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Evaluation of cattle husbandry effectiveness in farms maintaining the native breeds included into the programme of protection of genetic resources

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The aim of the study was to evaluate the effectiveness of cattle husbandry in farms maintaining two native Polish breeds included into the programme of protection of genetic resources, i.e. Polish Red (15 farms) and Whiteback (20 farms). The control group consisted of 15 farms maintaining the Polish Holstein-Friesian cows, in the intensive technologies. The information was collected directly from the farms on the basis of farmer survey conducted in 2011 and from own observations. The structure of costs and incomes as well as revenue from cattle husbandry were calculated. The costs per unit and profitability were determined per one cow and 1 kg of milk. Unit costing was accomplished according to the methodology used in the FADN. It has been shown that the current level of refunds from agri-environmental programmes to the native breeds of cows (including significantly lower milk yield) is the crucial support which to a large extent is decisive for their maintenance by farmers. However, the refunds do not compensate for the loss of revenue, compared to the farms with intensive milk production.

KEY WORDS: cattle / native breeds / production costs / production efficiency

Maintenance of animal biodiversity is an important aspect to consider from any point of view: agriculture, food production, cultural heritage, nature conservation, rural development as well as science [5, 10, 15, 16, 17, 19]. Most European cattle breeds are classified as native (local) breeds, i.e. kept in only one country. They are of tangible value for the preservation of genetic diversity, while also being important from the environmental, social, cultural, historical and frequently economic point of view [6]. However, many breeders in order to meet world competition and increasing demand for animal products decide to replace multiple purpose native breeds with high-producing international transboundary breeds [3]. A commonly used method to increase animal production is to cross local breeds with high-producing breeds. If this is done in an uncontrolled manner it may pose a serious threat to the local populations [3, 12]. The measures to support native breeds adopted in

Europe, following the Rio de Janeiro Convention, have prevented many valuable genotypes from dying out. Nevertheless, in most EU countries they are insufficient and do not compensate for the lost income [13]. Experiences of French and Italian farmers indicate that valuable regional products may be obtained from local cattle breeds, thus having a significant effect on the development of a given breed [4, 7 , 9, 16].

In Poland 4 cattle breeds are covered by the genetic resources conservation programme (Polish Red, Whiteback, Polish Black-and-White and Polish Red-and-White), which breeding is supported within agri-environment schemes [7, 18].

The aim of this study was to assess cattle farming efficiency on farms keeping two local breeds covered by the genetic resources conservation scheme, i.e. the Polish Red and the Whiteback.

Material and methods

The analyses were conducted on family farms keeping dairy cattle and located in south-eastern Poland. Farms were selected based on the number of cows and their breed.

Analyses were carried out on 50 farms, which were divided into 3 groups:

- group I (control) – 15 farms keeping from 30 to 70 Polish Holstein-Friesian (PHF) cows in intensive production systems;
- group II – 20 farms keeping from 10 to 30 Whiteback cows (BG);
- group III – 15 farms keeping from 10 to 30 Polish Red cows (PC).

Information on their agricultural production was collected directly on the farms based on invoices, bills, applications for area payments (ARMA) and from interviews conducted with farmers in 2011, as well as available documents from insurance companies, dairy cooperatives, milk recording and the authors' observations.

For each farm the following data were recorded: utilised agricultural area (UAA, ha), arable land (ha), permanent grassland (ha), main forage area (ha) and crop structure (%), the number of cows in the herd (head), the number of Livestock Units (Polish DJP = LU), stocking (LU/ha), production value (PLN), direct and indirect production costs (PLN), cost structure (%), income structure (%), volume of direct payments (PLN), structure of direct payments (%), total Standard Gross Margin (PLN) and income from agricultural activity (PLN).

Unit costs and profitability were determined in terms of their value per 1 cow and per kilogram of milk. This made it possible to obtain a more accurate representation of dependencies between the investigated indexes. Unit costs were calculated following the methodology used in the FADN system. Production costs were analysed in terms of their division into direct and indirect costs, i.e. depending on their cost centres, that is their relationship to the product. Direct costs are such cost components, which may be attributed to a specific type of activity. The volume of these costs is proportionally dependent on the scale of production. Moreover, they have a direct effect on the level (volume and value) of production. The following cost types were included in that category: fodder produced on the farm utilising indirect costs, purchased feeds, veterinary services and reproduction costs, insurance of animals, paid labour, purchase of animals and other costs (e.g. bedding).

In turn, indirect costs are costs, which at the time of their generation may not be ascribed to specific products, they are joint costs for the entire farm. These are outlays on fuels, electricity, running repairs of fixed assets involved in production (buildings, machines, equipment), insurance, taxes and depreciation. The calculated Standard Gross Margin represents the difference between revenue and direct production costs [1, 14].

Depreciation for fixed assets used in production was estimated at a 2.5% replacement value of farm buildings and a 10 % replacement value of vehicles and agricultural machines. The value of depreciation for individual fixed assets was determined on the basis of their current value at the beginning of a given year.

Thanks to the fact that labour inputs and expenditure were accumulated separately, income from agricultural activity was calculated as that obtained at the time of product sale, as revenue less direct costs, indirect costs and estimated depreciation costs. In reality this income represents the executed payment for labour of the family running the farm and owners' capital involved in the discussed operations and the balance of agricultural subsidies [1].

Results were analysed statistically using the StatSoft Inc. STATISTICA ver. 9.0 programme based on one-way analysis of variance, giving mean values for individual parameters along standard deviation. The significance of differences between means for the evaluated groups was determined using the Duncan test.

Results and discussion

Farms keeping native breeds were small in terms of their production levels. On average they had 12 PC dairy cows and 20 BG cows, at mean milk sales per 1 cow of 3000-3600 kg. On farms of group I (the control) on average 38 PHF dairy cows were kept, with a mean milk sale of 7000 kg/cow (Table 1). The high milk production on farms from group I resulted first of all from their land and crop structure, as well as the used cattle breed (PHF). Farms keeping native breeds, particularly the Polish Red cattle, had significantly higher shares of permanent grassland in their land structure, while the role of maize growing for silage was only minimal ($P \leq 0.01$). The share of animals representing native breeds in the herd ranged from 90% for BG to almost 99% for PC, respectively. In all the farm groups their land area was adequate to the number of animals kept and the LU stocking rate per 1 ha UAA was approx. 1.

The high milk yields of cows kept on farms from group I generated 2-fold greater direct costs per one cow ($P \leq 0.01$); however, when calculated per 1 kg milk they turned out to be comparable, within the range of 0.43-0.49 złotys (Table 2). On all the farms the primary direct cost was connected with expenditure on animal feeding, which confirms the results of studies by Wójcik [20] and Wroński [21]. In the control group they accounted for as much as over 70%, in comparison to 60% for BG and only 50% total costs for PC. On farms keeping local breeds expenses connected with feed purchase were also significantly lower ($P \leq 0.01$). Feeding of Polish Red cattle was to the greatest degree based on forage produced on the farm, with only 10% direct costs incurred on the purchase of feeds outside the farm. This was directly reflected in feeding costs both per 1 cow and per 1 kg milk. On

Table 1
Characteristics of the analysed farms

Specification		Group I (PHF) control	Group II (BG)	Group III (PC)
Number of farms		15	20	15
Area of agricultural land (ha)	x	58.03^{A}	29.54^{B}	16.05^{C}
	SD	23.75	15.19	5.54
Share of arable farming area in agricultural land (%)	x	56.65^{A}	49.80^{A}	24.56^{B}
	SD	11.70	16.45	16.00
Share of corn crops on maize silage in area of agricultural land (%)	x	21.43^{A}	9.42^{B}	2.49^{C}
	SD	9.44	6.50	3.81
Area of corn crops on maize silage per 1 cow (ha)	x	0.31^{A}	0.13^{B}	0.03^{C}
	SD	0.14	0.10	0.04
Share of grassland in agricultural land (%)	x	43.35^{A}	50.20^{A}	75.44^{B}
	SD	11.70	16.45	16.00
Share of main forage area in agricultural land (%)	x	68.67	60.28^{A}	78.08^{B}
	SD	14.67	14.60	14.07
Number of cows in farm (heads)	x	38.00^{A}	20.75^{B}	12.07^{C}
	SD	12.55	5.65	3.71
Share of cows of native breeds (%)	x	–	90.59^{A}	98.74^{B}
	SD	–	8.24	3.63
DJP stocking per 1 ha of agricultural land (heads)	x	0.94	1.05	1.04
	SD	0.35	0.33	0.29
DJP stocking per 1 ha of grassland (heads)	x	2.29^{A}	2.28^{A}	1.46^{B}
	SD	0.93	0.95	0.58
DJP stocking per 1 ha of main forage area (heads)	x	1.03^{A}	1.43^{B}	1.06^{A}
	SD	0.26	0.70	0.37
Sale of milk per 1 cow (kg)	x	7009.85^{A}	3662.55^{Ba}	3042.26^{Bb}
	SD	600.01	1216.00	681.24
Average price per 1 kg of milk (PLN)	x	1.08^{A}	0.98^{B}	0.92^{B}
	SD	0.05	0.14	0.04

PHF – Polish Holstein-Friesian;
BG – Whiteback;
PC – Polish Red
a, b – differences significant at P≤0.05
A, B – differences significant at P≤0.01

farms keeping native cattle breeds significantly lower feeding costs were incurred per 1 kg milk (by 0.12 PLN for the PC breed and 0.06 PLN for the BG cows, respectively).

One of the main advantages of animals representing native breeds is connected with their high resistance to disease [3, 7, 17]. On farms keeping PC cows costs of veterinary services incurred per 1 cow were by 60% lower, while on those with BG cattle they were by 44% lower in comparison to farms keeping PHF cows (Table 2). The low production intensity on farms keeping native breeds determined an increase in the share of indirect

Table 2
Amount and structure of costs of cattle husbandry

Specification		Group I (PHF) control	Group II (BG)	Group III (PC)
Direct costs of cattle husbandry per 1 cow (PLN)	x	3506.11^{Aa}	1708.44^{Ba}	1250.73^{Bb}
	SD	751.62	580.21	401.89
Direct costs of cattle husbandry per 1 kg of milk (PLN)	x	0.49	0.48	0.43
	SD	0.08	0.14	0.16
Share of feeding costs in direct costs (%)	x	71.22^{Aa}	60.14^{b}	50.10^{Ba}
	SD	4.67	13.14	17.77
Share of fodders from purchase in direct costs (%)	x	38.84^{A}	23.37^{B}	10.57^{C}
	SD	7.54	11.03	10.01
Direct costs of feeding of 1 cow on farm (PLN)	x	2500.19^{A}	1055.97^{B}	647.66^{C}
	SD	579.76	421.26	273.08
Direct costs of feeding per production of 1 kg of milk (PLN)	x	0.35^{Aa}	0.29^{b}	0.23^{Ba}
	SD	0.06	0.10	0.12
Direct costs of veterinary services per 1 cow (PLN)	x	158.97^{A}	89.85^{B}	65.96^{B}
	SD	82.40	58.09	37.71
Indirect costs of cattle husbandry per 1 cow (PLN)	x	1310.22^{A}	941.99^{B}	1007.10^{B}
	SD	254.56	296.57	335.99
Indirect costs of cattle husbandry per 1 kg of milk (PLN)	x	0.19^{Aa}	0.27^{b}	0.37^{Ba}
	SD	0.03	0.08	0.20
Total costs of cattle husbandry on farm (PLN)	x	180 594.93^{A}	53 959.26^{Ba}	26 683.25^{Bb}
	SD	60157.72	22877.81	8712.23
Total costs per 1 ha of agricultural land on farm (PLN)	x	3337.84^{A}	2035.58^{B}	1776.49^{B}
	SD	1362.48	708.28	581.70
Total costs per 1 cow on farm (PLN)	x	4816.33^{A}	2620.43^{B}	2257.82^{B}
	SD	885.90	799.11	533.33
Total costs per production of 1 kg of milk (PLN)	x	0.68	0.74	0.80
	SD	0.09	0.20	0.29

PHF – Polish Holstein-Friesian;
BG – Whiteback;
PC – Polish Red
a, b – differences significant at P≤0.05
A, B – differences significant at P≤0.01
Total costs do not include the estimated costs of depreciation

costs (overheads). When expressed per 1 cow they were lower by only 23-28% (P≤0.01) in relation to the control. In contrast, per 1 kg milk these costs were by 42% higher in group II (BG) and by as much as 92% in group III (PC). Similar dependencies were shown in the analysis of total cattle husbandry in the analysed farms. The high milk yield per 1 cow in farms of the control group caused significantly higher total costs, which were also higher per 1 ha UAA and per 1 cow. However, when expressed per 1 kg milk these costs were higher on farms keeping native breeds: by 0.06 PLN (11%) for the BG breed and

Table 3
Amount and structure of incomes of cattle husbandry

Specification		Group I (PHF) control	Group II (BG)	Group III (PC)
Total incomes from cattle husbandry on farm per 1 cow (PLN)	x	8202.14^{A}	4284.29^{B}	3422.58^{B}
	SD	1026.42	1278.09	609.24
Share of incomes from cattle husbandry in total incomes (%)	x	88.08^{A}	66.14^{Ba}	61.9^{Bb}
	SD	3.05	6.29	5.99
Share of incomes from milk production in incomes from cattle husbandry (%)	x	95.00	90.61	96.83
	SD	6.24	11.74	4.36
Share of refunds from EU in total incomes (%)	x	11.92^{A}	33.86^{Ba}	38.01^{Bb}
	SD	3.05	6.29	5.99
Refunds from EU per 1 cow (PLN)	x	1109.77^{A}	2103.80^{B}	2068.24^{B}
	SD	294.49	370.83	359.34
Agri-environmental refunds per 1 cow (PLN)	x	10.61^{A}	1155.97^{B}	1151.07^{B}
	SD	41.09	218.87	110.42
Share of agri-environmental refunds in refunds from EU (%)	x	0.72^{A}	55.83^{B}	56.49^{B}
	SD	2.80	10.18	8.01
Share of agri-environmental refunds in total incomes (%)	x	0.12^{A}	19.05^{B}	21.21^{B}
	SD	0.48	5.71	3.14
Refunds from EU per 1 kg of milk (PLN)	x	0.16^{A}	0.62^{B}	0.73^{B}
	SD	0.04	0.18	0.25
Refunds from EU per 1 ha of agricultural land (PLN)	x	712.98^{A}	1608.23^{B}	1588.99^{B}
	SD	38.65	375.25	267.60
Total incomes per 1 ha of agricultural land of farm (PLN)	x	6457.09^{A}	4868.07^{B}	4336.27^{B}
	SD	2195.10	1278.94	1243.36
Total incomes per 1 cow on farm (PLN)	x	9306.17^{A}	6388.09^{Ba}	5499.67^{Bb}
	SD	1049.80	1473.31	667.66

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BG – Whiteback;
PC – Polish Red
a, b – differences significant at $P \leq 0.05$
A, B – differences significant at $P \leq 0.01$

by 0.12 PLN (18%) for PC (Table 2). Higher unit milk production costs on farms keeping local breeds resulted first of all from the lesser scale and lower production intensity. The relationship between unit costs of milk production and yield and cow herd size was indicated in their studies by Sass [11], Skarżyńska [14] and Chabuz et al. [2].

In the analysed farms revenue was connected with cattle rearing and EU direct payments (Table 3). The volume of revenue was dependent first of all on the production scale; as a result, per 1 cow on farms keeping native breeds they were by 50% lower than in the control. Revenue from milk production accounted for over 90% revenue generated by agricultural production. The other several percent were connected with sales of

Table 4
Effectiveness of cattle husbandry in the analysed farms

Specification		Group		
		I (PHF) control	II (BG)	III (PC)
Gross margin from cattle husbandry per 1 dairy cow (PLN)	x	4714.57^{A}	2605.85^{B}	2165.68^{B}
	SD	532.41	938.90	562.23
Gross margin from cattle husbandry per 1 kg of milk (PLN)	x	0.67	0.71	0.74
	SD	0.05	0.18	0.21
Revenue from cattle husbandry without refunds from EU per 1 dairy cow (PLN)	x	1615.27^{A}	414.84^{B}	50.48^{B}
	SD	339.80	626.42	417.91
Revenue from cattle husbandry without refunds from EU per 1 kg of milk (PLN)	x	0.23^{A}	0.09^{Ba}	0.01^{Bb}
	SD	0.05	0.16	0.13
Share of refunds from EU in revenue from cattle husbandry (%)	x	40.80	91.31	99.57
	SD	10.34	27.06	17.21
Revenue from cattle husbandry with refund from EU per 1 dairy cow (PLN)	x	2725.05	2518.64	2118.72
	SD	310.83	875.13	401.18
Revenue from cattle husbandry with refund from EU per 1 kg of milk (PLN)	x	0.39	0.71	0.73
	SD	0.05	0.24	0.22
Revenue from cattle husbandry without refund from EU per 1 ha of agricultural land (PLN)	x	1151.94	275.14	82.84
	SD	518.15	464.18	373.60
Revenue from cattle husbandry with refund from EU per 1 ha of agricultural land (PLN)	x	1864.92	1883.37	1671.83
	SD	520.85	603.93	528.20

PHF – Polish Holstein-Friesian;
BG – Whiteback;
PC – Polish Red
a, b – differences significant at P≤0.05
A, B – differences significant at P≤0.01

breeding material and animals for slaughter. The greatest share, i.e. almost 10% of that agricultural activity, was recorded for farms keeping Whiteback cattle, which confirms its dual purpose type [8].

In many countries, including Poland, subsidies provide a very important argument supporting the development of local breeds [4, 13, 17]. Data presented in Table 3 show that direct payments constituted almost 34% total revenue of farms in group II (BG) and 38% in group III (PC); in contrast, in the control it was as little as below 12%. When expressed per 1 cow in groups I and II they were around 2 thousand PLN and they were two-fold

greater than in the control. Over 50% direct payments (55-56%) comprised payments from the agri-environment schemes, including e.g. subsidy to native cattle breeds. Farms from the control group practically did not use such a form of support, with payments within the agri-environment schemes accounting for a little less than 1% of total EU payments.

Any agricultural activity is measured by its efficiency, at present frequently expressed as income from production rather than Standard Gross Margin. The farms keeping local breeds had 2 times lower SGM per 1 cow (2605 PLN in farms keeping BG and 2165 PLN in those keeping PC) in relation to the control (4714 PLN) (tab. 4). Due to the relatively high indirect costs and depreciation in farms with native breeds, income from cattle husbandry (without direct payments) per 1 cow was very low, amounting to as little as 50.48 PLN for PC and 414.84 PLN for the BG breed, respectively. Farms keeping PHF cows generated much higher incomes, on average 1615.27 PLN. These results are consistent with those for other European countries [13]. According to Gandini et al. [4], lower incomes were obtained on farms in the Italian Piedmont region keeping for 20 years a local breed, Reggiana, in comparison to those with Holstein-Friesian cows. However, promotion of the parmigiano reggiano cheese, produced from milk of Reggiana cows, considerably improved these figures to the advantage of that breed. It was also the most important factor stimulating a successive rapid growth in the population of this cattle breed.

In view of a lack of renowned brands for products obtained from both breeds analysed in this study (the Whiteback and the Polish Red), the volume of income from their husbandry was determined practically only by subsidies, which in the income structure amounted to almost 100% (91.3% for farms keeping BG and 99.6% – PC cows). Despite the relatively high EU financial support for those farms, their income per 1 cow (even including direct payments) was lower by 206.41 PLN for the BG breed (7.5%) and 606.33 PLN for the PC breed (22%) in relation to farms keeping PHF cows. Such comparisons are much more advantageous in terms of figures per 1 ha UAA (Table 4). For farms keeping the PC breed it was only by slightly below 200 PLN lower (11%), while for farms with the BG breed it was even by almost 20 PLN higher (1%).

These results indicate that in Poland subsidies to native breeds do not fully compensate for the income lost in comparison to farms with intensive milk production systems. For this reason actions need to be taken to develop and promote niche products associated with these breeds. The present level of payments from agri-environment schemes granted to cows of native breeds (considering their significantly lower yields) provides considerable support, being a decisive factor for their maintenance by framers.

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