ACTA SCIENTIARUM POLONORUM

Acta Sci. Pol. Zootechnica 21(1) 2022, 17–28

www.asp.zut.edu.pl pISSN 1644-0714 eISSN 2300-6145 DOI:10.21005/asp.2022.21.1.03

ORIGINAL PAPER

Received: 12.02.2022
Accepted: 28.03.2022

COST ANALYSIS OF FEED PRODUCTION AND FEEDING OF BEEF CATTLE ON THE EXAMPLE OF A SELECTED INDIVIDUAL FARM

Hubert Piszcz, Sławomir Piotrowski, Anna Milczarek

Institute of Animal Science and Fisheries, Siedlce University of Natural Sciences and Humanities, B. Prusa 14, 08-110 Siedlce, Poland

ABSTRACT

The paper analyses the costs of production of roughage and nutritive fodder and fattening HF and Limousine crossbreds of feeder cattle. The costs of growing fodder for feeder cattle were calculated per one hectare. The cost of producing one tonne of feed was determined based on the farm's mean crop yield. The calculation included the cost of maintenance, including the cost of feeding 14 animals over 22 months. The animals were kept untethered in stalls with deep litter from the body weight of 36.86 kg to 812.14 kg on the selling date. The feeder cattle were fed according to the nutritional recommendations, and their feed rations were based on feedstock produced on the farm, except post-extraction meals and the mineral and vitamin mix Dolfos BO. It was demonstrated that the cost of producing one tonne of roughage ranged from PLN 66.98 (maize silage) to PLN 265.98 (hay), while that of grain oscillated from PLN 261.22 (rye) to approximately PLN 371 (oats and wheat). It was found that maize silage generated the highest cost in feeder cattle feeding. This fact should be associated with its largest share in feed rations, which as a result corresponded to nearly 5.5 tonnes per animal. As regards nutritive fodder, the highest cost was generated by nutritive fodder 2, which was also linked to its amount per animal. Throughout the fattening period, each animal consumed more than 10 tonnes of feed and its cost could be estimated at PLN 2,744.32. To sum up, the farm received PLN 1,611.96 of income from breeding one animal.

Key words: beef cattle, rations, costs

INTRODUCTION

Production of beef in Poland is continuously increasing. According to data from Statistics Poland, 4,698.8 thousand tonnes of slaughter cattle were produced in 2005, and in 2019 this figure was already 7,107.3 thousand tonnes. The produced beef mostly derives from dairy breeds, but a considerable part of the population of these cows are inseminated by beef breed bulls. A small yet increasing number of feeder animals are cattle of the utility beef type [Litwińczuk and Grodzki 2014]. Nogalski and Wroński [2011] claim that slaughter cattle breeding is an alternative to dairy farms. This mainly refers to farms that have a large surface area of grassland or wasteland and livestock buildings but do not want to or can't produce milk.

Profitability of slaughter cattle breeding depends on many factors, including balanced and efficient nutrition as feed has an impact on both weight gain and health and welfare of animals [Bilik et al. 2009, Bilik and Strzetelski 2014, Sablik et al. 2017, Skarżyńska 2017, Park et al. 2018, Mwangi et al. 2019]. It is estimated that expenditure on feeding accounts for about 60–70% of the costs of animal production. Many researchers [Juszczyk and Rekojarski 2007, Bilik and Strzetelski 2014, Radkowski and Radkowska 2015, Park et al. 2018] claim that feeding systems used in slaughter cattle production should be primarily low-cost. Therefore, feeding should be based on natural forage and roughage with a minimised share of nutritive fodder. This is possible due to the fact that cattle are ruminants, meaning that their digestive system, in addition to the true stomach – the abomasum, is composed of three other compartments – the rumen,

anna.milczarek@uph.edu.pl

reticulum, and omasum. These three additional compartments contain bacteria and protozoans living in symbiosis and facilitate the conversion of nutrients from fibrous feeds. Nutrients supplied with feed should provide maintenance of vital functions (basic life needs), energy for physical activity, growth of the animal, and maintenance of proper health and welfare of animals [Litwińczuk et al. 2013, Gołębiewski 2016]. Bilik and Strzetelski [2014] claim that roughage and agri-food semi-finished products can considerably reduce rearing costs without any negative impact on the amount of supplied nutrients. Such a feeding system improves animal breeding profitability given the increasing costs of production and decreasing animal selling prices. In turn, Barszczewski et al. [2017] demonstrated that feeding efficiency can be improved when grass silage with legumes is added to the feed ration. In turn, Sakowski et al. [2001], Nogalski and Kijak [2001] and McNamee et al. [2015] found that beef breeds and their hybrids show the best production performance, which is also reflected in satisfying the needs of consumers buying culinary beef sourced from such animals. Choroszy et al. [2009] report that depending on the weight of five basic cuttings, the carcasses are subject to EUROP grid classification. The higher the class on this scale is, the higher the price of carcass and – as a result – breeding profitability. After slaughter we can accurately determine carcass weight. Knowing the weight of the carcass and the animal's pre-slaughter body weight we can calculate the dressing percentage. The dressing percentage rate is closely linked to: breed, sex of the animal, nutrition, pre-slaughter transportation and pre-slaughter handling conditions [Młynek and Guliński 2007, Albertí et al. 2008, Litwińczuk et al. 2013, Semenov et al. 2019].

Analysing the cost of production, except animal purchasing cost, Wilczyński [2018] points out that costs in cash are lower (by 20%) on farms rearing slaughter cattle of beef breeds compared to farms feeding dairy cattle. In addition, surveys show that costs to the greatest extent (in more than 60%) affecting the cost of beef livestock production are the costs of feeding and machinery maintenance costs, so they should be specially examined by agricultural producers, since they may turn out to be the determinants of profitability of beef livestock production.

The paper aimed to analyse the cost of feed production and fattening beef cattle using the example of a selected private farm in the district of Siemiatycze in Podlaskie voivodeship.

MATERIAL AND METHODS

The surveys were carried out on a private farm consisting of 60 ha of agricultural land, including 15 ha of grassland. All field work on the farm is carried out using the farmer's own equipment (Table 1), except sowing and harvesting maize.

We calculated the cost of growing one hectare of fodder (maize silage, grass silage, hay, wheat, triticale, oats and rye) fed to cattle. In calculating the cost of machinery, the purchasing cost was taken into account together with the cost of spare parts and maintenance services. During respective field works the consumption of fuel and average working time were measured. The cost of labour at respective stages of the survey was consistent with the current hourly rates.

The feeding analysis covered 14 animals that were HF and Limousine crossbreds. The calves – aged from three to seven days – were purchased from local farms in November 2018. The average buying price of the calves was 650 zloty per animal. The animals were kept in stalls with deep litter for 22 months from the body weight of 36.86 kg to 812.14 kg on the selling date. During the rearing period animals received feed rations prepared according to the Nutritional Recommendations for Ruminants and Tables of Nutritive Value of Feed [IZ PIB 2014]. Feed fed to the cattle was almost completely produced on the farm. Basic feeds used in feed rations included: maize silage, grass silage with clover, pasture hay and two types of nutritive fodder (Table 2).

Until 6 weeks of age the calves received cow's milk only (from cows kept on the farm) and CJ mix (purchased). The ingredients of nutritive fodder are listed in Table 3.

Based on the ingredients of feed rations and the duration of respective feeding periods the conversion of feed per animal was calculated for the whole feeding period (Table 4).

We calculated the costs of production of nutritive fodders for feeder cattle. The calculations were based on market prices of respective ingredients given on invoices for purchases made by the farm.

The cost of feeding was calculated based on the following costs of other feeds:

1. average prices (based on invoices) of purchased feeds:
   - post-extraction rapeseed meal, PLN 1215 · t^{-1},
   - post-extraction soybean meal, PLN 1860 · t^{-1},
   - mineral and vitamin mix Dolfos Dolmix BO, PLN 4750 · t^{-1},
   - CJ mix for calves, PLN 2000 · t^{-1},
2. average prices of other feeds produced on the farm:
   - cow's milk, PLN 1400 · t^{-1},
   - straw, PLN 25 per bale.

RESULTS AND DISCUSSION

Tables 5–8 show the calculation of growing one tonne of roughage (maize silage, grass silage and hay) and cereal grains (wheat, triticale, rye and oats) for feeder cattle.

Table 1. The farm machinery

Item	Purchase cost along with parts and service costs, PLN	Estimated working time	Labor cost, PLN	Labor time (min/ha)
Tractors:			1 h	
New Holland T5.110 (107 kM)	300 000	10000 h	30.00	–
Ursus 5714 (80 kM)	150 000	10000 h	15.00	–
Ursus 3512 (47 kM)	100 000	10000 h	10.00	–
Machinery:			1 ha	
Plow (Unia TUR)	30000	1000 ha	30.00	60
Grubber (Unia KOS S 2.1)	25000	1000 ha	25.00	45
Disc cultivator (Unia ARES T)	30000	1000 ha	30.00	30
Seeding machine 1 (Agro Masz sr300)	40000	1000 ha	40.00	45
Seeding machine 2 (Rauch MDS 17.1)	15000	2000 ha	7.50	30
Sprayer (Krukowiak Heros 800 HX)	60000	3000 ha	20.00	30
Rotary mower (Famarol Z-105/1)	15000	600 ha	25.00	90
Hay turner (Mesko Z-275)	15000	1000 ha	15.00	45
Hay rake (Kuhn GA 300 GM)	15000	1000 ha	15.00	45
Spike-tooth harrow (POM U 348/1)	10000	1000 ha	10.00	20
Volok (AGRO FACTORY U854/1)	5000	1000 ha	5.00	20
Combine harvester (Bizon Sampo 2020)	200000	20000	100.00	60
Wrapping machine (SIPMA TEKLA)*	7000	5000 pc.	21.00	60
Baling press (Metal-Fach Z-562)*	60000	10000 bales	90.00	45
Front loader (Hydrometal AT200)	20000	20 years	17 PLN/year/pc	
Spreader (Gilibert Helix 8)	70000	20 years	58 PLN/year/pc	
Trailer Autosan D-55 (6 t) – 2 pieces	60000	20 years	50 PLN/year/pc	

* – calculation for 15 bales/ha.

Table 2. Composition (kg) of beef cattle rations

Age	Maize silage	Haylage	Meadow hay	Concentrated feed 1	Concentrated feed 2	CJ for Calves	Cow milk
day 0–7	–	–	–	–	–	–	6
day 8–14	–	–	0.2	–	–	0.5	6
day 14–28	–	–	0.5	–	–	1	7
day 29–42	–	–	1	–	–	1.5	5
day 43–month 3	–	–	1.5	2	–	–	–
month 3–6	–	–	2	3	–	–	–
month 6–9	3	–	2.5	3	–	–	–
month 9–12	6	4	–	–	3	–	–
month 12–14	10	6	–	–	3.5	–	–
month 14–18	14	7	–	–	4	–	–
month 18–22	20	10	–	–	5	–	–

Table 3. Composition (%) of concentrated feed

Item	Concentrated feed 1	Concentrated feed 2
Winter wheat	20	18
Oats	40	30
Winter triticale	18	20
Rye	–	10
Extracted rapeseed meal (min. 34% protein)	10	20
Extracted soybean meal (min. 46% protein)	10	–
Mineral and vitamin supplement Dolfos BO	2	2

Table 4. Total feed consumption of one fattening over the entire period, kg

Age	Maize silage	Haylage	Meadow hay	Concentrated feed 1	Concentrated feed 2	CJ for calves	Cow milk
day 0–7	–	–	–	–	–	–	42
day 8–14	–	–	1.4	–	–	3.5	42
day 14–28	–	–	7	–	–	14	98
day 29–42	–	–	14	–	–	21	70
day 43–month 3	–	–	72	96	–	–	–
month 3–6	–	–	180	270	–	–	–
month 6–9	270	–	225	270	–	–	–
month 9–12	540	360	–	–	270	–	–
month 12–14	600	360	–	–	210	–	–
month 14–18	1680	840	–	–	480	–	–
month 18–22	2400	1200	–	–	600	–	–
Total	5490	2760	499.4	636	1560	38.5	252

The costs of production of Fabrikant and Robletto maize silage with winter wheat as the preceding crop are presented in Table 5.

The average yield of maize silage per hectare was 57 tonnes. Assuming 3% losses in storage, the amount of feed was 55.29 tonnes, hence the cost of producing one tonne of maize silage was PLN 66.98.

Grass silage and hay were prepared from meadow grass (grass with clover). To reduce the cost of fertilization chicken manure was used in the amount of 10 t · ha^{-1}, supplemented with mineral fertilizers (Table 6).

The average yield of grass silage harvested three times a year is 51 bales weighing about 600 kg, which corresponds to 30.6 t · ha^{-1}, thus the cost of producing 1 tonne of grass silage was PLN 97.65. On the other hand, the average yield of hay harvested three times a year is 40 bales weighing about 250 kg each, which corresponded to 10 t · ha^{-1}, thus the cost of producing 1 tonne was PLN 265.98. The cost of producing both types of feed included three-time mowing. According to the Statistics Poland [2020] hay yield per hectare of a meadow or pasture is more than half lower.

Winter wheat was sown after winter rape in a no-tillage system to reduce the cost and loss of water (Table 7). Qualified sowing material of the Delawar variety was used – the sowing standard was 320 grains · m^{-2} at the optimum time. Qualified winter triticale of the Dinaro variety was sown after maize harvested for silage in the standard amount of 300 grains · m^{-2} at the optimum time.

The average yield of winter wheat in 2020 was 7.2 t · ha^{-1}, so the cost of producing one tonne of grain amounted to PLN 370.31. On the other hand, the average yield of winter triticale was 7.1 t · ha^{-1}, which resulted in the cost of producing one tonne of grain amounting to PLN 346.13.

Barley of Bingo variety was sown after winter rye in the standard amount of 400 plants per square metre using seeds from own crops. On the other hand, winter rye of the hybrid variety Helltop was sown after barley in the amount of two sowing units per hectare, with a slight delay. Table 8 presents the calculation of costs of barley and rye.

The average yield of barley in 2020 amounted to 4.3 tonnes per hectare, hence the cost of producing one tonne of grain was PLN 371.05. In turn, the average yield of winter rye was 8.1 tonne per hectare, so the cost of producing one tonne of grain equalled PLN 261.22. The farm's actual grain yield was higher than indicated in the Statistical Yearbook of Agriculture (2020). The mean wheat yield was higher by 2.81 t · ha^{-1}, and for triticale by 3.61 t · ha^{-1}, for rye by 5.38 t · ha^{-1}, and for oats by 2.06 t · ha^{-1}.

The costs of nutritive fodders 1 and 2 were determined based on the calculation of costs for their respective components (Table 9).

The introduction of rye and elimination of soybean meal from nutritive fodder 2 reduced its cost by PLN 76.97 · t^{-1}.

The costs of rearing one animal were determined based on the calculation of respective feeds used in feed rations (Table 10).

The cost of feed per animal amounted to PLN 2,793.53, which as the cost of producing 100 kg of livestock was nearly by half that indicated by Szumiec [2014]. This fact should be associated with the rearing efficiency measured with the rate of feed conversion per 100 kg of weight gain in livestock. The feeder animals converted about 10 dt of maize silage and grass and clover silage and about 2.7 dt of nutritive fodder (1 and 2) per 100 kg of body weight. Skarżyńska [2017] reports that on the best farms the conversion of nutritive fodder and silage (including grass silage) per 100 kg of weight gain is – respectively – 1.98 dt and 8.81 dt, and on the weakest ones – 3.94 dt and 14.3 dt. Ryschawy et al. [2012] and Wilczyński [2018] confirm that the basic feedstock

Table 5. Costs of growing 1 hectare of maize, including storage

Treatment or activity	Cost type	Cost, PLN
Post-harvest work with sowing aftercrops	Fuel 10l	42.80
	Lupin seeds 100 kg	200.00
	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	7.50
	New Holland T5.110 (107 kM)	15.00
	Disc cultivator	30.00
	Work	25.00
Winter plowing	Fuel 15 l	64.20
	New Holland T5.110 (107 kM)	30.00
	Plow	30.00
	Work	25.00
Harrowing	Fuel 5 l	21.40
	Ursus 3512 (47 kM)	3.33
	Harrow	10.00
	Work	8.33
Fertilization with manure[1, 2] (30 t per ha)	Fuel 25 l	107.00
	New Holland T5.110 (107 kM)	30.00
	Ursus 5714 (80 kM)	15.00
	Work	50.00
Mineral fertilization (twice)	Fuel 8 l	34.24
	Fertilizer “Urea” 200kg	264.00
	Fertilizer “potassium salt” 200 kg	276.00
	Ursus 5714 (80 kM)	15.00
	Seeding machine 2	15.00
	Work	25.00
Pre-sowing cultivation	Fuel 12 l	51.36
	New Holland T5.110 (107 kM)	15.00
	Disc cultivator	30.00
	Work	12.50
Sowing maize with fertilizer	Sowing service	130.00
	Seeds	460.00
	Fertilizer "Polidap" 200 kg	348.00
Weed control treatment	Fuel 5 l	21.40
	Herbicides: “Zeagran 340 SE”, “Ikanos 040 OD”	102.54
	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00
	Work	12.50
Harvesting with a forage harvester with transport and compaction	Harvest service	900.00
Cover with foil and protective nets[2]	Fuel 4l	17.12
	Foil	184.10
	Ursus 5714 (80 kM)	15.00
	Work	25.00
Sum		3703.32

[1] – the work of the front loader (Hydrometal AT20) mounted on the Ursus 5714 tractor is included in Table 10.
[2] – the work of the spreader (Gilibert Helix 8) is included in Table 10.

used in cattle fattening is maize silage, hay silage, and cereal grains supplemented with protein feeds. In addition, Wilczyński [2018] underlines that, next to machinery maintenance costs, animal feeding is the factor having the largest impact on the production cost.

No animal died or was prematurely sold during the rearing period. All 14 animals were sold in September 2020 at a gross price of PLN 7.80 per kg of live weight (Table 11). The overall body weight of all animals amounted to 11,380 kg, which corresponded to 812.86

Table 6. Production costs of haylage and hay from 1 ha of meadow when mowed three times

Treatment or activity	Haylage		Hay	
	Cost type	Cost, PLN	Cost type	Cost, PLN
Fertilization with chicken manure[1, 2]	Fuel 20 l	85.60	Fuel 20 l	85.60
	Droppings	300.00	Droppings	300.00
	New Holland T5.110 (107 kM)	30.00	New Holland T5.110 (107 kM)	30.00
	Ursus 5714 (80 kM)	15.00	Ursus 5714 (80 kM)	15.00
	Work	50.00	Work	50.00
Stringing	Fuel l	21.40	Fuel 5 l	21.40
	Ursus 5714 (80 kM)	5.00	Ursus 5714 (80 kM)	5.00
	Volok	5.00	Volok	5.00
	Work	8.33	Work	8.33
Mineral fertilization	Fuel 4 l	17.12	Fuel 4 l	17.12
	Fetilizer “Ultra 8” 200 kg	316.00	Fetilizer “Ultra 8” 200 kg	316.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	7.50	Seeding machine 2	7.50
	Work	12.50	Work	12.50
Mowing (set of 3 times)	Fuel 18 l	77.04	Fuel 18 l	77.04
	Ursus 3512 (47 kM)	45.00	Ursus 3512 (47 kM)	45.00
	Rotary mower	75.00	Rotary mower	75.00
	Work	112.50	Work	112.50
Tedding (set of 3 times, 3 times each)	Fuel 10 l	42.80	Fuel 45 l	192.60
	Ursus 3512 (47 kM)	22.50	Ursus 3512 (47 kM)	67.50
	Hay turner	45.00	Hay turner	135.00
	Work	56.25	Work	168.75
Raking (set of 3 times)	Fuel 12 l	51.36	Fuel 12 l	51.36
	Ursus 3512 (47 kM)	22.50	Ursus 3512 (47 kM)	22.50
	Hay rake	45.00	Hay rake	45.00
	Work	56.25	Work	56.25
Baling (3 times)	Fuel 22 l	94.16	Fuel 18 l	77.04
	Twine	81.60	Twine	64.00
	New Holland T5.110 (107 kM)	67.50	New Holland T5.110 (107 kM)	67.50
	Baling press	270.00	Baling press	240.00
	Work	56.25	Work	56.25
Loading and transport (3 times)	Fuel 17 l	72.76	Fuel 14 l	59.92
	Ursus 5714 (80 kM)	30.00	Ursus 5714 (80 kM)	30.00
	Work	50.00	Work	50.00
Wrapping and setting (3 times)	Fuel 13 l	55.64		
	Foil	510.00		
	Ursus 3512	30.00		
	Wrapping machine	63.00		
	Work	75.00		
Positioning in the warehouse (3 times)			Fuel 6 l	25.68
			Ursus 5714	22.50
			Work	37.50
Sum		2988.06		2659.84

[1] – the work of the front loader (Hydrometal AT20) mounted on the Ursus 5714 tractor is included in Table 10.
[2] – the work of the spreader (Gilibert Helix 8) is included in Table 10.

kg per animal. The live body weight was reduced by 7% accounting for the weight of feed and droppings that were still in the digestive tract, so the body weight adopted for calculation was 10,583.4 kg.

Table 7. The cultivation costs of 1 ha of winter wheat and winter triticale

Treatment or activity	Winter wheat		Winter triticale	
	Cost type	Cost, PLN	Cost type	Cost, PLN
Post-harvest work	Fuel 5 l	21.40	Fuel 5 l	21.40
	New Holland T5.110 (107 kM)	15.00	New Holland T5.110 (107 kM)	15.00
	Disc cultivator	30.00	Disc cultivator	30.00
	Work	12.50	Work	12.50
Mineral fertilization	Fuel 4 l	17.12	Fuel 4 l	17.12
	Fertilizer Ultra 8" 250 kg	395.00	Fertilizer "Ultra 8" 200 kg	316.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	7.50	Seeding machine 2	7.50
	Work	12.50	Work	12.50
Deep tillage	Fuel 12 l	51.36	Fuel 15 l	64.20
	New Holland T5.110 (107 kM)	22.50	New Holland T5.110 (107 kM)	22.50
	Grubber	25.00	Grubber	25.00
	Work	18.75	Work	18.75
Soil dressing and sowing	Fuel 10 l	42.80	Fuel 10 l	42.80
	Seed material	220.80	Seed material	286.00
	New Holland T5.110 (107 kM)	15.00	New Holland T5.110 (107 kM)	15.00
	Disc cultivator	30.00	Disc cultivator	30.00
	Ursus 5714 (80 kM)	11.25	Ursus 5714 (80 kM)	11.25
	Seeding machine 1	40.00	Seeding machine 1	40.00
	Work	31.25	Work	31.25
Weed control treatment (autumn)	Fuel 5 l	21.40	Fuel l	21.40
	Herbicyd "Expert Met 56 WG". "Legato 500 SC"	132.97	Herbicyd "Expert Met 56 WG", "Legato 500 SC"	132.97
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00	Sprayer	20.00
	Work	12.50	Work	12.50
Mineral fertilization (spring)	Fuel 8 l	34.24	Fuel 8 l	34.24
	Fertilizer "Kiserit" 100 kg	130.00	Fertilizer "Kiserit" 80 kg	104.00
	Fertilizer "ZakSan 33" 200 kg	204.00	Fertilizer "ZakSan 33" 180 kg	183.60
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	15.00	Seeding machine 2	15.00
	Work	12.50	Work	12.50
Fungicide protection and regulation of T1 and R1	Fuel 5 l	21.40	Fuel 5 l	21.40
	Fungicide "Wirtuoz 520 EC" Growth regulator"Moddus 250 EC"	219.76	Fungicide – Fungicyd "CINDO PLUS 50EW" "TARCZA ŁAN EXTRA" Growth regulator "Moddus 250 EC"	208.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00	Sprayer	20.00
	Work	12.50	Work	12.50
Mineral fertilization	Fuel 4 l	17.12	Fuel 4 l	17.12
	Fertilizer "ZakSan 33" 250 kg	255.00	Fertilizer "ZakSan 33" 200 kg	204.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	7.50	Seeding machine 2	7.50
	Work	12.50	Work	12.50
Fungicide protection T2	Fuel – Paliwo 5 l	21.40	Fuel – Paliwo 5 l	21.40
	Fungicide "Praxior"	148.60	Fungicide "SYRIUS 250EW"	58.60
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00	Sprayer	20.00
	Work	12.50	Work	12.50
Grain harvesting and transport	Fuel 20 l	85.60	Fuel 18 l	77.04
	Ursus 5714	15.00	Ursus 5714	15.00
	Combine harvester	100.00	Combine harvester	100.00
	Work	50.00	Work	50.00
Sum		2666.22		2457.54

Table 8. Costs of growing 1 ha of oats and rye

Treatment or activity	Oats		Rye	
	Cost type	Cost, PLN	Cost type	Cost, PLN
Fertilization with chicken manure[1, 2] 10t			Fuel 20 l	85.60
			Droppings	300.00
			New Holland T5.110	30.00
			Ursus 5714 (80 kM)	15.00
			Work	50.00
Post-harvest work	Fuel 5 l	21.40	Fuel 5 l	21.40
	New Holland T5.110	15.00	New Holland T5.110	15.00
	Disc cultivator	30.00	Disc cultivator	30.00
	Work	12.50	Work	12.50
Tillage	Fuel 17 l	72.76	Fuel 12 l	51.36
	New Holland T5.110	30.00	New Holland T5.110	30.00
	Plow	30.00	Plow	30.00
	Work	25.00	Work	25.00
Mineral fertilization	Fuel 8 l	34.24	Fuel 4 l	17.12
	Fertilizer “Ultra 8” 200 kg	316.00	Fertilizer “Ultra 8” 150 kg	237.00
	Fertilizer “Mocznik” 150 kg	198.00	–	–
	Ursus 5714 (80 kM)	15.00	Ursus 5714 (80 kM)	7.50
	Seeding machine 2	15.00	Seeding machine 2	7.50
	Work	25.00	Work	12.50
Soil dressing and sowing	Fuel 10 l	42.80	Fuel 10 l	42.80
	Seed material	120.00	Seed material	476.00
	New Holland T5.110	15.00	New Holland T5.110	15.00
	Disc cultivator	30.00	Disc cultivator	30.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Seeding machine 1	40.00	Seeding machine 1	40.00
	Work	31.25	Work	31.25
Herbicide	Fuel 5 l	21.40	Fuel 5 l	21.40
	Herbicide “MUSTANG FORTE 195 SE”	53.60	Herbicide “LENTIPUR 500SC”	52.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00	Sprayer	20.00
	Work	12.50	Work	12.50
Regulation R1	Fuel 5 l	21.40	Fuel 5 l	21.40
	Growth regulator “Moddus 250 EC”	63.20	Growth regulator “Moddus 250 EC”	79.00
	Ursus 5714 (80 kM)	7.50	Ursus 5714 (80 kM)	7.50
	Sprayer	20.00	Sprayer	20.00
	Work	12.50	Work	12.50
Grain harvesting and transport	Fuel 16 l	64.48	Fuel 18 l	77.04
	Ursus 5714 (80 kM)	15.00	Ursus 5714 (80 kM)	15.00
	Combine harvester	100.00	Combine harvester	100.00
	Work	50.00	Work	50.00
Sum		1595.53		2115.87

[1] – the work of the front loader (Hydrometal AT20) mounted on the Ursus 5714 tractor is included in Table 10.
[2] – the work of the spreader (Gilibert Helix 8) is included in Table 10.

The farm generated 1,616.75 zloty of income from rearing one animal. The calculation takes into account all the expenses (purchase of animals, cost of feed, veterinary care, sowing material, fertilisers, pesticides, third-party services, fuel, water, electricity, own labour, depreciation of buildings and machinery, maintenance of land, and insurance) and revenues (direct payments, and breeding subsidies). Wilczyński [2018] claims that revenue from the sales of beef cattle is to the largest extent determined by the cattle buying price. These results were corroborated by the results of the study carried out by Gaworski and Poletyło [2011] who emphasize that beef

Table 9. The cost of the production of 1 t of concentrated feed 1 and 2

Item	Raw material cost, t	Concentrated feed 1		Concentrated feed 2	
		Amount, kg ·t^{-1}	Cost, PLN	Amount, kg ·t^{-1}	Cost, PLN
Raw materials					
Winter wheat	370.31	200	74.06	180	66.65
Oats	371.05	400	148.42	300	111.31
Winter triticale	346.16	180	62.30	200	69.23
Rye	261.22	–	–	100	26.12
Extracted rapeseed meal (min. 34% protein)	1215.00	100	125.50	200	243.00
Extracted soybean meal (min. 46% protein)	1860.00	100	186.00	–	–
Mineral and vitamin supplement Dolfos BO	4750.00	20	95.00	20	95.00
Others	–	–	70.00	–	70.00
Total	–	1000	757.28	1000	681.30

Table 10. Costs of rearing 1 fattening for a period of 22 months

Item	Feed amount, t	Cost of 1 t of feed, PLN	Total, PLN
Feed costs			
Maize silage	5.4900	66.98	367.72
Haylage	2.7600	97.65	269.51
Meadow hay	0.4994	265.98	132.83
Concentrated feed 1	0.6360	755.80	479.97
Concentrated feed 2	1.5600	681.30	1062.83
CJ for calves	0.0385	2000	77.00
Cow milk	0.2520	1400	352.80
Sum	11.2359	–	2744.32
Other costs			
Straw	20 bales	25 PLN per bale	500.00
Veterinary care			100.00
Fuel costs for feeding and manure removal (40 l)			171.20
Electricity			52.00
Water			150.00
Cowshed depreciation			229.16
Trailer Autosan D-55 (6t) – 2 pieces			91.67
Front loader (Hydrometal AT200)			31.10
Spreader (Gilibert Helix 8)			106.30
Work with the handling of animals			550.00
Sum			1981.43
The sum of all costs			4725.75

Table 11. Economic account of the production of slaughter cattle on a farm

Item	Unit cost, PLN	Expenses, PLN	Revenues, PLN
Purchase of calves	650	9100	–
The cost of the feed	2744.32	38420.48	–
Other costs	1981.43	27740.02	–
Land tax	87.44	699.52	
Subsidies to ha*			
– area payment	483.79		3870.32
– for greening	323.85		2590.80
– additional payment	182.02		1456.16
– young farmer	256.62		2052.96
– ONW	179.00		1432.00
Disposable for slaughter cattle	326.76		4574.64
Sale of 1 kg of live cattle	7.8	–	82550.52
Total	–	75960.02	98527.40
Balance			+22567.38

*– the area (8 ha) necessary for the production of own fodder for 14 slaughter cattle was taken into account.

cattle breeding and beef production is an activity with a slow capital turnover. However, ultimately, considering the assumptions concerning prices, production factors and beef prices, the balance is positive, which – in combination with the forecast of an increasing requirement for high-quality beef – is a promising trend for the future of beef production.

CONCLUSION

To sum up, it should be concluded that feeding cost is a major component (with a share of more than 60%) of the cattle fattening cost. Considering all the expenses and revenues, the farm earned about PLN 1,616.75 from rearing one animal (over 22 months) up to the body weight of 812 kg.

ACKNOWLEDGEMENT

This research was funded by the Ministry of Science and Higher Education of Poland (Project no. 116/20/B).

REFERENCES

Albertí, P., Panea, B., Sañudo, C., Olleta, J.L., Ripoll, G., Ertbjerg, P., Christensen, M., Gigli, S., Failla S., Concetti, S., Hocquette, J.F., Jailler, R., Rudel, S., Renand, G., Nute, G.R., Richardson, R.I., Williams, J.L. (2008). Live weight, body size and carcass characteristics of young bulls of fifteen European breeds. Livestock Science, 114(1), 19–30. DOI: 10.1016/j.livsci.2007.04.010.

Barszczewski, J., Wróbel, B., Balcerak, M. (2017). The efficiency of feeding beef cattle using silage of various content of leguminous plants. Journal of Research and Applications in Agricultural Engineering, 62(3)1, 21–25.

Bilik, K., Strzetelski, J., (2014). Żywienie bydła mięsnego w warunkach chowu ekologicznego [Feeding beef cattle in an organic production system in the context of research conducted at the national research institute of animal production]. Wiad. Zootech., 3, 23–44 [in Polish].

Bilik, K., Węglarzy, K., Choroszy, Z. (2009). Wpływ intensywności żywienia buhajków rasy limousine na wskaźniki produkcyjne i właściwości dietetyczne mięsa [Effect of feeding intensity of Limousin bulls on production parameters and dietetic properties of meat]. Rocz. Nauk. Zootech., 36(1), 63–73 [in Polish].

Choroszy, B., Choroszy, Z., Topolski, P. (2009). Analiza składu tkankowego tusz buhajków rasy simentalskiej w zależności od uzyskanej klasy umięśnienia w systemie EUROP [Analysis of the tissue composition of Simmental bull carcasses according to EUROP muscling grade]. Rocz. Nauk. Zootech., 36(1), 17–23 [in Polish].

Gaworski, M., Poletyło, T. (2011). Ekonomiczno-technologiczna efektywność chowu bydła opasowego [Economic and technological efficiency of beef cattle raising]. Problemy Inżynierii Rolniczej, 2, 107–115 [in Polish].

Gołębiewski, M. (2016). Zalecenia dotyczące doboru cieląt oraz prowadzenia opasu [Recommendations for calf selection and fattening management]. Centrum Doradztwa Rolniczego w Brwinowie Oddział w Poznaniu. [in Polish]. https://cdr.gov.pl/images/wydawnictwa/2016/2016-ZALECENIA-DOTYCZACE-DOBORU-CIELAT-ORAZ-PROWADZENIA-OPASU.pdf

IZ PIB (2014). Zalecenia Żywieniowe dla Przeżuwaczy i Tabele wartości pokarmowej pasz [Nutritional Recommendations for Ruminants and Tables of Nutritive Value of Feed]. (Eds) J.A. Strzetelski, F. Brzóska, Z.M. Kowalski, S. Osięgłowski. Instytut Zootechniki PIB [in Polish].

Juszczyk, S., Rekojarski, M. (2007). Koszty bezpośrednie pasz łąkowo-pastwiskowych w gospodarstwach mlecznych województwa Łódzkiego. Roczniki Nauk Rolniczych, Seria G, 94(1), 35–45 [in Polish].

Litwińczuk, Z., Grodzki, H. (2014). Stan hodowli i chowu bydła w Polsce oraz czynniki warunkujące rozwój tego sektora [The state of cattle breeding and farming in Poland and the factors determining the development of this sector]. Przeg. Hod., 6, 1–5 [in Polish].

Litwińczuk, Z., Żółkiewski, P., Chabuz, W., Florek, M. (2013). Przyrosty dobowe i wartość rzeźna buhajków opasanych paszami z trwałych użytków zielonych i kiszonką z kukurydzy z uwzględnieniem wartości pokarmowej skarmianych pasz [Daily weight gain and slaughter value of young bulls fattened on fodders from permanent grassland and maize silage, taking into account the nutritional value of the fodder]. Rocz. Nauk. PTZ, 9(4), 27–35. [in Polish].

McNamee, A., Keane, M.G., Kenny, D.A., Moloney, A.P., Buckley, F., O'Riordan, E.G. (2015). Beef production from Holstein-Friesian, Norwegian Red x Holstein-Friesian and Jersey x Holstein-Friesian male cattle reared as bulls or steers. Livest. Sci., 173, 95–105. DOI: 10.1016/j.livsci.2014.12.009.

Młynek, K., Guliński, P. (2007). The effect of growth rate and at slaughter on dressing percentage and colour, pH48 and microstructure of longissimus dorsi muscle in Black-and White (BW) bulls vs commercial crossbreds of BW with beef breeds. Anim. Sci. Pap. Rep., 25(2), 65–71.

Mwangi, F.W., Charmley, E., Gardiner, C.P., Malau-Aduli, B.S., Kinobe, R.T., Malau-Aduli, A.E.O. (2019). Diet and Genetics Influence Beef Cattle Performance and Meat Quality Characteristics. Foods, 8(12), 648. DOI: 10.3390/foods8120648.

Nogalski, Z., Kijak, Z. (2001). Fattening performance and slaughter value of the offspring of Black and White cows and Welsh Black bulls. Czech J. Anim. Sci., 46(2), 68–73.

Nogalski, Z., Wroński, M. (2011). Doskonalenie technologii opasu bydła [Improving cattle fattening technology]. Przeg. Hod., 4, 17–20 [in Polish].

Park, S.J, Beak, S.-H., Jung, D.J.S., Kim, S.Y., Jeong, I.H., Piao, M.Y., Kang, H.J., Fassah, D.M., Na, S.W., Yoo, S.P., Baik, M. (2018). Genetic, management, and nutritional factors affecting intramuscular fat deposition in beef cattle – A review. Asian-Australas. J. Anim. Sci., 31(7), 1043–1061. DOI: 10.5713/ajas.18.0310.

Ryschawy, J., Choisis, N., Choisis, J., Joannon, A., Gibon, A. (2012). Mixed crop-livestock systems: an economic and

environmental-friendly way of farming? Animal 6(10), 1722–1730. DOI: 10.1017/S1751731112000675.

Radkowski, A., Radkowska, I. (2015). Przyrosty masy ciała bydła mięsnego rasy Limousine w zależności od udziału koniczyny białej (*Trifolium repens* L.) w runi pastwiskowej [Body weight gains of Limousin beef cattle depending on the proportion of white clover (*Trifolium repens* L.) in pasture sward]. Wiad. Zootech., 53(4), 3–9 [in Polish].

Sablik, P., Szewczuk, M., Januś, E., Błaszczyk, P., Rudzińska, M. (2017). Profitability analysis of Limousin cattle organic farming compared to the conventional cattle management system. Acta Sci. Pol. Zootechnica, 16(4), 57–62. DOI: 10.21005/asp.2017.16.4.09.

Sakowski, T., Dasiewicz, K., Słowiński, M., Oprządek, J., Dymnicki, E., Wiśnioch, A., Słoniewski, K. (2001). Jakość mięsa buhajków ras mięsnych [Quality of meat of beef breeds bulls]. Med. Wet., 57(10), 748–752 [in Polish].

Semenov, V., Baimukanov, D., Tyurin, V., Kuznetsov, A., Tsarevsky, I., Nikitin, D. Efimova, I. (2019). Features of adaptation and meat qualities of Aberdeen-Angus bulls on the background of immunostimulation. IOP Conf. Series: Earth and Environmental Science 433 (2020) 012024. DOI: 10.1088/1755-1315/433/1/012024.

Skarżyńska, A. (2017). Produkcja wołowiny w Polsce oraz czynniki determinujące jej opłacalność [Beef production and determinants its profitability in Poland]. Roczniki Naukowe Ekonomii Rolnictwa i rozwoju obszarów wiejskich, 104(4), 112–124 [in Polish]. DOI: 10.22630/RNR.2017.104.4.36.

Statistics Poland (2020). Statistical Yearbook of Agriculture. Warsaw 2020.

Szumiec, A. (2014). Efektywność ekologicznego chowu bydła mięsnego [Efficiency of organic beef farming]. Wiad. Zootech., 52(3), 73–81 [in Polish].

Wilczyński, A. (2018). Wpływ systemu produkcji na koszty i dochód gospodarstw produkujących żywiec wołowy [Costs and income of beef farms in different production systems]. Folia Pomer. Univ. Technol. Stetin., Oeconomica, 347(93)4, 103–112 [in Polish]. DOI: 10.21005/oe2018.93.4.09.

ANALIZA KOSZTÓW PRODUKCJI PASZ I ŻYWIENIA BYDŁA RZEŹNEGO NA PRZYKŁADZIE WYBRANEGO GOSPODARSTWA INDYWIDUALNEGO

STRESZCZENIE

W pracy dokonano analizy kosztów produkcji pasz objętościowych i treściwych oraz tuczu opasów mieszańców ras HF i Limousine. Przeprowadzono kalkulacje kosztów uprawy 1 hektara pasz wykorzystywanych w żywieniu opasów. Uwzględniając średni plon w gospodarstwie wyliczono koszt produkcji 1 tony paszy. Wykonano kalkulację kosztów utrzymania, w tym żywienia 14 opasów przez 22 miesiące. Zwierzęta utrzymywano w boksach bez uwięzi na głębokiej ściółce masy ciała 36,86 kg do 812,14 kg w dniu sprzedaży. Opasy żywiono zgodnie z zaleceniami żywieniowymi, a podstawę dawek pokarmowych stanowiły pasze wytwarzane w gospodarstwie, z wyjątkiem śrut poekstrakcyjnych i mieszanki mineralno-witaminowej Dolfos BO. Wykazano, że koszt produkcji 1 tony pasz objętościowych wahał się od 66,98 złotych (kiszonka z kukurydzy) do 265,98 złotych (siano), natomiast ziarna zbóż oscylował od 261,22 zł (żyto) do około 371 zł (owies i pszenica). Stwierdzono, że największe koszty żywienia wygenerowała kiszonka z kukurydzy. Fakt, ten wiązać należy z największym jej udziałem w dawkach pokarmowych, co w rezultacie stanowiło blisko 5,5 t w przeliczeniu na jednego opasanego osobnika. Z pasz treściwych największe koszty wygenerowała pasza treściwa 2, co również wiązało się z jej ilością w przeliczeniu na sztukę. Przez cały okres tuczu każde zwierzę spożyło ponad 10 t paszy, co oszacowano na koszt 2744,32 zł. Reasumując po uwzględnieniu kosztów kalkulacji, gospodarstwo z chowu jednej opasa uzyskało dochód na poziomie 1611,96 złotych.

Słowa kluczowe: bydło rzeźne, dawki pokarmowe, koszty

Anna Milczarek https://orcid.org/0000-0002-2714-3533