

The quality of production as a factor contributing to the effective activity of agricultural enterprises

Jakość produkcji jako czynnik wpływający na efektywność działania przedsiębiorstw rolniczych

Tetyana I. Balanovska, Olga P. Gogulya, Natalia I. Dragneva

National University of Life and Environmental Sciences of Ukraine, Kiev, Ukraine

Abstract. The study investigates the influence of the quality of agricultural production on the efficiency of agricultural enterprises. A special focus is given to the importance of borrowing the practical aspects of advanced foreign experience in product quality management into the practice of domestic enterprises. The differences between European and Ukrainian quality standards are briefly described, and the ways of their harmonisation are shown. Since most of the milk production in Ukraine concentrates in households, our study outlines their main problems and the further steps needed for the development of quality control for small-scale production.

Key words: operational efficiency • agricultural enterprise • product quality

Streszczenie. Praca przedstawia wpływ jakości produkcji rolnej na efektywność przedsiębiorstw rolniczych. Szczególną uwagę zwrócono na rolę przenoszenia najnowszych doświadczeń zagranicznych w zakresie praktyki zarządzania jakością produktów do przedsiębiorstw krajowych. Krótko omówiono różnice między europejskimi i ukraińskimi normami dotyczącymi jakości oraz wskazano sposoby ich zharmonizowania. Ponieważ produkcja mleka na Ukrainie jest w większości skupiona w drobnych gospodarstwach rolnych, niniejszy artykuł opisuje ich główne problemy oraz dalsze działania niezbędne do ulepszenia systemów kontroli jakości dla tego typu drobnej produkcji.

Słowa kluczowe: efektywność działania • przedsiębiorstwo rolnicze • jakość produktów

Introduction

One of the most important strategic issues in Ukraine in the context of food security is the level of product quality. The quantitative aspect of production improvement, i.e. the increase in its volume, is no longer the main subject of formal discussions, and the focus

Corresponding author – Adres do korespondencji: Assoc. Prof. Tetyana I. Balanovska, Department of Management, National University of Life and Environmental Sciences of Ukraine, Geroviv Oborony st., 15, 03041 Kiev, Ukraine; e-mail: balanovskaya@nubip.edu.ua

has been shifted to quality enhancement. However, the existing planning and administrative system does not have sufficient flexibility to rapidly respond to the changes in the consumer satisfaction with goods or services; in addition, it ignores the qualitative features of raw materials, finished products, and services. The gradual adaptation of the national economy to European Union's requirements will offer new opportunities and prospects for the promotion of Ukrainian products on the world market, provided that the production has a high quality and complies with international standards on quality management, standardisation, certification, and metrology. In view of this, there is a need to work out appropriate tools that will enable market participants (business entities) to enhance their functioning on the basis of the quality coefficients of products.

Investigations carried out by many scientists, among them Adler (1969), Ishikawa (1985), Deming (1986, 2012), Kolesnikov (1988), Crosby (1989), Juran (1989), Feigenbaum (1991), Hoychuk (2003), Ivanov et al. (2004), Bychkivskyy and Hunkalo (2005), Schichkov (2005), Hunkalo (2007), Novikov (2011), and others, have been dedicated to the theoretical and practical issues of quality control and to related problems.

Leading scientists have identified a wide range of effective production management practices, including those concerning the quality of products. Considering the current economic situation, however, some aspects of this issue appear to be insufficiently studied. As regards the agricultural sector, there is a need to determine the promising directions of the effective actions to be taken by enterprises with the aim of improving the quality of their products, which should be seen as vitally important for the practice of any modern agricultural enterprise.

The present study aimed to define the directions of the development of agricultural enterprises that can ensure high-quality production. The other objectives were to examine the impact of the quality parameters of agricultural products on the efficiency of the enterprises, and identify individual factors that determine the performance of milk producers.

Material and methods

The material for our research was the findings of Ukrainian and foreign scientists on quality management. The study was conducted using the following methods: an abstract logical method – to make theoretical generalisations and draw conclusions; statistical and economic methods – to analyse the quality of dairy cattle production and the efficiency of enterprises; a comparative method – to make comparisons relating to the quality of dairy production; mathematical economic modeling, correlation, and regression – to develop statistical models describing the influence of several factors on the profitability of dairy production; a graphic method – to visualise the results.

Results

The change of ownership, implementation of land reforms, completion of privatisation processes, and establishment of private market-orientated economic structures in Ukraine brought about radical changes in its agriculture. Although the market trans-

formation of the agricultural sector, aimed at improving its efficiency, eliminating crisis, and stabilising agricultural production, did not fulfil the expectations, nevertheless, it was successful in clearly outlining the priorities for development: struggling for quality and competitiveness, improving both quantitative and qualitative indices of agricultural production, gaining access to the world market.

An analysis of the economic trends of the last decade showed that households play an important role in Ukrainian agriculture, with their share in the gross agricultural output being still large (61.6% in 2000, 59.5% in 2005, 51.4% in 2009, and 48.2% in 2011), although agricultural enterprises are now dominant. The household farm production alleviated the negative impact of the economic crisis seen in the collapse of collective farms, and was the main source of livelihood for farmers' families and a factor contributing to the food security of the rural and urban population. However, this was accompanied by a decrease in the area of arable land, reduction in the number of farm animals, especially cows, and narrowing of the assortment of agricultural commodities and products, followed by the reduced consumption of meat, milk and dairy products, deteriorated trade balance in the dairy and meat sectors, and deteriorated quality parameters of products. Obviously, the issue of quality control grows in importance under the conditions of such a deep institutional change.

The rearing of dairy cattle constitutes a traditional and one of the most important branches of agriculture in Ukraine. Favourable climatic conditions and vast areas of agricultural land: 41 722.2 hectares, including 2429.2 thousand ha of hayfields and 5521.3 thousand ha of pastures, offer the possibilities for creating a large forage reserve, which will secure the production of high-quality milk and dairy products. While the profitability of milk production tends to increase (0.4% in 2004, 17.7% in 2010) as influenced by the level of purchase prices for milk, its quality parameters remain low.

Statistics show that households account for over 80% of the gross milk production of Ukraine. It should be noted that the milk passes a very difficult path from farms to milk-processing plants. Farmers often have no possibility of mechanising the milking operations, properly cooling the milk, or timely transporting it to the point of sale. As a result, the milk arriving at processing plants has high acidity levels. Accordingly, the price of such milk does not repay the expenses connected with its production. Hence, the proportion of milk going to the processing from households is significantly lower than that coming from agricultural enterprises.

During our study we analysed some aspects of product standardisation. Up to 2002, the flow of milk from agricultural enterprises to processing plants was regulated by two Russian standards: GOST 13264-70 and GOST 13264-88. The former established the quality requirements for first- and second-grade milk. The latter considered three grades of milk (high, first, and second), changed the requirements for total bacterial contamination and somatic cell count, and set the standard level of protein in milk.

With the introduction of the Ukrainian state standard DSTU 3662-97, the quality requirements became more stringent. In fact, this standard was to come into force on 1 June 1997, but this was postponed for five years due to the then high demand for dairy products which contributed only to an increase in the purchase prices of the raw material, to the neglect of such issues as the monitoring and improvement of milk quality parameters. Since the enforcement of DSTU 3662-97, payments have been made

not only based on fat, but also on protein, whose content requirements were set by the government. According to the currently binding standard, milk should be natural, whole, clean, and free from foreign (not peculiar to fresh milk) tastes and smells. As regards appearance and texture, it should be a homogeneous liquid coloured from white to light yellow, without sediment and clots. The standard has defined limits for antibiotics, pesticides, nitrates, hormones, and radionuclides that the milk could contain.

However, even the requirements for high-quality milk, specified in the above Ukrainian standard, did not match the quality requirements imposed on milk in the European Union. For example, the total bacterial count of milk should not exceed 300 thous./cm³ according to the Ukrainian regulations (vs. 100 thous./cm³ according to the relevant European Directive) and the density of milk should be 1027 kg/m³, (vs. 1028 kg/m³). To adjust the Ukrainian regulations to the EU ones, one more grade, referred to as “extra”, was added to the standard in 2008. The comparative characteristics of milk quality standards in Ukraine and the EU are shown in Table 1.

Table 1. Comparison of the European and Ukrainian milk quality standards

Parameter	Ukraine (DSTU 3662-97)				EU (Regulation (EC) No. 853/2004)
	2002–2008		Since 2008		
	Second-grade	First-grade	High-quality	Extra	
Total bacterial count (thous./cm ³)	≤ 3000	≤ 500	≤ 300	≤ 100	≤ 100***
Temperature (°C)	≤ 10*	≤ 10	≤ 8	≤ 6	≤ 6**
Mass fraction of solids (%)	> 10.6	> 11.5	> 11.8	> 12.2	–
Somatic cell count (thous./cm ³)	≤ 800	≤ 600	≤ 400	≤ 400	≤ 400****
Freezing point (°C)	not controlled				–0.52 (Council Directive 92/46/EEC, as amended)

* if stored up to 12 hours

** 8 °C with daily cleaning, and 6 °C if collection is not daily

*** geometric average over a two-month period, with at least 2 samples per month

**** geometric average over a three-month period, with at least 1 sample per month, unless the competent authority specifies another methodology to take account of seasonal variations in production levels

Source: DSTU 3662-97 Whole cow milk. Requirements for purchasing; Corrigendum to Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin. Official Journal of the European Union L 226, 25 June 2004, pp. 22–82; Council Directive 92/46/EEC of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products. Official Journal of the European Communities L 268, 14 September 1992, pp. 1–32 (as amended by Directives 92/118, 94/71 and 96/23 and Commission Decision 94/330)

As indicated by recent trends, the proportion of high-quality milk in the overall volume of milk received for processing in Ukraine tends to increase. Between the years 2005 and 2010, it rose from 17% to 31% (Fig. 1). In addition, over these 5 years a new grade – “extra” – appeared in the structure of milk received for processing, although its share is small, only 5%, while in the EU countries it exceeds 90%.

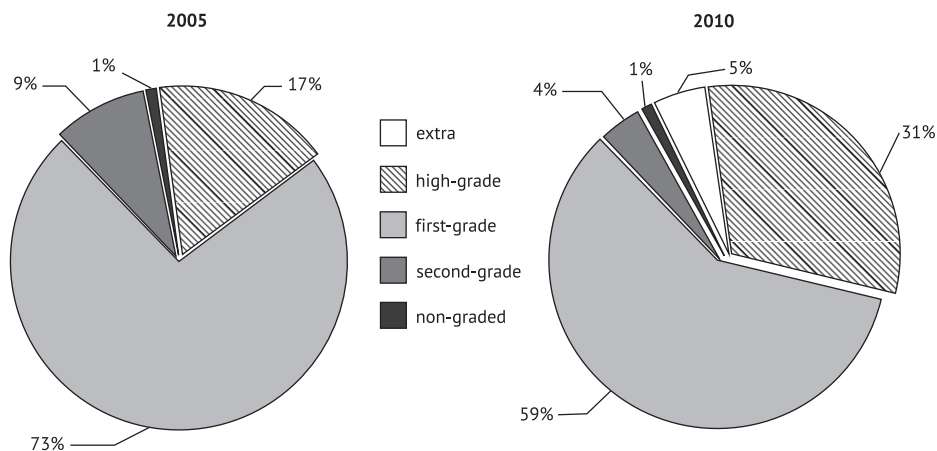


Fig. 1. Quality structure of milk received for processing in Ukraine in 2005 and 2010

Practice proves that agricultural enterprises have the potential for rearing high-yielding livestock, investing in industry development, and providing high-quality products.

Based on the data from agricultural enterprises located in the Khmelnytsky Region of Ukraine, we attempted to determine the relationship between the level of milk production profitability and the volume of milk sold as first- and second-grade, the expenses for forage per 100 kg of milk, and the average milk yield per cow. We made a correlation and regression analysis using the standard DSTU 3662-97 as a baseline, i.e. without taking the requirements for milk of “extra” grade into account.

As a result of the calculations we obtained the following equation of linear multiple regression:

$$y_{x_i} = 5.353 + 0.0036 x_1 - 0.0154 x_2 - 0.1117 x_3 - 11.2939 x_4 + 0.6477 x_5$$

where:

- y_{x_i} – profitability of milk production,
- x_1 – volume of milk sold as first-grade,
- x_2 – volume of milk sold as second-grade,
- x_3 – volume of milk sold as non-graded,
- x_4 – expenses for forage per 100 kg of milk,
- x_5 – average milk yield per cow.

The equation shows that the 100 kg increase in the volume of milk sold as first-grade will cause the 0.0036% profitability increase, while the rise in the sales of second-grade and non-graded milk will reduce the profitability by 0.0154% and 0.1117%, respectively. Increasing the cost of 100 kg of milk per kg of feed lowers the profitability by 11.2939%, whereas raising the average milk yield per cow by 100 kg increases the profitability by 0.6477%. An analysis of paired correlation coefficients indicated that the profitability rate is closely related to the average milk yield per cow ($r_{yx_5} = 0.643$), and to a considerable extent depends on the volume of first-grade milk ($r_{yx_1} = 0.49$).

The model developed in the study has a reliability of 0.95 and fits the investigational data well. The estimated Fisher F-test value is 17.144, which exceeds the tabular value of 2.37. The computed coefficient of determination (0.6) shows that there is a close relationship between profitability and output parameters. The model may be useful in making management decisions regarding the development of effective measures to improve the quality of raw milk production and optimise feed costs. Processing enterprises with government support should both establish close mutual cooperation with agricultural enterprises and promote the development of household farms with adequate conditions for the production of high-quality raw material.

Taking the experience of developed countries all over the world into account, we can claim that the quality issue should become an immediate national priority to both producers and consumers, especially at the stage when Ukraine intends to join the EU and focuses on markets abroad. We consider that Poland's experience is one of the best and most instructive examples to follow.

In the process of Poland's adaptation to join the European community, the country's dairy sector took extensive actions aimed to prepare the national legislative and regulatory guidelines for the implementation of European standards. Harmonisation of the laws of production, processing and sale of milk and milk products was mainly carried out in compliance with Council Directive 92/46/EEC of 16 June 1992 defining the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products; Council Directive 93/43/EEC of 14 June 1993 on the hygiene of foodstuffs; Council Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption; Council Directive 89/397/EEC of 14 June 1989 on the official control of foodstuffs; and Council Directive 93/99/EEC of 29 October 1993 on the subject of additional measures concerning the official control of foodstuffs.

The directions of the legislative harmonisation and the restructuring of the dairy sector in Poland were defined by the Ministry of Agriculture and Rural Development in the "Strategy of the development of the Polish dairy sector" of 1999, and presented during the negotiations with the EU. The strategic target of adapting the sanitary and veterinary standards for dairy products to EU requirements was to be achieved by taking the following measures: improving sanitary and veterinary conditions on farms that produce milk; adjusting sanitary standards in milk processing enterprises; developing and implementing quality systems (GMP, GHP, TQM¹) as well as systems

¹ GMP – Good Manufacturing Practice, GHP – Good Hygiene Practice, TQM – Total Quality Management.

for analysis and control (HACCP²); organising cattle and households identification and registration; appointing public laboratories that will perform assessment; and accrediting laboratories that will conduct the quality analysis of milk and dairy products.

The process of country's integration into the EU structures involves the incorporation of a number of European regulations into its legally set standards. The adjustment requires an appropriate system of correspondence as a prerequisite for the free flow of goods. It is also necessary to include the country in the unified system of conformity assessment for agriculture and foodstuffs through gradual harmonisation with EU requirements. One of the primary purposes of having the same conformity assessment system is to protect the domestic market from the influx of products which may pose a threat to the life and health of the population. The incorporation of EU laws into national directives and the transposition of European legal rules into domestic rules will serve this target well.

Ukraine has already made a number of positive steps towards integration into the European community. As shown by the experience of foreign countries, it can be expected that such integration and the implementation of EU practices in the country will allow domestic producers and processors to reach a higher level of development and improve the quality of domestic products, which will give them access to the world markets and consolidate the status of Ukraine as a reliable partner.

Conclusions

Ensuring a high quality of agricultural products, among them milk, belongs to the most important and challenging tasks for all entities involved in milk production and distribution (i.e. agricultural enterprises, processing and marketing companies), on the one hand, and for state authorities, on the other. The quality of milk and dairy products, however, cannot be guaranteed only through implementing control functions since there are numerous factors, such as animal breed, cow health, or the conditions of storage and sales, responsible for shaping the product quality parameters. Therefore, Ukrainian farmers and industrialists should focus on product quality and enhance control over all stages of the production and sale of milk and dairy products, while government agencies should contribute actively to the harmonisation of national standards with international ones. This shall improve the competitiveness of domestic products on the world market.

References

- Adler Yu.P. (1969), Introduction to experimental design. Moscow, Metallurgy Press.
Bychkivskyy R.V., Hunkalo A.V. (2005), QMS: Evaluation of the efficiency of. Standardization, certification and quality (Kharkiv), no. 4, pp. 42–46.

² HACCP – Hazard Analysis and Critical Control Points.

- Corrigendum to Regulation (EC) No 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for food of animal origin. Official Journal of the European Union L 226, 25 June 2004, pp. 22–82.
- Council Directive 92/46/EEC of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products. Official Journal of the European Communities L 268, 14 September 1992, pp. 1–32 (as amended by Directives 92/118, 94/71 and 96/23 and Commission Decision 94/330).
- Crosby Ph.B. (1989), *Let's talk quality: 96 questions you always wanted to ask Phil Crosby*. New York, McGraw-Hill.
- Deming W.E. (1986), *Out of the crisis*. Cambridge, MIT Press.
- Deming W.E. (2012), *The essential Deming: Leadership principles from the father of quality*. Edited by D. Orsini and D. Deming. New York, McGraw-Hill.
- DSTU 3662-97 Moloko koroviache nezbirane. Vimogi pri zakupivli [Whole cow milk. Requirements for purchasing]
- Feigenbaum A.V. (1991), *Total quality control*. New York, McGraw-Hill.
- GOST 13264-70 Moloko korov'e. Trebovaniia pri zagotovkakh [Cow Milk. Purchase requirements]
- GOST 13264-88 Moloko korov'e. Trebovaniia pri zakupkakh [Cow Milk. Purchase requirements]
- Hoychuk O.I. (2003), *Prodoval'cha bezpeka v Ukraini i sviti. Monografiya*. Kiev, Naukmetodtcentr agrarnoi osvity.
- Hunkalo A.V. (2007), *Development of regulatory and methodological framework assessment of quality management systems*. Dissertation. Lviv, Lviv Polytechnic National University.
- Ishikawa K. (1985), *What is total quality control? The Japanese way*. Englewood Cliffs, Prentice-Hall.
- Ivanov V.A., Shilov V.M., Oborin A.V. (2004), *Continuous improvement and its place in the QMS. Methods of Quality Management (Moscow)*, no. 4, pp. 41–44.
- Juran J.M. (1989), *Juran on leadership for quality: An executive handbook*. New York, Free Press.
- Kolesnikov L.A. (1988), *Fundamentals of the theory of system approach*. Kiev, Naukova Dumka.
- Novikov V.M. (2011), *Diagnostic self-assessment as an integral part of modern management. Standardization, certification and quality (Kharkiv)*, no. 2(69), pp. 38–40.
- Shichkov N.A. (2005), *Selection of methods for measuring quality management system processes. Methods of Quality Management (Moscow)*, no. 2, pp. 14–17.

Accepted for print – Zaakceptowano do druku: 10.06.2014