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FARM ECONOMIC SUSTAINABILITY – FINANCIAL RATIO ANALYSIS

TRWAŁOŚĆ EKONOMICZNA GOSPODARSTW – ANALIZA WSKAŹNIKÓW FINANSOWYCH

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Summary: Sustainable development is widely regarded as one of the pillars of building policies, strategies and business models. This assumption also applies to creation of specific practices related to running farm business. The key issue is how to measure agriculture sustainability. The article assesses the economic area of sustainable agriculture using the economic sustainability index, constructed on the basis of sixteen financial indicators. The source of data was the FADN, from which data on the economic situation of dairy farms (type 45). As a result of the research, the relationship between the economic size and the value of the economic sustainability index were determined. The research area covered five countries that are the largest dairy producers in European Union. In this case, high discrepancies in the level of economic sustainability index between farms were noted.

Keywords: sustainable agriculture, dairy farms, efficiency, profitability.

Streszczenie: Zrównoważony rozwój jest powszechnie uważany za jeden z filarów budowania polityki, strategii i modeli biznesowych. Założenie to dotyczy także kreowania określonych praktyk związanych z prowadzeniem gospodarstw rolnych. Kluczową kwestią jest sposób pomiaru stopnia zrównoważenia rolnictwa. W artykule dokonano oceny aspektu ekonomicznego rolnictwa zrównoważonego z użyciem wskaźnika trwałości ekonomicznej. Został on skonstruowany na podstawie szesnastu wskaźników finansowych. Źródłem danych był FADN, z którego zaczerpnięto dane o sytuacji ekonomicznej gospodarstw mlecznych (typ 45). W wyniku przeprowadzonych badań ustalono związek między klasą wielkości ekonomicznej a wartością wskaźnika trwałości ekonomicznej. Obszar badaczy stanowiło pięć państw będących największymi producentami mleka w Unii Europejskiej. W tym wypadku zauważono wysokie rozbieżności w poziomie wskaźnika trwałości ekonomicznej między gospodarstwami.

Słowa kluczowe: rolnictwo zrównoważone, gospodarstwa mleczne, efektywność, dochodowość.

1. Introduction

The concept of sustainable agriculture is considered to be one of the most important for the future functioning of the food economy and the behaviour of agricultural producers and agricultural sector stakeholders. On the one hand, it is seen as necessary, and on the other, as very ambitious. According to the Food and Agricultural Organization (FAO) of the United Nations, sustainable agriculture should mean management of natural resources, and technological change should be considered to ensure that people's current and future needs are permanently met. Sustainable agriculture is to be neutral to the environment, adapted to technical requirements, economically viable and socially acceptable (FAO, 2014). An aspect of sustainable agriculture that is worth paying attention to is the participation of agricultural producers in economic development and the benefits it receives. The consequences of this participation are to be decent employment conditions and the receipt of fair prices for agricultural products. Many studies on sustainable agriculture indicate that, in addition to environmental goals, it should provide an acceptable income for farmers to improve their quality of life (Hansen, 1996; Macrae, Henning, and Hill, 1993; Pretty, 1996; Rigby and Cáceres, 1997). Its main (long-term) goals include: (a) satisfying human food needs; (b) improving the quality of the environment; (c) making rational use of non-renewable energy sources; (d) using resources supplying "green" energy on farms; (e) maintaining agricultural profitability of agricultural activities; (f) improving the quality of life in rural areas and thus the quality of life of society as a whole (Rigby and Cáceres, 1997). Interesting conclusions about sustainable agriculture come from Velten, Leventon, Jager and Newig (2015). According to these authors, three groups can be distinguished that form the framework of sustainable agriculture such as activity, strategies and primary goals. Overarching goals include those environmental (related to production and not related to production), social and economic. From the point of view of the research topic, economic goals are of particular interest, which include: development, provision of livelihood, supply of products and services, and economic growth. The implementation of these goals is associated with the adoption of a specific strategy targeted at, among others, the maintenance of fixed assets, orientation towards demand, effectiveness and orientation towards quality. In turn, actions to implement this strategy relate to the functioning of the agri-food system, appropriate management and technological support, challenges related to environmental protection, increase in the quality of human capital and the functioning of the social, political and economic environment.

It is frequently pointed out that the promotion of sustainable agriculture is stimulated by actions taken by the state, involving, among others:

a) supporting sustainable farming practices and systems to protect the environment (Aerni, 2010; Öhlund, Zurek, and Hammer, 2015; Ogaji 2005; Lohr and Salomonsson, 2000),

b) protecting the agri-food market against an excessive inflow of products that can displace agricultural products (especially GMO) produced by production systems taking into account the assumptions of sustainable agriculture, and by importing products with a high health risk (Aerni, 2010; Andrew, Ismail, and Djama, 2017; Constance, 2010),

c) building awareness about sustainable agriculture by supporting education and competence development among farmers (Curry, Ingram, Kirwan, and Maye, 2012; Fowler and Rockstrom, 2001; Grudens-Schuck, 2000; Tatlidil, Boz, and Tatlidil, 2009; Zeweld et al., 2019).

In addition to the actions taken by the state, the global impact of the agribusiness sector on practices undertaken by agricultural producers is also indicated. Lee (2005) argues that, on the one hand, the decrease of agricultural prices may limit the desire to apply the principles of sustainable agriculture, which requires investment, high labour inputs and large financial resources at the initial stage of introducing changes on a farm. On the other hand, the high prices of the production means stimulate the adoption of sustainable farming practices that assume high rationality in the management of production factors, which at the same time increases economic benefits (Firbank et al., 2013; Kumar, Singh, and Mathur, 2006; Lubell, Hillis, and Hoffman, 2011; El Hage Scialabba and Müller-Lindenlauf, 2010; Syuaib, 2016).

Research on sustainable agriculture shows that a great emphasis is placed on the environmental aspect. However, the other two aspects, social and economic, should not be neglected. Only this approach allows a holistic approach to the concept of sustainable agriculture (Yli-Viikari, 1999; Dumanski, 1998; German, Thompson and Benton, 2017; Davarpanah, Bonab, and Khodaverdizadeh, 2016; Gómez-Limón and Sanchez-Fernandez, 2010).

Measuring sustainability in agriculture is difficult and reflects a subjective view of a scientific problem. The indicators used allow only for obtaining measurable information which includes just some aspects of reality (Yli-Viikari, 1999). The problem for researchers is to determine the type of indicators (including the time horizon) to make decisions about the sustainability of agriculture practices (Zhen and Routray, 2003). In the case of the economic aspect, such a set of indicators should determine the economic validity, allowing the farm to function in the long term and in a changing economic environment. A long period of time is understood as the farm's ability to be passed on to its successor (Latruffe et al., 2016). In determining economic sustainability, the term 'autonomy' refers to the degree of independence of a farm from external factors of production. This applies to means of production, external sources of financing and the diversification of agricultural income (Latruffe et al., 2016; Lebacq, Baret, and Stilmant, 2014; Ryschawy et al., 2013). As designing the right set of indicators, the method of collecting data and their validation is a big challenge, so there is no single procedure in the process of assessing a specific production system, including milk production (Roy and Chan, 2012).

The aim of the article is to determine the level of economic sustainability of groups of specialist dairy farms using a synthetic indicator and an analysis of its components describing the economic sustainability of the farm population studied. The conducted research includes farms of various economic size and takes into account changes in their results during 2004-2017. Farms from five countries that are the largest milk producers in the European Union were selected for the study, namely: Germany, France, the Netherlands, Poland and the United Kingdom.

2. Research methods

2.1. Research material

Data enabling the characteristics of individual farm groups and the calculation of indexes describing their economic sustainability were taken from the Farm Accountancy Data Network (FADN). Due to the availability of information and data confidentiality, which protects farms from being identified, average values for groups divided due to the Economic Size Class (ESC) were used. The research covered farms specializing in dairy cattle breeding designated as type 45 in the classification of farms in the FADN field of observation. The number of farms represented by the data used in the calculations is included in Table 1. During the selection of variables, the economic sizes that were not represented for at least ten years were excluded from the calculations.

Table 1. Number of farms represented (in thousands)

ESC	2004-2008	2009-2013	2014-2017	ESU	2004-2008	2009-2013	2014-2017
Germany					The Netherlands		
(4)	20.1-24.0	14.1-18.2	14.1	(5)	15.0-16.9	13.9-15.2	13.9
(5)	28.4-29.8	33.3-33.90	33.3-33.8	(6)	0.4-0.5	0.9-2.2	2.2-2.2
(6)	1.8-1.9	1.8-2.7	2.7-2.7	Poland			
France				(3)	21.3-24.5	32.6-33.1	32.0-32.5
(3)	5.4-7.0	1.4-3.3	1.3-1.7	(4)	4.1-5.3	11.0-17.7	17.1-17.6
(4)	21.6-26.8	9.4-14.4	9.3-9.4	(5)	0.6-0.8	1.8-3.7	3.5-3.7
(5)	24.5-25.8	30.6-31.7	31.7-31.7				
The United Kingdom							
(5)	12.1-14.3	8.2-10.1	8.3-8.4				
(6)	0.9-1.3	2.2-2.7	2.9-3.0				

ESC – Economic Size Class; (3) 25 000 ≤ EUR < 50 000; (4) 50 000 ≤ EUR < 100 000; (5) 100 000 ≤ EUR < 500 000; (6) EUR ≥ 500 000.

Source: based on FADN data.

The parameters characterizing the examined groups of farms are presented in Table 2. These data show that the economic size is closely correlated with individual variables. This means that as the ESU increases, the value of the analysed parameters also increases. This can be observed in particular by comparing the classes marked in the FADN terminology as fifth (economic size in the range from EUR 100 000 to 500 000) and sixth (economic size equal/greater than EUR 500 000).

Table 2. Description of surveyed groups of farms – data for 2017

ESC	Economic size (thous. EUR)	Dairy cows (LU)	Milk yield (kg per cow)	Total utilised agricultural area (ha)	Total labour input (AWU)	Unpaid labour input (FWU)	Total assets (thous. EUR)	Total liabilities (thous. EUR)
Germany								
(4)	78.8	25.7	6402.0	30.6	1.3	1.3	540.9	46.7
(5)	223.9	70.1	7612.6	73.4	1.9	1.6	974.3	213.1
(6)	1135.4	311.5	8868.4	398.6	9.3	1.6	3336.7	1512.8
The Netherlands								
(5)	300.5	80.1	8465.4	46.4	1.7	1.5	2453.6	754.5
(6)	727.2	195.7	9029.2	100.8	2.7	2.1	5897.0	2336.4
France								
(3)	43.3	20.0	4561.8	34.7	1.0	1.0	145.0	27.2
(4)	78.9	32.5	5669.2	54.6	1.3	1.2	257.8	75.8
(5)	206.2	69.3	6987.2	103.9	2.1	1.8	515.7	253.3
Poland								
(3)	37.7	16.5	5130.4	21.3	1.9	1.8	226.5	7.2
(4)	68.8	30.6	6305.1	35.7	2.1	2.0	402.1	25.2
(5)	147.6	64.4	7535.4	72.6	2.5	2.2	818.5	104.1
The United Kingdom								
(5)	287.9	103.6	7035.9	90.7	2.4	1.6	1595.1	214.0
(6)	800.1	272.0	7480.8	209.5	4.4	1.8	3313.7	740.8

ESC – Economic Size Class; (3) 25 000 ≤ EUR < 50 000; (4) 50 000 ≤ EUR < 100 000; (5) 100 000 ≤ EUR < 500 000; (6) EUR ≥ 500 000; LU – Livestock Unit, AWU – Annual Work Unit, FWU – Family Work Unit.

Source: own dataset based on FADN.

Based on the parameters characterizing the examined groups of farms in 2017, their high diversity can be seen despite the identical ESC (fifth class). Particular differences are observed when one compares the variables of Dutch and Polish farms (one of the interesting cases). In addition to the fact that Polish farms have a smaller herd of dairy cows and a 10% lower milk yield per cow, they also need 50% higher labour input to achieve half their economic size. In addition, Polish farms classified in the fifth ESC category had two-thirds lower total assets and almost two-fold lower liabilities.

2.2. Research method

The study of the economic aspect of sustainable agriculture is based on a combination of many indicators and building a synthetic indicator. Two approaches dominate in the literature. The first is to evaluate the value of a given indicator and determine its weight in a synthetic indicator. On the other hand, the second approach is to determine the synthetic indicator using a formula that takes into account previously selected indicators characterizing a given sustainable agriculture. Analysis of studies on the method of measuring sustainable agriculture showed that the authors, studying the economic component, focus their attention on the following three elements: farm economic viability, autonomy and efficiency. The most frequently calculated economic and financial ratios describing the indicated elements are shown in Table 3.

Table 3. Groups of indicators used to assess the economic aspect of sustainable agriculture

Group name	Indicators
Economic viability	Total arable land, income per employee relative to the minimum wage, degree of depreciation of fixed assets (%), diversification of production, degree of specialization, value of machines and devices, Total labour input, degree of mechanization of production, land productivity, value of arable land
Autonomy	Share of subsidies in agricultural income, share of insured land in the total agricultural land
Efficiency	Total output, fixed assets efficiency, farm net income, fertilizer consumption, farm gross margin, ability to generate cash

Source: own study based on (Davarpanah, Bonab, and Khodaverdizadeh, 2016; Majewski, 2013; Roy and Chan, 2012; Zahm et al., 2008).

The research used the method applied by Zorn et al. (2018), also by Dabbert and Braun (2012), and Mußhoff and Hirschauer (2011). It is based on the analysis of four areas of economic sustainability: profitability, liquidity, financial efficiency and stability (Table 4). In each of the areas, there is a group of indicators that allows calculating the synthetic economic sustainability index (ESA). Detailed information on how to calculate individual indicators can be found in the annex to the publication by Zorn et al. (2018).

$$ESA = \frac{(\sum_{i=1}^{N} P_i/N) + (\sum_{i=1}^{N} L_i/N) + (\sum_{i=1}^{N} F_i/N) + (\sum_{i=1}^{N} S_i/N)}{4}$$

ESA – economic sustainability index,
P_i – profitability ratios,
L_i – liquidity ratios,
F_i – financial efficiency ratios,
S_i – stability ratios,
N – number of ratios in evaluation areas.

Table 4. Groups of indicators used to assess the economic aspect of sustainable agriculture

Area of evaluation	Financial ratios	Area of evaluation	Financial ratios
Profitability	P1. Net profitability, P2. Return of assets, P3. Return on equity, P4. Income per family work unit, P5. Operating profit margin ratio	Liquidity	L1. Assets-turnover ratio, L2. Operating expense ratio, L3. Depreciation (amortization) expense ratio, L4. Net farm income from operations ratio
Financial efficiency	F1. Current ratio, F2. Working capital-gross revenues ratio, F3. Cash flow ratio, F4. Dynamic gearing ratio	Stability	S1. Fixed assets-total assets ratio, S2. Equity-fixed assets ratio, S3. Debt-equity ratio

Source: own study based on (Zorn, Esteves, Baur, and Lips, 2018).

The calculations of each indicator (a total of 17 indicators with a synthetic indicator) were made separately for the examined group of farms separated on the basis of the economic size, country and year of the analysis. As a consequence, approximately 3 000 data items were received, which were then organized, grouped and visualized in the form of tables and figures. Special attention was paid to changes in economic sustainability over time, differences in economic sustainability between the analysed countries and differences between the economic size of the analysed groups of farms. To better illustrate the results, the linear Min-Max transformation was performed (data normalization) so that the values are in the range from 0 to 1. After transforming the data, the value 1 means the desired size of the given indicator.

3. Research results

The conducted studies showed that the groups of farms specializing in dairy cattle located in France and the Netherlands showed the lowest economic stability (Table 5). The level of economic sustainability index for farms from these two countries allowed for over 85% of them to be included in the first and second quartiles. When analysing individual components of the ESA indicator, it can be concluded that one is dealing with various reasons for this state of affairs. In the French farm groups, financial efficiency ratios contributed to such low economic sustainability. On the other hand, for Dutch farms these were liquidity and financial efficiency indicators. In-depth analysis showed that the basic determinants of this situation were: high debts of farms, low cash flow and low value of production and current subsidies in relation to the current assets.

Polish farms were characterized by the highest values of the economic sustainability index. As shown in Table 5, almost 80% of all groups distinguished on

Table 5. Percentage of farm groups depending on the country, evaluation area and value of the economic sustainability index

Country	Profitability (P)				Liquidity (L)				Financial efficiency (F)				Stability (S)				ESA			
	quarter				quarter				quarter				quarter				quarter			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
DE (%)	36	17	29	18	21	40	13	26	2	24	45	29	33	24	10	33	21	29	43	7
FR (%)	37	43	17	3	0	20	60	20	66	34	0	0	0	0	57	43	43	43	14	0
NL (%)	37	22	30	11	81	15	4	0	78	22	0	0	0	0	44	56	67	22	11	0
PL (%)	3	14	14	69	0	2	36	62	0	34	40	26	55	36	9	0	0	7	14	79
UK (%)	14	36	39	11	46	50	4	0	0	0	25	75	25	64	11	0	14	36	50	0

ESA − economic sustainability index, DE − Germany, FR − France, NL − the Netherlands, PL − Poland, UK − the United Kingdom.

Source: own calculation.

the basis of the economic size class and conducting production in 2004-2017 in Poland were in the fourth quartile of the farms distribution. This was conditioned by their economic and financial results located in two areas of assessment, profitability and liquidity. The cost of own labour had a positive impact on the profitability ratios in the analysed time period. The year of 2017 is an example of this, in which they were three to five times lower than those incurred for farms located in other surveyed countries. This situation is likely to change in the future because one may expect some equalization of labour costs in EU countries. In the case of liquidity ratios, the low level of liabilities had an impact on the increased economic sustainability of Polish farms. The calculation of debt ratio showed that Polish farms are characterized by high financial independence. The considered indicator was on average 50-150% lower than its average level for German, Dutch and French farms.

It is also worth analysing the case of British farms. Indicators in the area of financial efficiency provide them with an advantage over groups of farms from other countries. This is confirmed by the percentage of these farms in the third and fourth quartiles. In total, 100% of British farms were included, with a zero share of French and Dutch farms. The amount of production value achieved was crucial for this division of the surveyed groups of farms. On average, it was 25% higher on British farms than on Dutch farms and almost twice as large as compared to French farms.

Another aspect of the study was to determine the diversity of the economic sustainability index in groups of farms separated on the basis of the economic size (Table 6). The calculations made it possible to state that in the years 2004-2017 the value of the ESA index higher than 0.61 (4th quartile) was achieved by more than half of the farms belonging to the group of ESC in the range from EUR 25 000 to 50 000. In addition, it was noted that along with the growing economic size, the

Table 6. Percentage of farm groups depending on ESC, evaluation area and value of the economic sustainability index

ESC	Profitability (P)				Liquidity (L)				Financial efficiency (F)				Stability (S)				ESA			
	quarter				quarter				quarter				quarter				quarter			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
(3)	28	24	24	24	0	0	5	95	24	52	5	19	48	19	33	0	10	14	24	52
(4)	40	26	5	29	0	0	50	50	29	17	33	21	55	12	31	2	29	26	14	31
(5)	20	33	25	22	24	43	29	4	28	13	30	29	16	33	29	22	29	25	24	22
(6)	14	12	45	29	67	31	2	0	21	36	17	26	0	26	7	67	21	31	36	12

ESA − Economic sustainability index, ESC − Economic Size Class; (3) 25 000 ≤ EUR < 50 000; (4) 50 000 ≤ EUR < 100 000; (5) 100 000 ≤ EUR < 500 000; (6) EUR ≥ 500 000.

Source: own calculation.

percentage of farm groups belonging to the highest of the separated quartiles decreased. Data included in Table 6 show that only 12% of farm groups with an economic size equal to or higher than EUR 500 000 qualified there. In addition, a high percentage of these farms appeared in the first quartile of the liquidity area. This means that this area had a special impact on the relatively low value of the economic sustainability index. The opposite situation occurred in the case of farms with an economic size class of less than EUR 100 000. It was in the area of liquidity that the group of these farms achieved the highest values of indicators. It is also worth analysing the stability area in which zero values appeared. Similarly to the liquidity area, this situation applies to groups of farms with the highest and lowest economic size. In the case of the lowest class, none of the studied farms was in the fourth quartile (the highest values of the average of individual indicators calculated for this area). In turn, none of the groups of farms with the highest ESC was placed in the first quartile. This means that thanks to this aspect they have an advantage over other farms. A detailed analysis of the indicators included in the stability area also showed the dependence of the results obtained on the value of equity and fixed assets. The higher level of these two economic figures also provided a higher value for the economic sustainability index.

4. Conclusions

Research on the sustainable development of farms is of interest to the many scientists dealing with issues related to environmental protection, sociology, economics, management and production systems. This is confirmed by the number of publications and proposals made in the field of measuring sustainable agriculture. Unfortunately, so far no single model has yet been developed to measure the level of sustainability.

Scientists are constantly looking for the best set of indicators to give a real picture of the operation and sustainability of farms. One of the three areas of sustainable agriculture is economic sustainability. Establishing this type of sustainability, as well as the level of sustainability of a farm, is quite difficult and depends on the parameters that will be used to measure it. The research used a method that contains indicators proposed by the majority of researchers dealing with the issue of researching the level of the economic sustainability of farms.

Dairy farms are characterized by linking two production areas. On the one hand, one is dealing with crop production (feed production) and on the other, animal production, therefore they should be of particular interest in determining their economic sustainability. Based on the FADN data, 16 indicators were calculated characterizing four areas of economic sustainability and a synthetic indicator of economic sustainability. The study of the variability of the level of economic sustainability indicator over time showed that in the examined groups of farms it was subject to high fluctuations. It was not possible to point to a specific development trend or high or low uniformity of the surveyed groups of farms, which also changed over the studied period of time.

The calculation of the set of indicators showed the existence of the differentiation between the analysed countries. In light of the conducted research, the basic determinants of heterogeneity of economic sustainability were the costs of family labour, credit risk, production value, and low cash flow. In addition, some farms were dependent on subsidies, which also limits their economic sustainability. This situation concerned mainly German and French farms, in which the share of subsidies in the income from a family farm accounted on average for over 80% (2004-2017). On the other hand, Polish farms characterized by a low level of debt ratio and a low share of subsidies in family farm income not exceeding 45% had the advantage in making the production independent from external financing sources.

In solving the research problem, it was found that there was a relationship between the economic size of dairy farms and the value of the economic sustainability index. A high percentage of farms with the highest calculated values of the said indicator occurred in the group with the lowest of the analysed economic size classes. In addition, it decreased with subsequent, higher ESC – the lowest value of only 12% was achieved in the class with an economic size equal to or exceeding EUR 500 000. This is due to the dependence on external production factors, subsidies and the sensitivity of their revenues to price changes. In addition to a high level of income, the large scale of milk production is associated with a high level of risk. The results may indicate the need for additional testing indicators of economic sustainability. Presumably, indicators that take into account the specifics of production in different countries or the values of the indicators taking into account this specificity, should be included.

Research on economic sustainability should be continued and expanded to include further aspects within the concept of sustainable agriculture, including environmental and social. However, this requires a significant commitment of resources and a change in the research method. This is due to the need to obtain data from individual research facilities, which limits inference to the population and narrows the scope of research. Nevertheless, the information obtained in this way will help in developing scientific concepts.

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