

## The Sustainable Development of Family Farms of Beef Cattle

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Agricultural farms are currently under constant pressure to meet the requirements of increasing competition and, at the same time, the requirements of limiting the negative impact of modern production methods on the environment (Sawa, 2008). Their development should take into account the maximisation of the net benefits from economic development, at the same time protecting and ensuring the recovery of usability and quality of the natural resources surrounding them in the long term (Czyżewski, 2012). The industrial character of agriculture ensures the achievement of production goals and, to some extent, economic goals, but it can exert a highly unfavourable impact on the natural environment, posing threats to biodiversity and human and animal health, and leading to the overproduction of food (Kuś, 2013) and, as a consequence, to the worsening of the economic situation of farmers. *"The essence of sustainable development is not found in the balancing of relations between such domains (governance) as economy, society, space or nature but in the choice of the degree of durability. The degree of durability is determined by the emphasis on environmental protection and striving to preserve natural capital in relation to the needs of the economy and society"* (Jeżowski, 2007, pp. 13-14).

### Materials and methods

The research was carried out in 95 farms in regions predisposed to the production of cattle (the region of south-eastern, south-western and north-eastern Poland). The analysed objects were compiled into two area groups: group I - up to 50 ha and group II - over 50 ha, in order to make comparisons sensible. For the purpose of data collection, a questionnaire was developed. The direct interviews were carried in 2016. Based on the obtained data, the area structure of farms and their financial support as well as economic indicators were analysed, including direct costs, indirect costs and net agricultural income. The costs of feedstuffs were calculated at production costs and, for purchased feeds, market prices from a given region were assumed. A descriptive statistics method was used in order to analyse the results, and the results were presented in a tabular form.

To assess the degree of implementation of the concept of sustainable development in cattle production farms, some indicators were selected according to the IUNG method due to the availability of data. To assess the obtained results, the scoring scales from 0 to 5 (Harasim, 2013, 2014) were used. According to the method, it was assumed that they characterised the condition of a farm that would harmoniously pursue production, economic, social and ecological goals. In order to assess the level of social sustainability, the following criteria were used: the criterion of education, age (a factor affecting the development and sustainability of a farm), own work and wage labour input - expressed as the ratio of actual labour cost per hour throughout the year, and fully capable workforce on the holding. The threshold value of working hours in the agriculture for fully capable workforce of 2120 working hours per year (Harasim, 2013) was adopted. To determine the sustainability of the agricultural production process in terms of meeting environmental requirements, it was assumed that the correct

selection and sequence of plants was respected -at least three groups of plants, the degree of soil coverage with vegetation, the species domination of sowing, the share of cereal in the sowing structure with the maximum threshold value of 66.7% of arable land (GO) and the maximum stocking density to 1.5 DJP / ha of UR.

The assessment of economic sustainability was based on selected indicators: profitability, income parity, and degree of specialisation of the holding, the share of subsidies in income, the economic effectiveness of a farm determined by net agricultural income per 1 cow, per ha and per 1 full-time employee.

The purpose of the research was to assess the level of sustainability of family farms producing beef livestock.

### The results and their discussion

The data analyses (Tab. 1) showed that the age of the owner of the farm was 43.38 on average and fluctuated from 41.57 in the north-east Poland region up to 47 in the south-east Poland. It can be stated that with the age of a person managing a farm, not only accumulation of certain resources of production factors takes place but also a decrease in occupational activity, which is expressed, *inter alia*, in a reduced ability to perform physical work and introduce technical advancements (Janc, 2004). This problem can be illustrated by, for example, the total labour expenditure (AWU = 1.96), where "older" farmers employed more people than the younger group, in which the expenditure amounted to 1.83 AWU whereas farms did not they differed greatly in the area. Currently, farm managers are required to have a wide knowledge in the field of modern techniques and technologies of cultivation, fertilisation, soil protection and animal husbandry, which requires constant updating of knowledge and raising qualifications, which forces them to make biological and technological progress as well as changing market conditions.

Table 1. General characteristics of human capital in beef cattle farms – social indicators

Item	Total farms	Region of North-Eastern Poland	Region of South-Western Poland	Region of South-Eastern Poland
Owner age (years)	43,38	41,57	43,00	46,84
Number of persons in household	4,53	4,50	4,38	4,79
Family labour force employed by the holding	1,95	1,80	1,95	2,41
Total labour force employed by the holding	2,25	1,93	2,48	2,51
(FWU)	1,82	1,79	1,85	1,83
(AWU)	2,07	1,83	2,34	1,96
Number of learners – to 16 years old	1,82	1,75	1,69	2,13
17–19 years old	1,10	1,11	1,25	1,00
19–26 years old	1,17	1,33	1,00	1,00
Owner's education (%):				
P – primary education	5,06	6,67	3,33	5,26
Z – vocational education	36,71	40,00	43,33	21,05
S – secondary education	41,77	43,33	30,00	57,89
WI – tertiary education (other than agricultural);	10,13	6,67	13,33	10,53
WR – tertiary education (agricultural)	6,33	3,33	10,00	5,26
Number of people receiving pension	1,47	1,33	1,73	1,36
Aggregate index of the level of sustainable farm	<b>3,67</b>	<b>4,00</b>	<b>4,00</b>	<b>3,33</b>

AWU – Annual Work Unit; FWU Family Work Unit.

Source: own calculations.

Therefore, the analysed farms were most often managed by people with secondary education (41.77%), with the highest result in the Podkarpackie region. The level of people with higher education was also relatively high (16.46%), especially in south-western Poland (23.33%). Noteworthy is the fact that the owners with higher education had only 6% higher education in agricultural education. From among the analysed farms, only 5% had primary education.

These results are confirmed in the studies by Marcysiak and Marcysiak (2011), who state that there are around 55% of farmers managing farms with secondary and higher education, which gives rise to the conclusion that in the recent years, the level of education has improved among the rural population. The assessment of farms in terms of social sustainability has shown that they achieve a high degree, as indicated by the calculated index of aggregated assessment of the degree of sustainability of the farm, bringing the average for all surveyed entities to 3.67.

The main characteristics of sustainable agriculture is the preservation of soil production potential as well as biodiversity of animals and plants, which is one of the basic elements of the natural environment used in agriculture.

The analysis of farms maintaining meat cattle (Tab. 2) revealed that they had a large area, 53.58 ha on average, with the smallest ones located in the south-eastern Poland. They kept, on average, 17 cows of high breed diversity, i.e. in 79 analysed farms it was as many as 13 meat breeds and their hybrids.

The highest breed diversity was found in south-western Poland (10 breeds). In this region, 1 ha of arable land was loaded with only 0.61 DJP. This value, on average, for all farms surveyed was 0.86 DJP/ha UR. The largest concentration of beef cattle was in the north-eastern region and amounted to 1.11 DJP/ha of UR.

The examined farms produced on average 42.72 kg of organic nitrogen per 1 ha of UR, which was fully managed within the farm and did not pose a potential threat to the environment. PLN 397.93/ha was allocated on average for the purchase of mineral fertilisers and 72.24 PLN/ha for the purchase of plant protection products.

All the analysed entities implemented an agricultural and environmental program to a different extent, thus obtaining, on average, PLN 121.73 per ha of compensation for the pro-environmental activities.

The position of the farm on the agricultural market is shaped mainly by its economic efficiency. In the longer term only those entities that better adjust their production potential, scale and production structure, and production costs to the market requirements will ensure better developmental opportunities (Domagalska & Strzelczak, 2000).

Table 2. General characteristics of farms – environmental indicators

Item	Total farms	Region of North-Eastern Poland	Region of South-Western Poland	Region of South-Eastern Poland
Number of cows	17,24	19,43	22,31	6,05
Number of cattle – total	46,88	53,17	47,62	35,84
Average area of farm (ha)	53,38	39,59	77,22	38,78
Cultivation area – total (ha)	30,90	21,34	45,32	23,98
Permanent pasture (ha)	18,75	13,97	28,74	11,04
Organic area (ha)	2,75	2,11	5,22	0,00
Share of cereals in the sown area (%)	55,95	53,94	61,85	50,12
Pastures in relation to farm size (%)	36,06	35,05	35,33	38,77
Liczba upraw – Number of crops (average)	5,15	4,15	5,20	5,75
Coverage index of the soil vegetation (%)	55,45	43,54	56,74	72,27
Livestock density per hectare (LU)	35,51	39,51	36,86	27,16
Number of breeds/meat breeds/crossbreeds	13 / 8 / 5	5 / 2 / 3	10 / 7 / 3	5 / 3 / 2
Nitrogen production on the farm (kg/ha)	42,72	56,98	32,25	36,73
Use of mineral fertilizers (PLN/ha)	397,93	434,85	459,05	109,95
Use of plant protection products (PLN/ha)	72,24	58,82	95,50	45,07
Implementation of agri-environmental packages (PLN/ha)	121,07	115,27	108,51	174,90
Aggregate index of the level of sustainable farm	<b>3,60</b>	<b>3,80</b>	<b>3,60</b>	<b>3,20</b>

Source: own calculations

The analysed farms (Tab. 3) were characterised by very diverse revenues depending on the region, amounting to as much as 2000 PLN per 1 ha of agricultural land (comparing Podkarpackie with Podlasie regions), with a similar area of use. Regional diversification could also be observed by analysing direct costs between regions although these were mainly the result of feed costs which are the lowest in the south-eastern region and which resulted from the intensity of production.

The largest disproportions were recorded when analysing net agricultural income per one full-time employee. This ratio ranged from PLN 2615.77 in the region of south-east Poland to PLN 5945.88 for the region of south-western Poland. In the Podkarpackie region, it was lower by 39.54% in relation to the average monthly gross wages in the national economy in 2013, which proves the high differentiation of the income in the agricultural population, thus threatening further economic development of the village.

Net agricultural income per 1 ha of arable land was comparable in all studied regions and amounted to an average of PLN 1169.19/ha. After converting this indicator to 1 cow

on the farm, it was found to be the highest in the region of south-western Poland. It resulted from low specialisation of farms, amounting to only 29%, and targeting them primarily on the plant

production and a fairly high share of subsidies in income, which accounted for as much as 65%. Therefore, on these farms the aggregate ratio of the assessment of the degree of farm sustainability was the highest and amounted to 3.40.

Table 3. Measures of the economic efficiency of beef cattle farms

Item	Total farms	Region of North-Eastern Poland	Region of South-Western Poland	Region of South-Eastern Poland
Farm revenues per ha (PLN)	4 309,42	4 940,42	4 034,58	3 213,46
Feed costs per cow (PLN)	3 937,41	3 995,10	4 117,57	3 217,47
Direct costs per cow (PLN)	4 579,11	4 755,33	4 492,86	4 289,61
Net farm income (PLN)	66 475,61	48 225,29	98 376,02	28 715,35
Net farm income per person (PLN)	2 199,23	1 765,61	2 987,53	1 214,06
Net farm income per cow (PLN)	1 522,40	953,93	2 281,74	1 025,74
Net farm income per ha (PLN)	1 169,19	1 158,60	1 251,90	961,10
Profitability (%)	58,47	42,12	82,55	50,58
Average gross wages in the national economy (PLN)	4047,21*			
Income parity (%)	52,33	41,62	71,81	29,13
Share of payments in income (%)	47,37	14,45	65,03	96,53
Level of farm specialisation (%)	45,87	62,24	29,01	45,65
Economic efficiency of farms (%)	1,41	1,41	1,49	1,14
Aggregate index of the level of sustainable farm	<b>3,20</b>	<b>3,20</b>	<b>3,40</b>	<b>2,20</b>

Source: own calculations.

\* Average gross wages in the national economy in 2016

Based on the obtained results (Tab. 4) with the application of the index of synthetic farm sustainability ( $W_s$ ), the degree of sustainability of the surveyed farms was determined (Harasim, 2014). The carried assessment indicates that the holdings of the south-eastern region of Poland, in terms of particular criteria (social, environmental and economic), achieved the average level of equilibrium  $W_s = 2.91$  while in the farms of the north-eastern and western Poland, the equilibrium level was high -  $W_s = 3.67$ .

Table 4. Synthetic index of farm sustainability

Index values	0,00	0,1–1,0	1,1–2,0	2,1–3,0	3,1–4,0	4,1–5,0
Level of sustainability	none	very low	low	average	high	very high
Synthetic index of sustainability	Total farms	Region of North-Eastern Poland	Region of South-Western Poland	Region of South-Eastern Poland		
<sup>1</sup> criteria E-S	3,43	3,60	3,70	2,77		
<sup>2</sup> criteria E-Ś	3,40	3,50	3,50	2,70		
<sup>3</sup> criteria Ś-S	3,63	3,90	3,80	3,27		
<sup>4</sup> criteria E-Ś-S	<b>3,49</b>	<b>3,67</b>	<b>3,67</b>	<b>2,91</b>		

Source: own calculations.

$W_s$  – synthetic index of sustainability,

$W_{zk}^s$  – aggregate indicator of sustainability of the given assessment criterion.

Sustainability criteria: <sup>1</sup>E-S – economic-social; <sup>2</sup>E-Ś – economic-environmental; <sup>3</sup>Ś-S – environmental-social; <sup>4</sup>E-Ś-S – economic-environmental-social.

The adoption of two criteria for the assessment – the economic and social ones as well as economic and environmental criteria also reveals the average level of sustainability in holdings in the south-eastern region, amounting to 2.77 and 2.70, respectively. The farms in the north-western and south-western Poland have a high level of balance in this respect (3.70 and 3.50). The farm assessment in terms of social and environmental criteria revealed a high level of sustainability in all the analysed regions. However, in the south-eastern Poland the synthetic ratio of sustainability for farms was only 3.27. This indicator for holdings in the north-eastern and south-western regions was higher and amounted to 3.90 and 3.80, respectively.

### **Summary**

On the basis of the obtained results, it was determined that farms maintaining beef cattle in three studied regions implemented the assumptions of the concept of sustainable development trying to achieve the social, environmental and economic balance. In all the surveyed farm groups, environmental objectives are implemented in a way that does not threaten the environment. The basic environmental indicators, i.e. the stocking of animals (0.86 DJP per 1 ha UR), the level of mineral fertilisation and the use of plant protection chemicals as well as the production of organic nitrogen (42.72 kg / ha UR) were not exceeded. In addition, all the farms implement the agro-environmental program which favours the concept of sustainable agriculture development. The calculated aggregate ratio of the assessment of the environmental sustainability of the holding is 3.60 on average, which indicates a high degree of sustainability.

The analysis of selected economic indicators revealed that in all the cases beef production was a profitable activity at the farm level. However, if we calculate agricultural income per 1 full-time employee, we can notice large disproportions. All the farmers remained in the income disparity regardless of the geographical location of their farm. In the region of south-eastern Poland, monthly net agricultural income was lower by over PLN 2,833 from the average monthly remuneration excluding agricultural activity, which amounted to PLN 4047.21.

The farms in south-western and north-eastern Poland achieved a satisfactory balance between social-environmental and economic factors, as indicated by the calculated synthetic index of sustainability of the surveyed farms, amounting to 3.67. Therefore, we can talk about a high level of sustainability in this case. In the region of south-eastern Poland, the assumption of income balance and thus the living conditions of the rural population was disturbed, as indicated by the calculated synthetic index of sustainability of the researched farms, amounting to 2.91, which informs about a medium degree of sustainability, especially due to economic criteria.

### **Bibliography**

- Czyżewski B. (2012). Produktywność zasobów w rolnictwie w Polsce wobec paradygmatu zrównoważonego rozwoju. *Studia Ekonomiczne/Economic Studies*, 2 (LXXIII): 165–188.
- Domagalska M., Strzelczak L. (2000). Zarządzanie finansami w warunkach konkurencji rynkowej na przykładzie wybranych gospodarstw sadowniczych. *Mat. Konf. Wyd. Olsztyn-Kortowo*, t. 1: 17–22.
- Harasim A. (2013). Metoda oceny zrównoważonego rozwoju rolnictwa na poziomie gospodarstwa rolnego. *Studia i Raporty IUNG-PIB, Puławy*, 32 (6): 58–66.
- Harasim A. (2014). Przewodnik do oceny zrównoważenia rolnictwa na różnych poziomach zarządzania. IUNG-PIB, Puławy, 91 ss.
- Jeżowski P. (2007). Kategoria rozwoju zrównoważonego w naukach ekonomicznych. W: *Ekonomiczne problemy ochrony środowiska i rozwoju zrównoważonego w XXI wieku*. Oficyna Wydawnicza SGH, Warszawa, 138 ss.
- Kuś J. (2013). Specjalizacja gospodarstw rolnych i jej konsekwencje produkcyjne, ekonomiczne i siedliskowe, *Studia i Raporty IUNG-PIB, Puławy*, 32(6): 167–185.
- Janc K. (2004). Znaczenie kapitału ludzkiego w procesach globalizacji. W: *Człowiek, region, państwo w procesach globalizacji, regionalizacji i integracji*, G. Rdzanek, E. Stadtmüller (red.). Wyd. Arboretum, Wrocław, ss. 71–82.
- Marcysiak A., Marcysiak A. (2011). Wpływ cech jakościowych kapitału ludzkiego na wyniki ekonomiczne gospodarstw rolniczych. *Zesz. Nauk. SGGW – Problemy Rolnictwa Światowego*, 11 (26): 4: 129–137.
- Rocznik Statystyczny Rolnictwa (2014, 2015, 2016)*. Główny Urząd Statystyczny, Warszawa.
- Sawa J. (2008). Nakłady materiałowo-energetyczne jako czynnik zrównoważenia procesu produkcji rolniczej. *Inżyn. Roln.*, 5 (103): 243–248.

## **THE SUSTAINABLE DEVELOPMENT OF FAMILY FARMS OF BEEF CATTLE**

### **Summary**

The aim of study was to assess sustainability degree of beef cattle farms. Using the synthetic farm sustainability index, we determined the degree of sustainability of beef farms. The application of this assessment by beef producers can ensure the efficient production of safe, high quality beef, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of beef cattle. The assessment indicates that farms of south-eastern Polish region, in terms of different criteria (social, environmental and economic) achieved an average degree of sustainability, while degree of sustainability in farms of north-eastern Polish region was high. Based on the results, it was found that on farms in the Podkarpace region, implementation of the objective of equal income and thus equal living conditions of the rural population have been disrupted.

**Key words:** sustainable development, economic efficiency, beef cattle