

Economic losses related to raw milk quality on commercial dairy farms in Kosovo

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1. Introduction

Milk somatic cell counts (SCC) increases when cows have mastitis. Almost all of the major and minor components in milk are affected by mastitis (Munro *et al.*, 1984). Mastitis may be clinical or sub-clinical, with sub-clinical infection preceding clinical manifestations. Yet, the relationship between the two within a herd is not predictable (Rolands and Booth, 1988).

Mastitis reduces the milk yield, changes milk composition, shortens the productive life of affected cows, and it is very costly to the dairy farmer. Most estimates show that on the average an affected quarter suffers from a 30% reduction in productivity and an affected cow is estimated to lose 15% of its production (Morris, 1973). The fat and lactose percentage significantly increases with decreasing bulk milk SCC. The control of this costly disease must be based on a continuing program of prevention and elimination of infection.

Setting up and maintaining such a program can reduce losses from mastitis by 50% or more (Janzen, 1970).

Abstract

The main goal of this research is to study the impact of somatic cell counts (SCC) on the profitability of commercial dairy farms in Kosovo based on the existing raw milk quality standards in order to determine the economic losses caused by high somatic cell counts in the raw milk produced by Kosovo dairy farms.

The research results come from individual raw milk samples that were taken from June to September 2007 on 50 farms in the Dukagjini region and in the Kosovo plain. These samples were collected from 656 lactating cows out of a total of 816 cows under investigation. The strategy of the study is based in the collection and analysis of data concerning the following parameters: SCC, herd size, raw milk yield, raw milk protein and application of proper milking procedures. Based on the existing administrative instruction for raw milk quality standards for the year 2007, research found that the overall annual financial losses calculated on the 50 dairy farms under investigation reached an amount of €42,263 per year, whilst the average annual financial loss per farm was €845. Sixty-four percent (64%) of the 50 dairy farms produced milk that fell in Class III of the Administrative Order and received a price being 20% lower than the Class I price, resulting in an average annual loss of 2,772 euros/farm.

Key words: Quality standards, milk industry, farm management, Kosovo.

Résumé

L'objectif de cette recherche est d'étudier l'impact du comptage des cellules somatiques sur la rentabilité des exploitations laitières commerciales du Kosovo sur la base des normes de qualité du lait cru et ce, afin de déterminer de quelle entité sont les pertes économiques provoquées par un comptage élevé. Les résultats de la recherche dérivent de l'analyse d'échantillons individuels de lait cru prélevés dans 50 exploitations de la région de Dukagjini et de la plaine du Kosovo entre Juin et Septembre 2007. Ces échantillons ont été collectés à partir de 656 vaches laitières sur un total de 816 vaches investiguées. La stratégie d'étude se base sur la récolte et analyse de données concernant les paramètres qui suivent : comptage des cellules somatiques, taille du troupeau, rendement du lait cru, teneur en protéines du lait cru, et application de procédures adéquates de traite. Sur la base de l'instruction administrative concernant les normes de qualité du lait cru pour l'an 2007, nous avons mis en évidence qu'en général les 50 exploitations investiguées ont vécu une perte financière annuelle s'élevant autour de €42263 par an, avec une perte moyenne de €845 par an, par exploitation. 64% des 50 exploitations laitières produisaient un lait de Classe III en recevant un prix de l'ordre de 20% inférieur au prix de la Classe I, avec une perte annuelle de 2772 euros/exploitation.

Mots clés: Normes de qualité, industrie laitière, gestion d'exploitation, Kosovo.

The high presence of SCC in raw milk partly depends on the natural resistance or the sensitivity of each individual cow. Additionally, the environment cleanliness, which will determine the concentration of microorganisms to which the udders are exposed, the level of stress which the cow is subject to, the non application of sanitary practices and proper milking procedures and the handling of the milk on the farm and during its delivery to the collection site are all factors contributing to high SCC. Mastitis is a widespread disease in modern dairy herds. The occurrence of mastitis varies according to country, region, production system and mastitis control measures (Yalcin, 2000).

There are many factors that have an impact in the profitability of dairy farms in Kosovo such as: the lack of sufficient knowledge in balancing the feed rations for dairy cows that have high genetic potential to achieve

high yields, the poor reproduction efficiency, the poor barn hygiene, the size of the herd, the poor raw milk quality, etc. Research studies conducted by various local and international institutions in Kosovo have identified the quality of raw milk produced on Kosovo dairy farms as the main factor that affects the financial income and, at the same time,

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hinders the sustainability of dairy farms in Kosovo (Zaug, 2007).

The number of dairy farms in Kosovo has sharply increased over the last few years due to the scarcity of alternative income-generating opportunities.

Table 1 – Structure and Organization of Milk Sector in Kosovo.

	Percentage	Total (tons)	Local Production	Imports	Imports Share
Home consumption	34.4%	110,608.00	110,608.00		
Green (fresh) market	29.5%	94,727.00	94,727.00		
Processed market	36.1%	116,214.00	34,200.00	82,024.00	70.6%
Total	100%	321,559.00	239,555.00	82,024.00	29.4%

Source: MAFRD - Agricultural Rural Development Plan 2007 - 2013

According to the statistics carried out by the Ministry of Agriculture, Forestry and Rural Development (MAFRD), the annual domestic equivalent milk consumption is estimated at 321,559 tons. Based on a resident population of 2 million people, the consumption of milk and dairy produce is estimated at 160 litres per person per year. It is estimated that the Kosovo dairy industry has only 30% of total domestic market share of value-added dairy products, including UHT fluid milk. Many of the highest margin business opportunities (such as fruit yogurt or different cheeses) have been captured by more sophisticated marketers from Western Europe, and are dominated by established regional brands that Kosovars have known and trusted for years.

Concerning on-farm quality standards, the raw milk produced on farm is generally of poor hygiene and without standards, and with a high micro-biological count; as for dairy processors, the quality standards throughout the processing chain are inconsistent. To improve the product quality and, indirectly, the farm productivity, in January 2007, the Kosovo's Ministry of Agriculture adopted the milk quality administrative instruction MA –NR 20/2006, with the aim to establish official and uniform milk quality standards. The administrative instruction sets quality parameters for different classes of raw milk based on definable criteria such as bacteria count, somatic cell count, residue limits, etc. This means that licensed dairy processors will not be legally allowed to purchase raw milk that does not meet these minimum standards. Dairy processors are routinely testing milk samples from their suppliers on a monthly basis; the raw milk samples are taken from every farmer and from the Milk Collection Centre (MCC) twice a month for payment purposes from dairy processors and sent to the raw milk laboratory at the Kosovo Veterinary and Food Agency (KVFA) for chemical and bacteriological analyses. The equipment used for raw milk testing is composed of Bactoscan®, Foss somatic Minor® and Milko scan FT 120® (FOSS – Denmark).

The average test results from the KVFA raw milk lab are indicating that 57.31% of all samples for the year 2007 were below or equal to 400.000 SCC/ml and 29.44% above 600.000 SCC/ml.

The quality of the milk produced on Kosovo dairy farms remains a major challenge for farmers as it is generally well below the standards of raw milk quality that are applicable on developed farms of western countries. In terms of economic losses, mastitis is undoubtedly the most important disease the dairy industry has to cope with (Blood and Radostits, 1989).

The main purpose of this research was to study the impact of several parameters on SCC in raw milk on fifty commercial dairy farms in Kosovo and to determine the economic loss as consequence of high SCC based on existing standards of the administrative order on raw milk quality in Kosovo.

2. Material and method

2.1. Cattle management practices on commercial farms in Kosovo

Most of barns are of inadequate size for the relevant number of cows kept. The average yield per cow is still very low. One of the reasons for this is the bad quality of forage, the untimely harvesting and the failure to feed the animals high protein & energy feed. Usually, animals are kept indoors almost throughout year. During this period, feedstuff is provided by farmers and it is generally composed of hay from various plants, silage and concentrates are used. Because of small plots of land (2.2 hectares per farm), which in most cases is fragmented in many parcels, livestock grazing is practiced on relatively few farms in Kosovo (Kosovo Agriculture Statistics, 2005). The barns are mainly new buildings constructed without proper building plans, which in most cases result in poor ventilation and hygiene. Both open and closed types of milking systems are present. Almost all commercial farms have installed water systems which enable *ad libitum* drinking.

2.2. Data collection, sample handling and analysis

This research was conducted on 50 commercial farms with different numbers of dairy cattle representing all regions of Kosovo that are delivering raw milk to two milk processors. One of them is the largest milk processor in Kosovo, “Devolli”, and the other one is a smaller dairy processor, “Rona”. The purpose of research was to confirm the hypothesis that selected parameters are in direct correlation with SCC. The higher the value of these parameters, the higher the SCC and vice versa. Milk recorders were responsible for taking raw milk samples and delivering them to the KVFA raw milk laboratory as well as for the collection of other data included in the study. Milk analyses were done from samples of raw milk taken from respective farms using the standard method – A4 according to the International Committee for Animal Registration ICAR (2007). Samples were taken in the evening and in the morning with sterile bottles that contained AZIDIOL to preserve 40 ml of milk samples for 24 hours. Then they were put in a mobile

refrigerator at a temperature of 4°C and transported to the laboratory for analysis. Each test-tube was identified through specific labelling for each farm.

Milk samples were initially analyzed on farm by using mobile digital equipment called "Porta SCC" which shows the number of SCC in 1 ml of milk. Then, samples were sent to the raw milk laboratory of the Ministry of Agriculture, Forestry and Rural Development where milk samples were analyzed for additional parameters with the modern FOSS equipment. The MAFRD Administrative Instruction describing the standards for raw milk quality was used to calculate the economic losses.

This Administrative Instruction determines the parameters for the raw milk quality, the methods to verify the quality, classify the raw milk according to its quality and to take samples for the analysis. The fresh milk is classified in four classes according to its quality: a) class Extra; b) class I; c) class II, and d) class III.

This instruction defines the correction factors to use on the basis of CFU (colony forming units) of bacteria and of the SCC, in order to determine into which category the raw milk falls after the analyses and understand if the raw milk will receive a price incentive or disincentive relative to the base price.

2.3. Statistical analyses

In order to determine the role of parameters that have an impact on the profitability and the sustainability of dairy farms in Kosovo, a Regression Analysis statistical package has been used (Ragsdale, 2001). The regression analyses have shown good results in identifying the factors that hinder the sustainability of dairy farms in Kosovo. This statistical program is used as a tool to statistically confirm the correlation between milk quality and the above-mentioned parameters that are the main factors having an impact on the profitability and sustainability of Kosovo dairy farms. The linear regression model was used to evaluate the impact of independent variables as to possible effects on the SCC in the raw milk, which in the linear regression model is presented as a dependent variable, whilst all other parameters are considered as fixed variables.

3. Results

The statistics of the regression model, i.e. the root mean square error (RMSE), the coefficient variation (CV), the average of the dependent variable (SCC), the standard deviation (Std DEV) R square, the adjusted R square, the intercept and other coefficients are presented in Table 2 and Table 3.

According to the results of the regression analyses, there is an indirect correlation between the dependent variable intercept SCC and the coefficient of the yield which means that when SCC increases the yield decreases. In this study, the increase of 1,511 SCC/ml in the raw milk will result in a yield decrease of one litre. The P value shows that we are

60% confident of these results. Good milking practices are definitely a factor having an impact on the increase of SCC. This is explained by the fact that the P value is below 0.05. This means that we are between 95% and 99% confident that good milking practices have an impact on the SCC. By contrast, the correlation between the number of milking cows in the herd and the SCC is direct, which means that for one dairy-cow increase in the herd, the SCC will increase by 23,696, but this is not a significant factor. The standard error (RMSE) in the regression model shows the unexplained variability around the regression line, which is the true random variability after the effect of independent variables has been removed. The R square shows the proportion of total variability in SCC explained by the regression model, which means that 25% of the changes in SCC are caused by the analyzed parameters.

Table 2 – Multiple regression statistics for SCC as function of four variables using linear functional form on 50 dairy farms in Kosovo.

Variable or Statistics	Linear Functional form	
	Estimated Coefficient	P - value
Intercept (SCC)	2,465,067	0,390
Milk Yield	- 1,511	0,386
Milk Protein	- 386,854	0,655
Proper milking procedures	-946,747	0,001
Number of lactating cows	23,696	0,389

Note: Dependent variable = SCC.

Table 3 – Regression model statistics.

Dependent variable mean	1050172
Standard Error of the Estimate (RMSE)	738209
Coefficient of Variation (CV)	0,703
R-Squared	0,250
Adjusted R-Squared	0,183
No. of Observations	50

Note: Dependent variable = SCC.

3.1. Results of financial effects before the treatment

Based on the results of conducted laboratory analysis, there are significant differences between the farms included in the study for the respective period regarding the SCC in the raw milk. In order to calculate the financial loss, a correction factor for milk quality was used based on MAFRD Administrative Instruction MA 20/2006 (Table 4).

The financial effects are calculated for every individual dairy farm for one-year period according to the following rule:

Initially, the base price of raw milk was calculated on the basis of the fat composition of the milk:

- For each 1% fat, the raw milk price was €0.07
- Base price per litre = % fat in milk X €0.07

Table 4 – MAFRD Administrative Instruction MA 20/2006.

Correction factor	Classification		SCC/ml
	Class	CFU koloni/ml	
1,15	E	≤ 100,000	≤ 400,000
1,00	I	≤ 200,000	≤ 500,000
0,95	II	≤ 500,000	≤ 600,000
0,80	III	> 500,000	> 600,000

To calculate financial gains or losses, after determining the base price of raw milk, a correction factor from MAFRD Administrative Instruction was applied; then, on the basis of the average of the two official SCC test results obtained during the month, it was determined in which class the raw milk sample falls:

- If the average SCC per farm is lower or equal to 400.000, the farm belongs to the group EXTRA and the raw milk price is increased by 15% with respect to the base price (115% of the base price);

- if the average SCC for farm is between 400.000 and 500.000 somatic cells, the farm belongs to the group I, and the raw milk price is kept equal to the base price (100%);

- If the average SCC for farm is between 500.000 and 600.000 somatic cells, the farm belongs to the group II and the raw milk price is reduced by 5% with respect to the base price (95% of the base price);

- If the average SCC for farm is greater or equal to 600.000 somatic cells, the farm belongs to the group III and the raw milk price is reduced by 20% with respect to the base price (80% of the base price).

Financial effects are separately calculated for each single farm for a one-year period (365 days respectively). The farm loss was calculated as follows:

- Effect 1 = Yield * Class Extra Price * 365 days

- Effect 2 = Yield * real price (correction factor) * 365 days

- Loss (Euro) = Effect 1 – Effect 2

From this formula, the loss percentage of each farm is separately calculated. By assuming that all milk produced had received the Extra class price, the overall financial loss calculated for the 38 dairy farms that did not receive the price for Extra Class milk was equal to €166,233 annually, whereas the average annual financial loss per farm was €3,325.

Table 5 – Financial effects according to the group of milk quality using Class I as basis.

Grouping	Samples	No. of cows / farms	Average of cows / farms	No. of milking cows	Average of milking cows	Average SCC/farm	Average yield	Average Annual Loss/Profit	% of Annual Loss/Profit
EXTRA	12	256	21	213	18	277,292	239	3,917	11%
I	3	33	11	42	8	401,788	123	0	0%
II	1	11	11	8	8	581,250	123	-334	-1%
III	32	496	16	384	12	1,448,308	143	-2,372	-7%
Total	50	816	16	634	12	1,090,172	188	1040	(1)

Table 5 shows the actual revenue generated for the year by milk class and the average annual financial losses per farm. Initially, financial effects were analysed for each individual farm and then by group analysis as well. The average annual financial loss per farm is €845.

Table 5 shows that the poorest quality of milk is produced by farms that belong to the third group where the average annual loss per farm is €2772, as result of the high SCC, whilst group II presents an average annual loss per farm equal to €559.

There are significant differences in those farms that produced EXTRA raw milk quality during the whole research period and those farms that produce poor milk quality

Around 66% of all commercial dairy farms that were studied are producing poor raw milk quality, while the remaining 34% of them produce raw milk with acceptable standards.

4. Discussion

The dairy sector in Kosovo is believed to be a very important contributor to the local population's diet and to Kosovo's future economic development. Although the country has favorable natural conditions for milk production, the local industry needs to consolidate farms for greater efficiency and to further increase the processing quality and consistency in order to effectively compete with imported products. One of the current challenges for commercial dairy farmers in Kosovo is how to reduce the costs associated with the presence of the high Somatic Cell Counts in raw milk. Dairy products are homogenous; consumers are more willing to switch from one brand to another when products are homogeneous. With the products homogeneity, consumers tend to be less loyal because any brand of dairy products is able to meet their needs (Besanko *et al.*, 2003). The sale of milk products coming from Kosovo dairy farms depends on the quality of the fresh milk produced on those farms. Supplying milk processors with quality milk is essential for the production of high quality final milk products that consumers will buy. To ameliorate the quality of dairy products, it is fundamental to improve the relationship between dairy farmers, dairy processors, and retailers in order to avoid possible problems; communication links must be established and utilized on a regular basis, since current problems with the quality of dairy products are mainly due to the scarce communication among the stakeholders of the dairy industry supply chain. Furthermore, to improve the competitiveness, trust must be established with partners in the dairy supply chain (Handfield and Nichols, 1999).

The high SCC number indicates the occurrence of mastitis among dairy cows, which is one of the main factors affecting the quality of milk produced on Kosovo farms. Mastitis also causes great economic losses on US dairy farms (Campbell and Marshall, 1975).

The presented results lead us to conclude that the SCC in the fresh milk produced on Kosovo dairy farms is very high

if compared to the existing standards approved by MAFRD. This is a worrying issue for all stakeholders in the milk industry. The significant differences between various farms included in our research emphasize managerial divergences in many ways which are directly linked to the inexistent knowledge of proper farm management practices.

The imported dairy products are dominating the market. The improvement of the fresh milk quality (reduction of SCC) is a relevant factor for the increase in the demand for domestic milk by Kosovar consumers, resulting in a positive effect on the sustainability of cattle-rearing farms in Kosovo.

The improvement of the quality of milk by moving from Class III to Class Extra may be achieved through the application of good managerial practices and a realistic intervention in the dairy cattle farming infrastructure in Kosovo. This would help avoid great economic losses which are now affecting the sustainability of dairy farms in Kosovo.

There is serious concern that if commercially-oriented dairy farms with continue to produce low quality milk, some of them will not have any chance to sell milk legally in and will lose investments.

5. Conclusions

The milk sector is important because it can supply Kosovars with quality livestock products at reasonable prices. It can create better living standards for all citizens and farmers while protecting the environment in villages and rural areas. It can also increase the competitiveness of livestock products. The competitive economic pressure on milk production in Kosovo derives at least in part from unfair competition of imported products creating difficulties for domestic producers to survive. Dairy producers will improve their profits by making sure to produce dairy products of higher quality while keeping costs as low as possible; consumers are assumed to buy a product as long as the perceived value of the product equals the price of the product (Schrimper, 2001). In order to be competitive on the market, it is necessary that Kosovo farmers increase their work efficiency and produce milk products being acceptable for Kosovo consumers. Much research conducted with Kosovo farmers shows that the quality of domestic milk, i.e. the production of safe food, is a determinant factor for the survival of Kosovo farmers.

The results of this study have confirmed that the quality of fresh milk produced in Kosovo, based on existing standards, is still low and requires immediate improvement. Only the milk which is of acceptable quality will enable processors to make milk and milk products packaged for consumers demanding high quality, and by doing this they will be able to compete with the imported products.

Many deficiencies observed, especially those dealing with farm management, may be ameliorated by applying

more advanced hygiene practices and improving infrastructures such as milking equipment, adequate milk storage, overall farm hygiene, etc.

This study points out opportunities for a proper approach in the future for avoiding factors that contribute to the decrease of the quality of milk produced on Kosovo farms thereby gaining the trust of consumers for domestic milk and milk products.

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References

- Besanko D., Dranove D., Shanley M., Schaffer S., 2003. *Economics of Strategy*, Hoboken, New Jersey, p 209-210.
- Blood D.C. and Rodostits O.M., 1989. *Veterinary Medicine*. 7th Edition, London, Bailliere Tindall.
- Campbell J.R. and Marshall R.T., 1975. *The Science of Providing Milk for Man*, Mc Grow - Hill USA, p 1-22 and 329-348.
- Handfield R.B. and Nichols E., 1999. *Supply Chain Management*, New Jersey, p 9-83.
- International Committee for Animal Recoding-ICAR 2007: www.icar.org/Documents/Rules%20and%20regulations/Guidelines/Guidelines_2007.pdf*
- Janzen J.J., 1970. Economic Losses Resulting from Mastitis, *Journal of Dairy Science* Vol. 53 No. 9, p 1151-1160.
- Morris R.S., 1973. *Aust.vet. J.*, 49,p 153-160.
- Munro G.L., Grieve P.A. and Kitchen B.J., 1984. Effects of mastitis on milk yield, milk composition, processing properties and yield and quality of milk products. *Aust. J. Dairy Technol.* 39, p 7-16.
- Ragsdale C.T., 2001: *Spreadsheet Modelling and Decision Analysis, Regression analyses*, Cincinnati Ohio, p 407-457.
- Rolands G.J. and Booth J.M., 1988. Methods of data collection and analysis for cases of clinical bovine mastitis. In 'Proceedings of the Society for Veterinary Epidemiology and Preventive Medicine', p 116-125.
- Schrimper R.A., 2001. *Economics of Agricultural markets*, New Jersey, p 131- 145.
- Yalcin C., 2000. Cost of Mastitis in Scottish Dairy Herds with Low and High subclinical Mastitis Problems. *Turkish Journal of Veterinary and Animal Science*, 24:465-472.
- Zaug U., 2007. Raw milk quality standards - Swiss Kosovo Dairy Consolidation Project KDCP – June 2007.