COST PRICE CALCULATION METHODOLOGY FOR BEEF FARMS

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Abstract
Quality of information about cost structure of farm is of high importance when making management and production process improvement decisions. Aggregating and analyzing production process cost information by correct and unified methodology provides possibility of evaluating the structure of expenditures. Moreover, it is possible to identify most important cost positions and get perspective on production process. By collecting and processing data using unified methodology it is possible to conduct comparing evaluation between different farms. This is done to identify the most and less efficient farms, their work methods and cost structure. When developing unified methodology, it is essential to take into account that different farms might use different production systems and structure. When creating revenue and expense calculations, it is essential to receive accurate data. Good quality data is fundamental for receiving good quality and usable results. Precise data accounting is another important factor that ensures good quality of cost calculation. Precise accounting decreases number of cost allocation coefficients used for allocation of cost positions and thus decreasing effect of assumptions on unit production cost calculation. Fixed cost allocation by its nature to divide all costs by farm specializations is the most challenging when calculating unit production cost. In order for calculations to be of good quality, precise data on use of assets, specifics and intensity of farming is necessary. By identifying these indicators it is possible to create maximally precise calculation of unit production cost of beef.
Key words: unit production cost, data quality.

Introduction

It is important to conduct evaluation of production process and cost analysis for farm of any specialization that is involved in production. This would provide a possibility for improving production process, decreasing production costs and improve or maintain quality of the product produced. Thus, it is necessary for farms to have efficient decision-making system, which is swift and precise, in order for farms to be competitive (Tanure et al., 2013). Taking into account soon-to-be cancelled milk quota in the EU, there is a possibility that milk production output will increase, which will increase demand for fodder. Prices will increase for roughage and concentrated forage (Kempen et al., 2011). In order for beef farms to preserve or improve their competitiveness, they must improve efficiency and ability to produce product of good quality. In the times of growing competition in global agricultural market, it is essential to pay attention to increasing production efficiency and competitiveness of the farm for the farm not to rely on the EU and governmental subsidies as a substantial part of its income (Potter, 2007). For a farm to become more efficient, it has to identify its weak spots that are in need of improvement. One of the tools for identifying and analysis of the weak spots is unit production cost calculation. Unit production cost calculation provides detailed information on production cost positions and significant insights for decision-making regarding further production. In order to be able to conduct such a calculation, a methodology is necessary as well as knowledge for interpretation of the results.

The aim of this article is to create a farm activity evaluation methodology of calculating unit production cost, which can be used by beef producing farms.

Tasks of the research:

1. Identify information necessary for unit production cost calculations and methods of acquiring information;
2. Create cost classification and grouping system of costs for beef producing farms;
3. Investigate use of unit production cost at beef producing farms in evaluating farm performance.

Materials and Methods

Monographic and graphic methods, analysis and synthesis, induction and deduction are used in this article. Research results of different authors on farm efficiency evaluations, cost calculation methods and cost classification are used as a source of information.

Results and Discussion

Accounting and cost allocation

In times of increasing competition between producers of agricultural products, necessity to improve efficiency is increasing as well. It can be improved by analyzing cost structure and production results (Bezat-Jarzębowska and Rembisz, 2013). When calculating costs of production process, a farmer has to know, which data should be taken into consideration, what kind of accounting should be conducted in order for the calculation to be useful for decision making when dealing with managerial issues on the farm. It is very important to calculate unit production cost by using reliable data (Jurgens et al., 2013).

Expenses, amounts sold and sales prices should be accounted for (Paracchini, 2015). When calculating, only amount of beef sold is taken into account rather than amount of beef produced (Jurgens et al., 2013). For calculating unit production costs, data quality is very important and it has very strong effect on end result. The more precise is the input data, the more precise is the result. In collecting good quality and valid information it is necessary to collect interim results. For instance, a farm that is involved in production of beef has to follow the unit production cost of fodder because it has direct effect on unit production cost of beef (Tanure et al., 2013). That would also facilitate allocation of costs between specializations.

When calculating unit production cost of beef, one has to take into account these positions:

- Direct costs contain purchase of production resources that are connected to beef cattle. These are fertilizer, seeds, crop protection products, fodder, fuel, electricity, veterinary services, medicines, energy, insurance, contract workers etc. Production activity costs should be taken into account as well. For instance, services bought from outside the farm, consumption on a farm, herd renewal or expansion costs (buying cattle).
- Indirect costs are costs that are attributed to the whole farm and allocated to each enterprise by proportion defined (European Commission, 2012; Schader et al., 2013; Paracchini, 2015).

If beef producing farm has other cattle enterprises, it would be helpful to divide contract labor costs, veterinary costs, and fodder cost separately for each enterprise (Åby et al., 2012a). It should be done in order to avoid using allocation coefficients for calculating variable costs allocated to beef production and other cattle breeding enterprises. If separate accounting for each enterprise is not possible and large portion of farm's income is generated by crops, it is more helpful to create interim cost calculations by calculating production costs of each crop. Production costs of crop include purchase of seeds, crop protection products, fertilizer etc. (Manjunatha et al., 2013; Meul et al., 2014). When calculating indirect costs, farm's cost analysis has to include costs of maintenance of agricultural machines, service costs. When calculating workloads of machinery and intensity of use, it is possible to calculate adequacy of the machinery to the needs of the farm (Lansink et al., 2004). By calculating costs of using machinery and analyzing its use, it is possible to calculate fuel use and labor costs that are connected with operating the machinery.

There is also a possibility of creating more accurate calculation that analyzes different production cycles on the farm. These cycles are starting from calculation unit cost of production of calves at different stages of their lives, for example, calves under 6 months old, calves between six months and a year of age etc. It is also possible to calculate for how long a suckler cow should be held in a herd for it to break even (Åby et al., 2012b). By aggregating information it is possible to construct a calculation model where data can be entered (Table 1).

Calculations should include governmental and the EU support. By adding the EU and governmental support, it is possible to analyze what portion of total revenues comes from production and what portion comes from subsidies and support payments (Helming and Peerlings, 2014). These payments are important factor that reduces production costs and is significant source of funds (Schader et al., 2013). Size of payments is significant factor to ensure efficiency of production – it can be impeding as well as supporting (Bojneca and Latruffe, 2013).

When evaluating farm's activity, impact on environment should be evaluated as well. This includes taking samples for soil nutrient balance analysis, analysis of fertilizer used; yield (Pacini et al., 2003). This kind of analysis shows if farm's production model is sustainable or is it short-term, where unit production cost is decreased on the account of exploiting environmental resources.

Methods for data collection

Data for calculating unit production cost can be obtained from accounting data. Farms, especially the multidisciplinary ones, should have precise accounting in order to be able to identify stages of production process that create the whole operational system (Schouten et al., 2014). L. Mouysset has investigated that it is preferable for farms to have several enterprises. This is so because prices of agricultural products are unstable and are influenced by many external factors. Multidisciplinary farming ensures risk diversification and improves profitability of the farm (Mouysset et al., 2011). Multidisciplinary farming decreases risk of becoming insolvent, however, having more than one field of specialization creates significant problems for calculating unit production costs. This is so because two or more enterprises utilize the same production resources, for example, land, labor, machinery etc. In everyday life it is almost impossible to identify which enterprise has benefitted from particular resource and thus increased attributable costs.

Therefore, cost accounting should be conducted based on the product the cost is attributed to. It would allow identifying costs that are attributed to production of beef and the rest of the enterprises of the farm (Frank, 1996). The more complex is the farming system, the harder it is to conduct accurate tracing of production stages, which has an effect on reliability of calculations of production results and use of the results in further planning (Kempen

Table 1

Methodology scheme of calculation

Income	**Comments**
Income from sales of beef cattle production (beef, rearing material, manure, other income)	Units produced, sales price and amounts sold should be taken into account for calculation of costs to units produced, which results in unit production cost.
Expenses	**Comments**
Purchased fodder	Expense position that is attributed to all grazing livestock units. It is possible to allocate position by using livestock unit under assumption that all grazing livestock units are given constant amount of fodder per livestock unit.
Forage costs: • Seed • Fertilizers • Pesticides • Other specific costs related to fodder crops	Complicated variable expense position, especially, if the farm is involved in producing crops for sale. In such cases precise accounting of costs is necessary for allocating variable costs to crop production.
Other cattle breeding related costs (veterinary costs, purchase of rearing material etc.)	Expense position that can be attributed not only to grazing livestock but to other livestock units as well. That is why precise accounting of expenses is necessary. In practice it is observed that most of these costs are attributed to cattle, usually dairy cattle.
• Building and machinery upkeep expenses • Energy expenses • Labour costs • Other expenses • Taxes and dues	Expenses that are attributed to the farm as a whole. Building upkeep related to beef cattle breeding is separated from this position.
Wages, rent, interest paid	Expenses that are attributed to the farm as a whole. Beef cattle related expenses are separated from this position.
Depreciation	Expenses that are attributed to the farm as a whole. Beef cattle related expenses (depreciation of buildings, specialized machinery, etc.) are separated from this position.
Unit production cost: expenses of producing beef in (euro) divided with beef produced (kilograms)	Total beef sold divided by total costs attributed to beef production.

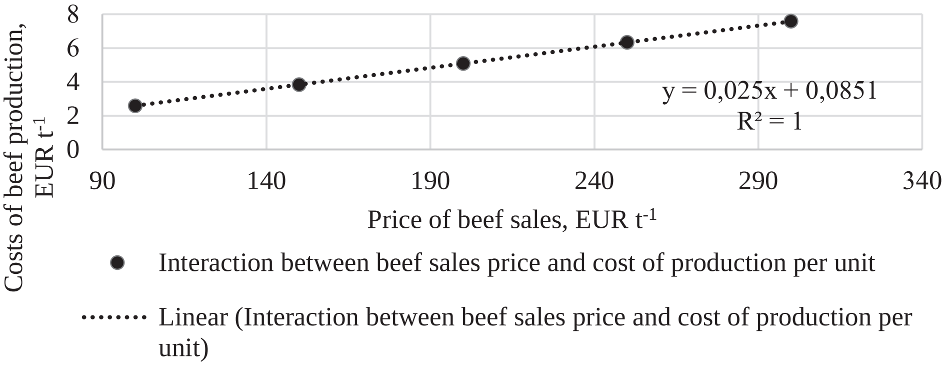
Source: Created by author using data of Jurgens et al., 2013.

et al., 2011; Schouten et al., 2014). In the analyzed articles significant role in reliability of data is played by two factors- accuracy of cost accounting and cost accounting directly related to particular enterprises. Essentially, the most significant risk in accounting is not sufficient level of detail. This data collection method has an advantage of access to the origin of the data, which allows collection of data necessary for unit production cost calculation.

If observing the issue on more global scale, to be able to compare unit production costs between farms in a state, region or Europe, a unified data accounting system should be used. Within the country Farm Accountancy Data Network (FADN) data can be used for unit production cost calculation (Latruffe et al., 2012; Jurgens et al., 2013). FADN data is gathered with a purpose of using them for analysis. Therefore, risk of data being insufficient for analysis decreases. The major problem of FADN data is their reliability. Accounting data for calculating unit production cost can be used if unit production cost analysis is necessary for one or several farms. However, if data is necessary to more farms for inspection of a particular tendency or comparison, it is preferable to use FADN data.

Cost grouping and structuring

For more accurate unit production cost calculation, it is necessary to divide costs by their nature. For instance, all crop related costs should be grouped by particular crop, which is crop's unit production cost (Martin et al., 2014; Picasso et al., 2014). Moreover, to identify the most suitable production technology to particular conditions, farms can use interim results. For instance, cost of building a shed and its effect on cost of kilogram of beef should be taken into account (Tanure et al., 2013). Technology used on the farm has a significant effect on efficiency of the farm. For example, how fast the farm can produce fodder, how well it can be preserved and feed it to cattle (Latruffe et al., 2012). By separating costs attributed to a particular production phase, procedure or production of interim production it is possible to use coefficients to allocate costs to beef production. Costs can be grouped by purpose whether they are related to whole farm operations or to cattle only. By



Source: Calculated by author based on theoretical data

Figure 1. Sales price effect on functionality of coefficient of indirect costs, theoretical calculations (European Commission, 2012).

using this approach European Commission (European Commission, 2012) has included coefficients into cost calculation method. Coefficients are used to separate costs related to milk production from total costs. The same method can be used to separate costs attributed to beef production. Variables in the coefficients have to be altered to calculate unit cost of production of beef kilogram. Coefficients are calculated based on a real situation in the farm. Thus, coefficients are dynamic and there are no two identical coefficients if production conditions are different. In the section of variable costs that contain costs of growing crops by European Commission methodology, costs of growing crops are not separated. This creates an inaccuracy because crops that are not consumed within the farm or are not added to stock, are sold. Therefore, for more accurate results it is preferable to use coefficients based on hectares by dividing area of fodder crops by total area used by the farm. This results in proportion of area of total area that is used for growing fodder crops. By using this indicator costs of growing crops that should be allocated to cattle breeding can be found. Afterwards fodder preparation costs can be used to calculate how much of farm's used land is given to beef production. This parameter is created by adding suckler cows to rearing bull to calves (in livestock units) and dividing it by total livestock units on the farm (European Commission, 2012).

European Commission has included calculation of indirect cost coefficient in the Dairy Report 2012. It is calculated by dividing total income from milk by total income from farm.

Calculation of this coefficient is simple, however, it does not provide accurate information because sales price has significant effect on coefficient (Figure 1). By creating a theoretical calculations under certain assumptions or changing only sales price of beef, it is possible to have different unit prices as a result. Production cost dynamic per unit depends on sales price. For example, using the equation 'y=0.025x', it can be concluded that the increase in beef sales price for one euro per ton increases unit production cost for 2.5 euro cents per kilogram. R^2 shows that coefficient calculation methodology does not include a mechanism that limits the impact on the selling price on production cost. This leads to a situation when lower sales price leads to lower costs per one kilogram produced.

Currently the best alternative to using indirect cost coefficient is to use farmers' or experts' evaluation of allocation of costs in multidisciplinary farm.

Data processing and analysis, result analysis

Data from farms can be analyzed in different dimensions. For instance, costs of fodder effect on growth rate of cattle or on total beef output. By processing unit production cost data, it is possible to analyze efficiency of farm's production. Production efficiency is determined by such factors as return on investment in assets, for instance cost per unit, profit from one hectare etc. (Gadanakis et al., 2015). Significant impact on farm's profitability is its ability to reaching maximum yield from one hectare, e.g., ability to utilize land and capacity of the crop to produce the highest quality fodder at the lowest cost (Martin et al., 2014). Sustainable use of agricultural land is key to prosperity of a farm (Kuhlman et al., 2010). Essentially, beef production is turning grass into a product with value added.

In the process of data processing different indicators of efficiency of utilization of resources can be used.

- Cost of fodder and actually produced amount of fodder (tonnes) is an important indicator of efficiency (Rearte and Pordomingo, 2014).
- Efficiency is affected by the farm's ability to utilize appropriate agricultural machinery and harvest adequate amount of yield depending on invested resources (Gadanakis et al., 2015).

- Farm's efficiency is determined by its ability to utilize its resources. For example, manure can replace fertilizer, thus decrease cost of production (Ondersteijn et al., 2003).
- The number of people employed on farms with the same number of cattle indicates the level of efficiency or availability of machinery for improving efficiency of production (Figiel and Kufel, 2013).

It has to be noted that in the conditions of limited resources a farmer has to maximize output of land, which makes possible herd expansion and make production more intensive (Bezat-Jarzębowska and Renebisz, 2013). One of the ways of effective utilization of land is to use it as intensively as possible, for example, by seeding grass that produces at least 40 tonnes of grassland yield from a hectare. Great attention should be paid to the quality of grass because grass is an important factor of production of fodder, consequently affecting the quality of beef and production efficiency (Sullivan et al., 2010).

One can conclude that it is essential to create accurate dosage of fodder according to physiological condition of an animal, intensity of growth to age and other factors. Feeding inappropriate dosage of fodder leads to not only wasting resources but possible damages of cattle health by causing digestive disorders. For a farm to utilize resources effectively it is important to pay attention not only to quantity of fodder but quality as well. For example, fodder and purchased forage can be compared based on protein content in dry matter per kilogram and cost per kilogram of protein in grown and purchased fodder (Van Middelaar et al., 2013). This would provide objective perspective on the value of grown fodder crops and how much the farm can save up by improving the quality of grasslands and not buying feed additives.

In order for a farm to maintain high quality of fodder production, soil analysis, soil nutrient balance analysis have to be conducted regularly and soil fertilizing plan that is based on results of analyses has to be fulfilled (Halberg et al., 2005; Schönhart et al., 2011).

When evaluating consumer demands and expectations towards beef quality, one has to calculate if cost reduction would not negatively affect the demand for beef production (Lobato et al., 2014). It is possible to create very intensive and fast production technology; however, one has to evaluate the effect of fodder on beef quality.

Evaluation of beef production technology, data for decision-making

When deciding upon which beef production technology to use, one has to consider cost calculation methodology, which eventually can affect end result (Åby et al., 2012a). While for analysis of current production technology or alternative technology it is essential to have accurate data, in cost structuring it is recommended to divide indirect costs based on experts' evaluation.

When seeking for the most appropriate farming model, it is useful to calculate the period for how long it is profitable to keep a cow or a bull in a herd. Necessary data for analysis is growth rate, amount of fodder fed to cattle, costs of fodder, labor costs (Oishi et al., 2013). Farms that are aware of their unit production costs can plan and analyze production activities. In case of necessity they can adjust and change cost positions that are related to beef production. This kind of analysis of cost positions provides an opportunity of swift and focused changes in production intensity and structure because economic structure and functional principles of production process is known prior to the change (Samson, 2013).

Efficiency of a farm is affected by its production technology – crop yield is lower at biological farms than at conventional farms, which affects efficiency of utilizing of particular production factors (Nemecek et al., 2011). When analyzing production, one has to take into account cattle life cycle, growth rate for more accurate planning of feeding and create culling scheme (Oishi et al., 2013). Not all breeds of beef cattle have the same growth rate potential. Productivity of the cattle has s significant impact on unit production cost of one kilogram of beef. By developing genetics of a herd farm can improve growth rate dynamics (Murphy, 2014). Before establishing beef production or working on improving production efficiency, one has to be able to detect which of the beef cattle breeds is the most suitable for given production conditions.

When choosing beef production technology, several factors have to be taken into account. These are value of production, added value of production, total income of the farm, income structure, and diversification of the farm (Paracchini, 2015). Low unit production cost does not imply having profit. Profit is difference between revenues and cost of production. Thus, when optimizing production cost, it should be done so that beef quality, visual appearance and taste would not be affected (Morales et al., 2013). Therefore, production technology planning, intensive or extensive, should account for potential revenues from one kilogram of beef (Lobato et al., 2014). Essentially, when choosing production technology not only cost of producing one kilogram of beef should be considered, but price at which the produced beef can be sold should be considered as well (Åby et al., 2012a). The most significant difference between production technologies is intensity of feeding – costs of fodder in intensive breeding technology will be higher than in extensive breeding technology. Therefore, it is important to calculate variable costs per one kilogram of growth rate (Åby et al., 2012a). When reaching unified quality level on the farm at which quality of beef of all cattle is equal, a farmer has to evaluate if beef pre-processing and storage can be introduced into production cycle to postpone sales to the moment when consumers are ready to purchase beef for particular price (Kristensen et al., 2014). When conducting cost analysis of a farm, it is easier for manager to make managerial decisions, develop the farm and improve production process, which leads to increased production efficiency and higher quality of beef produced.

Conclusions

1. Data quality is of high importance for ensuring validity of unit production cost calculations. Unit production cost calculation is directly dependent on quality and accuracy of input data. Poor data quality can lead to misconceptions about true costs of production. Inaccurate information of production costs is not valid for decisions which affect farm development.
2. In order to get an accurate beef kilogram cost calculation, qualitative and accurate information of beef production costs that should be separated from other farm operating costs is required. If costs of beef producing are not separated from other farm costs, it is possible to apply weightings to separate costs which are related to production of beef and other economic activity.
3. Operating costs have to be classified according to their nature, why certain costs are made. This will ensure more cost accuracy and reliability. Classifying costs, it is possible to get an accurate picture of the cost structure of farms beef specialization.
4. By cost calculation with the exact distribution of costs relating to one kilogram of beef production, farms allow a farm manager to make more qualitative decisions concerning farm development and raise efficiency.

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