

TECHNOLOGICAL AND ECONOMIC ASPECTS OF MEAT CATTLE FARMING IN LATVIA

Irina Pilvere, Liga Proskina, Aleksejs Nipers

Latvia University of Agriculture

irina.pilvere@llu.lv, liga.proskina@llu.lv, aleksejs.nipers@llu.lv

Abstract. World beef production is increasing at a rate of about one percent a year. Beef is one of the most consumed meat types in the European and American cuisine. Profitable beef farming requires continuous appraisal and adaptation of production systems in response to advances in technology and evolving market and agricultural policy conditions. Meat cattle farming is regarded as a prospective industry in Latvia, as there are appropriate conditions for the industry and it is an alternative for dairy and pig farming that faced various problems in recent years. The aim of this research is to identify the key technological and economic solutions in meat cattle farming. In Latvia cattle herds mostly consist of intensive breeds such as Charolais and Limousine, medium intensive breeds – Hereford and Aberdin Angus – and the extensive Highland breed. In 2012 and 2013 in Latvia the feed, capital and technology costs prevailed in the percentage distribution of the beef production costs. In Latvia meat cattle farming usually employs a pasture system. Other feeds and their quality play an essential role in achieving high cattle growth and productivity rates. The provision of dietary energy, protein and dry matter play a crucial role in the increase of live weight of young cattle. The provision of dietary energy and protein are essential in raising suckler cows and breeder bulls.

Keywords: technologies, cow farming, milk production, indicators.

Introduction

World beef production is increasing at a rate of about one percent a year, in part because of population growth but also because of a greater per capita demand in many countries [1]. As regards the consumption trends, these have changed significantly over the past decades, mainly influenced by economic reasons and health issues. Europeans like beef and veal and this is demonstrated also by the recovery of consumption in the last 5 years, stimulated also by the European Union [2]. The reason is that beef is one of the most consumed meat types in the European and American cuisine. The EU and the US have dominant global positions in terms of beef production and consumption, with recent numbers indicating consumers eating 17.2 and 27.7 kg per head per year on average in the EU-27 and the US [3].

For this reason, it is important that farmers wish to engage in cattle farming. And that is why profitable beef farming requires continuous appraisal and adaptation of production systems in response to advances in technology and evolving market and agricultural policy conditions [4]. Cattle farming plays an important role not only in food production but also in efficient land use. Marginal grasslands unsuitable for dairy farming may be used for production of suckler-based beef to contribute to availability and access to animal-source food [5]. A. Jamieson is also of the opinion that farming steep hillsides and dry, and sandy or, conversely, wet places and places with diverse micro-relief, which would otherwise be unutilised and overgrown by shrubs, is possible by means of pasture livestock. It helps maintain the traditional rural landscape, which not only local residents but also the general public are interested in [6].

The year 2014 was complicated for livestock farming in Latvia, as the dairy industry suffered from the embargo on dairy products imposed by Russia, milk purchase prices were low due to concerns about exceeded milk quotas and the situation in the world market, while pig farming was influenced by the outbreak of African swine fever in a number of regions, which limited trade in both live pigs and pork; exports of the mentioned products to Russia were stopped, and competition among the European Union Member States increased and the pork prices in the European market fell, which caused losses to pig farmers in Latvia [7]. For this reason, beef production in Latvia is considered to be a prospective industry, as it gradually develops. The number of meat cattle rises, and the meat cattle productivity indicators improve. Efficient farming is possible on large farms; therefore, increases in the number of meat cattle are observed for both meat breed cattle and suckler cows. The increases in the number of meat cattle indicate growth in the beef production industry. It is an industry that is appropriate for the production of organic products [7]. Besides, the green area that is suitable for meat

cattle farming is considerable in size. In 2014, meadows and pastures occupied 35 % of the utilised agricultural area [8].

Therefore, the overall aim of this research is to identify the key technological and economic solutions in meat cattle farming. To achieve the aim, the following specific research tasks are defined: 1) to examine the key meat cattle breeds farmed in Latvia; 2) to analyse the main economic indicators of beef production in Latvia; 3) to assess the aspects of farming and feeding meat cattle in Latvia.

Materials and methods

The main materials used for the research are as follows: various publications and research papers, reports of institutions, including governmental; data from the JSC Agricultural Data Centre that provides a single database on animals and the livestock industry in Latvia [9]. The research used the Report of the Subproject “Development of Efficient Farming Models” [10]. Multifactor regression analysis was used to estimate the differences between various indicators in beef production [11]. The appropriate qualitative and quantitative research methods have been used for various solutions in the process of study: monographic, analysis and synthesis, regression, data grouping, logical and abstract construction etc.

Results and discussion

1. Examination of meat cattle breeds in Latvia

Meat cattle farming in Latvia does not use local meat cattle breeds but imported ones. Meat cattle of various breeds and their bioproducts are imported from abroad. Every farm has to take into consideration its opportunities, the soil fertility and feed crop area when choosing the most appropriate meat cattle breed for farming. If a farm has pastures of very high quality, it can farm meat cattle breeds suitable for intensive farming such as Charolais, Limousine and Simmental. However, if the agricultural land of the farm is of lower quality and, accordingly, the quality and yield of grass biomass is lower, the demanding Hereford and Aberdinangus breeds or the extensive Highland and Galloway breeds would be the most suited. In 2014, 53955 meat cattle, of which 15742 or 29 % represented various breed crosses, were farmed in Latvia. The following purebred breeds were the most widespread: Charolais (CA) – 16984 young cattle, Limousine (LI) – 5472, Hereford (HE) – 5202 and Aberdinangus (AN) – 2613. Of the extensive breeds, Highland (HA) was the most popular breed with 871 cattle, accounting for 49 % of the total number of meat cattle in Latvia in 2014 [7]. According to the sources of specific literature, the characteristics of meat cattle breeds significantly differ; therefore, a general analysis involved average indicators for domestic animals, which are presented in Table 1.

Table 1

Average characteristics of meat cattle breeds in Latvia [12-16]

Characteristic/Breed		CA	LI	HE	AN	HA
Cow live weight, kg		758	629	597	565	470
Calf live weight at birth, kg	heifers	42	38	34	30	28
	bull-calves	43	38	36	33	31
Young cattle live weight, kg	7 months	317	272	182	200	-
	12 months	440	423	330	335	-
	18 months	530	490	465	430	-
	24 months	648	600	570	535	-
Average daily live weight gain by young cattle, g		1575	1200	1233	-	650
Age of weaning, days		211	213	216	215	231
Live weight at the age of weaning, kg		270	246	235	215	161
Age of first calving, months		30	31	29	26	35

- no data

Live weight at birth characterises the productive abilities of the parents, and it plays a great role in the pace of growth of cattle. Live weight at the age of weaning characterises the pace of growth, the mother's instinct and milk productivity, and all these characteristics influence the live weight of calves

at the age of 12 months; for these reasons, meat cattle are rated by their live weight at birth, at the age of weaning and at the age of 12 months. Further, characteristics based on LDC monitoring data in Latvia are shown to compare the actual situation with that described in the specific literature (Table 2). One can find that over the analysed period live weights at birth were lower for the CA and HA breeds, whereas the LI, HE and AN breeds featured higher live weights at birth than those specified in the literature. A similar situation was observed for live weights at the age of weaning – they were lower for the CA, LI, HE and AN cattle, whereas the HA breed presented higher live weights than specified in the literature. In contrast, the cattle of all the breeds did not reach the live weights at the age of 12 months that were specified in the literature, which means that actually meat cattle are not farmed in compliance with the keeping and feeding standards and are raised under extensive conditions.

Table 2

Characteristics of calves of meat cattle breeds in Latvia [17]

Breed	Live weight at birth, kg				Live weight at the age of weaning (aged 6-8 months), kg				Live weight at the age of 12 months, kg		
	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012
CA	40.9	40.9	40.7	40.9	271.1	269.6	264.6	265.1	354.4	355.5	356.6
LI	37.7	37.6	38.3	39	243.2	248.4	243.8	244.3	341.2	350.3	343.8
HE	37.8	38.1	37.7	38.4	237.7	233.0	235.9	229.8	310.9	317.9	312.8
AN	34	34.5	33.3	34.3	220.4	218.7	232.6	236.9	296.2	275.8	311.1
HA	27.3	25.8	25.4	25	168.4	151.1	140.1	154.1	282.6	261.0	279.3

2. Main economic indicators of beef production in Latvia

A specific of meat cattle farming is that meat is the only product produced by it; therefore, the production of calves in meat cattle farming is more important than in dairy farming. All costs incurred on a herd mostly relate to calves. The purchase price of cattle has significantly risen in Latvia since 2000 (877 EUR·tonne⁻¹) and reached 1624 EUR·tonne⁻¹ in 2014 [18]. Since the beef purchase prices in Latvia are usually lower than in the EU – it may be explained by the level of specialisation in beef production, which is considerably lower than in the EU in general [7], it is important to produce beef as cheap as possible. That is why it is necessary to analyse the costs for cattle farms. Average production costs for cattle farms in Latvia for 2012 and 2013 and the percentage distribution are presented in Table 3.

Table 3

Average production costs for cattle farms in Latvia in 2012 and 2013, EUR and % [19; 20]

Indicator	Average production costs for cattle farms			
	in 2012		in 2013	
	EUR	%	EUR	%
<i>Total cost</i>	41898	98.5	40131	100.0
<i>Total intermediate consumption</i>	30037	71.7	28708	71.5
<i>Total specific cost</i>	15171	36.2	16175	40.3
- purchased feed	2012	4.8	2141	5.3
- self-produced feed	9111	21.7	9974	24.9
- purchased and self-produced seeds, seedlings	489	1.2	650	1.6
- purchased fertilisers	63	0.1	435	1.1
- self-produced crops	845	2.0	767	1.9
- plant protection products	37	0.1	27	0.1
- insemination, veterinary costs	287	0.7	351	0.9
- other costs	2326	5.6	1828	4.6
<i>Overhead costs</i>	14866	35.5	12533	31.2
- maintenance of buildings and machinery	4037	9.6	3544	8.8
- fuel, lubricants	6841	16.3	5713	14.2
- electricity, heating	818	2.0	706	1.8
- services, machinery rent	407	1.0	583	1.5
- other overhead costs	2763	6.6	1986	4.9
<i>Capital costs</i>	6985	16.7	7170	17.9
-machinery, equipment	5255	12.5	4868	12.1

Table 3 (continued)

Indicator	Average production costs for cattle farms			
	in 2012		in 2013	
	EUR	%	EUR	%
-buildings, constructions	1111	2.7	1518	3.8
-other fixed assets in agriculture	619	1.5	784	2.0
<i>Interest payments</i>	<i>635</i>	<i>1.5</i>	<i>561</i>	<i>1.4</i>
<i>Paid labour</i>	<i>1668</i>	<i>4.0</i>	<i>2180</i>	<i>5.4</i>
<i>Rent costs</i>	<i>488</i>	<i>1.2</i>	<i>619</i>	<i>1.5</i>
<i>Cattle purchases</i>	<i>2086</i>	<i>5.0</i>	<i>894</i>	<i>2.2</i>

As shown in Table 2, the greatest cost item is intermediate consumption. In intermediate consumption, the greatest cost item is feed, which comprised 30.2 % of the total cost in 2013 (more than 4/5 of it related to self-produced feed). In intermediate consumption, the overhead costs made up 31.2 % and were mostly related to the operation of machinery and technologies as well as the maintenance of production buildings and machinery. The capital costs – the construction of buildings and constructions, the purchase of machinery and equipment (recorded as annual depreciation) and related interest payments on loans – comprised 19.3 % of the total cost, while the technology costs made up additional 17.9 % in 2013. According to farm accountancy data for 2013, the paid labour costs made up only 5.4 % of the total cost, while the land rent costs comprised 1.5 % and cattle purchases accounted for 2.2 %. Beef production is efficient taking into consideration the presented costs which allow generating the profit of 3760 EUR in 2013 and 4096 EUR in 2012 per farm. However, if farmers intend to increase the profit level, they need to reduce the production costs.

3. Solutions in farming and feeding meat cattle in Latvia

Cattle housing. Cattle housing is the key capital cost position. It performs several functions, as it has to provide refuge from adverse weather conditions, dry and clean sleeping-places, access to feed and drinking water and a possibility to separate and isolate some livestock or livestock groups. Cattle housing has to be easily cleaned and ensure appropriate manure management. The kind of livestock housing for a farm is determined by the chosen pattern of farming – the purpose of raising meat cattle and the cattle breeds and the production intensity chosen. Cattle housing is mainly needed for keeping pregnant cows, suckler cows and calves. Cows may be housed tied and loose. Both tied and loose housing are used for young cattle as well. It is advised to use loose housing, dividing livestock by age groups. The tied housing system may be practised for meat cattle; yet, it considerably increases the cost of construction of a cowshed and the use of labour and does not ensure that livestock can freely move, which consequently worsens the cows' oestrus and their insemination (breeder bulls may not be kept with cows during the mating period) as well as the welfare of calves (calves are born in an unfavourable environment and they may not suck cow's milk when they want). The key cattle housing solutions are as follows: 1) loose housing; 2) free stall barns; 3) loose housing with sloping floors for suckler cows; 4) loose housing for young cattle; 5) sheds with sides and an outdoor feeding lot [12; 14; 15].

Cattle diets. Since feed makes up almost a third of the total cost, farmers have to particularly focus on this cost item. In Latvia, meat cattle are usually grazed, and persistent grazing and the fencing system are the key pasture systems. Persistent grazing means the entire pasture area is available to pasture cattle throughout the year or grazing season; yet, the potential of use of pastures reaches only 50 % under such a system. To avoid the disadvantages of persistent grazing, several separated areas may be established in pastures, thus adjusting the burden of grazing to grass growth intensity and raising the potential of use of pastures up to 70 %. Part of pastures may be used for the production of haylage or hay. If all the areas of pastures are located in a single location, work with cattle is significantly eased by a system of stationary and durable fences. If cattle are grazed under the fencing system, the pasture area is divided into a number of smaller enclosures in which the entire herd is consecutively grazed. The system allows farmers to efficiently use the potential of pastures; yet, it is labour intensive, as the fences have to be often relocated. If establishing a fencing system on a farm, one has to remember that there has to be a possibility to separate some cattle by means of fences and to perform cattle cleaning operations or veterinary manipulations [12; 15]. Other feedstuffs and their

quality play an essential role in cattle growth and productivity. A purposefully designed feed ration can ensure high cattle productivity and a rational use of feed [21]. The feed ration has to be designed in a way to meet the daily dry matter requirement for cattle of certain live weight and productivity level. Adult meat cattle absorb, on average, 1.8-2.2 kg dry matter per 100 kg live weight. The dry matter absorption capacity of young cattle to be fattened is higher – 2.0-2.3 kg per 100 kg live weight. The dry matter absorption capacity of calves can reach even 3.6 kg per 100 kg live weight [22]. In order that cattle do not feel hungry, the amount of dry matter they consume has to be equal to 2.5 % of their live weight. Pasture grass, hay, haylage, straw and grain are the key source of dietary energy and nutrients, and the quality of feed contributes to two thirds of the quantity and quality of the livestock products produced. Cattle diets have to be differentiated according to the cattle physiological periods and uses.

A great focus has to be put on diets for suckler cows, as their feed requirements differ during their pregnancy and lactation periods. Extra dietary energy is necessary for intensive embryo growth during the final third stage of pregnancy; after it – for lactation and the restoration of live weight lost due to insufficient amounts of grass during the previous summer, very intensive lactation or late calving as well as because of all the mentioned reasons. Any deviation from the normal health condition of a cow (the cow is too fatty or lean) raises the risk of metabolism diseases, reduces the amount of milk for the calf and causes insemination and calving problems.

During the suckling period, calves have to be provided with a sufficient amount of cow's milk, which, in its turn, is influenced by the cow's diet. At the age of 2-3 weeks, calves of meat cattle breeds too start seeking additional feed and are fed the same diet their mothers have. Therefore, the feed has to be of high quality, so that it is suited to the calf as well. Giving additional feed to calves until their weaning is of great importance in case pastures were unproductive or the grass was overgrown in summer, while in winter the quality of feed is poor.

Young cattle diets. Young cattle stomachs are smaller in size; consequently, they have to eat feed of higher dietary energy value and containing more protein per kg dry matter. The best choice is quality haylage and silage in combination with grain or protein-rich feedstuffs. Young cattle to be raised for breeding purposes are fed self-produced feed and a small amount of feed concentrate. A daily live weight gain does not have to be less than 700 g, so that the required live weight is reached during the insemination period (18 months).

The following variables (x_i) were included in a regression model [11] for daily young cattle live weight gain, y : x_1 – daily dietary energy requirement (MJ), x_2 – daily protein requirement (kg) and x_3 – daily dry matter absorption capacity (kg) (Table 4). The absolute value of the correlation coefficient calculated $R^2 = 0.971$ indicates a strong causal relationship, while the determination coefficient of 0.942 means that 94 % of weight gain by young cattle may be explained by the linear regression model ($p < 0.05$).

Table 4

Coefficients of multifactor statistical regression analysis for the relationship between the live weight gain and young cattle diets [12; 14; 16; 21; 22]

Model/ Indicators	Unstandardized coefficients		Standardized coefficient Beta	t	Sig.
	B	Std. Error			
(Constant)	0.161	0.074	x	2.170	0.037
Daily dietary energy requirement, MJ	0.002	0.002	0.189	1.098	0.280
Daily protein requirement, kg	1.810	0.222	1.340	8.163	0.000
Daily dry matter absorption capacity, kg	-0.073	0.004	-1.308	-19.814	0.000

Dependent Variable: live weight gain, kg

So, the following linear regression equation describing young cattle weight gain with regard to the key young cattle diet components may be developed:

$$y = 0.161 + 0.002 \times x_1 + 1.810 \times x_2 - 0.073 \times x_3, \quad (1)$$

where y – daily live weight gain, kg;
 x_1 – daily dietary energy requirement, MJ;

- x_2 – daily protein requirement, kg;
 x_3 – daily dry matter absorption capacity, kg.

The livestock industry professionals emphasise that no considerable live weight gain is possible without feeding cattle additionally. Therefore, to contribute to faster cattle growth and faster capital turnover in an enterprise, it is necessary to introduce an intensive technology for keeping and feeding young cattle to be fattened, which involves no grazing. However, a number of practitioners in Latvia seek to use as extensive and cheap feeding solutions as possible for meat cattle to be fattened. In Latvia, cattle can be best economically fattened by grazing, without giving additionally feed concentrate, by using the portion-type grazing system on condition that pastures are well maintained and have a high proportion of papilionaceous plants there. According to observations in the USA, 800-1200 kg live weight gains per hectare of good pastures are possible for cattle, under similar conditions, also in Latvia [12].

It is important to meet physiological requirements with regard to diets for adult meat cattle, so that the cattle do not get too lean or fatty, which may become a cause of various diseases. The amounts of dietary energy (MJ) and protein (kg) in feed are essential criteria in designing a feed ration for adult cattle. For example, if protein is lacked in the feed ration, cows will not give enough milk and will not ensure intensive calf growth during the first months after calving. A sufficient amount of dietary energy in feed is required, so that the cattle organism can absorb protein. A deficit of dietary energy can result in live weight losses, whereas an increased amount of dietary energy contributes to cattle obesity. Such deviations from the normal physiological condition of cattle cause metabolism diseases and hinder the insemination and calving of cows as well as other health problems.

The following linear regression equation describing changes in young cattle weight gain with regard to the key young cattle diet components may be developed:

$$y = 571.162 + 2.692 \times x_1 - 0.187 \times x_2, \quad (2)$$

- where y – live weight (kg);
 x_1 – daily dietary energy requirement, MJ;
 x_2 – daily protein requirement, kg.

Table 5

Coefficients of multifactor statistical regression analysis for the relationship between the live weight gain adult cattle diets [12; 14; 16; 21; 22]

Model/Indicators	Unstandardized Coefficients		Standardized Coefficient Beta	<i>t</i>	Sig.
	B	Std. Error			
(Constant)	571.162	8.692	x	65.711	0.000
Daily dietary energy requirement, MJ	2.692	0.382	2.119	7.055	0.000
Daily protein requirement, kg	-0.187	0.024	-2.377	-7.915	0.000

Dependent Variable: live weight gain, kg

So, the absolute value of the correlation coefficient calculated $R^2 = 0.867$ indicates a strong relationship between the variables. The determination coefficient of 0.751 means that 75 % of weight gain by adult cattle may be explained by the linear regression model ($p < 0.05$).

Conclusions

1. Beef production in Latvia is considered to be a prospective industry, as there are suitable conditions for it and this industry is an alternative for milk production and pig farming, which faced various problems in recent years. In the period 2010-2013 in Latvia, cattle herds mostly consisted of intensive breeds such as Charolais and Limousine, medium intensive breeds – Hereford and Aberdin Angus – and the extensive Highland breed, the characteristics of which were slightly lower than their potential specified in the specific literature.
2. In Latvia, the following cost items prevailed in the percentage distribution of the meat cattle production costs for 2012 and 2013: feed up to 30.2 %, including self-produced feed 25 %, and capital and technological costs up to 27 % of the total cost, which determined the key opportunities for optimisation in the future. The key component of capital costs relates to cattle housing, the kind

of which and the techniques of farming cattle are determined by the purpose and intensity of raising the meat cattle and the breeds chosen. Beef production is efficient taking into consideration the presented costs which allow generating profit in 2012 and 2013.

3. Grazing is usually practised in raising meat cattle, and other feedstuffs and their quality play an essential role in cattle growth and productivity. A crucial role in young cattle live weight gain is played by the amounts of dietary energy, protein and dry matter the young cattle are provided with. It is indicated by the absolute value of the correlation coefficient calculated $R^2 = 0.971$, which points to a strong causal relationship, while the determination coefficient of 0.942 means that 94 % of weight gain by young cattle may be explained by the linear regression model ($p < 0.05$).
4. In raising suckler cows and breeder bulls, the dietary energy and protein requirements are important for live weight gain. It is indicated by the absolute value of the correlation coefficient calculated $R^2 = 0.867$, which shows a strong relationship between the variables. The determination coefficient of 0.751 means that 75 % of weight gain by adult cattle may be explained by the linear regression model ($p < 0.05$).

Acknowledgment

This research paper is prepared with the support of the Ministry of Agriculture and refers to the research carried out within project No 2013/86 “Competitive and Efficient Production of Milk and Meat”, subproject “Development of Efficient Farming Models”.

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