WIOLETTA WRZASZCZ
KONRAD PRANDECKI
Institute of Agricultural and Food Economics
– National Research Institute
Warsaw

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ECONOMIC EFFICIENCY OF SUSTAINABLE AGRICULTURE

Abstract

This paper presents the issue of productivity and profitability of agricultural holdings. It particularly focuses on selected sustainable farms' groups that provide environmental benefits. The following groups of farms were analysed: ecological, agri-environmental, Norfolk and sustainable. Farms specialised in cereal production were also the subject of analysis – the contrasting group to sustainable ones. The research was conducted using agricultural accountancy data – FADN 2012. The purpose of this paper is to present the economic efficiency of selected farms' groups characterised by different influence on the natural environment.

Introduction

Agriculture, due to its specific character, is especially linked to the natural environment. Therefore, concern for the quality of nature and natural resources is not only a requirement of civilisation but, at the same time, a prerequisite for agricultural production. Each agricultural activity needs, above all, access to water, suitable climate and soil quality (Chartes C.J., Varma S. 2010; Rapidel B. et al. 2011; Wollenberg E. et al. 2012.). Furthermore, production processes in agriculture affect the level of biodiversity, status of the landscape and volume of pollutant emissions, which can indirectly lead to a drop in productivity of agriculture.

Implementation of the idea of sustainable development is one of the methods of counteracting the negative environmental trends. The idea is characterised by simultaneous concern for the environment, maintaining good social relations and ensuring economic profitability of the conducted activity. In this light, the research on environment-friendly agriculture requires an accurate production and economic account. The account allows for comprehensive assessment of the economic efficiency of a farm.

The term "economic efficiency" was sourced from praxeology[1]. This science deals with explaining the reasons for and assessment of deliberate actions. T. Kotarbiński was one of its forerunners. As efficient he considered only these solutions which are characterised by efficiency and economy of action (Kotarbiński T. 1955). Efficiency defines to what extent the undertaken actions enable accomplishment of the objective. Whereas economy of action boils down to assessment of thrift and productiveness; hence, the ratio between the degree of resources use to the measure of intended achievements (Kotarbiński T. 1972).

According to the above, identification of economic efficiency of an economic unit allows assessment of the undertaken actions based on their monetary value. This assessment should cover the economic objective. In case of industrial agricultural economy, the basic aim is to secure a defined income (Woś A., Zegar J.St. 2002). In the context of sustainable development of agriculture such approach should be supplemented with environmental and social issues.

The basic elements of economic efficiency include productivity and profitability of the involved factors of production. Ensuring sustainable development is possible when environmental issues of the two components are taken into account. The level of productivity of agricultural holdings is primarily determined by how they use natural resources. The social value of environmental resources is, then, directly reflected in cash flows – charges, taxes and payments – that take place between the agricultural producer and the state.

The paper aims at presentation of the economic efficiency of farms exerting different impact on the natural environment. Selection of individual groups of agricultural holdings (forms of sustainability) allowed to define the impact of pro-environmental agricultural practices on the production and economic account.

The subject and method of research

The analysis dealt with individual farms covered by agricultural accountancy under the Farm Accountancy Data Network – the Polish FADN in 2012. This group comprised of 10.6 thousand farms. The research used the most current data at the disposal of the Agricultural Accountancy Department of the Institute of Agricultural and Food Economics – National Research Institute (Polish: *Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy, IERiGŻ-PIB*).

The group of farms under the FADN agricultural accountancy system excludes the holdings which did not use agricultural areas or their surface was below 1 ha of UAA. Thus, farms dealing only with livestock production were excluded, mainly poultry farms of high scale of livestock production, and farms of small scale of traditional crop production. The research does not include agricultural holdings which were focused on the use of permanent grasslands and/or orchards. The aforementioned farm groups significantly differ in terms of production and economic results from the average units; therefore, they were not covered by the research.

[1] Praxeology can be translated as science of efficient action. A. Espinas was the founder of praxeology.

Economic efficiency of an agricultural holding should be considered from the perspective of productivity and profitability of committed factors of production. The use of indices referring to a farm or its resources makes it possible to assess the average economic efficiency[2].

Productivity is the fundamental element of economic efficiency of an agricultural holding. It is defined as a quotient of a single output and a single input (Farrell M.J. 1957). It can be analysed in the context of individual factors (land, labour and capital) and holistically. Its level can result from production growth (maximisation of outputs) or cost reduction (minimisation of inputs). Examining the productivity of agriculture in the context of sustainable development requires to consider externalities. This, above all, pertains to ecosystem services[3] significant for agricultural production. Externalities can be included into the productivity in two ways. Firstly, it is possible to build a new productivity index which includes the internalisation of externalities[4]. Secondly, assessment can cover organisation of agricultural holdings from the perspective of its compatibility with the principles of sustainable development.

Productivity research attempts conformable with the first method[5] were conducted on numerous occasions[6]. They failed to bring the expected effects due to selective inclusion of environmental factors, such as water pollution or assessment of the elements cycle, and exclusion of a number of ecosystem services. Moreover, the need to make a prior valuation of externalities is a drawback of this method. Their very separation can be controversial. Additional doubts are

[2] See a proposal of measurement of economic efficiency of agricultural holdings based on public statistics data (Wrzaszcz W., Zegar J.St. 2014) and agricultural accountancy system (Zegar J.St. 1986).

[3] In Poland, just like in the case of the term sustainable development, there is no clear-cut translation of the term *ecosystem services*. Usually the terms *usługi środowiska* and *usługi ekosystemowe* are used, but literature, at some points, argues that the word *benefits* (*świadczenia*) should be used instead of *services* (*usługi*), because the former covers also the provision of goods (Mizgajski A., Stępniewska M. 2009). This term, however, is most often understood as *utilities* (*pożytki*) for humans stemming from the functioning of the ecosystem (TEEB 2010).

[4] Such measures can be implemented based on ecological economics. This school of economics is funded upon three essential assumptions: 1. the use of renewable resources should not exceed their regenerative capacities; 2. the use of non-renewable resources should not be faster than the rate of capital increase by their renewable substitutes; 3. emission of waste should not exceed the natural assimilative capacities of the environment as regards absorption of harmful substances (Daly H.E. 1990). As a consequence, it is necessary to implement the paradigm considering: acceptance of sustainable development as a leading concept, rejection of economic growth as an infinite and always positive process, and its replacement with the economics of moderation, and also limitation of the dominant role of the market and conviction of its ability to self-regulate (Dietz R., O'Neil D. 2013). It is also important to differentiate between ecological economics and environmental economics. The latter derives from the neoclassical economics, which results, e.g., in a different approach to the issues of growth and market. In practice, both these environmental strands are recognised as leading concepts of sustainable development (Prandecki K. 2007).

[5] The first method is characterised by including as many externalities as possible into the account, both on the side of outputs and inputs. According to the idea of sustainability their selection should cover both environmental and social aspects of agricultural production, but in the second case their inclusion at the level of an agricultural holding is limited. Social relations should be monitored at the level of rural areas (Prandecki K. et al. 2014).

[6] See (Gollop F., Swinand G.P. 1998; Byerlee D., Murgai R. 2001; Melfou K. et al. 2007).

cast by the methods of valuation of the effects and data sources (Byerlee D., Murgai R. 2001). This causes discrepancies in the obtained results and prevents their comparison. Doubts relate also to the classification of individual ecosystem services because they are analysed both on the side of outputs and inputs. Some examples are, for instance, the problems in the assessment of pollination of plants by insects or the processes of emission and absorption of greenhouse gases. Nonetheless, the method will gain in importance along with the development of the method of externalities valuation.

Examination of the organisation of agricultural holdings is another method for assessment of productivity of agriculture in the context of sustainable development. The key element of this method is precise and adequate to the needs selection of farm classification criteria. The manner of the selection should as best as possible reflect the priorities of sustainable development. Agricultural holdings thus classified can be analysed with the use of neoclassical productivity assessment methods, i.e. with the use of, e.g., ratio analysis of land productivity or TFP index (Total Factor Productivity). These methods are commonly used which is their advantage as it comes to, for instance, international comparisons. In this paper it was recognised that the above method is more relevant to the implementation of the assumed goal.

Therefore, different farm groups were selected (forms of sustainability)[7], which allowed to define the impact of pro-environmental agricultural practices on the production and economic account. For comparative purposes, farms specialising mainly in cereal production were also selected. These holdings were closely analysed as regards the production potential, and production and economic results, significant when assessing their efficiency. The results of selected farm groups were referred to the overall of the researched holdings.

The environment-friendliness of agricultural holdings is ensured to a different extent by various forms of agriculture. The research differentiates the selected four farm groups which were characterised by pro-environmental agricultural activity. Detailed analysis covered the following farms[8]: ecological (in short: ECO)[9], **agri-environmental** (AENV)[10], **Norfolk** (NORF)[11], **sustainable**

[7] Forms of sustainable agriculture were also analysed in the following publications: (Prandecki K. et al. 2014; Toczyński T. et al. 2013; Wrzaszcz W., Zegar J.St. 2014). These forms do not express the level of sustainability of agricultural holdings but a different manner of organisation of agricultural production.

[8] See a detailed description of the method in (Prandecki K. et al. 2014).

[9] This group covered both farms holding a certificate awarded by an authorised certification body and farms in the process of adjusting to this agricultural production system. The guiding principle under the ecological system is crop cultivation in compliance with the Good Agricultural and Environmental Condition with due care for the phytosanitary status of crops and soil protection. Additionally, this includes the need to maintain the area of permanent grasslands and landscape features not used for agricultural purposes, see http://www.minrol.gov.pl /pol/Jakosc-zywnosci/Rolnictwo-ekologiczne/Akty-prawne.

[10] These are farms participating in the agri-environmental programme contained in the Rural Development Programme for 2007-2013 (RDP 2007-2013). Its key assumption is promotion of agricultural production based on methods compliant with the requirements of protection of the environment and nature, see http://www.minrol.gov.pl/ pol/Wsparcie-rolnictwa-i-rybolowstwa/PROW-2007-2013/Dokumenty-analizy-raporty.

[11] These farms are characterised by rich structure of field cropping, which has a positive impact on soil fertility. The cropping system in the Norfolk system involves 50% of cereals, 25% of structure-for-

(SUSTB)[12]. A group comparable to farms providing ecosystem services were **cereal holdings** (specialist type STF 151, abbreviation: CRLH)[13]. The full name of this type of holdings is defined as "holdings specialist in cereals, oilseeds and protein crops for seeds". Because the major part of holdings in this group was targeted at cereal production they were termed, in short, "cereal holdings". Narrow crop production specialisation in these holdings (monoculture of crops or crop production of low level of diversity of species) points to agricultural practices far removed from the principles of sustainable agriculture. Therefore, they can be treated as unsustainable. Such approach allows indication of differences in productivity between industrial and sustainable agriculture.

The number, structure, basic features attesting to their production potential, and key results informing about their economic efficiency, including on productivity, were presented with reference to the above-specified farm groups (i.e.: overall, ecological, agri-environmental, Norfolk, sustainable and cereal holdings). The production and economic potential of researched farm groups was briefly characterised taking into account the average values, such as: utilised agricultural area (ha), labour inputs (expressed in full-time employment units[14] – AWU), livestock population (expressed in livestock units[15] – LU), value of assets and value of Standard Gross Margin (defined in the European size units[16] – ESU).

After a general analysis of selected farm groups, at the background of overall holdings, they were examined also in terms of area groups. For the needs of the paper, the following groups were identified: 1-4.99 ha of agricultural area; 5-24.99 ha of agricultural area; 25-49.99 ha of agricultural area; 50 ha of agricultural area and more.

The selected farm groups were analysed in terms of their economic efficiency, including productivity and profitability. To this end, ratio and comparative

ming crops (legumes, fodder crops) and 25% of root crops, and it is more extensively discussed in (Prandecki K. et al. 2014).

[12] These farms meet the selected criteria of environment-friendliness of agricultural production. The sustainability criteria of agricultural holdings included (Wrzaszcz W. 2012): share of cereals in the cropping system on arable lands; number of crop groups cultivated on arable lands; index of arable lands coverage with vegetation in winter; stocking density on utilised agricultural areas.

[13] The principles of farm classification into individual types of farming were presented in detail in the following publications (Goraj L. et al. 2012; Goraj L. et al. 2010).

[14] 1 AWU, *Annual Work Unit*, is equivalent to full-time own or contractual employment, i.e. 2,120 working hours per year. Whereas 1 FWU, *Family Work Unit*, is equivalent to full-time employment of a farming family member.

[15] 1 LU, *Livestock Unit*, is a conventional livestock unit weighting 500 kg.

[16] *Standard Gross Margin* (SGM) is regionally averaged direct surplus. *Standard Gross Margin* concerning a given crop or animal is the standard (three-year average in a given region) production value obtained per 1 hectare or per 1 animal, less standard direct costs necessary for the production. The sum of *Standard Gross Margins* of all activities taking place in an agricultural holding indicates the economic size of the holding, in other words production potential of agricultural holdings. 1 ESU, *European Size Unit*, is the equivalent of EUR 1,200, see (Goraj L. 2007).

analyses were used, which applied the selected production and economic categories, i.e.: production value of a farm, gross value added of a farm, income from a family farm[17]. The research also uses aggregated cost categories and balance of payments and taxes to comprehensively analyse the production and economic account. The environmental issues are reflected in the form of cash transfers, such as taxes and environmental charges, and various types of payments. This justifies the need to conduct a full production and economic account of a farm, based not only on production value but also on the analysis of cash transfers.

The assessment uses the following selected ratios[18]:

- **Productivity of land inputs:**
  – production value per hectare of agricultural area,
  – gross value added per hectare of agricultural area.
- **Productivity of labour inputs:**
  – production value per full-time employee in total,
  – gross value added per full-time employee in total.
- **Profitability of land inputs: income per hectare of agricultural area.**
- **Profitability of labour inputs: income per full-time employee (own labour).**

To sum up, the selected productivity and profitability indicators referring to a full-time employee outline the average economic efficiency of engaged labour unit, while the categories referred to the area unit allow to compare the economic efficiency of selected farm groups, at the same time, eliminating the differences in their size measured with utilised agricultural area.

Production potential

The research covered 10,589 individual holdings keeping farm accountancy under the Polish FADN (Table 1). The most numerous in the group were agri-environmental holdings (23%), followed by sustainable (22%) and Norfolk (15%) holdings, while ecological holdings were the least numerous fraction (4%). The differentiated farm groups did not form separate sets, which is indicated in Table 2. Taking as the point of reference the four sustainability criteria describing organisation of crop and livestock production in agricultural holdings (the share of cereals, winter crop coverage, number of groups of cultivated

[17] The production value of a farm – basic production and economic category pointing to the performance of farming. It results from the sum of crop, livestock and other production value.
The gross value added of a farm – production and economic category defined on the basis of the difference between the production value of a farm and intermediate consumption, adjusted by the result of the balance of current payments and taxes (covers payments and VAT balance to operating activities and also other taxes, e.g., agricultural, forestry, property). This amount allows indirect verification of the impact of farming efficiency (expressed both in the level of costs incurred on agricultural activity and activity of the farm manager as regards securing external funds) on the production value of a farm. Therefore, it is a suitable parameter for comparisons of farms having different property ownership structure (Bocian M., Malanowska B. 2014).
The income from a family farm – it is the basic economic objective of a farmer's activity and an important determinant of the level of life of a farming family; thus, it can be an important indicator of a farm's efficiency in agriculture (Wrzaszcz W., Zegar J.St. 2014).

[18] Cf. (Zegar J.St. 1986).

crops and stocking density on agricultural areas)[19], it can be stated that Norfolk farms stood out in this regard. In the researched population of farms specialist cereal holdings accounted for 13%.

The average area of a researched farm was 37 ha, the case was similar for ecological and Norfolk holdings (Table 1). In this respect, agri-environmental and sustainable holdings (difference of ca. 20% against the average), and cereal holdings (over 2 times greater) differed definitely *in plus*. The differences followed from the area structure of separated farm groups (Figure 1). Among cereal holdings every second one noted an area of at least 50 ha of UAA, while in case of sustainable agriculture – only every 4th-5th farm had such an area. Taking into account the labour inputs, it can be stated that most of the holdings having a positive impact on the natural environment (excluding Norfolk holdings), and also cereal holdings, were characterised by better work organisation.

The average size of a livestock herd at a researched farm amounted to 27 LUs. At this background only ecological and cereal holdings significantly differed from the average (14 and 2 LUs, respectively). As far as it is understandable in the second case, given the specific character of production of specialist cereal holdings, it is unjustified for ecological holdings. The idea behind the ecological production is keeping a closed cycle of nutrients within an agricultural holding, which should incline to omnidirectional agricultural production. The presented data confirm disparity between agricultural theory and practice[20]. Differences in the area of selected groups of holdings and livestock population were reflected in the total value of assets of the holdings. Contrary to cereal holdings (difference *in plus* by ca. ½ against the average), ecological holdings were characterised by the lowest value of assets (by ca. ¼ against the average farm).

The value of Standard Gross Margin allowed synthetic assessment of the economic potential of selected groups of holdings. As indicated by the data in Table 1, only ecological farms deviate in this respect from the average (the value of SGM was lower by 38%). Whereas cereal holdings, despite having double the area of average holdings, have the same production potential. This result attests to the significance of livestock production and also differentiated crop production in formation of the value of SGM. Omnidirectional character of agricultural production and rich structure of agricultural crops contributes not only to generating environmental profits but also measurable economic benefits.

[19] See the part of the paper on the object and method of research.

[20] The issue was considered, e.g., in the following publications (Nachtman G. 2014; Wrzaszcz W., Zegar J.St. 2014). Research proved that the phenomenon of limiting livestock production scale at ecological farms not only increases but even turns into complete cessation of this production line.

Table 1

Production potential of examined groups of holdings

No.	Specification	Total	1-5 ha of UAA	5-25 ha of UAA	25-50 ha of UAA	above 50 ha of UAA
			Overall			
1	Sample size	10,589	212	5,213	3,074	2,090
2	UAA (ha per farm)	36.85	3.26	15.12	35.31	96.71
3	Working persons (AWU per farm)	2.01	2.65	1.81	2.03	2.44
4	Livestock (LU per farm)	27.34	11.59	15.23	35.01	47.86
5	Total assets (PLN thousand per farm)	1,270.64	675.24	650.19	1,330.52	2,790.54
6	Standard gross margin (ESU per farm)	21.69	19.10	11.02	23.46	45.96
			Cereal holdings			
1	Sample size	1,389		305	380	704
2	UAA (ha per farm)	74.70		17.28	37.26	119.79
3	Working persons (AWU per farm)	1.70		1.24	1.48	2.02
4	Livestock (LU per farm)	2.07		0.99	1.38	2.90
5	Total assets (PLN thousand per farm)	1,877.86		580.98	1,074.40	2,873.40
6	Standard gross margin (ESU per farm)	21.59		4.88	10.70	34.71
			Ecological holdings			
1	Sample size	422		249	84	79
2	UAA (ha per farm)	37.41		13.63	35.51	118.59
3	Working persons (AWU per farm)	1.89		1.69	2.09	2.29
4	Livestock (LU per farm)	14.39		7.33	14.12	38.56
5	Total assets (PLN thousand per farm)	926.01		463.84	1,019.32	2,361.09
6	Standard gross margin (ESU per farm)	13.49		5.96	12.62	39.17
			Agri-environmental holdings			
1	Sample size	2,487		1,000	792	683
2	UAA (ha per farm)	45.26		16.00	35.96	99.59
3	Working persons (AWU per farm)	1.96		1.72	1.92	2.35
4	Livestock (LU per farm)	27.48		14.64	30.02	43.79
5	Total assets (PLN thousand per farm)	1,408.87		623.54	1,260.74	2,751.28
6	Standard gross margin (ESU per farm)	23.03		10.13	21.47	44.09

cont. Table 1

	Norfolk holdings					
1	Sample size	1,540		700	505	299
2	UAA (ha per farm)	36.21		15.55	35.13	90.44
3	Working persons (AWU per farm)	2.06		1.83	2.07	2.57
4	Livestock (LU per farm)	31.20		15.98	37.06	60.51
5	Total assets (PLN thousand per farm)	1,293.76		673.57	1,394.57	2,681.22
6	Standard gross margin (ESU per farm)	21.51		10.74	23.07	45.26
	Sustainable holdings					
1	Sample size	2 309	21	869	822	597
2	UAA (ha per farm)	44.37	3.95	15.88	35.74	99.16
3	Working persons (AWU per farm)	2.05	1.74	1.77	2.00	2.55
4	Livestock (LU per farm)	25.87	3.45	13.54	30.19	38.64
5	Total assets (PLN thousand per farm)	1,527.14	293.75	646.97	1,394.09	3,034.92
6	Standard gross margin (ESU per farm)	23.45	3.99	9.85	21.97	45.94

Note: Lack of values in crossed boxes was linked to insufficient sample size. According to the FADN principles, results are presented for groups of at least 15 holdings.
Source: own study based on the FADN 2012 data.

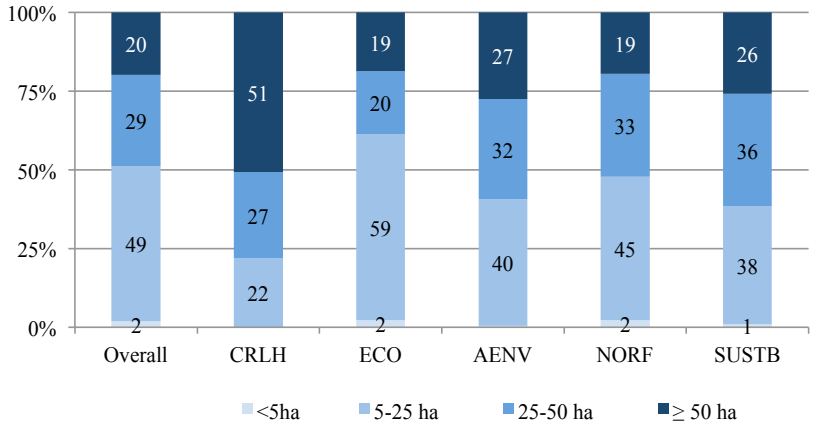

Fig. 1. Area structure of researched farm groups
Source: own study based on the FADN 2012 data.

Table 2

Share of holdings by form of sustainability

Specification	Ecological	Agri--environmental	Norfolk	Sustainable
Ecological	100			
Agri-environmental	27	100		
Norfolk	43	15	100	
Sustainable	36	23	67	100

Source: own study based on the FADN 2012 data.

Production and economic results

Production of a farm

Production value of a farm is the basic production and economic category which consists of value of crop, livestock and other production[21]. The agricultural production value is fundamentally influenced by the production value of a farm (it represents from 97% to 99%, depending on the form of sustainable agriculture), while other production makes a symbolic contribution in terms of value. Relatively the highest importance of other production is apparent in ecological holdings (3%), which follows from a slightly different organisation of the farms. Agricultural production of ecological holdings is often supplemented with, for instance, agritourism activity based on the assets of an agricultural holding.

In case of an average agricultural holding and most of the analysed groups, the value of crop production exceeded the value of livestock production (Figure 2). Norfolk holdings noted different relations, though; this followed from a high share of crops cultivated for fodder for reared livestock. These crops were a source of internal turnover of a farm and they were not a direct agricultural product intended for sales. The connection between crop and livestock production at Norfolk farms (this is mainly ruminant farming) is the strongest as compared to other researched groups having a positive impact on the natural environment.

The production value of an agricultural holding against the utilised agricultural area is one of the basic ratios to measure productivity. **Land productivity** is thus determined. Land productivity of an average individual farm is at the level of PLN 7.3 thousand per ha (Figure 3a). At this background agri-environmental, sustainable and Norfolk holdings achieved lower results by 17%, 11%

[21] It covers mainly: rents for leased land ready for sowing, revenues on occasional transfer of forage area, products of the forest, provision of services, equipment rental, interest on current assets necessary for current operation of an agricultural holding, revenues on agritourism, revenues concerning past accounting years, other products and revenues.

and 9%, respectively, while ecological farms clearly differed from the average – their result was lower by 58%. The presented numbers confirm the lower land productivity for farms providing ecosystem services, especially in case of ecological holdings – of course, if they are measured in static terms. It is highly probable that in a long-term perspective and at full cost-benefit accounts – externalities, these relations would be reversed. It should be emphasised that farms of simplified crop structure, intensively organised and exploiting resources of the nature surrounding them, fail to generate high production results, what is more, they are far from the average (production value of a cereal holding per area unit was lower than the average by 36%). The presented numbers prompt to state that the simplified crop production results not only in negative environmental effects but also is not justified in *stricte* economic terms – taking land factor charges as the economic criterion. Whereas most of the holdings operating in line with the laws of nature ensure enough agricultural production volume. Differences between the researched holdings would be probably more pronounced in the full cost-benefit account based on valuation of externalities.

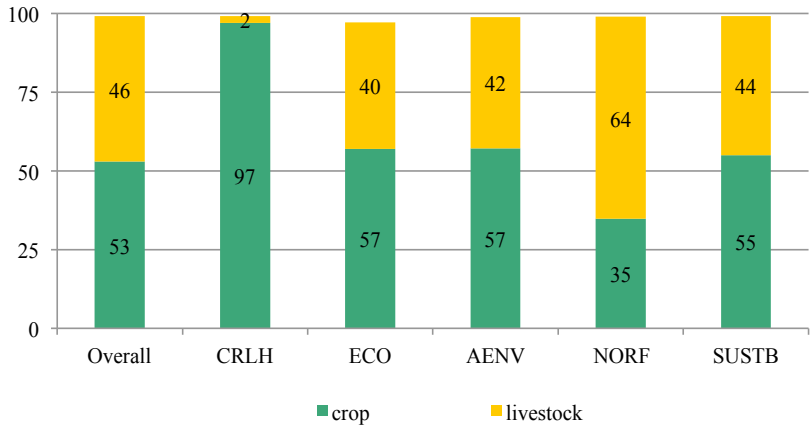

Fig. 2. The share of crop and livestock production in the overall production of agricultural holdings
Source: own study based on the FADN 2012 data.

Another ratio to measure productivity is production value of a farm referred to labour inputs – annual work units (AWU). This index is termed **productivity, or labour productivity**. The agri-environmental and sustainable holdings reached comparable results within the scope as average units, while ecological and Norfolk holdings – likewise in the case of land productivity – differed considerably *in minus* (difference of 54% and 13%, respectively). Contrary to them, cereal holdings reached a result exceeding the average by as much as 54%. Cereal holdings note a relatively low labour-intensity of production, which results from simplified crop production, cessation of absorbing livestock production and also efficient use of own labour resources.

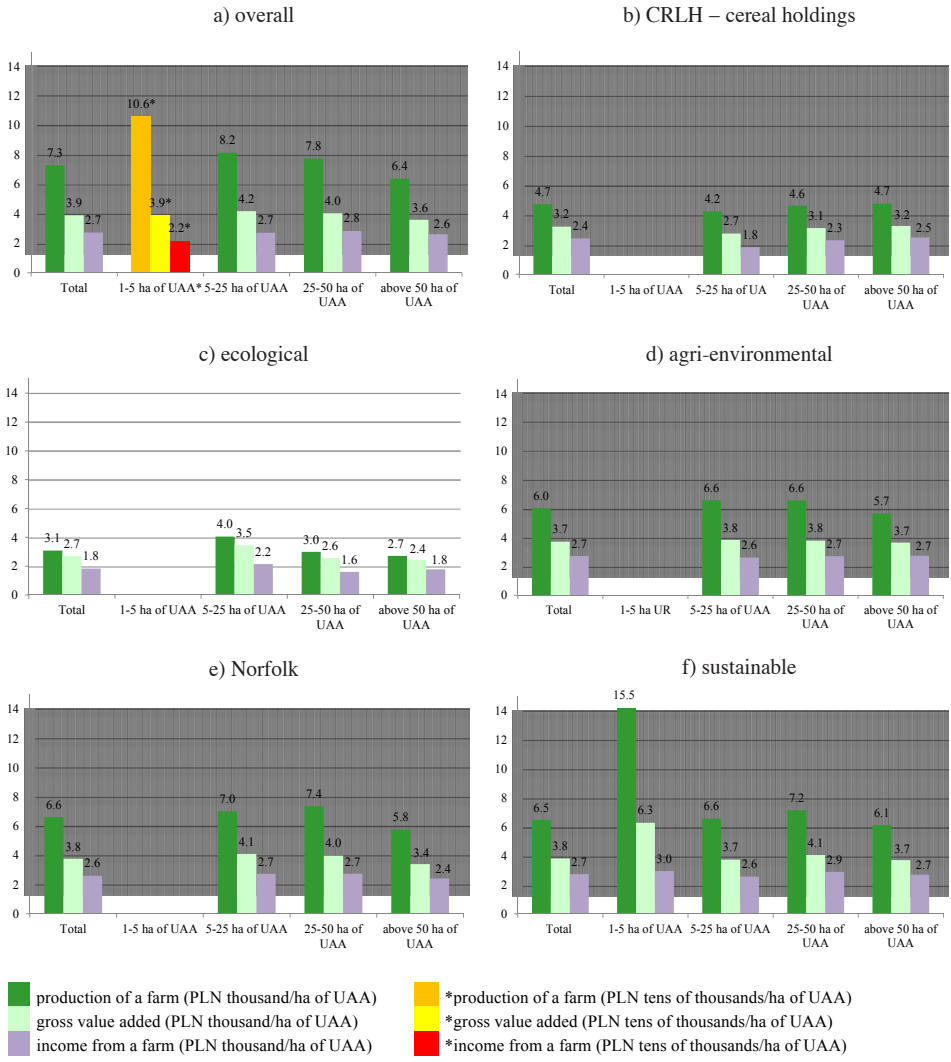

Fig. 3a-f. Productivity and profitability of land in researched farm groups
Source: own study based on the FADN 2012 data.

Taking into account the size of examined farm groups, Figures 3 and 4 illustrate land and labour productivity. As compared to all units, farms below 5 ha of UAA noted very high productivity of land (PLN 106 thousand per ha) and labour (PLN 130.7 thousand per AWU). The group includes specialist holdings with high livestock population, low labour inputs and relatively small area, which determined the result. The organisation of the farms was not consistent with the principles of sustainable development. Considering the insufficient number of farms of 1-5 ha it was not possible to compare results in this respect.

The presented illustrations point to a decreasing unit productivity of land along with an increase in the area of holdings providing ecosystem services[22]. Cereal holdings, on the other hand, are characterised by a positive trend in this respect. In the latter case, the numbers attest to the economic justification of increasing the utilised agricultural area. However, it should be stressed that unit productivity result in the largest cereal holdings was significantly different *in minus* than the average for units with a comparable acreage (26%) and most of the considered farm groups conducting pro-environmental activity (from 17% to 23%, depending on the form of sustainability).

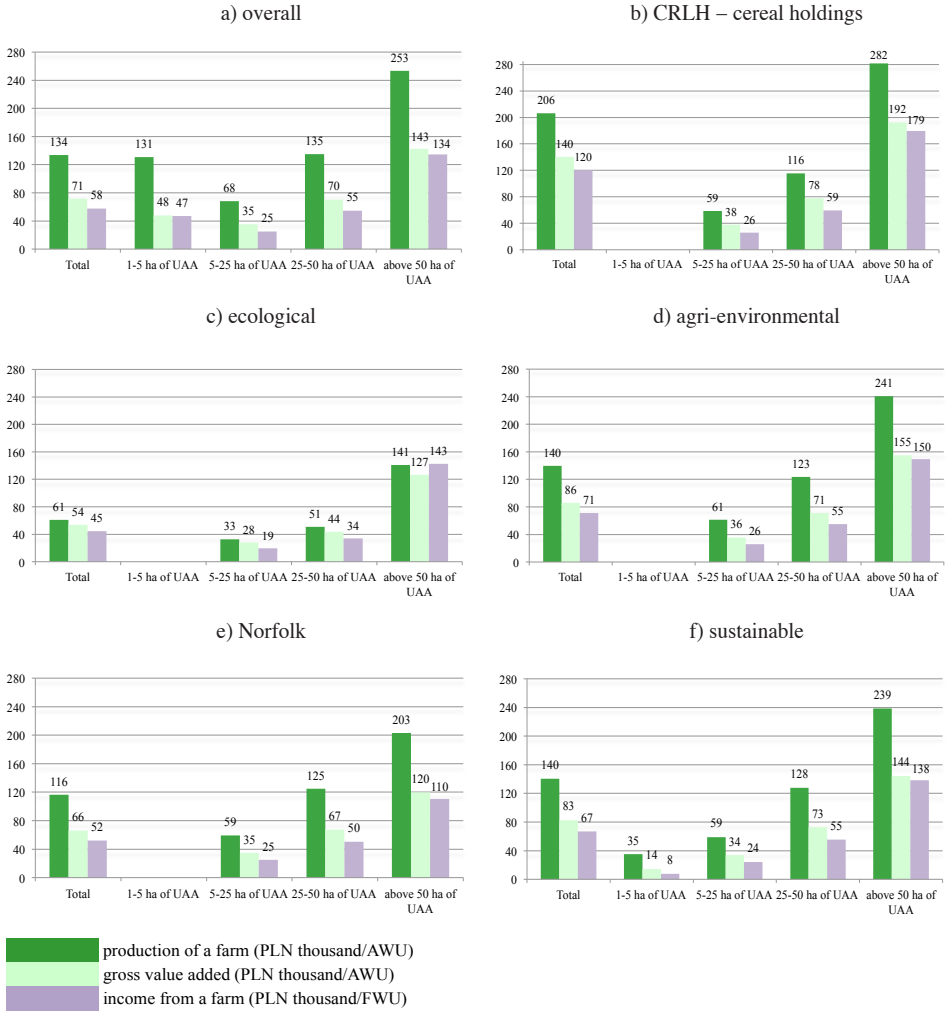

Fig. 4a-f. Productivity and profitability of labour in researched farm groups
Source: own study based on the FADN 2012 data.

[22] Identical conclusions concerning the relationship between production value and factors of production are presented in (Zegar J.St. 1986).

Labour productivity, both in the case of cereal holdings and farms generating positive externalities, increased accordingly to a change in their area. As far as specialist cereal holdings below 50 ha of UAA were characterised by lower labour productivity at the background of most of farms conducting pro-environmental activity, in the case of the largest ones (above 50 ha of UAA) they showed a significant advantage. These results confirm a very high and practically unrivalled position (in classical terms) of farms specialist in simplified crop production as compared to farms providing benefits for the society at large.

Costs and payments

Total direct costs and farming overheads linked to the operation of an agricultural holding are expressed as intermediate consumption. These costs for an average holding amounted to PLN 4.3 thousand per ha (Table 3). In this regard, cereal holdings and holdings providing ecosystem services were characterised by lower production intensity. Ecological holdings were especially visible in this respect, which stems from the specific character of this production system based on justified and limited use of external factors of agricultural production.

On average, direct costs (including: costs of seeds and seedlings, fertilisers, plant protection products, costs of feedstuffs for the animals, veterinary care) constituted 3/4 in the structure of intermediate consumption. These costs were at a similar level in most of the examined groups of pro-environmental farms, except for ecological holdings – their share represented 58% of the value of intermediate consumption. This is a typical feature of the farming system given the legal restrictions linked to limiting the intensity of agricultural production.

The presently implemented Common Agricultural Policy instruments condition the possibilities of obtaining financial support by agricultural producers via environmental restrictions and remuneration for provided ecosystem services. These conditions take on the form of such regulations as cross-compliance, which are tied with direct payments. They pertain to diversification of this type of payments, depending on the type of undertaken crop and livestock activity, and cover activities for sustainable development in the form of, e.g., agri-environmental programmes[23]. The implementation of these activities by farmers is confirmed by the level of payments that they receive. These payments largely shape the economic account (Table 3). The account conducted in line with the FADN methodology is typical of the category of balance of payments and taxes from operating activities. It covers payments to operating activities and VAT balance from operating activities, less taxes of an agricultural holding. It points to the direction of cash transfer to a farm – in case of value added, or from a farm – when the balance is negative (Bocian M., Malanowska B. 2014). In case of all considered forms of sustainable agriculture, the balance was positive and the transfer of funds linked to operating activities differed *in plus* from the average (the balance was higher by 48% for ecological holdings, by 42% – agri-environmental holdings, by 8% – Norfolk

[23] Detailed description of support programmes targeted at agricultural producers is presented on www.minrol.gov.pl.

holdings, and by 3% – sustainable holdings, against the average for all examined holdings). The values of these balances point to a cash compensation from the state for these pro-environmental activities, but the question whether or not the compensation is sufficient continues to be valid.

The presented fact sheet (Table 3) allows to compare the level of costs and the balance of payments and taxes to operating activities and investment activities for selected farm groups, taking into account their area. Given the unit level of costs incurred by farms of more than 5 ha, it can be stated that these values drop along with an increase in their area – the trend concerns both cereal holdings and individual farm groups conducting pro-environmental activities[24]. This conclusion pertains to both the value of intermediate consumption and depreciation value, while in case of the costs of external factors the direction of change is opposite. Larger farms incur relatively higher costs for contractual employment, which is connected to the need to employ workers, and also servicing of loans – larger farms more often take more cost-intensive investment decisions. In case of cereal holdings, the increase in the value of these categories along with the area was the highest at the background of other researched farm groups – providing ecosystem services.

Table 3

Values of selected categories from the results account of an agricultural holding (PLN/ha)

Specification	Total	1-5 ha of UAA	5-25 ha of UAA	25-50 ha of UAA	above 50 ha of UAA
Overall					
Intermediate consumption	4,331	64,777	4,904	4,673	3,718
Balance of payments and taxes from operating activities	932	-2,385	933	961	927
Depreciation	885	9,977	1,163	973	699
Net value added	3,018	28,943	3,019	3,071	2,901
Costs of external factors	335	9,011	301	285	346
Balance of payments and taxes from investment activities	-172	-2,745	-155	-187	-160
Cereal holdings					
Intermediate consumption	2,397		2,400	2,444	2,389
Balance of payments and taxes from operating activities	895		909	944	885
Depreciation	575		770	682	545
Net value added	2,622		1,960	2,419	2,697
Costs of external factors	256		119	169	279
Balance of payments and taxes from investment activities	-139		-83	-133	-143

[24] See (Zegar J.St. 1986).

cont. Table 3

Ecological holdings					
Intermediate consumption	1,756		2,149	1,827	1,574
Balance of payments and taxes from operating activities	1,378		1,553	1,412	1,302
Depreciation	606		1,012	721	412
Net value added	2,099		2,441	1,852	2,029
Costs of external factors	302		279	316	295
Balance of payments and taxes from investment activities	-81		-70	-97	-79
Agri-environmental holdings					
Intermediate consumption	3,647		4,181	4,171	3,301
Balance of payments and taxes from operating activities	1,323		1,424	1,373	1,278
Depreciation	773		1,012	897	665
Net value added	2,947		2,831	2,892	2,994
Costs of external factors	298		216	250	336
Balance of payments and taxes from investment activities	-162		-181	-194	-144
Norfolk holdings					
Intermediate consumption	3,855		3,976	4,387	3,358
Balance of payments and taxes from operating activities	1,005		1,060	1,003	990
Depreciation	918		1,125	1,042	729
Net value added	2,844		2,966	2,936	2,673
Costs of external factors	326		269	285	360
Balance of payments and taxes from investment activities	-190		-145	-274	-153
Sustainable holdings					
Intermediate consumption	3,636	9,615	3,815	4,076	3,367
Balance of payments and taxes from operating activities	960	466	990	981	943
Depreciation	827	2,606	1,016	970	709
Net value added	2,998	3,693	2,733	3,100	3,009
Costs of external factors	318	1,500	186	265	375
Balance of payments and taxes from investment activities	-192	213	-142	-236	-183

Note: Lack of values in crossed boxes was linked to insufficient sample size. According to the FADN principles results are presented for groups of at least 15 holdings.
Source: own study based on the FADN 2012 data.

Value added

Production value of a farm, adjusted by the volume of intermediate consumption and balance of payments and taxes from operating activities, indicates **gross value added of a holding**. This is production and economic category which reflects the increase in the value of goods manufactured in a given agricultural holding with the involvement of all three factors of production, regardless of who owns them. Moreover, it reflects the impact of agricultural policy on the economic situation of farms through the system of payments and taxes (Goraj L. 2009).

Gross value added of an average holding was PLN 3.9 thousand per ha (Figure 3a). The analysed forms differed, to a smaller or greater extent, in terms of this result depending on the group. According to the above presented numbers, despite lower production value and intermediate consumption of a farm, and higher payments for farms conducting pro-environmental activity, their result as gross value added is below the average. The conducted static analysis attests to the fact that the forms of sustainable agriculture fall short of other holdings as regards the generated agricultural production volume, and the policy instruments offset the difference only partially. Despite the high share of the value of balances of payments and taxes from operating activities in the gross value added – especially for ecological and agri-environmental holdings (51% and 36%, respectively) – their results do not match the average of economic units functioning in agriculture.

Gross value added of farms targeted at cereal monoculture was also below the average (the result is lower by 18%). It points to a lack of justification for simplification and narrow specialisation of agricultural production, both in terms of microeconomic rationality (targeted at economic benefit) and social rationality (targeted at care for public goods).

Considering the utilised agricultural area, trends and relations between examined holdings as regards unit gross value added are similar to those illustrated by land and labour productivity (Figures 3 and 4).

Another production and economic category is **net value added**. It is defined as the difference between gross value added and depreciation value. Depreciation of own fixed assets is valuated according to replacement value and concerns: perennial plantations, buildings and fixed equipment, drainage facilities, machines and tools[25]. Net value added reflects the executed payment for all factors of production (land, capital and full labour and management inputs). Thus, it is a useful measure of income obtained by all owners of factors of production (land, labour and capital) engaged in activity of an agricultural holding (Goraj L. 2009).

The data presented in Table 3 point to blurring of differences in the level of economic surplus between forms of sustainable agriculture and cereal holdings, and average results. The average net value added of individual farms amounted

[25] Depreciation is not calculated for land, forests, quotas and production limits, and current assets.

to PLN 3 thousand per ha and similar result was achieved by agri-environmental, Norfolk and sustainable holdings. The difference between the result for ecological and cereal holdings and the result for the overall examined group also decreases, and in case of net value added it amounts to 30% and 13%, respectively. The narrowing gap between the examined farm groups was caused by a more beneficial level of costs and the balance of payments and taxes from operating activities.

Income of a family farm

Net value added, adjusted by the cost of external factors and volume of the balance of payments and charges from investment activities, points to the level of farm income (Bocian M., Malanowska B. 2014). The cost of external factors covers remuneration for contractual employees (including social insurance of contractual workers), rents linked to lease of land and buildings, and interest and charges connected to loans taken out for purchase of land, buildings, machinery and equipment, livestock and materials. The amount of income illustrates the level of remuneration for own factors of production involved in operating activities of an agricultural holding and of risk taken by farm manager in an accounting year.

Farms conducting pro-environmental activities incurred similar costs linked to coverage of external factors as average units (Table 3). At this background, cereal holdings noted *in minus* difference (the difference in the level of costs amounted to nearly ¼). The generic structure of this group of costs allows explanation of these differences. Remuneration costs of average individual holdings were higher than other costs, i.e. costs of rents and interest (by 43%, 29% and 28%, respectively), while in case of cereal holdings rents constituted the greatest share of this group of costs and were at the level above the values of paid interest and remunerations (by 45%, 31% and 24%, respectively). In case of cereal holdings, labour inputs are relatively lower, while labour productivity is higher. This determines a lower level of costs linked to payment for contractual employment. Whereas high relative value of rents paid in this group of farms was dictated mainly by the additionally leased utilised agricultural area.

As regards ecological farms, relative relations in the structure of costs of external factors are different. They are dominated by the costs of remunerations (57%), which connects to fairly high labour-intensity of this farming system, often exceeding the possibilities of own resources of a farming family and conditioning employment of contractual employees. Other farm groups having a positive impact on the environment do not differ greatly from the average both in terms of level and generic structure of costs linked to coverage of external factors.

A significant item correcting the economic account is also the balance of payments and taxes to investment activities. This balance follows from the value of payments and taxes that are not connected to operating activities of a farm in a given accounting year. This is largely the result of values of investments made in an agricultural holding. In line with the FADN methodology, the production and economic account concerning a given accounting period considers a part

of the awarded investment subsidy (its amount depends on the period of using a given fixed asset), while in total it considers the value of input VAT on conducted investments. Hence, in case of farms making investments the value of this balance is negative.

Profitability of land and labour at a family farm is illustrated on Figures 3 and 4. On average, the use of 1 ha of agricultural area made it possible to generate income at the level of PLN 2.7 thousand per ha. A comparable result characterised agri-environmental, Norfolk and sustainable holdings. This is important information because it evidences a similar profitability of environment-friendly agricultural production.

It should be emphasised that, despite lower productivity of land of examined forms of sustainable agriculture, the support scheme in the form of payments (mainly to operating activities), and – or rather above all – more efficient organisation of an agricultural holding manifested in the level and structure of costs linked to functioning of an agricultural holding, allowed ensuring results comparable to the results of average holdings. Only *ecological farms* kept a significant economic distance to the remaining researched groups (PLN 1.8 thousand per ha). The presented results can point to insufficient *legal and financial protection* of the production system because they compensate for low profitability of factors of production to a negligible extent only. For comparison, farms generating negative externalities – in this analysis these are cereal holdings – also cannot be recognised as a lucrative farming method (their result was at PLN 2.4 thousand per ha).

A slightly different picture comes up when analysing **labour profitability** in the selected farm groups. One full-time equivalent of own labour at an average individual farm reached a result of PLN 57.7 thousand per FWU. Norfolk holdings noted a comparable labour profitability (PLN 52.0 thousand per FWU), while in case of agri-environmental and sustainable holdings the result was even better (respectively, PLN 71.3 thousand per FWU, 24% difference against the average, and PLN 66.8 thousand per FWU, 16% difference). The above results and relations between them are promising, taking into account their further development. Unfortunately, ecological holdings are still the last (PLN 44.6 thousand per FWU, 23% *in minus* difference against the average), which is evidenced by the aforementioned observations concerning this farming system in agriculture. However, very high production profitability in case of cereal holdings (PLN 120.3 thousand per FWU and, at the same time, twice higher than the average) ranks them at the leading position. Despite low land profitability of cereal holdings, the labour factor is highly remunerated. This results from their area, production scale and efficient organisation of own labour resources. A relatively low labour-intensity of monoculture crop production releases these farms from the need to employ contractual workers (remunerated).

The presented illustrations show also the relations in the level of profitability of land and labour between the examined farm groups in terms of area groups. The figures contained in this paper attest to a significant increase in labour profitability along with the area of a farm. Changes in this regard were especially favourable

for ecological and cereal holdings (result of PLN 142.6 thousand per FWU and PLN 179.4 thousand per FWU, respectively, in area groups of at least 50 ha of UAA). In case of ecological holdings, these are justified by the amount of payments to the holdings and benefits stemming from market ties. Increased scale of ecological production – large and uniform batch of raw material/agricultural product – fosters easier conclusion of promising contracts with recipients, e.g. processing plants, or a network of department stores (Wrzaszcz W., Zegar J.St. 2014). High production scale of cereal holdings and thus their better commercial standing can be also manifested in lower prices of industrial means of production. The level of land profitability as regards the area of examined farm groups does not take on uniform trends; hence, it is difficult to attempt explanations thereof.

Conclusions

This paper focuses on the issue of productivity and profitability of selected farm groups. Attention was especially drawn to farms providing ecosystem services (forms of sustainability), namely: ecological, agri-environmental, Norfolk and sustainable holdings. Cereal holdings – having high degree of crop production specialisation, were taken as the group for comparison. The research was based on farm accountancy results collected under the FADN system for 2012, additionally classifying farms by their utilised agricultural area.

The conducted research showed that selected farm groups conducting pro-environmental activity are different in terms of production potential expressed as volume of engaged factors of production – land, labour and capital. The production potential of most of the examined farm groups can be recognised as comparable to the average for farms keeping accountancy. The only exception are ecological farms which differ significantly *in minus* from the rest, both in terms of number, area, livestock population, assets and generated gross margin. The production potential of cereal holdings is close to the average, despite twice larger utilised agricultural area. This result attests to the significance of livestock production and also differentiated crop production in formation of the value of SGM. Omnidirectional character of agricultural production and rich structure of agricultural crops contributes not only to generating environmental profits but also measurable economic benefits.

The selected environment-friendly farm groups do not match the other farms in terms of generated production volume. Probably, in the long term and at full economic account, considering the externalities and common goods, these relations would reverse in favour of the sustainable forms of agriculture. Also farms of simplified crop structure, intensively organised and exploiting resources of the nature, fail to achieve impressive production results, in addition, they are far from the average.

As regards labour productivity some farm groups having a positive impact on the natural environment matched the average. Cereal holdings were characterised by the highest labour productivity, which was preconditioned by a rather low labour-intensity, which results from simplified crop production, cessation of absorbing livestock production and efficient use of own labour resources.

Subsequent production and economic categories compared to the agricultural area point to blurring of differences between holdings organised by the principles of sustainable development and cereal holdings, and average units. The narrowing gap between them was caused by a more beneficial level of costs and the balance of payments and taxes from operating activities.

The presented values concerning land profitability of the analysed groups showed that agri-environmental, Norfolk and sustainable holdings were characterised by similar production profitability as the population of FADN holdings, while ecological holdings failed to match them. A slightly different picture comes up when analysing labour profitability, since a result comparable to the average was achieved by Norfolk holdings, while a better one was typical for agri-environmental and sustainable holdings, which should be recognised as a promising premise for further development of these forms of agriculture. Unfortunately, ecological holdings generate worse economic results also in this respect. Basing on the relatively unfavourable economic results of ecological holdings, it can be stated that the financial support system under the government programmes targeted at this farming systems is insufficient.

Despite low land profitability of cereal holdings, own labour coverage reached a high level. This follows, primarily, from their large area and fairly low labour-intensity.

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Key words: economic efficiency, profitability, productivity, sustainable agriculture, ecosystem services, cereal holdings, production potential, land inputs, Total Factor Productivity

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