8	36.89	63.19	71.3	38.73	65.36	68.8
8	- Crop production (%)	40.98	43.59	#	60.58	80.27	#	89.55	92.86	#	80.02	72.98	#
9	- Livestock production (%)	58.15	55.74	#	38.18	18.49	#	9.91	6.58	#	18.40	25.42	#
10	- Other production (%)	0.87	0.68	#	1.24	1.24	#	0.54	0.55	#	1.57	1.60	#
11	Total subsidies (thous. €)	1.51	11.70	673.4	1.65	11.80	617.0	1.22	11.59	846.8	2.02	13.45	564.7
12	Gross farm income (thous. €)	18.71	32.37	73.0	14.89	26.97	81.1	20.93	39.56	89.0	19.79	36.14	82.6
13	Family farm income (thous. €)	12.11	21.32	76.1	8.90	17.56	97.2	12.21	25.14	105.9	11,46	22.27	94.4
14	Gross investment (thous. €)	5.18	11.30	118.0	3.88	8.03	106.8	7.36	7.13	-3.1	7.68	17.03	121.8
15	Net investment (thous. €)	0.31	2.51	698.8	-0.61	1.23	#	2.14	-2.07	#	2.44	7.28	198.9

Source: Prepared on the basis of 2004 and 2015 FADN data.

Table 3. Elements of soil organic matter balance (SOMB in t/ha) by sustainable intensification implementation

No.	Specification	TOTAL		CS		WS		CNS		PS	
		2014	2015	2004	2015	2004	2015	2004	2015	2004	2015
1	Crop degradation	-0.63	-0.60	-0.60	-0.58	-0.65	-0.72	-0.87	-0.83	-0.77	-0.63
2	Crop reproduction	0.05	0.11	0.06	0.12	0.05	0.03	0.01	0.04	0.01	0.10
3	Crop balance [1+2]	-0.58	-0,49	-0.55	-0.45	-0.60	-0.69	-0.86	-0.79	-0.76	-0.53
4	Natural fertilizers	0.76	0.73	0.87	0.84	0.51	0.19	0.16	0.12	0.20	0.27
5	Organic fertilizers	0.41	0.43	0.40	0.42	0.45	0.39	0.40	0.41	0.46	0.60
6	**SOMB [3+4+5]**	**0.59**	**0.68**	**0.72**	**0.81**	**0.37**	**-0.11**	**-0.29**	**-0.27**	**-0.10**	**0.35**

Source: Prepared on the basis of 2004 and 2015 FADN data.

The result of the organic matter balance is derived from the sowing structure, as well as from natural and organic fertilisation (Table 3, 4). Each analysed group of farms was dominated by the cultivation of soil degrading crops and the dominant crop were cereals. Despite the small share of structure-forming crops in sowings (i.e. pulses, legumes and grasses on arable land), in recent years there has been a dynamic growth of their area, in particular in progressive farms. Taking into account the whole sowing structure, grown crops deteriorate the production potential of the soil by removing significant amounts of organic matter. The highest negative values were recorded in constantly not sustainable farms. Those farms were characterised by the high share of root and industrial crops and vegetables. In this light, natural and organic fertilisation becomes particularly important.

The presented figures confirm the importance of the livestock production in the proper balancing of organic matter (Table 3). Farms without the livestock production, or with the very small animal headage virtually do not have a possibility of balancing soil organic matter properly, as evidenced by the presented results of studies for constantly not sustainable farms and withdrawn farms. In their case, the greater importance is held by the straw ploughing practice (organic fertiliser), but it is not sufficient to balance the negative result dictated by the cultivation of soil-degrading crops. Alternative in their case remains the purchase of manure in the market, although it is not a common practice.

Table 4. Crop structure according to sustainable intensification implementation

No.	Specification	TOTAL		CS		WS		CNS		PS	
		2004	2015	2004	2015	2004	2015	2004	2015	2004	2015
1	Cereals	69.6	59.0	73.1	61.0	67.0	49.0	42.9	42.2	51.5	52.5
2	Corn	9.4	12.7	8.2	12.2	7.2	13.6	11.7	10.4	20.5	19.0
3	Oil and industrial crops	7.2	13.4	7.0	13.3	7.6	16.4	5.7	9.6	9.7	15.3
4	Root crops	7.7	4.4	6.2	3.1	11.0	13.6	21.2	19.2	13.2	4.4
5	Vegetables	1.7	1.1	0.5	0.3	2.6	3.6	17.4	15.3	4.0	0.6
6	Pulses	0.9	5.0	0.9	5.2	1.5	3.2	0.8	2.9	0.6	5.4
7	Grasses, papilionaceous	2.7	2.2	3.1	2.6	1.8	0.3	0.2	0.1	0.3	1.1
8	Catch crops	0.4	3.9	0.4	4.0	0.6	2.0	1.1	2.9	0.04	4.8

Source: Prepared on the basis of 2004 and 2015 FADN data.

Table 5. Farms` productivity and profitability outcomes according to sustainable intensification implementation

No.	Specification		€/ha				€/labour unit		
			TO	GFI	FFI	S	TO	GFI	FFI
1	Total	2004	1 299	603	384	50	20 016	9 296	6 819
2		2015	1 768	874	571	316	32 785	16 207	12 308
3	2015/2004 %		36.1	44.9	48.8	535.3	63.8	74.3	80.5
4	CS	2004	1 335	605	392	49	21 040	9 537	6 894
5		2015	1 819	867	571	314	34 458	16 428	12 214
6	2015/2004 %		36.2	43.3	45.9	540.8	63.3	72.3	77.2
7	WS	2004	1 121	566	339	63	15 059	7 611	5 176
8		2015	1 225	775	504	339	21 089	13 337	10 452
9	2015/2004 %		9.3	36.8	48.9	441.4	40.0	75.2	101.9
10	CNS	2004	1 296	735	429	43	14 603	8 284	6 996
11		2015	1 810	1 133	720	332	24 411	15 284	14 458
12	2015/2004 %		39.7	54.2	67.9	672.2	67.2	84.5	106.7
13	PS	2004	1 036	529	306	54	17 024	8 698	6 926
14		2015	1 524	843	519	314	29 827	16 491	13 099
15	2015/2004 %		47.1	59.2	69.4	479.4	75.2	89.6	89.1

Source: Prepared on the basis of 2004 and 2015 FADN data.

Economic sustainability of agricultural holdings may be assessed through the productivity and profitability of the production factors. The values of the indicators with regard to agricultural land and labour inputs are shown in Table 5. The highest land productivity, as well as its positive growth rate were characteristic of both constantly not sustainable farms, and constantly sustainable farms (2015). Although progressive farms achieved much lower outcomes, the growth rate of the land productivity gave them the first place. Against that background, withdrawn farms generated the lowest production outcomes, both in static and dynamic terms. In the of the land profitability, constantly not sustainable farms developed a definite economic advantage in comparison to other groups of farms. The growth rate of the land profitability was also their attribute, but in this case also progressive farms more dynamically increased their outcomes. The average value of external transfers (subsidies) did not differentiate the analysed groups of farms (2015), although, taking into account the growth rate, it was constantly not sustainable farms which were most active in obtaining external financing.

In case of the labour productivity, constantly not sustainable farms did not come up to constantly sustainable farms in terms of their outcomes, although the growth rate of this productivity was very high. This was due to both lower production values, and higher labour inputs. In contrast, the highest labour rate, as well as its growth rate, were characteristic of constantly not sustainable farms. This result was driven by a favourable ratio between the production and costs associated with running a farm.

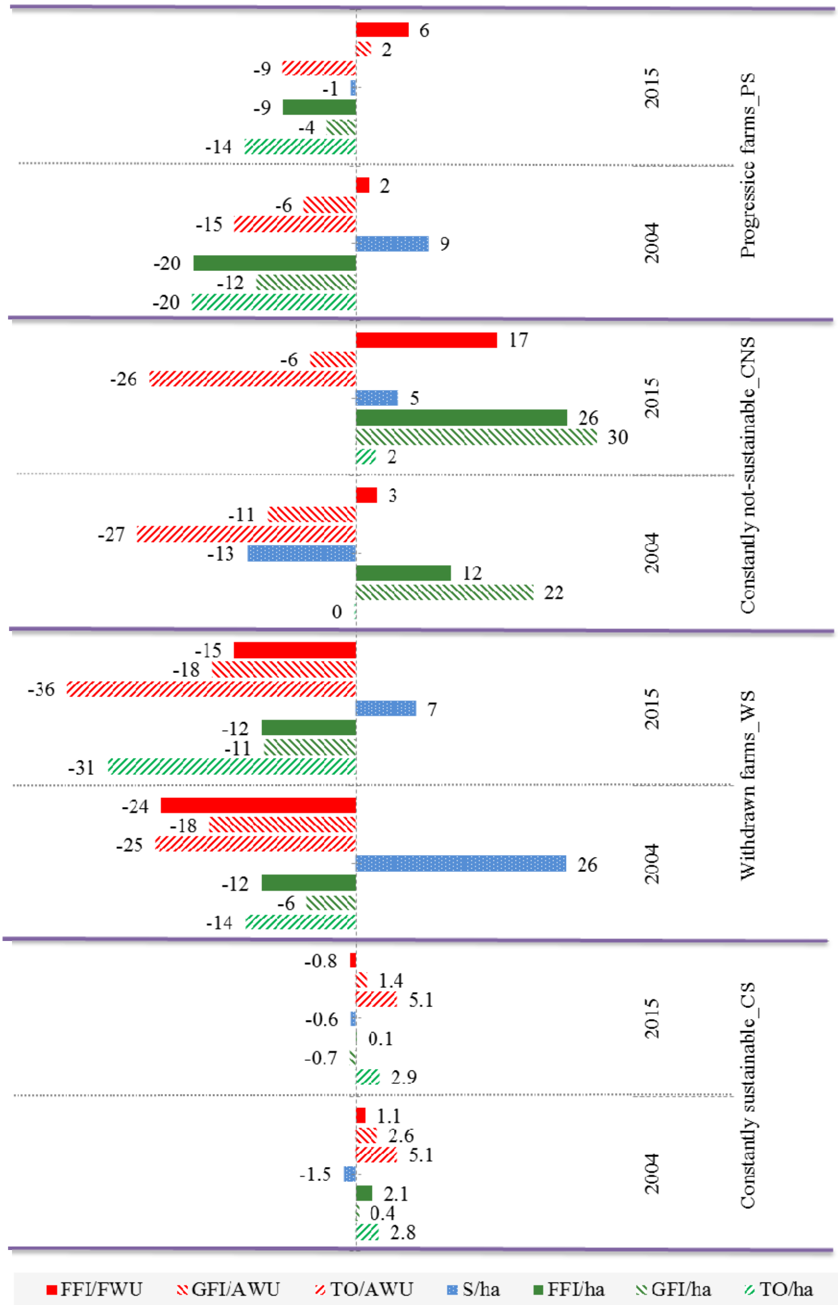

Figure 3. The relative difference (%) of farms` productivity and profitability (total farms` average = 100%) in 2004 and 2015 according to sustainable intensification implementation
Source: Prepared on the basis of 2004 and 2015 FADN data.

Fig. 3 shows the relative differences (in percentage terms) between the analysed groups of farms and the average outcomes of units covered by FADN with regard to the productivity and profitability of the production factors, as well as the value of subsidies in relation to the used area. These differences relate to 2004 and 2015, which allows to assess their direction and scale of changes.

The presented figures show that both in 2004 and in 2015 constantly sustainable farms had the economic efficiency similar to the average outcomes. The economic situation of withdrawn farms was unfavourable, and their distance tended to deepen over time. The resignation from using sustainable intensification involved the deterioration of the economic situation in relation to other farms. The opposite group were progressive farms, which, by undertaking the reorganisation towards environmental friendliness, improved their results and relations with respect to average farms. In the analysed period, their economic distance strongly decreased with regard to the majority of considered efficiency indicators and, in case of the labour profitability, they even created a slight advantage. Despite the reorganisation of farms towards sustainable intensification, the stream of subsidies they received did not deviate from the average, which confirms the previous findings regarding the conditions of access to this kind of support. On the other hand, constantly not sustainable farms gradually strengthened their advantage in the labour productivity and profitability, as well as the absorption of subsidies when compared to average farms. In parallel, their distance towards average farms in terms of the labour productivity was decreasing. The presented relations between the groups of farms point to the acquisition of the increasing individual economic benefits by constantly not sustainable farms when compared to average farms. The economic situation of these entities does not motivate to stop the process of specialisation and industrialisation.

Conclusions

1. The primary determinant of the sustainable intensification process is a positive soil organic matter balance.
2. FADN data indicate that Poland is dominated by farms fitting in the sustainable intensification process.
3. Organisation of farms determines the reproduction of soil organic matter. Of fundamental importance here is the livestock production and the stocking density.
4. Average production outcomes of constantly sustainable, constantly not sustainable and progressive farms are comparable. However, in terms of economic outcomes, in the lead we have constantly not sustainable farms, due to their cost advantages and the absorption of crop coupled support. These farms are also less active in terms of investments, which is the effect of their organisation and production orientation. It may be concluded that current support in a form of subsidies for farms increases the income advantage of specialised crop farms.
5. The high productivity of the production factors in constantly sustainable and progressive farms is an important argument that encourages farmers to carry out production tasks through sustainable intensification. The least favourable situation applies to withdrawn farms. On the other hand, the outcomes of profitability of the production factors speak for constantly not sustainable farms.

6. The stream of support addressed to the analysed groups of farms in absolute terms was comparable which puts into question the validity of the existing criteria of allocation thereof, in particular taking into account the leading strategic goal i.e. the sustainable agricultural development. The result of the soil organic matter balance could be an effective tool used in farm subsidisation.
7. The economic efficiency of constantly sustainable farms was similar to the average for all FADN farms in the analysed period.
8. The distance between withdrawn farms and average farms deepened, which points to the lack of economic justification for quitting the sustainable intensification process in the period under consideration. In parallel, the economic relation of progressive farms improves, though they do not obtain any greater support in a form of subsidies due to pro-environmental reorganisation.
9. The economic advantage of constantly not sustainable farms in case of the labour productivity and profitability is very large and is strengthened over time. At the same time, these farms obtain the increasing stream of subsidies in relation to average farms.

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