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DISCUSSION PAPER

Institute of Agricultural Development in Central and Eastern Europe

DEVELOPMENT AND FUTURE PERSPECTIVES FOR BULGARIAN RAW MILK PRODUCTION TOWARDS EU QUALITY STANDARDS

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DISCUSSION PAPER No. 19
1999



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SUMMARY

Over the last 8 years, the transformation process with structural changes and the worsening of production technology in the Bulgarian dairy sector has led to a dramatic reduction of milk quality in Bulgaria. The improvement of the raw milk quality and the harmonisation of Bulgarian standards with EU milk quality standards is therefore one of the major conditions for the prospective integration of Bulgaria into the EU as well as for increasing the competitiveness of the Bulgarian dairy sector.

This discussion paper presents the results of an in-depth analysis of the Bulgarian agriculture with special emphasis on milk production. The investigation aims to identify the basic problems of Bulgarian milk production, the main differences between the Bulgarian and the EU quality regulations for raw milk, and future necessary alterations in Bulgarian milk production farms with regard to the quality requirements of the European Union.

The analysis' results show the causes for the development of the Bulgarian dairy sector in the transitional period. The comparison of the quality standards for raw milk emphasises the urgent need to adjust the Bulgarian system, especially regarding the number of control parameters and quality grades, the level of requirements for the hygienic quality of raw milk and the lack of a functioning pricing system based on the classification of raw milk. With respect to the improvement of raw milk quality and thus of economic results of Bulgarian dairy farms, the most urgent improvements are needed in the area of forage production, hygienic and housing conditions of animals as well as milking and feeding technology.

ZUSAMMENFASSUNG

Bedingt durch strukturelle Veränderungen sowie durch eine Verschlechterung der eingesetzten Produktionstechnologie in der bulgarischen Milchproduktion kam es in den vergangenen Jahren zu einer drastischen Verschlechterung der Rohmilchqualität in Bulgarien. Die Verbesserung der Rohmilchqualität als auch die Harmonisierung der Qualitätsanforderungen an Milch und Milchprodukte in Bulgarien mit denen der EU sind somit wichtige Voraussetzungen für eine zukünftige EU-Mitgliedschaft sowie für die Verbesserung der Wettbewerbsfähigkeit der bulgarischen Milchwirtschaft.

Im Rahmen dieses Diskussionspapier werden die Ergebnisse einer Studie zur Entwicklung und Situation des bulgarischen Milchsektors vorgestellt. Ziel der Untersuchungen war es, die Hauptprobleme der bulgarischen Rohmilchproduktion zu identifizieren sowie die Unterschiede zwischen den Qualitätsanforderungen für die Rohmilchgewinnung, -verarbeitung und -vermarktung in Bulgarien und der EU herauszuarbeiten. Des Weiteren sollten die ökonomischen Auswirkungen einer verminderten Milchqualität auf das Unternehmensergebnis beispielhaft dargestellt und notwendige Veränderungen in den Unternehmen zur Verbesserung der Milchqualität aufgezeigt werden.

Die Ergebnisse der Analysen verdeutlichen die Ursachen der Entwicklung des bulgarischen Milchsektors in den vergangenen Jahren des Transformationsprozesses. Der Vergleich der Qualitätsstandards für Rohmilch zeigt den großen Anpassungsbedarf des bulgarischen Systems hinsichtlich der Anzahl von Kontrollparametern und Qualitätsklassen, des Niveaus der hygienischen Grenzwerte sowie der Preisbestimmungskriterien. Als Möglichkeiten der Unternehmen zur Verbesserung der Milchqualität und somit des Unternehmensergebnisses werden vor allem die Bereiche Futterproduktion, Haltungsbedingungen und Melktechnik ermittelt.

ԾԱՇՐԻՆ

Աւեաիւեծա ըծծեծծիւ իծիւիւ ա ըաեիւծի ըծիւիւնծիւ իծաչ իծաճիւիւ իծեիւ է աեիւաաիւծի իա ըծիւիւիւեծա իա իծիւեչիւիւնծիւ ա իւա+իւ ըաեծիւ ա Աւեաածե իծաչ իիւեաիւեծա 8 աիւեիւ աիւաիւծա ա իւ ածիւաե+իւ իաիւեչաիւ ա եա+աիւծիւ իա իւեիւծիւ. Շաճիւա իիւեաաաիւծիւ իա եա+աիւծիւ իա ըծիւիւծիւ իւեիւ է ըծիւիւեչեծաիւծիւ իա Աւեաածե ըծիւաած շա եա+աիւծիւ ը ըիւ իա Աաճիւաեիւ ըիւ շա աաիւ իծ աեաիւեծա ըեիւիւ շա աւաիւծիւ եւծաաեծաիւ իա Աւեաածե ա ԱՆ, ըաեա է շա իիւեաաաիւ իա եիւեծաիւծիւ-նիւիւիւիւնծա իա աւեաածե իւա+աիւ ըաեծիւ.

Օիւ շա աիւեաա իծաաիւծա ծաճեծաեծա իծ աեիւ շաաւեաիւ+աիւ աիւեեչ իա աւեաածեիւ ըաեիւ ըծիւիւնծիւ ը իւա+ածաիւ աիւեիւ իա իւա+իւ ըաեծիւ է իիւաիւ իա իւաեիւծիւեչիւիւնծիւ. Օաեծա իա եչեաաաիւծիւ ա աա ըա իաաաեաա իիւիւիւծա իծիւեաիւ իա իծիւեչիւիւնծիւ իա իւեիւ ա Աւեաածե, իիւիւիւծա ծաճեե իաա իաճաաեծա շա եա+աիւծիւ ի ըծիւիւծիւ իւեիւ ա Աւեաածե է ա ԱՆ է իաիւծիւեիւծա աւաիւ եչիւիւիւ իա իւաեիւծիւեչիւիւնծաեիւծա ըաճիւ ա ըիւծաաեծա ը եչեիւաիւեծա շա եա+աիւծիւ իա Աաճիւաեիւ ըիւ.

Ծաճեծաեծա իծ աիւեեչեծա իիւեաա իծե+եիւծա շա ծաճեծաեծիւ իա իւա+իւ ըաեծիւ ա Աւեաածե ա իծաճիւիւ իաճեիւ. ըաաիւաաիւծիւ իա ըծիւաաեծա շա եա+աիւծիւ ի ըծիւիւծիւ իւեիւ իիւ+ածաաա ըիւաա իաիւծիւեիւնծ իծ եիւաաեծաիւ իա աւեաածեա ըծաիւ շա եա+աիւծիւ իա իւեիւծիւ, իիւաիւ ի իծիւաիւ իա աճիւ իա եիւծիւեիւծա իաճիւաճե է աճիւ իա եա+աիւաիւծա եաճիւծե, իաիւծիւ իա եչեիւաիւեծա շա ըաաաիւծա ըաճեծաճեիւծա շա եա+աիւծիւ իա ըծիւիւծիւ իւեիւ է եեիւա իա աեիւաաա ըեիւա իա շաիւաաիւ իա ըծիւիւծիւ իւեիւ, իիւաաիւ իա իաիւծիւ եա+աիւ. շա աա ըա իիւեա եա+աիւծիւ իա ըծիւիւծիւ իւեիւ է աա ըա իիւաիւծ ըեիւիւե+աիւեծա ծաճեծաե իա իւա+իւծա ըաճիւ ա Աւեաածե ըա իաիւծիւեիւ իաե-նիւաիւ իիւաիւծիւ ի իծիւաիւ իա իծիւեչիւիւնծիւ իա եա+աիւաիւ ըծաա, ըաաաիւծա է ըեիւաիւ իա իծաաաաիւ իա աեիւծիւ, եաեծիւ է ըաճիւիւիւեծա իա աիւա է ըծաիւա.

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LIST OF ABBREVIATIONS

BDS	Balgarski Darzhaven Standart [Bulgarian State Standard]
CEEC	Central and Eastern European Countries
DIN	German Institute for Standardisation
DM	German Mark (currency)
DVSK	Bulgarian State Veterinary Sanitary Control Service
EC	European Community
EEC	European Economic Community
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
ISO	International Standardisation Organisation
M	million
ml	millilitre
MJ NEL	megajoule net energy lactation
mt	metric tons
NSI	National Statistical Institute of the Republic of Bulgaria
PTM	production, treatment and marketing
SAPI OOD	Sistema za Agropazarna Informacija (Agricultural Market Information System)
SCC	somatic cell count
SNF	solids-non-fat
sq. km	square kilometres
TBC	Tuberculosis
TS	total solids

1 INTRODUCTION

Although, with 2.5 million tons of total milk production (1989), Bulgaria has one of the smallest milk production sectors in the Central and Eastern European Countries (CEEC), its agriculture and especially the dairy sector were of major importance until 1990.

Following the political changes in the countries of Central and Eastern Europe in 1989, Bulgaria has experienced a difficult transitional period. Liberalisation has increased competition between different enterprises, but the various economic sectors and industries have not been affected to the same extent by these structural changes. The transition from a centralised planned to a market economy has deeply influenced Bulgarian agriculture as well as the food processing industry, and has led to drastic falls in production, especially in milk production. As a result of the reduction of livestock and the loss of animal productivity, the total raw milk output of the Bulgarian dairy sector was reduced by more than 45 per cent between 1990 and 1996. In addition, a dramatic reduction of milk quality could be observed. This was caused by the small-scale structure of the milk production after privatisation, the lack of investment capital and therefore of production technology, as well as mismanagement in the dairy farms and political mistakes.

Since the production of high-quality dairy products largely depends on the quality of the raw milk produced on the dairy farms, improving production conditions is one of the most important factors for increasing competitiveness, not only on the domestic, but also on the foreign market. The harmonisation of Bulgarian standards with the EU milk quality standards is therefore one of the major conditions for the prospective integration of Bulgaria into the EU.

This study is the result of an in-depth analysis of Bulgarian agriculture, with special emphasis on milk production. The paper aims to identify the basic problems of Bulgarian milk production, the main differences between the Bulgarian and the EU quality regulations for raw milk, and future necessary alterations in Bulgarian milk production farms with regard to the quality requirements of the European Union. This will be the basis for the development of investment strategies for these enterprises. To gain a comprehensive insight, it was necessary:

- to analyse the development of Bulgarian agriculture and especially the dairy sector during the transition period;
- to compare the country-specific standards for milk production, treatment and the marketing of raw milk in Bulgaria with regulations for the EU member countries (e.g. Germany); and
- to establish the economic importance of the raw milk quality for the result of the dairy farms.

After the introduction, chapter 2 mainly focuses on the development of the Bulgarian agricultural and especially the dairy sector, as well as on the macroeconomic influences on milk production and the dairy industry in the transition period.

Based on the literature, the main aspects of quality management for milk and dairy products are analysed in chapter 3. After the description of the milk production process and the definition of different quality aspects of milk, the main factors influencing raw milk quality on dairy farms were determined.

Chapter 4 contains a comparison of the most important norms and standards for raw milk production and delivery in Bulgaria and the EU, using Germany as an example. The similarities and differences are analysed and explained.

Referring to the selected factors influencing raw milk quality determined in chapter 3, the economic effects of reduced raw milk quality on the results of dairy farms are established in chapter 5, using examples from the literature.

In the last chapter conclusions will be drawn; firstly for the further development of the Bulgarian standards for raw milk production and delivery towards a harmonisation with EU standards, and secondly for changes that are required in the dairy farms to increase the milk quality as well as their economic results.

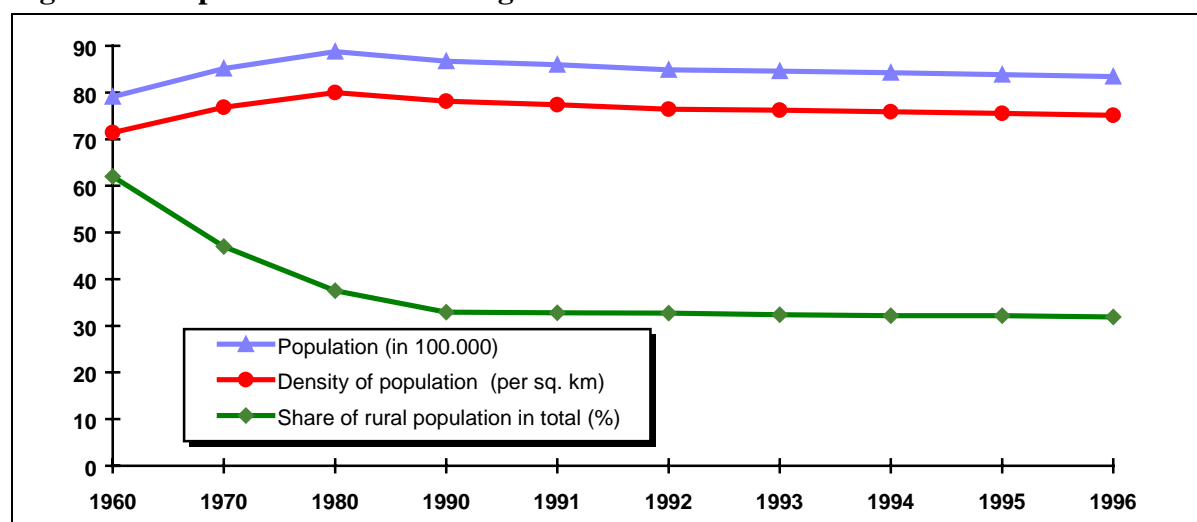
2 DEVELOPMENT OF THE BULGARIAN AGRICULTURAL AND DAIRY SECTOR BEFORE AND IN THE TRANSITION TO A MARKET-ORIENTED ECONOMY

2.1 The Bulgarian agricultural sector

The development of agriculture in general and of milk production in particular has gone through different stages and periods, always reflecting the stages of development of the national economy as a whole.

In the 1960s, Bulgaria was a typical agricultural country - at 62 per cent, the percentage of the rural population was comparatively high; but this percentage was considerably reduced during the following twenty years as can be seen in Figure 1 (cf. Annex - Table A.1). At the same time, the share of the population who started buying farm products increased, thus stimulating the development of agriculture in general. During the transitional period since 1990, general economic stagnation, especially in the industrial sector, has been accompanied by a drop of 3.8 per cent in total population compared to 1990. The drop was 0.8 per cent lower in rural areas.

Figure 1: Population trends in Bulgaria from 1960 to 1996



Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

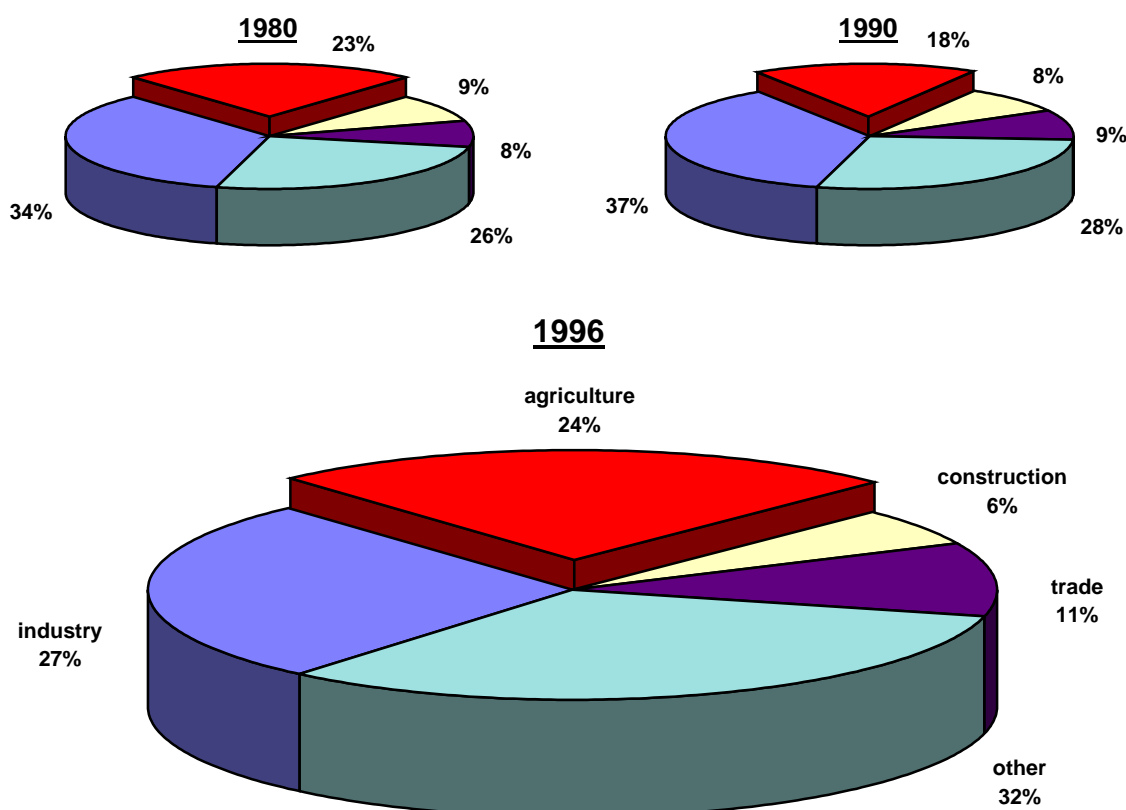
The process of restoring land ownership, together with growing unemployment in the villages are some of the reasons for the rapid structural changes in Bulgaria's agriculture. They also explain the rising percentage of employment in the agricultural sector and in the number of private farmers.

The rate of unemployment in rural areas is considerably higher than in urban areas; e.g., more than 7 per cent higher in 1995 (Table A.2).

Parallel to global trends, the share of agricultural labour in the Bulgarian labour force declined significantly in the period 1975-1990. This was caused by an increase in the size of farms and by the possibilities of mechanisation, which resulted in increased productivity. According to SARTMADZHIEV ET AL. (1997), in 1989/1990 the degree of mechanisation of the different milk production processes in Bulgarian agriculture was as follows: 99 per cent of milking, 64.7 per cent of feeding, 85.8 per cent of manure collection. About 46 per cent of milk production processes were completely mechanised.

The high share of unemployment in the villages during the last 7 years, together with the lack of capital and other problems such as the legal restoration of land ownership, are the main causes for the development of small-scale extensive farms. The share of employment in agriculture grew from 17.9 per cent in 1990 to 24.2 per cent in 1996 (Figure 2 and Table A.3), and this trend is highly indicative of the process taking place in the country. It means that today one in four Bulgarians is engaged in agricultural production; that was true for the Western European countries in the 1950s (NDONGO 1997). We must also bear in mind that the share of small farmers keeping 1-2 animals and producing for subsistence is not considered in this statistic. The actual consumption of marketed agricultural goods has clearly fallen much more than formally recorded.

Figure 2: Employment by employment sector



Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

As a result of privatisation, the share of people working in the private sector of the national economy has increased considerably since 1990 (Table A.4); in 1996 the percentage was almost six times higher than in 1990. This growth can be explained mainly with the large percentage of people employed on private agricultural farms, although their share in total employment in the private sector decreased by about 17 per cent in the same period.

At the beginning of transition, the government started the privatisation process by restoring ownership of the state-owned material assets, animals included, to their former owners. Unlike in the other CEECs, however, this process had a disastrous effect on Bulgarian agriculture. The official public acts and laws of Government not only virtually destroyed the co-operative farms' assets, they also destroyed production capacities. The development of an unfavourable production structure and therefore a loss of productivity, mass slaughtering and uncontrolled export of animals were the result.

The facts mentioned above led to a considerable reduction of the share of agriculture in the country's gross value added (Table A.5); whilst, in 1990, it had reached a share of approx. 18 per cent, in 1996 this figure was only 11.7 per cent. In exports, the statistical data also show a decreasing percentage of agricultural goods, with the exception of livestock exports. This led to a decrease in the trade balance between 1990 and 1996.

2.2 The Bulgarian dairy sector

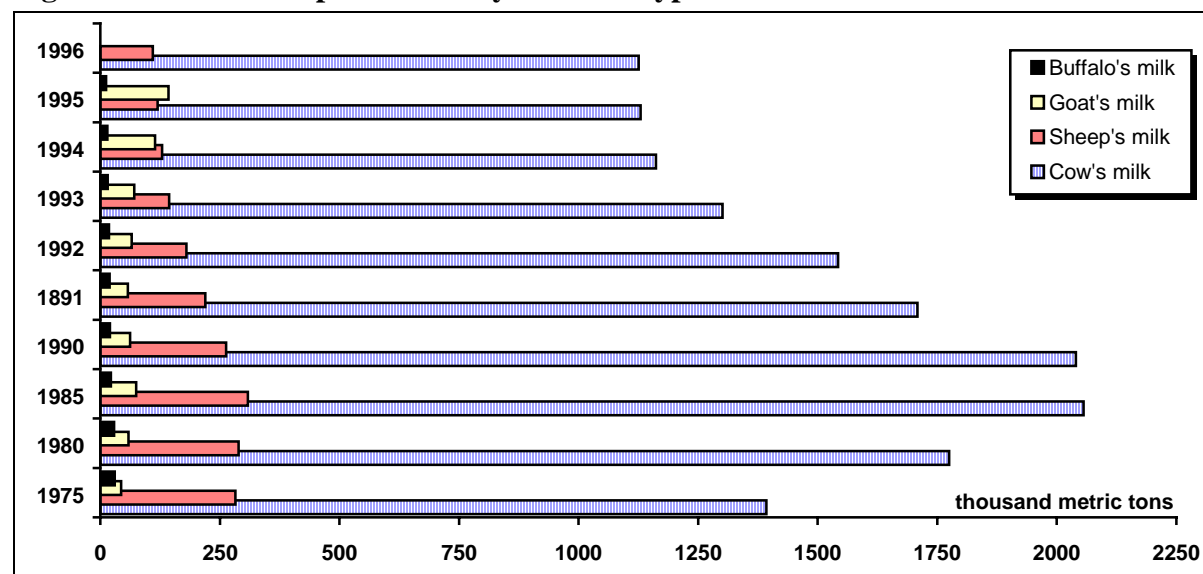
The policy of the Bulgarian government in the 1970s and 1980s was directed towards increasing the number of milk-producing animals, and consequently the output of milk and milk products. This process was accompanied by changes in:

- the structure of plant cultivation, the priority having been given to forage crops;
- the breed reorganisation of animal husbandry, new, highly productive breeds having been introduced. Special dairy breeds of cattle accounted for 85 per cent, while dual-purpose breeds accounted for 14 per cent of the total number of animals in the country;
- the necessary production equipment; the production processes were modernised and highly mechanised. In 1989/90, for instance, the milking of cows - the area with the highest degree of mechanisation - in 52.7 per cent of the co-operative farms was done using milking bucket installations, 45.2 per cent of the farms used central milking installations and 3.1 per cent used milking parlours (SARTMADZHIEV ET AL. 1997);
- agricultural training and studies; many agrarian specialists were trained at that time and took an important part in increasing production.

These facts resulted in the growth of animal numbers and their productivity, the increased production of raw milk, and thus a larger quantity of dairy products in the period up to 1990.

Although the number of animals is not the only factor that is decisive for milk production, it is very important. During the last ten years, most of the developed countries as well as CEECs showed a downward trend in the number of reared animals. This reduction amounted to 5 per cent in the EU member countries, but to about 15-25 per cent in CEECs. In Bulgaria a small reduction in livestock figures can also be observed for the late 1980s. But the dramatic changes in the structure of agriculture after 1990 have had a disastrous effect on the number of milk-producing animals. Cattle and sheep livestock have been affected most, being reduced by approx. 63 per cent between 1990 and 1997, while the number of goats has increased by 96 per cent (Table A.6 and Figure A.1). Especially in 1992, an enormous number of cattle, sheep and buffalo were exported (MIHAJLOV 1995; MAKAVEEV 1997).

This drastic reduction in the number of animals has significantly influenced the total production of milk in the country, as well as the production of the different milk types (Figure 3 and Table A.7).

Figure 3: Total milk production by different type

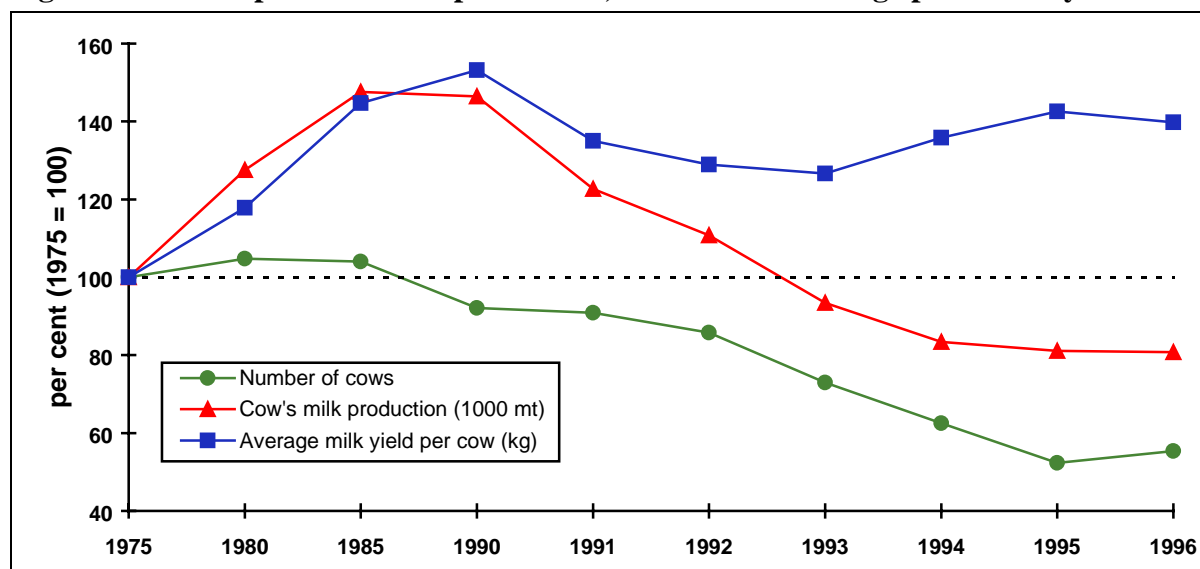
Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1998).

The figure shows the sharp decline in the total amount of milk after the period 1985 to 1990, which was the most successful period for milk production in Bulgaria. In 1996 total milk production was only 58 per cent of the quantity produced in 1990; in other words, production had been cut almost by half. The greatest drop in milk production of about 45 per cent during that time was registered for sheep's and cow's milk, while the quantity of goat's milk increased by approx. 130 per cent from 1990 to 1995.

The share of different milk types also changed significantly (Table A.8). The highest proportion of cow's milk (85.5 per cent) was recorded in 1990. A gradual decrease in the percentages of cow's and sheep's milk, and an increase in goat's milk led to the following proportions in 1995: 80.5 per cent cow's milk; 8.5 per cent sheep's milk; 10.1 per cent goat's milk and 0.9 per cent buffalo's milk. Until 1997 the share of cow's milk slowly increased again, but the share of sheep's milk decreased further. At first glance, this structure of milk production does not appear to be a problem, but in fact the following two main issues need to be considered:

1. dairy products made from sheep's milk have always played a decisive role in Bulgaria's exports. The reduced quantities of sheep's milk have led to a decrease in the output of sheep's milk products;
2. often goat's milk cannot be collected, stored and therefore processed separately from cow's milk, because of the lack of cooling and storing equipment. Since the share of goat's milk has increased strongly in the last 6 years, so has the amount of mixed goat's and cow's milk; but this practice is not in accordance with regulations and standards. Moreover, measuring the quantities of the different milk types, and processing this mixed milk have become more difficult as a result.

Figure 4 (see also Table A.9) shows the changes in the number of cows, in the average milk yield, and in the total amounts of milk being produced over the last 20 years (base year = 1975).

Figure 4: Development of milk production, number and average productivity of cows

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1997c), NSI (1998).

The number of serious mistakes made in agricultural reform, especially on the large-scale state and cooperative farms, have resulted in a reduction in the number of cows, in the milk yield, and also in productivity. A decrease of 36.7 per cent in the number of cows, of 65.6 per cent in cow's milk, and of 13.4 per cent in the productivity of the cows took place from 1990 to 1996 (base year = 1975).

Until 1990, most animals were kept on cooperative and state farms. During the period 1975-1990, a trend developed towards decreasing the share of privately kept animals at the same time as increasing their milk quantities (Table A.10). This does not apply to goats; the share of goats kept on private farms and the share of milk produced by them has been constant at approx. 100 per cent since 1975. Comparing the different types of animals in private enterprises, cattle and cow production is the least popular. In 1975 only 21 per cent of their total number were kept privately, dropping to 17.9 per cent in 1990.

The processes of reorganising agriculture which started in 1990 have been accompanied by changes in ownership. Although animals were restored immediately, arable land was not restored at the same time. As a result, the new private owners of animals were not able to produce fodder for them. This inadequately planned distribution of production factors has caused difficulties everywhere, especially in milk production.

Nevertheless, in the private sector the number of animals increased sharply between 1990 and 1997, as did the quantity of milk produced. The private owners, however, were unprepared and lacked the knowledge to manage well-functioning dairy farms, especially to rear young breeding animals for replacement.

This problem was especially pronounced in cattle breeding. There were many reasons for this, the most important being the lack of adequate knowledge and experience of profitable private farming, for instance of animal housing, milking technologies, balanced feeding and the rearing of replacement animals. Last but not least, farmers lacked knowledge about the planning of private enterprises to improve farm results. This led to low and irregular incomes in these enterprises, especially in the period 1991-1994, when the variable and unusually low purchasing prices for milk forced many cow's milk producers to switch to other areas of

production. At the same time, the government did not support milk producers. Meanwhile, the available cooperative and state farms were producers of replacement animals and the private farms bought breeding livestock from them.

The ratio *total cattle : cows* shows if there is a regular age structure in the herd. Values of 2.5-2.6 are considered normal for guaranteeing the optimal age structure and regularity of replacement herd programmes. In Bulgaria, this ratio was inadequate after 1991, and has even deteriorated in the last years (Table A.11). Its decline to 1.62 in 1997 has caused much concern.

The ratio on private farms is even worse, having declined from 1.95 to 1.53 in 1997. This means that it is impossible for private farms to either maintain the same number of cows or increase it by drawing on their own replacement sources alone. MAKAVEEV (1997) made the prognosis that cow numbers could already reach 1990 values in 2004 by natural reproduction alone, i.e. without the import of cattle. In comparison to the figures and analysis mentioned above, this seems to be a rather optimistic and unrealistic prediction.

Only in 1975 did the average milk yields from goats on private farms fall below the country's average. Since then, steady milk yields steadily increased in the privately run operations until 1990, and still do today (Table A.12).

The highest milk yields from cows in all forms of enterprises were observed in 1990. From 1990 to 1993, milk yields decreased in the country as a whole (-17.4 per cent); after that they increased slowly, except for a sharp peak in 1996 (+10.4 per cent). But on private farms, the average milk yield per cow decreased sharply only between 1990 and 1991 (-8.7 per cent). After that it increased steadily, reaching a higher level in 1996 than in 1990 (+7.5 per cent). This trend was also observed in most other European countries, including CEECs.

Improving milk productivity by intensifying production is clearly one possibility of increasing the profitability of dairy production enterprises. The reduction of milk yields without a reduction of costs (as in Bulgaria) leads to an increase of the average costs per kg of produced raw milk (especially the fixed costs), and thus to a lack of competitiveness of dairy production on both the domestic and international markets.

Since 1990 the share of purchased cow's milk in total production has decreased dramatically (Table A.13). While, in 1989, this share was 86.3 per cent of total production, it fell to 38.4 per cent in 1994. The share of private farms in 1994 was similarly low with 34.0 per cent.

The sharp drop in purchased milk has caused a large number of problems for the dairy industry, for example insufficient quantities of raw milk for processing and the resulting high surplus of processing capacities. Moreover, social and health problems have resulted from the consumption of raw milk and dairy products produced on private plots and sold on private markets without any sanitary control.

2.3 Macroeconomic influences on milk production and the dairy industry in Bulgaria

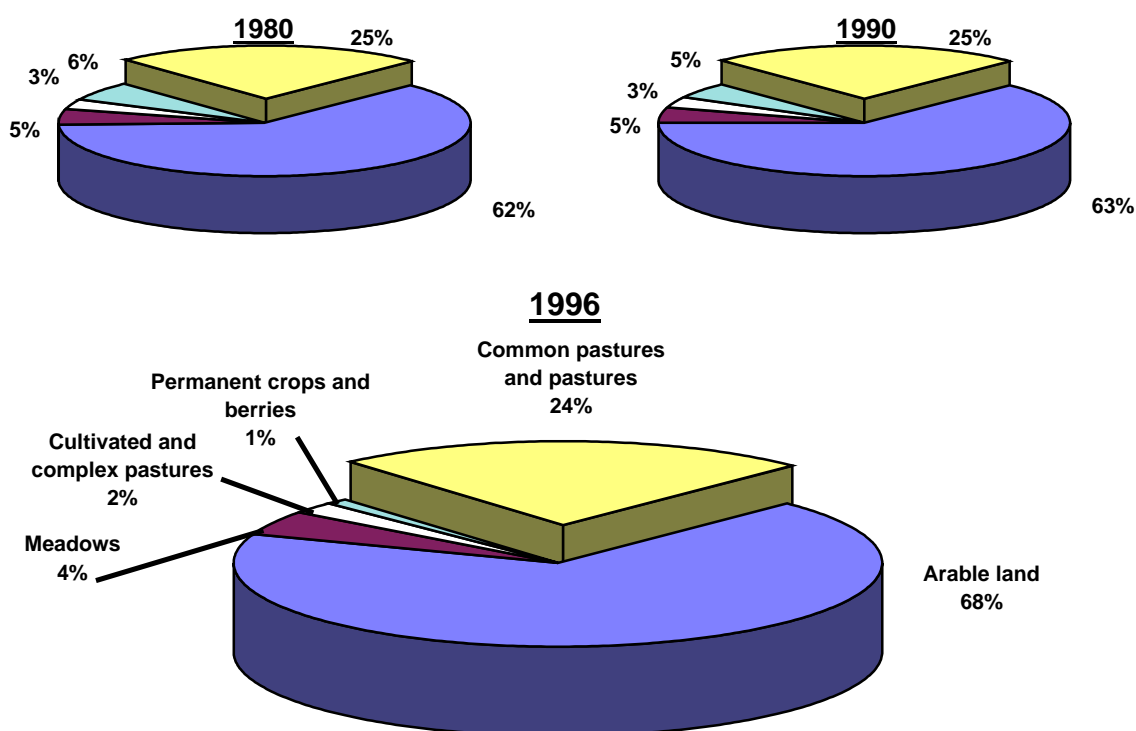
2.3.1 Land restitution and the effects of land use

Progress in the sector of milk production depends to a large extent on the availability of arable land to produce fodder crops. As can be seen in Figure 5, the total area of arable land has been relatively constant since the 1980s; the percentage of common pastures is very high and declined only slightly from 24.6 per cent in 1980 to 23.8 per cent in 1996 (Table A.14).

Since the beginning of the 19th century, western European countries have been aiming at the intensive use of common pastures (DARDZHONOV 1995). But in Bulgaria the very extensive way of using common pastures does not stimulate dairy cow production much, because farmers cannot produce feed intensively. Therefore regulations must be developed and introduced by the Bulgarian government to create the possibilities of renting, buying and selling the pastures, or providing contract work and thus stimulating the implementation of modern technologies for feed production on these pastures.

In 1980, only 9.7 per cent of arable land were used by private farms (Table A.15). Land restitution, which started in 1991, progressed slowly; therefore the share of arable land used for private plots only reached 39.1 per cent in 1995, and 43.4 per cent in 1996. By contrast, 86 per cent of the total number of cows and buffalo, 92 per cent of sheep and 100 per cent of goats were kept privately. This quantitative imbalance of the *land : feed : animal* ratio caused by the different shares of privatised land and livestock is one of the main reason for the difficulties with the agricultural reform in Bulgaria and the recent disastrous effects.

Figure 5: Arable land, permanent crops, common pastures and pastures on 1st July



Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

As a result of the very extensive use of land and the strong reduction in the number of animals for milk production, milk production per ha of arable land and per capita halved between 1990 and 1994 (Table A.16 and A.17). The data for Germany in the same period show a reduction of only 18 per cent in the number of cattle and of 3 per cent in total milk production per ha of arable land. Compared with other European countries, Bulgaria reached the second highest reduction rates and thus the second lowest productivity rates per ha of arable land, after Russia.

2.3.2 Privatisation and its effect on the structural change of milk production

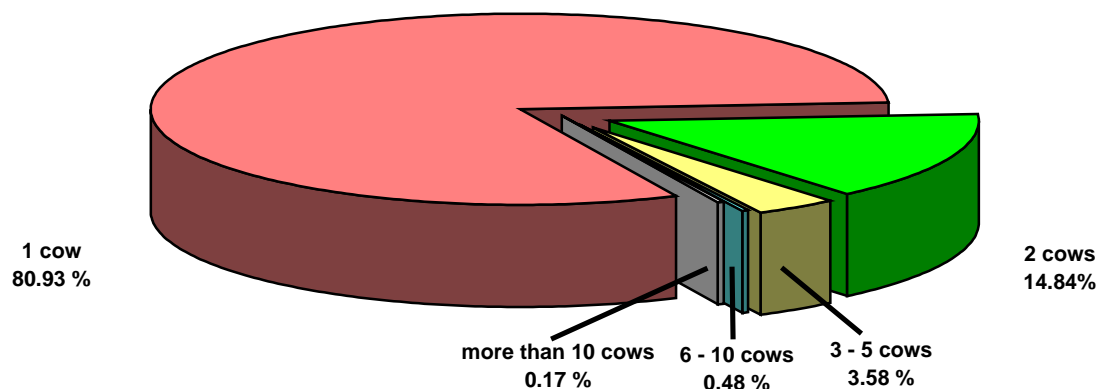
Another peculiarity in the development of Bulgarian agriculture over the last years is the way it has been restructured (number and size of farms). On the one hand, cooperative farms were

split up, and production factors (animals, equipment etc.) strictly restored to their former owners. On the other hand, land was not privatised, and there is no legal framework or financial support for the development of new market-oriented enterprises. As a result, the structure of milk production has changed from large, intensive and highly specialised enterprises to small private farms and subsistence plots with a small number of animals and extensive production methods.

According to SARTMADZHIEV ET AL. (1997) and PANAYOTOVA, M. (1997a), the specialisation activities of the Bulgarian government in the cattle sector in the 1980s resulted in a structure of three different types of complexes: dairy complexes, breeding animal complexes, and cattle fattening complexes. During that time, 1320 cooperative farms and state complexes were producing milk, with an average of 359 cows per farm.

But since restructuring, most of the cows have been kept on small farms of 1-2 cows each, especially on private family farms. Figure 6 shows that, in 1995, 95.8 per cent of the private farms kept only 1 or 2 cows, and only 0.2 per cent kept more than 10 cows (Table A.18). This new structure will also negatively affect the organisation of milk and cattle production, the implementation of new technology, animal breeding and selection, as well as the monitoring and improvement of milk quality in the future.

Figure 6: Classification of private farms according to number of breeding cows on 1st January 1995



Source: Based on NSI (1995a).

2.3.3 Restructuring of agriculture and its effect on the qualification of workers

The current situation in Bulgarian agriculture is also characterised by the low levels of qualification and farming skills among the people who are directly engaged in private farm production. Some of the reasons are listed below.

- Before 1990, agricultural training in Bulgaria was highly specialised, i.e. restricted to training experts to work in specific areas of agricultural enterprises, and not giving them training in other fields of agricultural production. This is currently making the necessary adjustment to new areas difficult for them.
- As a result of the high share of unemployment in the industrial sector and the splitting up of cooperative farms, as well as of the strict restoration of animals to their former owners, people without the necessary agricultural knowledge, e.g. factory workers etc., have set up private agricultural enterprises to earn a living. Consequently, serious mistakes have been made in the management and feeding of livestock, which has led to a reduction in total production levels and thus in profits.

- Before 1990, the Bulgarian centrally planned economy was highly restrictive. Those in charge of enterprises were not able to freely develop future business strategies or make decisions. Following the collapse of the planned economy, they therefore lacked the knowledge needed to independently devise strategies for business development. As a consequence, there have been a number of instances of bad planning and wrong decisions in Bulgaria in recent years, even in larger enterprises, adversely affecting overall company results.
- Due to Bulgaria's poor economic situation, there have been no specific state-funded training programmes in recent years. These would enable the new managers, especially those managing small private farms, but also employees in agricultural cooperatives, to acquire the knowledge needed to understand the workings of a market economy, as well as learning about new production and processing technologies for agriculture.

These facts are also responsible for the low efficiency and quality of production.

2.3.4 Development of prices and effects on the demand and supply of milk products

In a market-oriented economy, prices are determined by demand and supply. Production is regulated mainly by the demand for the products, which directly depends on the income and purchasing power of the households, as well as on the quality of the product and its competitiveness compared with other products.

Until 1990, the dairy industry in Bulgaria progressed successfully and, partly due to governmental support, reached its highest results that year (Table A.19). The following period has been characterised by a continuous and permanent drop in dairy production. Between 1990 and 1996, the production of yellow cheese declined by 77.8 per cent, that of liquid milk by 75.6 per cent, and that of white cheese by 70.3 per cent. The greatest reduction (more than 60 per cent of the total) was observed at the beginning of the period, in particular before 1992-1993. This was clearly caused by the reduced demand for milk products. But a comparison of the statistics for the production and the per capita consumption of milk products reveals that the development of the large number of subsistence economies (whose production is not included in the production statistics) is also responsible for the above average decrease in the demand for milk products, especially in the cases of milk and yoghurt.

Production of butter declined after 1985, falling to 9.3 per cent of the 1985 production level in 1996. The main reasons for this are, firstly, the global reduction in butter consumption, which is due to its effect on consumer health and the resulting substitution with margarine in people's diet; and, secondly, the sharp increase in butter prices caused by a decrease in the quality of raw milk and thus an increase in production costs.

Although the per capita consumption of milk products did not decline as much as their production, because of the increasing self supply by households, it fell by about 50 per cent between 1990 and 1996 (Table A.20). Similar trends were observed in other Central and East European countries (JAMBS 1995). But in the period 1985-1990 when consumption was the highest, the average per capita consumption of milk and milk products in Bulgaria was always lower than the biologically optimal norm of 237 kg, and even below the minimum of 220 kg; both figures for the per capita consumption of milk are FAO recommendations. In 1996 the average value amounted to only 28 per cent of the minimum recommended by the FAO. This shows that the situation in Bulgaria is indeed dramatic.

The main reasons for reduced consumption are the increase in market prices for milk and dairy products and the significant decline in consumers' income. This has led to a dramatic

decrease in the purchasing power of households in the last 7 years (Table A.21), varying from 65 to 80 per cent for the different types of dairy products.

This correlation becomes even clearer when comparing the development of the basic indexes for total household incomes, market prices, and the household consumption of some dairy products for the period January - June 1997 (Table A.22). This critical period was characterised by the highest inflation since 1990. The largest decrease in the household consumption of white cheese (57.1 and 71.4 per cent) was observed in February and March, when the basic market price indexes were 5.4 and 2.8 times higher respectively than the basic indexes for total household income of the population. But later, when market price indexes were lower than household income indexes, the consumption of milk and cheese increased by almost 30 per cent.

The dairy industry in Bulgaria was hit worse than that in other CEEC, since there was no governmental support at all in regulating and managing these processes; neither were there subsidies to compensate for the price changes. Moreover, the government maintained minimal prices for some milk products to protect the consumers, but at the same time did not subsidise or protect milk producers. Therefore milk producers bore most of the costs resulting from this situation. On the input side, the prices for goods and services used in the production of raw milk increased much faster than did the purchasing price for raw milk. Table A.23 shows that input prices, e.g. for energy, diesel and water, grew between 1.1 and 5.9 times faster than the purchasing price for raw milk, although the purchasing price for milk increased far more than those for other agricultural products. On the output side, the government-regimented market (consumer) prices for milk products also grew 2 or 3 times faster than the uncontrolled purchasing price for raw milk. (Table A.24). These unfavourable price relations and the prospect of obtaining higher prices have induced a large number of milk producers to stop raw milk deliveries to the processing enterprises, and to directly sell the raw milk on the regional markets. As mentioned above, this has resulted firstly in insufficient quantities of raw milk for processing, and thus a high surplus of processing capacities; and secondly in social and health problems because of the consumption of raw milk and dairy products without any sanitary control.

3 QUALITY CONTROL AND A QUALITY ASSURANCE SYSTEM

3.1 Main aspects of quality management for milk and dairy products

Because of the great importance of the quality of milk and milk products for human health, it is necessary to put into practice very strict quality controls which guarantee the safety of these products and the desired composition for the consumer.

Quality control for dairy products may be achieved by:

- inspecting the raw milk to ensure that it fulfils the requirements for high-quality raw milk and does not contain any poor or undesirable materials;
- monitoring the processing of milk products to ensure that the ingredients, the temperature and time of treatment and/or storage, and the processing technology are in compliance with the norms;
- inspecting the final product to ensure that no low-quality milk products are delivered to the consumer.

But in order to overcome all problems and to reach a fairly high level of quality assurance for milk and milk products, a wider approach than mere quality control is required. This

comprehensive quality system is called Total Quality Assurance System or Total Quality Management System. It includes the whole production and distribution system, from raw milk producers to the processors of milk products, and finally to the customer or consumer.

Since the pre-1990 administrative management forms have not been adapted to the situation of a market-oriented economy, such a total quality assurance system is an important part of the new production management for the Bulgarian dairy industry, and is therefore closely linked with its structural reform.

The most important requirement for any kind of effective quality assurance system for milk products is the establishment and implementation of standards and norms for the whole country. These should contain:

- the definition of the various control parameters for the quality of milk and milk products, and the determination of the optimal values of these parameters for each quality grade and brand;
- the definition of uniform methods for measuring the specified control parameters; as well as
- the establishment of an effective quality-dependent payment system using the desirable level of the control parameters as an incentive for milk producers and processors to improve the quality of raw milk and the final dairy products.

In general, the first step in a total quality assurance system has to be an analysis of consumer and/or customer expectations. But as has been shown and analysed in chapter 2 of this paper, in this period of transition, there are a large number of specific problems in the production, processing and distribution of milk and milk products in Bulgaria; the low level of knowledge and information about consumer/customer reactions is only one example. Therefore this consumer-oriented method is currently not the most suitable way to determine milk quality in Bulgaria.

An alternative and more convenient approach would currently be to establish a step-by-step approach of improving quality and safety of the final milk products. This quality assurance system would have to include:

- a detailed analysis of all links of the whole production chain - from the raw milk producer (farm level) to the customer/consumer (consumer level);
- identifying the main factors at each step, and assessing how and to what extent they influence the quality of the final milk product;
- decisions of where and how improvements can be made for increasing the quality and guaranteeing the safety of the final milk product.

And in future it will be necessary to focus the attention of management and workforce more on the prevention of problems, instead of finding remedies for them, by identifying potential hazards or quality failures and developing preventive measures for their control.

3.2 Description of the Bulgarian milk production chain

The production process of milk and dairy products in Bulgaria has a large number of intermediate stages. This is due to the unfavourable production and processing structure which has developed after 1990 (see chapters 3 and 4).

The main stages are raw milk production at farm level; collection and cooling in the collection station or on the farm; processing in the dairy enterprise; distribution; and transport between the various stages (Figure 7).

Although the customer or consumer is at the end of this chain, his expectations concerning the quality of the raw milk, the animal health and their housing, as well as the environmental conditions, can also influence the beginning of the production chain. Therefore, the milk production chain, in the sense of a chain encompassing a quality assurance system, has to be seen as a cycle. The quality of the final product has to be ensured at each of the stages. This means that the risk of lowering the quality, e.g. through contamination with germs or other undesired substances, increases as the number of links in the production chain rises. In this respect, the elimination of some interim stages (especially milk collection stations) would be very important to reduce the risk of deteriorating the milk product quality. However, the number of links depends on the size and structure of the production and processing enterprises; e.g., if dairy farms are larger and have their own milk collection and cooling equipment, the raw milk is purchased and transported directly from the farms to the processing enterprises. Therefore a structural change of the existing raw milk production in Bulgaria could increase the quality of the final product.

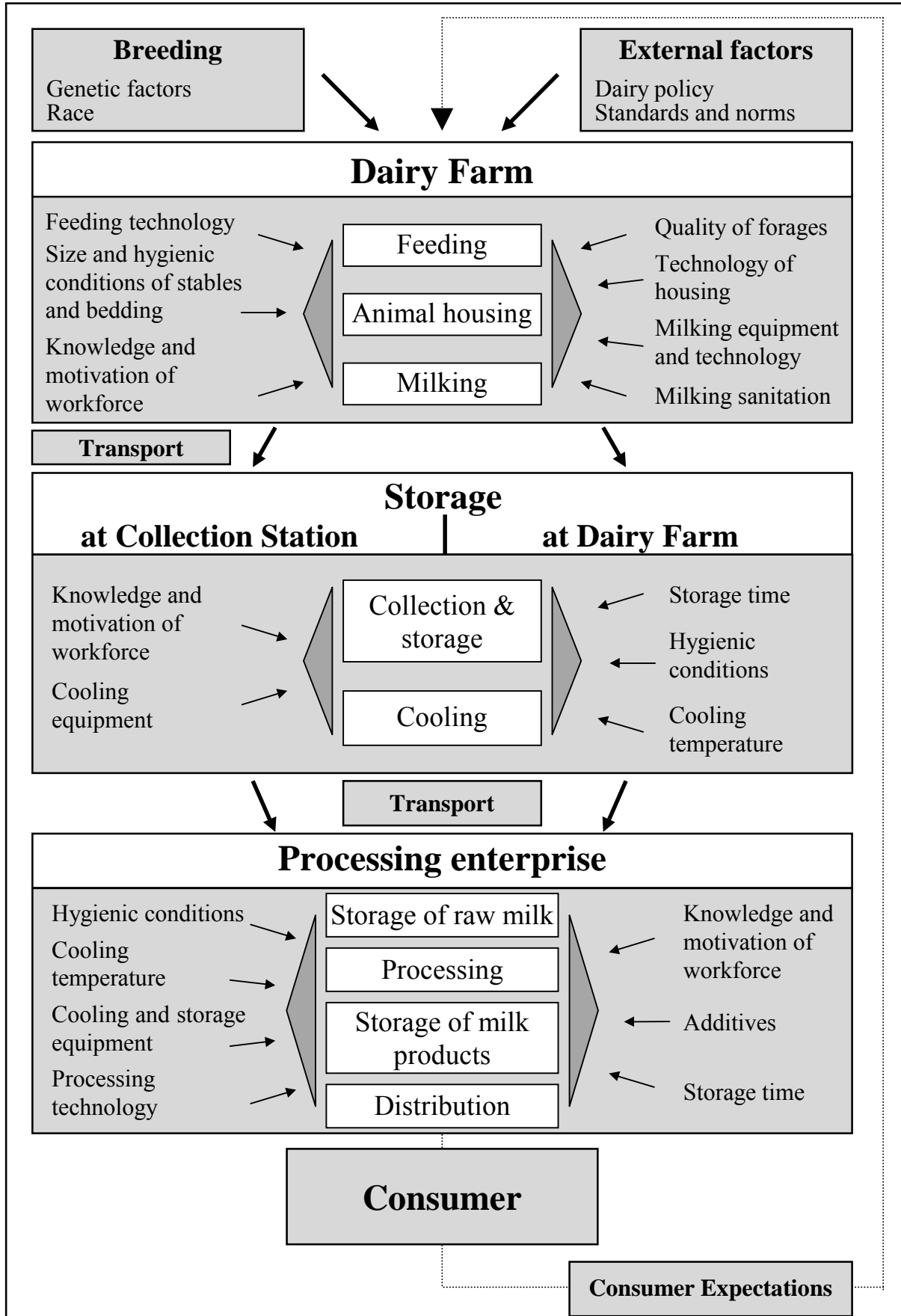
Since the quality at each stage of the dairy chain is immediately dependent on the quality at the preceding stage, the production of high-quality raw milk at the farm level is of decisive importance. Therefore the first step of the above-mentioned quality assurance system in the Bulgarian dairy sector would involve analysing and recording the production process for raw milk at farm level. However, dairy farms do not exist in isolation; external factors such as dairy policy and governmental regulations, as well as animal breeding and consumer expectations influence the production conditions and therefore the quality of raw milk.

The main factors at farm level that affect the quality of the raw milk can be categorised as follows.

- Feeding - the feeding technology and the quantity and quality of the forage influence the composition (fat and protein content) and therefore the quality of the raw milk.
- Animal housing - the size and the hygienic conditions of stalls and bedding as well as the housing technology influences the animal welfare. This clearly affects their productivity as well as the milk quality.
- Milking - the milking technology, equipment and sanitation influence the hygienic conditions and animal welfare during milking and thus the raw milk quality.

Additionally, the knowledge and motivation of the farm's workforce have to be mentioned in this respect. Since they can influence all the factors mentioned above, knowledge and motivation have a decisive impact on animal welfare and therefore on the raw milk quality.

Figure 7: Main stages of the milk production chain



Source: Own figure.

The next step in the production process is the delivery of the milk. The raw milk has to be collected, stored, cooled, and transported to the dairy enterprise. There are two different systems in Bulgaria which are used according to dairy farm size and structure.

1. Small farms, which do not have their own tanks, deliver their milk in cans to the collection stations, where the milk is inspected, its volume measured and recorded, samples are taken, and the cans are emptied into a tank for cooling and storage awaiting transport to the processing enterprise. This includes a number of different stages, and the cooling chain of the raw milk is often interrupted, leading to a high risk of milk contamination and a reduction in raw milk quality. Another disadvantage of this system is the possibility of manipulating the milk amount and its quality because of the low level of technology for quality control in the collection stations.
2. Large farms, which do have their own tanks and cooling equipment, deliver their milk directly to the processing enterprises. The smaller number of intermediate steps and the closed cooling chain often result in higher-quality raw milk.

The main factors affecting the milk quality at this stage are the initial quality of the raw milk, the cooling temperature, the closed cooling chain, the hygienic conditions, and also the equipment for storage, cooling and transport. Knowledge and motivation of the workforce also play an important role.

The last major link in the production chain for milk products is the processing enterprise. Since the number of factors influencing the product quality is so large, depending on the processing method and the requirements of the final product, it would be impossible to mention them all in this study. The most important ones are hygienic conditions, the cooling and storage equipment, the processing technology, the quality of used additives, and the qualification and motivation of the workforce. The storage time and the distribution channels for the final products are of equally great importance.

3.3 Definition of different aspects of raw milk quality

Quality does not exist in isolation and it is not confined to production economics, represented for instance by statistic quality control or total quality management. BOWBRICK (1992) shows this by defining several quality concepts: different people involved in producing, distributing, buying or consuming the product have different ‘quality’ needs with respect to a given product.

According to the International Standardization Organization (ISO), quality is defined as the “*entirety of properties and attributes of a product or a service related to its suitability to fulfil defined or assumed needs*” (ISO 8402 1989; DIN 55350 1989).

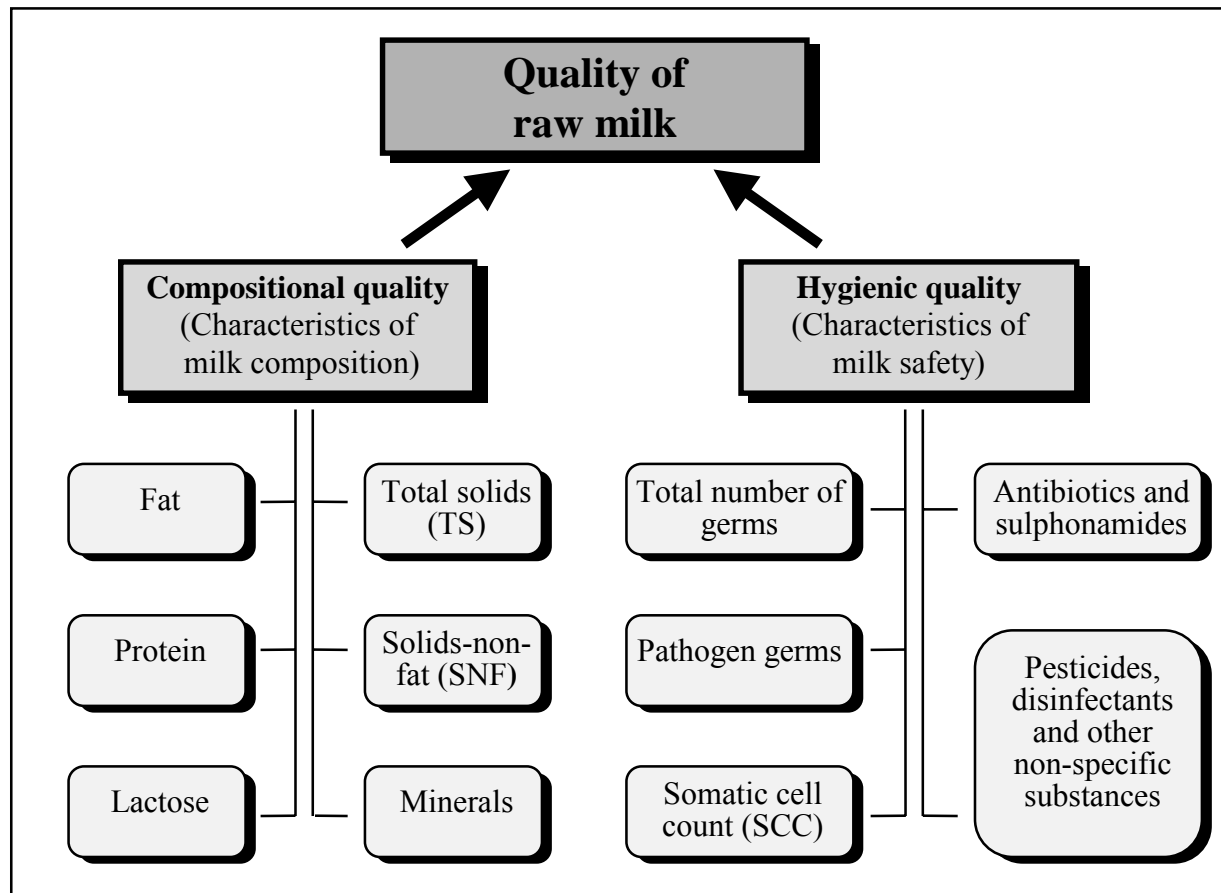
Quality parameters for milk production and processing have been described in various studies. They are the subject of contracts between farmers and dairies, and some of them are even determined in laws and decrees, in order to protect the consumer (for good overviews, see, for instance, LANZ 1994; HARDING 1995; KALLWEIT ET AL. 1988).

According to this literature, the quality of raw milk can be defined as a combination of the following two main factors (Figure 8):

- the compositional quality - i.e. the characteristics of the raw milk which are related to its natural composition, and which have special importance for the further processing process, and

- the hygienic quality - i.e. the characteristics of the raw milk which are related to its hygienic conditions and safety for the consumer.

Figure 8: Different aspects of milk quality



Source: Own figure.

Compositional quality includes the major natural components of milk such as fat, protein, lactose, minerals, and complex traits such as total solids (TS) and solids-non-fat (SNF). The nutritive value of liquid milk, its yield, and the quality of milk products are in direct relation to the amount of different milk constituents and the correlation between them. Moreover, the concentration of milk constituents in combination with the milk yield has great influence on the economic effectiveness of processing. Since the cost of raw milk accounts for up to 70 per cent of the cost of the final product, the financial value of each kg of milk is directly related to its compositional quality. Also, the definition of standards for the compositional quality of raw milk enables the identification of milk adulterations. In most countries, the criterion of compositional quality is therefore used by dairies to calculate the purchasing price. Specific traits which have to be included in the quality payment scheme, and specific levels which have to be reached are related to factors such as: the purpose for which the raw milk is to be used (e.g. for liquid milk or for processing into cheese, yoghurt or other products); the technical possibilities of analysing a large number of samples; market demand and consumer preferences.

Hygienic quality covers all factors that can directly influence the safety of milk and milk products. The main factors are the total number of bacteria including pathogen germs, the somatic cell count (SCC), as well as residues of antibiotics and sulphonamides, pesticides and other harmful substances.

Since milk, when it leaves a healthy udder, is relatively free from bacteria (less than 10.000 bacteria/ml), the total number of bacteria can be used as an indicator of good hygienic milking practice and housing conditions (HARMON 1995; KALLWEIT ET AL. 1988). Milk produced without any monitoring of animal health and hygienic circumstances of the production process may contain a large number of different bacteria. The most harmful to human health are:

- pathogen micro-organisms, which can cause very serious and dangerous diseases in milk consumers, including tuberculosis (TBC), brucellosis, coli infections, leptospirosis, salmonellosis, Q fever; they are even potentially fatal. Since pasteurisation kills most of these, it is one way to minimise the risk. However, some pathogens can survive pasteurisation and may produce toxins that are harmful to people;
- milk spoilage organisms, which can cause very serious changes in milk composition, impairing its nutritional, technological and organoleptic properties.

Deterioration of raw milk and milk products caused by germs mainly manifests itself in the following ways:

- decreasing content of milk protein and fat as a result of its lipolysis and proteolysis action. These compositional changes lower the nutritional value of milk, reduce the yield of milk products, and cause defects in milk products;
- production of enzymes which may pass from the raw or heat-treated milk to the milk product (especially heat-resistant types) and cause defects in taste, smell, consistency etc.;
- production of toxins which stay in the milk or pass into the milk products and cause alimentary disorders or food poisoning.

The *Somatic Cell Count (SCC)* represents another criteria for the hygienic quality of raw milk. Mastitis, one of the most widespread udder diseases in milk cows, is characterised by a high somatic cell count; it is caused by unhealthy living conditions. Mastitis milk contains pathogen organisms, is chemically changed (e.g. lower levels of protein, casein, fat and lactose), or includes enzymes capable of creating further damage at a later stage (defects in taste, flavour). The consumption of mastitis milk is therefore harmful to human health, and SCC should be used to determine the hygienic quality of raw milk and udder health. In addition, mastitis is a disease which reduces the milk yield as well as the quality of raw milk and the final products, and it therefore causes economic losses for the farmer and the processor (see chapter 5.5).

Besides its natural constituents, raw milk sometimes also contains non-specific undesired ingredients. These include residues of antibiotics or sulphonamides, mostly caused by medical treatment, pesticides and heavy metals, which the animals absorb during feeding, as well as residues of disinfectants from the milking and storing equipment. These wasting constituents of raw milk are undesired, because they:

- are harmful to public health;
- reduce the quality of milk and milk products by impairing taste, smell or colour;
- reduce or hinder its usability for processing following the regular technological process, especially when additives are used in the production of milk products such as cheese, yoghurt and fermented milk (inhibiting effect); and
- cause economic losses for producers and processors.

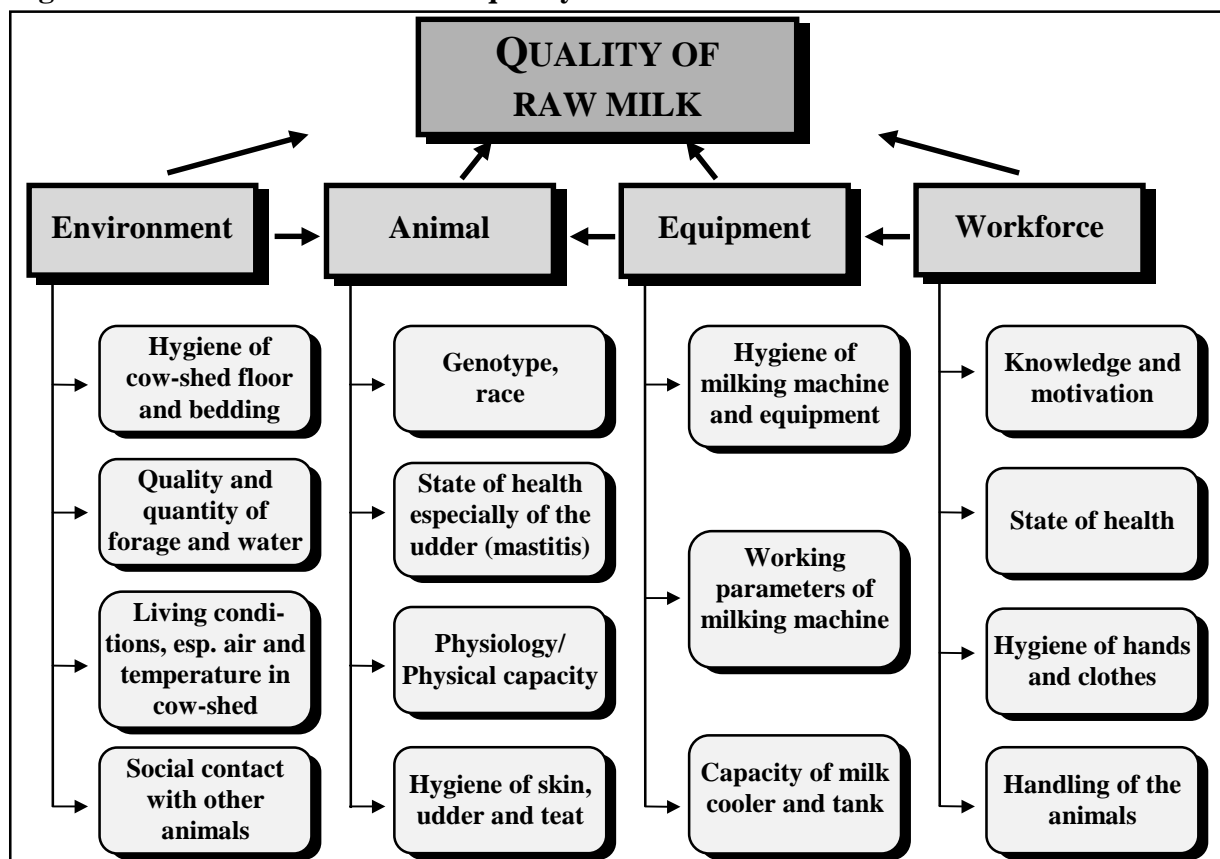
It is therefore necessary to guarantee the safety and quality of milk and milk products by monitoring the most important aspects, such as antibiotic residues, and by laying down standards about the permitted levels.

3.4 Main factors which influence raw milk quality on the dairy farm

As has been shown above, the quality of raw milk produced at the farm level is of decisive importance for the quality of milk and milk products at each stage of the whole chain, last but not least for the quality of the final milk products.

In order to obtain a high milk quality at the farm level, it is important that farmers are aware of the sources of quality improvement, and that they understand how to monitor these. Quality management on a dairy farm therefore has to start with a detailed analysis and monitoring of those factors in the production process which have a major impact on the quality of raw milk, the most important being the **animal**, the **environment**, the **equipment** and the **workforce** (Figure 9).

Figure 9: Main influences on the quality of raw milk at farm level



Source: Own figure.

One of the main factors is the **dairy cow** itself. The milk quality first of all depends on race and genotype, as well as on the physical capacity of the animal. It is, for example, possible to improve the compositional quality of milk by breeding and selecting animals with a high breeding value for the desired milk constituents (e.g. fat and protein). The hygienic quality can also be influenced, e.g. by using animals with a high breeding value for mastitis resistance. In addition, the raw milk quality depends on the hygienic conditions of the skin, udder and teats, as well as on the general state of the cow's health. The hygiene of udder and teats is of decisive importance for the total number of bacteria in the produced raw milk. Due to dirty teats, the bacteria count could be 50 - 70 per cent higher than in the case of clean and

disinfected udder and teats. A cow's state of health clearly influences its milk output and also the milk quality. As mentioned above, the health of the udder is especially relevant for the somatic cell count, and consequently influences the hygienic quality of the raw milk. Additionally, the medical treatment of sick cows or udders increases the danger of antibiotic residues in the milk.

The **environment** represents a complex system of factors influencing raw milk quality; the most important among these are:

- the hygienic conditions of the cowshed and bedding, which especially affect the hygienic quality of milk;
- the quantity and quality of forages and drinking water, which have a strong correlation with the content and consequently the compositional and hygienic quality of the milk; and
- the living conditions (e.g. the air and temperature conditions in the cowshed), and the social contact with other animals, which affect the animal welfare and therefore the physical capacity and the milk quality of the cow.

Since milking, storage and cooling **equipment** comes into contact with the raw milk, it could clearly be a major source of contamination at the farm level. Therefore the hygienic conditions during milking, storing and cooling are of decisive importance for the quality, and especially the hygienic quality, of raw milk. Additionally, the technological parameters of milking machines (vacuum level, number of pulses etc.) can decrease the hygienic quality of milk by reducing animal welfare, stressing the udder and causing mastitis or other animal diseases. Since the growth of bacteria in raw milk strongly depends on the duration of the storage time and the cooling temperature, the technology and capacity of the milk cooler and storage tank also influence the hygienic quality of milk.

The last main factor to have a strong impact on raw milk quality is the **workforce**, e.g. the farmers or workers. Firstly, they can directly contaminate the milk with dirty or non-disinfected hands and clothes, thus reducing its quality, and possibly increasing the bacteria count two or three times in comparison with good hygienic conditions. Secondly, they can transmit diseases to the animals or directly to the raw milk (e.g. in the case of open milking systems), thus contaminating the raw milk with pathogen micro-organisms and other bacteria. Dangerous diseases, like coli infection, hepatitis or diphtheria could in such a way be transmitted to large numbers of consumers. Furthermore, as mentioned at the beginning of the chapter, the workforce's/farmer's knowledge of the requirements concerning the quality and standards for milk production have a decisive impact on the quality of the milk, as does the motivation to fulfil these requirements. Also, the handling of the animals can influence their welfare and thus the quality of the raw milk.

4 ANALYSIS AND COMPARISON OF THE EXISTING STANDARDS FOR RAW MILK QUALITY IN BULGARIA AND THE EU/GERMANY

4.1 General importance of standards

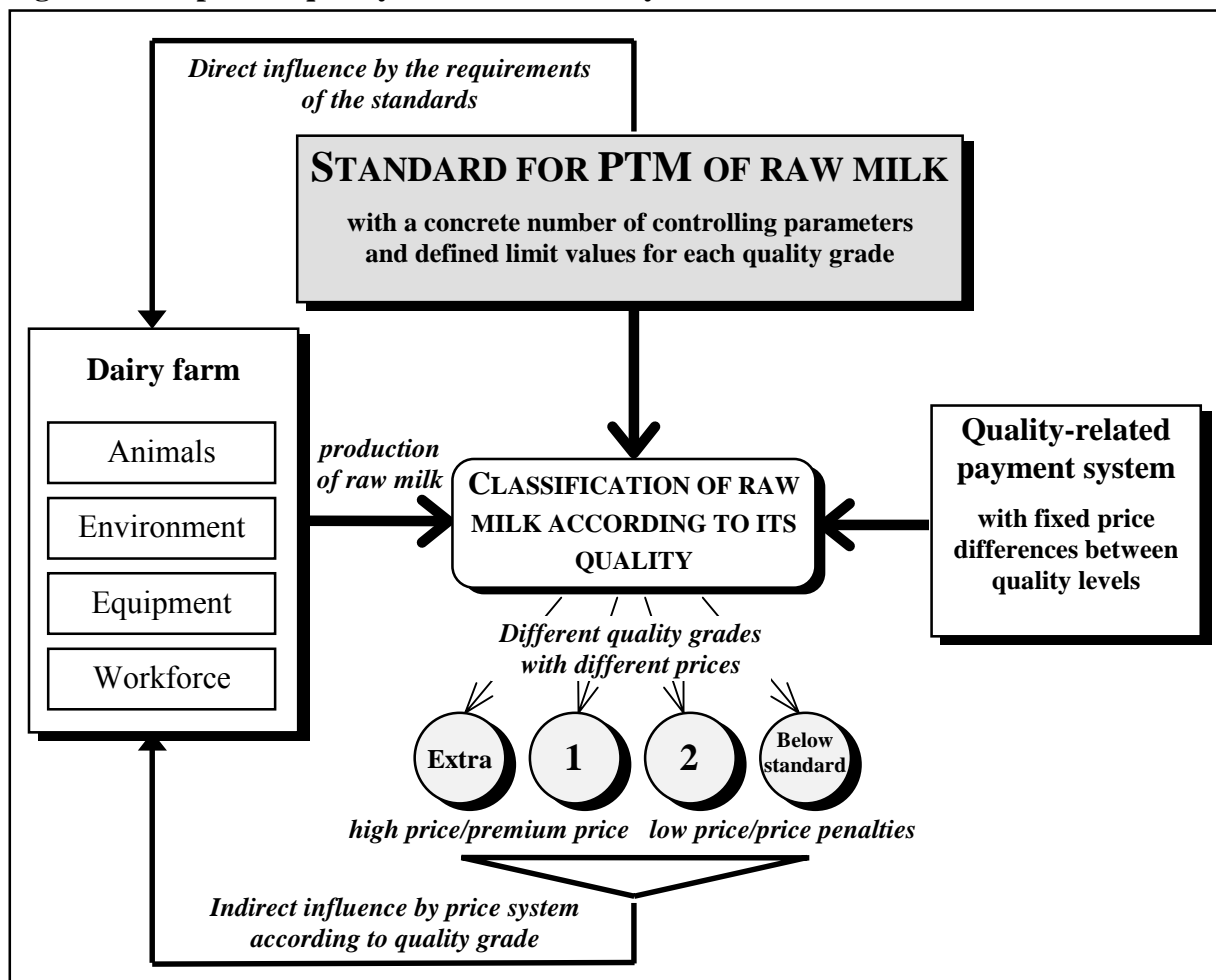
According to the International Organization for Standardization (ISO) standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. International Standards thus contribute to making life simpler, and to increasing the reliability and effectiveness of the

goods and services we use (ISO 1998). The German Institute for Standardisation defines a standard as a document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context (DIN 1998). Standards become a type of insurance (for people) in that they guarantee safety for people's health. They regulate the main requirements for each quality level. Standards are not an end in themselves but a regulatory instrument.

In the production of raw milk and milk products, they ensure that generally accepted requirements are met, and are thus used to help increase the quality of (both raw and processed) milk products.

There are separate regulations and standards for the production, treatment and marketing of raw milk; for the construction and equipment of collection stations and processing enterprises; for heat-treated milk and milk-based products etc. Since it is impossible to discuss all of them in this paper, the main focus will be on the standard for production, treatment and marketing (PTM)¹ of raw milk, it being the main one to affect dairy farms.

Figure 10: Impact of quality standards on dairy farms



Source: Own figure.

¹ This is not an official abbreviation, but only used here by the authors.

As shown in Figure 10, the standard for the production, treatment and marketing of raw milk take a central and decisive place in the whole quality assurance system, as an instrument which directly and indirectly influences the dairy farmers. It can generally be assumed that higher requirements for controlling characteristics in the standard will result in a higher quality of the raw milk. But the quality level of raw milk depends not only on existing standards, but also on a functioning payment system which gives economic incentives for the production of high-quality raw milk.

The main objectives of EU standard for the production, treatment and marketing of raw milk are to harmonise the requirements for the production, treatment and marketing of raw milk, and to lay down the compulsory minimums for parameters to be used for measuring quality in the different countries. However, each country has its own standards, linked to the specific conditions for production, the needs of the dairy industry, and the specific expectations of the consumer. But according to international agreements it is compulsory for EU member countries to meet the requirements which have been laid down in European regulations and standards as minimums.

The need to harmonise the Bulgarian standards with those of the EU has been shown above, as has the importance of these standards for the quality of raw milk, and thus of the final milk products. One of the first steps towards increasing the quality of Bulgarian milk products is therefore to analyse and compare the existing national standard for the production, treatment and marketing of raw milk with those of other countries, and to find possibilities of changing and improving them.

4.2 Main sources of the raw milk quality regulations in the EU, Germany and Bulgaria

a) Sources of regulations in the EU (cf. OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES 1992, 1994)

The main sources of EU regulations and standards are:

- the council directive 92/46/EEC (issued on 16/06/1992), which lays down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products; and the council directive 94/71/EC (issued on 13/12/1994) as the amending directive of EC regulation 92/46/EEC.

Further important regulations are (cf. OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES 1989a, b, 1991; BÖHM and HEESCHEN 1995):

- commission directive 89/362/EEC (issued on 26/05/1989) on the general conditions of hygiene in milk production holdings; and
- council directive 89/384/EEC (issued on 20/06/1989), which establishes the detailed procedures for monitoring the freezing point;
- commission decision 91/180/EEC (issued on 14/02/1991), which establishes certain methods of analysis and testing of raw milk and heat-treated milk;
- commission regulation 1854/96/EC (issued on 26/09/1996), which establishes a list and reference methods to be applied for the analysis and quality evaluation of milk and milk products throughout the common market;

- several regulations concerning drugs and non-specific harmful substances in foodstuffs of animal origin:
 - council regulation R 2377/90 (issued on 26/06/90), laying down a Community procedure for establishing maximum residue limits of veterinary medicinal products in foodstuffs of animal origin;
 - council directive D 81/602, concerning the prohibition of certain substances having a hormonal action and any substances having a thyrostatic action and
 - council directive D 88/146, concerning the prohibition in livestock farming of certain substances having a hormonal action

b) Sources of regulations in Germany (cf. Bundesgesetzblatt 1995; Böhm and Heeschen 1995):

Due to its EU membership, Germany's regulations for raw milk quality are based on the EU regulations; they are the minimum basis for the German regulations. The country-specific standard for the production, treatment and marketing of raw milk is based on:

- the German dairy regulation (“Verordnung über die Hygiene- und Qualitätsanforderungen an Milch und Erzeugnisse auf Milchbasis - Milchverordnung”), issued on 24/04/1995, and the 5th amendment to the regulation on dairy quality (“5. Verordnung zur Änderung der Milch-Güteverordnung”), dated 27/12/1993.

Further German regulations for the production, treatment and marketing of raw milk and milk products are based firstly on product-specific German government regulations (e.g. „Käse-Verordnung“, „Butter-Verordnung“ and „Milcherzeugnis-Verordnung“), and secondly on specific regulations on food and food hygiene by the different German states (i.e. „Lebensmittelhygieneverordnung“ and „Speiseeishygiene-Verordnung“).

In the various West German states, these regulations are monitored by different institutions, e.g. extension services, governmental organisations, veterinary services. But in accordance with the restructuring of the agricultural sector in the eastern part of Germany, only one testing association per state („Landeskontrollverband - LKV“) is authorised to do this work. This results in a more effective organisational structure, with a single information centre for the farmer, the dairy industry and the governmental institutions.

According to the different quality parameters regulated by the standards mentioned above, raw milk will be classed into the two categories “1” and “2” after 01/01/1998 (previously there were three). Additionally, the quality of the raw milk produced in German milk production enterprises is defined in special contracts between the farmers and the dairy plant. For example, the dairy plants can introduce a specific class “S” for raw milk whose quality is higher than category “1”, especially with respect to the number of germs and the somatic cell count; it can then pay a premium price for raw milk that meets the requirements of this class. Special agreements about the compositional quality of the raw milk can also be added to the contracts, e.g. premium prices for higher fat or protein content.

c) Sources of regulations in Bulgaria

The main regulations concerning the quality of raw milk and milk products in Bulgaria are laid down in the following sources:

- Bulgarian state standard (BDS) No. 2778-97 for the classification of raw cow's milk issued in 05/1997 (cf. BDS 2778-97); this standard came into force on 01/01/1998 and has replaced the old BDS 2778-89.

Further requirements for the production, marketing and classification of raw milk in Bulgaria are laid down in:

- Regulation No. 3/1998 of the Ministry of Agriculture, Forestry and Agrarian Reform issued on 08/01/98 (cf. NAREDBA No. 3/98);
- Regulation No. 12/79 on veterinary sanitary requirements for milk-producing holdings issued on 19/05/1979 (cf. NAREDBA No. 12/79) and
- Regulation No. 5/89 on hygiene norms for maximum residue limits of chemical and biological residues in foodstuffs.

The main veterinary sanitary requirements for the construction and operation of milk processing establishments are laid down in Regulation No. 29/95, issued on 14/11/1995 (cf. NAREDBA No. 29/95).

According to the BDS 2778-97 and Regulation No. 3/98, some of the quality parameters, e.g. freezing point, number of germs and SCC, will be monitored by the State Veterinary Sanitary Control Service (DVSK), others, e.g. fat, protein, SNF and density, by the dairy plants.

Depending on the different quality parameters regulated by the above-mentioned standard, the raw milk will be grouped into 3 categories: "Extra", "1" and "2". Additional quality requirements of the raw milk produced are laid down in special contracts between the farmers and the dairy plant.

4.3 Comparison of the existing quality standards for raw cow's milk in Bulgaria and Germany

4.3.1 Control parameters for the raw milk quality

To gain a better overview and to structure the comparison, it is useful to divide the different quality control parameters into several groups of characteristics (see also Table A.25):

- a) *organoleptic characteristics* - consistence, colour, taste and smell
- b) *compositional characteristics* - fat content, protein content, solids-non-fat (SNF)
- c) *physical and chemical characteristics* - density, freezing point, acidity, cooling temperature, cleanliness
- d) *hygienic and safety characteristics* - somatic cell count (SCC), total number of germs, number of pathogen germs, antibiotics and inhibiting substances

But not all of these characteristics are relevant for the quality assurance systems in Germany and Bulgaria. There are major differences between the two raw milk quality standards, namely:

- the number of quality grades (2 in Germany compared to 3 in Bulgaria);
- the number of parameters used for measuring quality (only 2 characteristics in Germany compared to 6 in Bulgaria), and
- the value (level) of the control parameters for each grade.

In general it could be observed that the Bulgarian quality standard for raw cow's milk is characterised by a higher number of quality parameters but a lower level (value) of most control parameters, especially the hygienic parameters, and also a lower density of samples taken than the German standard. Reasons for this are:

- the low level of raw milk quality in general - which is caused by the small-scale structure of the farms; the low level of mechanisation of raw milk production, cooling and storage; the low level of knowledge among the farmers/workforce; the unfavourable living, housing and hygienic conditions for the cows in these farms; and the high level of mastitis infection in the dairy herds;
- the lack of technical possibilities to mechanically check a large number of samples for the most important hygienic parameters - firstly, since there is no equipment for automated electronic analysis, only reference methods (e.g. plate count etc.) of counting germs and somatic cells have to be used, which are very expensive as well as time- and labour-consuming. Secondly, because of the small structure of the milk production farms, and therefore the huge number of milk producers with only few cows (see chapter 2.3 and Table A.18), a large number of samples have to be controlled for raw milk quality. Hence it is practically impossible to carry out regular individual quality checks of each milk producer. Therefore only simple methods for a fast measurement of the hygienic parameters have so far been used in Bulgaria, e.g. reduction test, titrable acidity test and test of cleanliness by mechanical filters etc.;
- the high risk of raw milk adulteration - caused by the high number of small milk producers and their mostly unfavourable production conditions; the risk of adulteration of the raw milk, e.g. by adding water or mixing different types of milk, is very high in Bulgaria.

As suggested above in the German standard for the production, treatment and marketing of raw milk, only a few of the Bulgarian quality parameters are regulated, i.e. the fat and protein contents, the active acidity, the cooling temperature, the freezing point, the number of germs and the somatic cell count, as well as the level of residues of antibiotics and inhibiting substances. In general, the quality level is higher in Germany than in Bulgaria.

In the following paragraphs the German and Bulgarian standards will be compared and the differences looked at in detail (Table A.25).

- a) **organoleptic characters** - these only exist in the Bulgarian standard. According to the Bulgarian standard, every batch of raw milk delivered to the milk collecting stations or the dairies has to be inspected for smell, taste, colour and consistency. The low basic level of the milk quality, the unfavourable production conditions and especially the use of open systems for milking, storage and cooling in Bulgarian milk production enterprises makes these analyses necessary. In Germany, these characters are not included in the regulations because of the high level of mechanisation in milking and the storage of the raw milk in closed tanks.
- b) **compositional characters** - here, the Bulgarian standard differs from the German in its lower minimum level of fat and protein contents.
- c) **physical and chemical characters** - this group of characters includes the largest number of quality parameters. Only two of these, however, are used in both the German and the Bulgarian standards, namely the measurement of the freezing point and the cooling temperature of the raw milk. The regulations for these two parameters currently differ only in terms of their values.

Both standards also include acidity as a control parameter, but the methods of measuring this differ. In Germany the active acidity (pH) is measured, which is related to the udder health; values exceeding 6.8 show presence of mastitis in milk. By contrast, the Bulgarian standard stipulates that the titrable acidity (°T) of raw milk is to be monitored, because it is a simple, rapid and low-cost method of controlling the hygienic quality of milk. In this process, the quantity of lactic acid is measured, which is a by-product of bacterial actions and directly linked to the number of germs as well as the duration and the temperature of the milk storage.

The parameters density and cleanliness only exist in the Bulgarian standard. Density is used as a simple, fast and low-cost method for detecting adulterations of the raw milk. This parameter is closely related to the fat and SNF contents. Measuring cleanliness is a simple and cheap indirect method to obtain information about the hygienic quality of raw milk. This parameter is important for the Bulgarian system because of the low quality of raw milk in general. Since the German standard has more accurate methods of measuring the other parameters for the hygienic quality of raw milk, e.g. total number of germs and somatic cell count, it does not include these parameters.

- d) **hygienic and safety characters** - all quality parameters in this group are included in the Bulgarian and the German standards, and neither standard allows the presence of pathogen germs, residues of antibiotics and other inhibiting and harmful substances in the raw milk. But the values for the total number of germs and the somatic cell count (SCC) differ; the Bulgarian standard permits a much higher number of germs (up to 1.5 million germs/ml) and somatic cells (up to 1 million cells/ml) than the German standard, which allows only up to 100 000 germs/ml and up to 400 000 cells/ml in the raw milk. The higher maximum values of these parameters in the Bulgarian standard have been adapted to milk production conditions in Bulgarian and reflect the low quality level of milk in general.

4.3.2 Raw milk classification and pricing system

According to the Bulgarian quality standard for raw cow's milk, the raw milk is graded according to the parameter with the lowest quality level. Some of the control parameters in the Bulgarian standard, i.e. fat, protein and solids-non-fat contents, density, and freezing point are standard values, and the price setting depends on the contracts between the farmers and the dairy plants. With the exception of the freezing point, which is controlled fortnightly by the DVSK, these parameters are analysed daily by the dairy plant. For all other control parameters, like titrable acidity, total number of germs, somatic cell count etc., specific limiting (minimum or maximum) values for the different grades exist, and the purchasing price of the raw milk depends on these grades. This latter group of parameters is analysed fortnightly by the DVSK.

But in Bulgaria there is no functioning pricing system related to the classification of the raw milk. The lack of fixed and state-regulated price reductions (penalties) for overstepping or undercutting the limiting values is one main important difference between the German and the Bulgarian standards. According to the Bulgarian standard, price differences between the several quality levels are regulated by agreements between the farmers and the dairy enterprises. Consequently, such price differences may be used by the dairies to compete with other processors, not assuring the health of the consumer, especially in seasons with a low raw milk supply.

According to the German standard, all quality parameters, with the exception of the fat and protein contents, are limiting values; if they are overstepped or undercut, a price reduction will

result. The classification of the raw milk into certain grades depends only on the quality parameter “number of germs”; raw milk that is categorised as “second class” must not be processed into fresh milk products. Most of the quality parameters are analysed in the laboratories of independent control institutions, e.g. „LKV“ in the eastern part of Germany and several extension services in the western part of Germany.

For the parameters number of germs, somatic cell count (SCC), and residues of antibiotics and inhibiting substances, the German standard contains regulations about state-regulated and fixed price reductions for the entire milk amount delivered in the control period when the limiting values are overstepped. For all other parameters the purchasing price of the raw milk depends on the contract between farmer and dairy. Additionally, the processing enterprises often introduce price bonuses for raw milk of higher quality than officially required, as an incentive to improve raw milk quality.

It can be concluded that the large number of control parameters, the use of indirect control methods because of technological constraints (necessities), the unsatisfactory level of the limiting values of some control parameters, as well as the lack of fixed state price regulations for the most important control parameters are the main disadvantages of the Bulgarian standards. Regarding the harmonisation of the Bulgarian and German (EU) standards for the production, treatment and marketing of raw milk, but also the incentives for improving the milk quality in general, the Bulgarian standard will need to be amended.

5 ECONOMIC EFFECTS OF REDUCED RAW MILK QUALITY ON THE RESULTS OF THE FARMS

It was mentioned in the former chapters that the quality of the raw milk produced on farms has a decisive importance for the milk processing process, as well as for the quality of the final milk products, and therefore for the human diet. But without a functioning pricing system related to the quality of raw milk, the farmers apparently lack incentives to produce high-quality raw milk. Therefore this chapter aims to outline the importance of the raw milk quality for the economic results of dairy farms in general, and specifically in Bulgaria.

It is often neglected that many of the factors which influence the quality of raw milk also have an effect on the milk yield of the cows. An improvement of these factors will thus affect not only the milk quality but also the milk yield, and this will clearly influence the economic results of the enterprises. For Bulgaria the most important factors in this respect are (see also Chapter 3.4 - Figure 9):

- the quantity and quality of the forage and water;
- the living/housing conditions of the animals, esp. air and temperature in the cowshed;
- the genotype and race of the animals;
- the physiology and the physical capacity of the animals;
- the animals' state of health; and
- the knowledge and motivation of the workforce.

In the following, the influence of these six factors on the economic results of the production enterprises will be investigated in detail.

5.1 Quantity and quality of the forage and water

The amount, the composition and quality of the forages, as well as their continued availability, have a decisive influence on the quality of the cow's raw milk. According to STOCKINGER and STARK (1995) especially the quality of the basic ration (e.g. silage, hay and greenstuff) plays an important role, because:

- the animals' feed consumption of basic rations with low energy concentration is lower than of rations with high energy content;
- the nutrient deficit of low quality basic rations, although it can be balanced with a higher amount of concentrates, leads to a loss of the permanently high yield level of dairy cows; and
- in general, a higher quality of the basic ration does not cause higher production costs (mostly better management and higher quality of the work).

This means that a high quality level of basic rations results in a high quality level of raw milk, and also in a high milk yield from the basic ration. The economic effects of different quality levels of the basic ration are calculated in Table 1.

Table 1: Impact of different quality levels of the basic ration on the efficiency of milk production

		quality of the forage	
		high	low
energy content	MJ NEL/kg dry matter	6.2	5
feed consumption	kg dry matter/day	11.5	10
energy consumption by basic ration	MJ NEL/day	71.3	50
energy consumption by basic ration	MJ NEL/200 days	14,260	10,000
maintenance requirements	MJ NEL/200 days	7,814	7,814
available for milk production	MJ NEL/200 days	6,446	2,186
Milk yield from forage (with 3.17 MJ NEL/kg)	kg milk/200 days	2,033	690
total milk yield per year 5 000 kg	kg milk/200 days	2,740	2,740
milk yield from the concentrates	kg milk/200 days	706	2,050
amount of concentrates needed ¹	kg/200 days	392	1,139
costs of concentrates ²	DM/200 days	129	376
costs of basic ration ³	DM/200 days	214	150
total costs of forage	DM/200 days	343	526
difference	DM/200 days	182	

Note: ¹-1.8 kg milk per kg concentrate; ²-0.33 DM per kg concentrate; ³-0.15 DM per kg MJ NEL.

Source: Based on STOCKINGER and STARK (1995).

Beside the milk yield, especially the fat and protein content of milk can be influenced with feeding. Depending on the cows' diet, the fat content of raw milk can vary over a range of 3 percentage units, and the protein content can vary by 0.6 percentage units.

The fat content is hardly influenced by the structure and content of crude fibre of the forage, because a high share of cellulose in the forage leads to a high production of saliva, which influences the pH value and the production of acetic acid (acetate and butyrate) in the rumen of the animals, leading to a high fat content in the raw milk. By contrast, a high share of concentrates, e.g. cereals, pellets of hay and straw, leads to a low concentration of acetate and butyrate and a high concentration of propionate in the rumen of the animal, which negatively affects milk fat. Forages with a minimum content of dry matter of 18 per cent, like meadow or

sweet lupine hay, beet leaves and coarse oats meal, have a positive impact on the milk fat production. A reduction of the fat content in raw milk on the other hand can be caused, for example, by potatoes or alfalfa silage. That means that in general a basic ration, which is mostly cheaper than concentrates, leads to a higher fat content in the raw milk and, since most of the dairy enterprises calculate a fat-corrected milk amount, to higher milk returns. In the case of a fat correction of the delivered milk amount, a 0.1 per cent increase of the fat content in the raw milk leads to a 1.8 per cent increase of the total milk amount and therefore of the milk returns for the enterprise (STOCKINGER and STARK 1995).

Since the genotype rather than the feeding influences the protein content of raw milk, the effect of forage selection is not as high on the protein content in milk as it is on its fat content. The most important part the feeding plays for the protein content in raw milk is the supply of energy to the animals, because the amino acids required for milk protein synthesis are derived from the micro-organisms in the rumen, and high-energy forages stimulate the microbial protein synthesis in the rumen, increasing the available amount of amino acids in the bowel. But a lack of protein in the forage also reduces microbial activities in the rumen and thereby the digestibility, leading to a reduced intake of forages. As a result, the milk yield will decrease and the nutrients in the raw milk, e.g. fat and protein, will be reduced. In contrast, a high protein content in the forage (more than 16 per cent crude protein in the dry matter) only leads to a small increase in the milk protein content, but also to a higher stress of the liver which has to reduce the ammonium to urea.

In Bulgaria, the two facts mentioned above are of special importance, because most enterprises do not carry out forage analyses. Consequently they suffer from a lack of knowledge about the contents and quality of the used forages, and have fewer opportunities to influence the animals' output and the quality of the raw milk. This results in economic losses for the enterprises.

The continued availability of forage also has a great influence on the milk quality. Caused by a variation of the ration, e.g. the change from winter to pasture feeding, the milk yield will increase by approx. 10 - 15 per cent (NICKERSON 1995). But at the same time, the fat content of the milk will more or less decrease because of the lack of crude fibre in the young grass. To avoid this reduction at the beginning of the pasture period, it is necessary to add forages with a high content of crude fibre to the ration. This phenomenon is known as the "spring flush" and is observed especially in countries where pasture or green forages are used in the spring and summer time. In Bulgaria the impact of the "spring flush" on the quantity and quality of the milk output is very high, especially on small private farms because of their lack of high quality forages in winter time. Due to their high share in Bulgarian raw milk production this leads to large fluctuations in the total milk output, and therefore to large price differences for raw milk between the pasture period (low price season) and the rest of the year (high price season). For example, with the beginning of the 1998 pasture period the Bulgarian raw milk price has been cut by half in comparison with the previous winter period. This is certain to significantly influence the financial situation and the economic results of the farms.

In addition to influencing fat and protein content, the forage can also affect the taste and the smell of the milk. The level of influence depends on the kind of substances in the forage (e.g. alcohol, ketone, ester), the time lapsed between feeding and milking, and the degree of deterioration of the forage (mould, frozen forage etc.). Since organoleptic parameters like taste and smell are included in the standards for milk classification in Bulgaria, these influences can cause price reductions for the farmer. The negative effects of taste and smell can be avoided by limiting such forages in the ration, especially in the milking time, and by feeding only high-quality forages. Because of the transmission by air of the taste and smell from the forage to the milk, these forages should not be stored directly in the barn.

Summing up, in Bulgaria, low-quality forages as well as the wrong feeding management mainly result in lower milk returns and higher feeding costs, which have a negative impact on the profits of the milk production enterprise.

5.2 Living and housing conditions of the animals

The living and housing conditions, especially the air and temperature in the cowshed, are the main factors that affect the raw milk quality and yield. The lack of oxygen and the high temperatures of overcrowded barns, especially in the summer, lead to a reduction of fodder intake and to a decrease of the fat content in raw milk. On the other hand, temperatures below 0 °C cause higher maintenance requirements for the animals and result in a drop in milk output, and therefore in a relative increase of the fat content in raw milk. Table 2 shows the effects of air temperature on the animals and on the economic results of the farms. Due to the large fluctuations in temperature between the Bulgarian winter and summer, and the sometimes crude living and housing conditions of the animals, especially in small private and subsistence plots, this factor is of special importance for milk producers.

Table 2: Impact of the air temperature on milk output, raw milk quality and their economic effects

Temperature	Effects on the milk output and raw milk quality	Economic effects
below 0 °C (cold stress)	decrease of milk output (25 %), only relative increase of the fat content, increase of the dry matter and the solids-non-fat of the milk,	reduced milk returns and increase of the expenses for fodder by approx. 30 %, because of the higher maintenance requirement,
from 0 °C to 20 °C	constant milk output and content	no
from 20 °C to 30 °C	small decrease of the milk output and the milk fat content	see below
above 30 °C (heat stress)	strong decrease of milk output (more than 40 %), only relative increase of the fat content, decrease of the dry matter, of solids-non-fat, of protein and lactose content	reduced milk returns and increase of the expenses for fodder by approx. 20 %, because of the reduced forage and increased concentrate intake by the animals

Source: Based on NICKERSON (1995), KALLWEIT ET AL. (1988).

5.3 Genotype and race

The existing different races of cattle have mainly evolved through breeding and selection. The breeding for required results, e.g. milk, meat and labour, as well as the adaptation of the animals to the regional environmental conditions and fodder supply, have led to large variations in the output and quality (esp. compositional quality) of cow's milk, as can be seen from the example of selected races in Saxony in Table 3.

Table 3: Milk output and content of milk from selected cattle races in Saxony

race	number of cows	milk kg	fat %	fat kg	protein %	protein kg	fat and protein kg
BW/HF	218,581	6,133	4.39	269	3.44	211	480
German Simmental	2,263	5,295	4.08	216	3.46	183	399
German Red Pied	2,196	5,795	4.21	244	3.38	196	440
German Brown	594	5,575	4.13	230	3.52	196	426
Angeln	196	5,722	4.33	248	3.44	197	445
Jersey	36	4,357	5.85	255	4.02	175	430

Note: BW = Black-and-White, HF = Holstein-Frisian.

Source: Based on SÄCHSISCHER LANDESKONTROLLVERBAND (1997).

Table 3 also shows that the highest milk yield and the highest fat and protein content in raw milk are not correlated; this is due to their different heritabilities. Heritability is a measure of the degree to which heredity influences a certain trait. According to NICKERSON (1995), the yields of milk volume, fat and protein have heritabilities of 0.25 (25 per cent); the heritability of the milk composition, however, i.e. percentages of fat and protein, is significantly higher at 0.5 (50 per cent). The fat and protein content of the milk were also found to be always transmitted together, while the milk yield and content will be transmitted separately.

The economic effects of different races firstly depend on their different milk outputs and raw milk contents; this was discussed above. But the different races also vary in their requirements for fodder, housing conditions and equipment, which also influence the level and structure of the costs and therefore the economic results of the enterprises Table 4 presents a comparison of the economic results of two different cow races for milk production kept under German conditions.

Table 4 shows that the differences between the economic results of the two cattle races are not as high as a comparison of the milk yields would suggest. Therefore it can be concluded that the selection of a special race for milk production is a complex decision, depending not only on the milk yield and compositional quality, but also on the environmental conditions, the regional forage supply, and the living and housing conditions. The necessity of a detailed analysis of all these factors is further increased by the special problems of the Bulgarian milk production enterprises, e.g. high share of bought-in feedstuffs (silage, concentrates etc.), large seasonal price fluctuations, a lack of market information and other factors.

Table 4: Economic results of selected cow races

performance character	GS	BW/HF
milk output (kg/year)	5,618	6,524
milk returns (0.62 DM/kg)	3,483	4,045
calf returns		
male: 0.45*820 (BW 320 DM)	369	144
female: 0.45*570 (BW 270 DM)	257	122
cull cow returns:		
GS: 0.25*650 kg*3.05 DM/kg	496	
BW: 0.25*615kg*2.70 DM/kg		415
total returns	4,604	4,726
replacement 0.25*2,800 DM (BW 2,700 DM)	700	675
milk replacer 40 kg (BW 20 kg)*2.47 DM/kg	99	49
calf starter 50 kg (BW 25 kg)*0.53 DM/kg	27	13
concentrate 1,150 kg (BW 1,470 kg)*0.34 DM/kg	391	500
minerals 60 kg*1.15 DM/kg	69	69
insemination, veterinary and medical costs	175	205
electricity, water, housing costs	65	65
insurance, miscellaneous costs, marketing costs	135	135
interest, current assets	143	131
variable costs of equipment	18	20
total variable costs	1,822	1,862
contribution margin I	2,783	2,863
total costs for basic ration	391	400
of which		
corn silage 0.15 DM/10 MJ NEL	144	147
grass silage 0.16 DM/10 MJ NEL	108	111
hay 0.21 DM/10 MJ NEL	42	43
grass, green 0.12 DM/10 MJ NEL	96	99
contribution margin II	2,392	2,463
basic ration requirements in MJ NEL	26,083	26,736
of which		
corn silage	9,568	9,808
grass silage	6,386	6,546
hay	2,062	2,113
grass, green	8,067	8,269

Note: GS = German Simmental, BW = Black-and-White, HF = Holstein-Frisian.

Source: Based on STOCKINGER and STARK (1995).

5.4 Physiology and physical capacity of the animals

The physiological factors which influence the compositional milk quality and milk output are (KALLWEIT ET AL. 1988):

- the stage of lactation,
- the lactation age, and
- seasonal fluctuations.

Since milk output and composition change throughout lactation, the stage and duration of the lactation period have a decisive impact on the economic results of the enterprises. In general the duration of lactation is calculated to be 305 days. But depending on the herd management and the reproductive ability of the cows, it can vary between 270 and 600 days. It starts with the calving and ends approx. 60 days before the next calving with the drying off. The milk

yield increases after the beginning of the lactation, and at 8 to 10 weeks the cow reaches its highest milk output per day. The milk yield then decreases, and at the end of lactation, it will sometimes only amount to 30 per cent of its highest level. That means that approx. 60 per cent to 70 per cent of the total milk output will be milked in the first half of lactation. The decrease of milk output per day cannot be compensated by the increasing fat and protein content in this period either. This leads to a constant reduction of the average milk yield per day after the fourth month of the lactation period. Therefore it can be concluded that short lactation periods lead to higher economic results than longer ones. The calculation of STOCKINGER and STARK (1995) in Table 5 supports this theory.

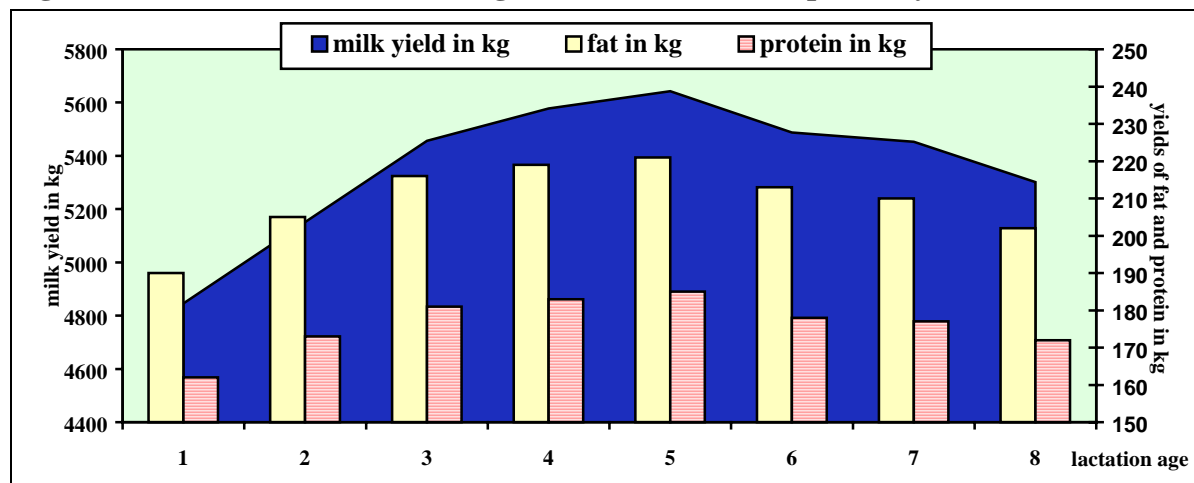
Table 5: Comparison of the milk production costs of different durations of lactation

Variant:		I	II	III	IV
calving interval (CI)	days	365	386	407	428
duration of lactation ¹⁾	days	305	326	347	368
milk output per day	kg	16.4	15.7	15.0	14.3
milk output per CI	kg	5,000	5,118	5,205	5,262
milk returns (0.63 DM per kg)	DM	3,150	3,224	3,279	3,315
calf returns (0.9 calf per year)	DM	657	657	657	657
cull cow returns (0.25 cows per year)	DM	488	488	488	488
total returns per CI	DM	4,295	4,369	4,424	4,460
replacement (0.25 female calf)	DM	650	650	650	650
calf rearing	DM	117	117	117	117
basic ration ²⁾	MJ NEL	26,083	27,584	29,084	30,585
costs for basic ration	DM	391	414	436	459
costs for concentrates ³⁾	DM	296	296	296	296
other costs	DM	594	594	594	594
total variable costs	DM	2,048	2,071	2,093	2,116
contribution margin per cow and CI	DM	2,247	2,299	2,331	2,344
contribution margin per cow and year	DM	2,247	2,174	2,090	1,999
loss of contribution margin per day	DM	-	3.49	3.72	3.93

Note: ¹⁾ dry period of 60 days; ²⁾ 71.46 MJ NEL per day, 0.15 DM per 10 MJ NEL; ³⁾ 90 kg * 0.33 DM/kg
CI = calving interval.

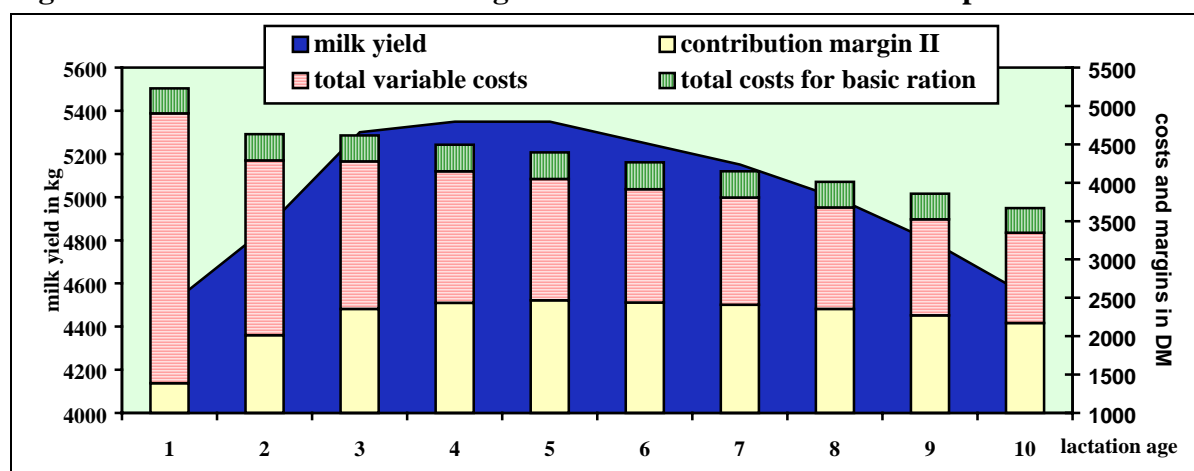
Source: Based on STOCKINGER and STARK (1995).

As mentioned above, the lactation age (number of lactation periods) also affects the milk quality and milk yield. The milk yield of cows increases up to 30 per cent from the 1st to the 5th lactation. After this it remains stable for several years, and then proceeds to decline after the 8th or 9th lactation. Against this, a constant reduction of the milk content can be observed from the 2nd lactation, i.e., with each successive lactation, the fat content decreases by approx. 0.05 per cent and the SNF content decreases by about 0.1 per cent (NICKERSON 1995). But this decrease of the milk contents will be compensated by the stronger increase of the milk output, which is shown by the data on fat and protein yield of lactation in Figure 11.

Figure 11: Effects of the lactation age on the milk, fat and protein yields

Source: Based on KALLWEIT ET AL. (1988).

The increasing milk, fat and protein outputs and their positive effect on the milk returns suggest that in general milk cows should be used for at least five lactations. Table A.26 presents a calculation of the optimal useful life of milk cows. The economic results in Figure 12 show that the optimal useful life of milk cows under the calculated conditions is five lactations, because the milk output and the contribution margin II reach their maximum values. A shorter lifetime of milk cows would thus lead firstly to losses in milk returns, and secondly to higher replacement costs and therefore total variable costs.

Figure 12: Effects of the lactation age on the economic results of milk production

Source: Based on STOCKINGER and STARK (1995).

The seasonal fluctuation in the milk yield and quality, especially milk composition, is strongly related to the climatic conditions, as well as the feeding; the effects of these factors have already been discussed in sections 5.1 and 5.2 above.

In Bulgaria, problems such as the lack of knowledge and motivation among the workforce, insufficient herd management, low quality forages, and inadequate animal housing often lead to a reduction in the reproductive ability of the cows. Together with the relatively high costs of artificial insemination, this results in an increasing duration of the lactation period and therefore in economic losses for the farmers. Especially in small private enterprises does the high lactation age of cows, which is due to very high replacement costs, also result in economic losses. And the large seasonal fluctuations in milk yield and therefore in raw milk prices negatively influence the results of all types of enterprises (see section 5.1).

5.5 State of health

It is obvious that animal health will influence the physical capacity and therefore the milk output of the cows. But it also has a great impact on the compositional and hygienic quality of the raw milk. Besides the general state of health of the milk cows, which is mostly influenced by the feeding, the living and housing conditions, and the herd management, udder diseases, especially clinical and subclinical mastitis, are the most important reasons for a reduced raw milk quality. Mastitis causes a reduction of the milk output and several contents of the milk, e.g. casein, lactose, calcium and phosphorus, as well as a strong increase in the somatic cell count (SCC) of raw milk. Therefore SCC can be used as an indicator for mastitis.

The economic relevance of mastitis for milk production is very high. The losses of the farms caused by mastitis have several sources, including the following (BLOSSER 1979):

- reduction of the cow's milk output (70 per cent),
- unutilisable raw milk (11 per cent) and reduced sales value of raw milk (5 per cent),
- higher costs for veterinary services, medication and labour (6 per cent), and
- reduction of cull cow returns and higher costs for replacement, because of the reduced useful life of the animals (8 per cent).

The main share of the economic losses for the farmer result from the loss of milk output that is caused by the mastitis infection of the udder and thus of the high SCC of raw milk. As can be seen in Table 6 it leads to a strong reduction of the farms' milk returns.

Table 6: Link between the SCC of raw milk and estimated losses in milk production (per cow and year)

SCC of the bulk milk tank per ml	reduction of the milk output in the case of a milk yield per cow and year of:				
	in %	3000 kg		6000 kg	
		in kg	in leva*	in kg	in leva*
< 100,000	0	0	0	0	0
200,000	6	180	46,980	360	93,960
400,000	8	240	62,640	480	125,280
600,000	10	300	78,300	600	156,600
800,000	11	330	86,130	660	172,260
1,000,000	12	360	93,960	720	187,920
> 2,500,000	> 20	> 600	> 156,600	> 1,200	> 313,200

Note: *calculated at the 1997 average purchasing price (261 leva per kg)** of raw milk in Bulgaria.

Source: Own calculations based on PANAYOTOVA (1997b), **SAPI OOD (1998).

Subclinical mastitis is estimated to cause an average reduction of the milk output of approx. 20 per cent (HARMON 1995; KALLWEIT ET AL. 1988). And according to several analyses by the authors, it can be assumed that, in 1997, approx. 25 to 35 per cent of all Bulgarian cows were infected. That means that the reduction of the milk output as a consequence of subclinical mastitis alone will have resulted in economic losses of 17 billion leva (17 million DM) for Bulgarian milk production (see Figure 13). For a Bulgarian cooperative farm with a livestock of 300 milking cows in 1997, economic losses of 14.6 million leva (14,600 DM) can thus be calculated. In addition, the other economic losses for the farmer mentioned above also have to be taken into account.

Figure 13: Economic losses of the Bulgarian milk production sector in 1997 caused by subclinical mastitis

<p>30 % x 358,000 cows (Bulgarian livestock in 1997)</p> <p>= 107,400 cows x 3,102 kg average milk yield per cow and year (1997)</p> <p>= approx. 325,000 t milk output x 20 % loss of milk production caused by sub. mastitis</p> <p>= 65,000 t loss of milk output x 261,000 leva* per t</p>
<p>= 17 billion leva economic losses due to the reduction in milk output</p>
<p>Note: *calculated at the 1997 average purchasing price (261 leva per kg)** of raw milk in Bulgaria.</p>

Source: Own calculation based on NSI (1998), ** SAPI OOD (1998).

Moreover, the change in milk contents caused by mastitis reduces its usability for processing, and therefore the output and returns of the processing enterprises. The increased chlorine and sodium contents and the decreased lactose content cause changes in the flavour of the milk (salty, bitter); in the case of the production of sterilised milk, the reduced stability against heating leads to quality and quantity reductions; and the reduced protein, casein, calcium and acid contents have a negative influence on the duration, the quality and the yield of cheese production.

But it should equally be mentioned in this context that animal health affects not only the economic losses for farmers and processors, but also consumer health. The large market share of uncontrolled raw milk for consumption represents a potential hazard in that the risk of a transmission of diseases from animal to consumer via the milk is very high.

5.6 Knowledge and motivation of the workforce

Especially in countries like Bulgaria, which have a low level of technology and a high labour input in the milk production process, the knowledge and motivation of the workforce have a great impact on the milk quality and output. Since the workforce can influence all the factors mentioned above, insufficiently qualified and motivated workers are often responsible for a reduction of livestock efficiency and milk returns, as well as for increasing costs for feeding, replacement, veterinary services etc. The economic effects of these on the results of the enterprises have been described above. In the case of Bulgaria, the strategy of the agricultural restructuring, the highly specialised vocational training, and the high share of unemployment in the industrial sector result in a workforce in milk production that lacks the necessary knowledge. Moreover, the very low level of wages is one major reason for the moderate motivation of the workers, especially on co-operative farms. Therefore the training of the workforce and a quantity- and quality-oriented incentive payment system can hardly influence the economic results of milk production enterprises in Bulgaria.

6 SUMMARY AND CONCLUSIONS

This analysis provides substantial information about the development of the Bulgarian dairy sector in the transitional period of the last 7 years, about the major differences between the Bulgarian raw milk standard and the German regulation, as well as about the economic influences of reduced milk quality on the results of the dairy farms.

The development of the Bulgarian dairy sector can be summed up as follows:

- The reduction of household income has led to a decrease in purchasing power of 64.0 - 76.6 per cent for different milk products, and also to a decline in the household consumption of dairy products of 20.0 - 66.7 per cent. This in turn has negatively affected overall milk production and cow's milk production, and consequently the number of milk-producing animals, with the exception of goats.
- The slow progress of land restitution until 1997 has led to only a 43.4 per cent increase in the share of arable land used for private plots, while at the same time 86 per cent of cows and buffalo, 92 per cent of sheep and 100 per cent of goats have been kept on private or subsistence plots. This disproportion has resulted in a very small production structure in the Bulgarian dairy sector, and in a strong reduction of the quantity and quality of raw milk and milk products.
- Milk producers have borne most of the costs of the crisis in the dairy sector. While prices for the goods and services used as inputs in the production of raw milk (electricity, water, fuel etc.) have grown between 1.1 and 5.9 times faster than the purchasing price for raw milk, market prices for processed milk products have grown 3 times faster.
- Caused by the very small production and processing structures, which are a result of the Bulgarian privatisation strategy, the production chain for raw milk and milk products in Bulgaria has a large number of intermediate stages; this increases the risk of a reduced raw milk quality. A structural change of the dairy sector, e.g. the increase of dairy farm sizes, and the simultaneous elimination of the milk collection stations, will increase the quality of the raw milk and thus of the final milk products.

The comparison of raw milk standards in Bulgaria and in Germany shows that the most important differences are:

- the higher number of parameters for controlling and classifying the raw milk quality in the Bulgarian standard - 16 compared to only 9 in the German standard;
- the higher number of quality grades in the Bulgarian standard - 3 compared to 2 in the German standard;
- the lower level of requirements for the hygienic quality of raw milk in the Bulgarian standard, especially regarding the total number of germs allowed (1,500,000 germs/ml versus 100,000 germs/ml in the German standard) and the SCC (1,000,000 somatic cells/ml versus 400,000 somatic cells/ml in the German standard);
- the lack of a functioning pricing system based on the classification of raw milk, with fixed minimum state penalties. In Bulgaria, the price differences resulting from this classification are therefore used as a factor of competitiveness by the dairies, and the aspect of food safety and consumer health are ignored.

With respect to the raw milk quality, the main factors affecting the economic results of Bulgarian farms are:

- the quantity and quality of the forage, especially the basic ration; the lack of high-quality forages as well as the lack of quality controls of the basic ration in most Bulgarian dairy farms mainly result in lower milk returns and higher feeding costs, which have a negative impact on the profits of these enterprises;
- the living and housing conditions of the animals; the special climatic conditions in Bulgaria, with large temperature fluctuations over the year, and the sometimes crude living and housing conditions of the animals, especially in small private and subsistence plots, lead to a decline in milk output and quality and therefore to reduced economic results of the farms;
- the stage of lactation and the lactation age; due to the high cost of artificial insemination, and unfavourable herd management, the duration of lactation and the lactation age are higher than the economic optimum, especially on the small private and subsistence plots. This results in higher costs and lower output, as well as a reduction of the raw milk quality;
- animal health; unfavourable production and hygienic conditions, especially in small private and subsistence plots, cause a high share of mastitis infections in the Bulgarian livestock of milking cows, and therefore estimated losses of about 6 per cent of the total Bulgarian milk output. In addition, the high market share of uncontrolled raw milk for consumption, and thus the very high risk of a transmission of diseases from animal to consumer, underline the great importance of animal health;
- the knowledge and motivation of the workforce; especially in countries like Bulgaria, which have a low level of technology and a high labour input in the milk production process, these factors have a large impact on milk quality and output and thus on the economic result of the farms.

From the above-mentioned facts it can be concluded that a number of changes and measures are needed to improve Bulgarian raw milk production in general, and specifically the raw milk quality and the economic results of the farms. These could include:

- reduction of the market share of uncontrolled raw milk for consumption, by implementing a functioning quality control and payment system which also includes the small private and subsistence plots, to secure the health of the consumer;
- installation of special independent laboratories with modern equipment;
- establishment of an information system for milk producers and processors, and introduction of training programmes for the workforce, especially on small private and subsistence plots;
- provision of financial support to improve the raw milk quality by modernising the production technology and improving the hygienic and living conditions of the animals;
- support for the structural changes and reorganisation of the existing milk production farms to establish efficient and competitive enterprises;
- stimulating foreign direct investments in the Bulgarian dairy sector, especially in milk production farms.

But one of the most important conditions for an improvement of the raw milk quality is an adjustment of the Bulgarian standard for raw milk production, treatment and marketing to comply with EU regulations (e.g. Germany). Changes to the Bulgarian standard will have to concentrate especially on the following points:

- reducing the limiting values of the hygienic characters, especially the number of germs and the somatic cell count (SCC);
- including the control parameter “active acidity” in the Bulgarian state standard for raw milk quality as a possibility to monitor the health of the udder and mastitis infections;
- excluding the organoleptic characters as well as cleanliness and density from the Bulgarian state standard; these characters may be part of a separate agreement between the farmer and the processor;

Due to the recent unfavourable situation of the Bulgarian dairy sector, it will be impossible to introduce the changes mentioned above immediately. In order to increase the raw milk quality and to reach the high EU quality requirements for raw milk as soon as possible, a step-by-step introduction of the proposed changes will be necessary. In addition, the temporary issuing of production licenses, and thus the limitation of raw milk production to those producers who have the necessary knowledge and production conditions, could speed up the restructuring process.

Furthermore, the introduction of a functioning pricing system based on the different raw milk quality classes and including fixed state-regulated price reductions for overstepping or undercutting the limiting values of the control parameters, will be an incentive for farmers to improve the raw milk quality. Because of the large regional and seasonal price variations in Bulgaria, it could be more useful to determine price differences and penalties in relative and not in absolute values.

Hence results the need for investments in the milk production sector to fulfil the standards’ requirements, and thus to improve the raw milk quality. Since the quantity and quality of the milk output in the Bulgarian enterprises, and thus their economic results, largely depend on animal health, the living and housing conditions of the animals, and the quality and quantity of the forage, the investment strategies of the enterprises should be related to these objectives. The most urgent improvements are needed in the areas of:

- the technology of forage production, as well as the analysis of the quality of the basic ration
- hygienic conditions especially during milking, as well as in the barn
- the milking and feeding technology, and
- animal productivity through breeding and selection.

Only with investments in the areas mentioned above will the enterprises be able to fulfil the higher requirements of the raw milk quality. Due to their unfavourable financial situation, milk production farms in Bulgaria are clearly not able to realise these investments of their own accord. Therefore governmental support in the shape of credit or investment programmes and tax exemptions are urgently needed.

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Table A.1 Rural population as part of total population on 31st December in the Republic of Bulgaria

	1960	1970	1980	1990	1990/ 1960 (%)	1991	1992	1993	1994	1995	1996	1996/ 1990 (%)
Population (in 1000)	7906	8515	8887	8669	+9.7	8596	8485	8460	8427	8385	8339	-3.8
Density of population (per sq. km)	71.4	76.8	80.0	78.1	+9.4	77.4	76.4	76.2	75.9	75.5	75.1	-3.8
Share of rural popu- lation in total (%)	62.0	47.0	37.5	32.9	-47.0	32.8	32.7	32.4	32.2	32.2	31.9	-3.0

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.2 Employment and unemployment rates by residence

		in per cent		
		1993	1994	1995
Employment rate	in towns	48.2	46.9	49.6
	in villages	34.0	31.1	34.6
Unemployment rate	in towns	19.5	18.0	12.8
	in villages	26.3	27.3	19.3

Note: Before 1993 and after 1995, data were not recorded by residence.

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.3 Employment by branches of economy

Employment by branches	1970	1980	1990	1991	1992	1993	1994	1995	1996	1996/1990 (%)
Total (in 1000)	2749	3998	4097	3564	3274	3222	3242	3282	3280	-20.0
Share in employment sectors (%):										
agriculture	9.9	23.2	17.9	19.1	20.7	21.7	22.8	23.4	24.2	+6.3
industry	42.1	34.3	36.6	34.5	32.6	30.4	29.1	28.1	27.2	-9.3
construction	11.0	8.5	8.2	7.1	6.3	6.5	5.9	5.7	5.5	-2.7
trade	8.4	8.3	9.1	9.6	10.0	10.3	11.4	10.9	10.9	+1.8
other	28.6	25.7	28.2	29.7	30.4	31.1	30.8	31.9	32.2	+3.9

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.4 Share of employment in the private sector

	1990	1991	1992	1993	1994	1995	1996
Total employment in 1000	4096.8	3564.0	3273.7	3221.8	3241.6	3282.2	3279.5
Employment in the private sector (in 1000)	247.0	360.0	579.4	912.1	1167.1	1332.8	1377.9
(in %)	6.0	10.1	17.7	28.3	36.0	40.6	42.0
of which:							
agriculture (%)	66.1	47.5	54.8	50.9	49.7	48.3	49.2
industry (%)	8.5	8.9	6.8	8.5	10.0	10.8	10.9
construction (%)	5.1	6.9	5.1	7.4	6.9	7.0	6.9
trade (%)	10.2	23.8	24.3	20.5	21.7	21.9	19.3
other (%)	10.1	12.9	9.0	12.7	11.7	12.0	13.7

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.5 Importance of agriculture for the national economy

	1990	1991	1992	1993	1994	1995	1996	1996/1990
Share of agriculture in the gross value added (%)	18.1	14.5	12.0	10.6	12.3	13.9	11.7	-6.4
Share of agriculture in exports (%)	2.7	3.5	7.1	3.1	4.7	4.9	2.5	-0.2
of which: livestock (%)	0.5	1.0	2.8	1.3	1.4	0.6	0.7	+0.2
Share of food processing industry (%)	12.4	18.4	18.6	17.3	17.4	16.9	16.5	+4.1
of which: white and yellow cheeses (%)	0.3	-	1.2	0.9	0.8	-	-	-
Trade balance for agricultural products¹	2.9	1.5	9.4	1.7	2.8	4.9	1.0	-1.9

Note: ¹ Agricultural exports in relation to Agricultural imports (in current prices).

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.6 Development of livestock from 1970 to 1997

(in thousands)

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1997/ 1990 (%)
Cattle total	1277.6	1656.3	1795.7	1751.3	1575.1	1456.9	1310.4	973.7	750.4	638.2	632.0	582.0	-63
of which cows	589.1	669.9	701.9	696.7	617.3	609.4	574.9	489.3	418.9	350.5	371.0	358.0	-42
Sheep total	9608.0	10013.0	10432.7	10500.7	8130.3	7938.1	6703.4	4814.3	3763.2	3397.6	3383.0	3020.0	-63
of which ewes	5974.9	6088.3	6271.9	6327.3	5006.9	4951.6	4527.9	3535.1	2832.5	2357.9	2386.0	2000.0	-60
Goats total	335.1	320.6	467.2	473.6	432.9	498.1	552.7	611.2	676.4	795.4	833.0	849.0	+96
of which shegoats	281.2	255.2	357.6	398.4	366.6	417.1	448.1	498.6	539.6	656.0	-	-	-
Buffalo total	74.3	68.6	47.5	32.7	23.0	25.5	25.1	22.1	17.2	13.7	14.0	11.0	-52
of which cows	38.7	32.7	21.3	14.4	11.2	13.1	13.3	12.6	10.2	6.6	8.0	7.0	-38

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1997c).

Table A.7 Total milk production by type

(in thousand metric tons)

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1996/ 1990 (%)
Total milk	1748.9	2151.4	2461.8	2384.9	2004.7	1806.4	1531.1	1420.5	1404.0	1387.0	-42
of which:											
cow's milk	1392.8	1775.0	2056.2	2039.6	1708.7	1542.6	1300.8	1162.1	1130.0	1126.0	-45
sheep's milk	282.7	289.1	308.4	262.9	219.3	180.0	143.6	129.4	119.6	110,0*	-58
goat's milk	43.3	58.8	75.2	62.1	57.5	65.8	71.1	114.5	142.5	-	-
buffalo's milk	30.1	28.9	22.0	20.3	19.3	17.9	15.6	14.4	11.9	-	-

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, *NSI (1998).

Table A.8 Shares of different types of milk in total milk production

(in per cent of total)

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
cow's milk	79.6	82.6	83.5	85.5	85.2	85.4	85.0	81.8	80.5	81.2	80.8*
sheep's milk	16.2	13.4	12.5	11.0	10.9	10.0	9.4	9.1	8.5	7,9*	7.5*
goat's milk	2.5	2.7	3.1	2.6	2.9	3.6	4.6	8.1	10.1	-	-
buffalo's milk	1.7	1.3	0.9	0.9	1.0	1.0	1.0	1.0	0.9	-	-

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1998).

Table A.9 Number, milk output and average productivity of milk cows

(in per cent of 1975)

Traits	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
Number of cows	104.8	104.0	92.1	90.9	85.8	73.0	62.5	52.3	55.4	53.4
Cow's milk output	127.5	147.6	146.4	122.7	110.8	93.4	83.4	81.1	80.8	83,4*
Average milk productivity per cow	117.8	144.7	153.2	135.0	128.9	126.6	135.8	142.6	139.8	141,1*

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1998), NSI (1997c).

Table A.10 Share of the private sector in livestock and milk production

(in per cent)

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
Cattle	21.0	20.5	20.4	17.9	26.8	31.9	50.2	67.6	79.8	81.0	81.3
Cows	29.9	29.2	27.5	23.5	34.0	41.3	60.6	76.6	83.5	85.4	86.3
Cow's milk	15.9	19.8	20.2	23.2	34.1	46.1	67.8	81.5	84.4	98.1*	98.7*
Sheep	39.3	38.1	36.3	31.4	40.0	48.6	74.4	87.5	92.3	92.9	94.1
Ewes	44.9	44.8	45.0	39.7	48.5	54.8	78.8	89.6	93.0	94.2	91.8
Sheep's milk	39.7	44.4	48.0	47.4	54.8	66.3	85.7	92.6	94.3	99.4*	99.5*
Goats	98.5	95.3	98.3	99.1	99.4	99.6	99.8	99.9	99.9	99.9	99.9
Shagoats	99.1	96.9	98.8	99.5	99.8	99.9	99.9	99.9	99.9	-	-
Goat's milk	99.3	98.8	99.4	99.6	99.7	99.9	99.9	99.9	99.9	-	-
Buffalo	83.8	76.4	71.6	59.4	67.6	71.5	79.3	81.0	86.2	85.7	90.0
Buffalo cows	88.7	82.8	76.9	68.6	75.3	79.5	85.4	86.4	88.3	87.5	85.7
Buffalo's milk	85.6	81.9	79.3	79.7	83.6	87.0	88.7	92.2	93.7	-	-

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1998).

Table A.11 Ratio of total animals to female animals for several types of animals

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997
<i>Cattle total : cows</i>											
for total farms	2.47	2.56	2.56	2.55	2.39	2.28	1.99	1.79	1.82	1.70	1.62
for private farms	1.74	1.79	1.89	1.95	1.92	1.76	1.65	1.57	1.74	1.61	1.53
<i>Sheep total : ewes</i>											
for total farms	1.66	1.66	1.66	1.62	1.60	1.48	1.36	1.32	1.44	1.41	1.51
for private farms	1.44	1.41	1.34	1.28	1.32	2.05	1.29	1.29	1.43	1.40	1.50
<i>Goats total : shegoats</i>											
for total farms	1.26	1.31	1.19	1.18	1.19	1.23	1.23	1.25	1.21	-	-
for private farms	1.25	1.29	1.18	1.18	1.19	1.23	1.22	1.25	1.21	-	-
<i>Buffalo : buffalo cows</i>											
for total farms	2.10	2.23	2.27	2.05	1.95	1.88	1.75	1.69	2.08	1.75	1.57
for private farms	1.98	2.06	2.11	1.77	1.32	1.70	1.63	1.58	2.04	1.14	1.17

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1997c).

Table A.12 Average milk yield of dairy animals

(in kg)

Types of animals	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996
<i>Cows</i>	2,198	2,589	3,181	3,367	2,968	2,833	2,783	2,985	3,135	3,072
of which in private sector	1,124	1,704	2,264	2,852	2,605	2,703	2,778	3,000	3,125	3,066
<i>Buffalo</i>	924	1,244	1,583	1,725	1,666	1,382	1,393	1,574	1,665	-
of which in private sector	884	1,211	1,631	1,914	1,831	1,472	1,441	1,636	1,705	-
<i>Goats</i>	45	45	48	158	149	139	136	197	218	-
of which in private sector	42	46	54	159	149	139	136	197	218	-
<i>Sheep</i>	174	176	191	51	47	44	45	47	49	50*
of which in private sector	175	180	192	58	50	47	47	47	50	-

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, NSI (1998).

Table A.13 Share of purchased cow's milk in total production

		1989	1990	1991	1992	1993	1994
Cow's milk	total production in M kg	2,061	2,041	1,704	1,537	1,279	1,102
	purchase in M kg	1,778	1,731	1,270	1,038	840	423
	in % of production	86.3	84.8	74.5	67.5	65.7	38.4
of which produced in:							
public sector	total production in M kg	1,673	1,568	1,121	826	414	206
	purchase in M kg	1,555	1,442	980	634	301	118
	in % of production	92.9	92.0	87.4	76.8	72.7	57.3
private sector	total production in M kg	388	473	583	711	865	896
	purchase in M kg	223	289	290	404	436	305
	in % of production	57.5	61.1	49.7	56.8	50.4	34.0

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.14 Arable land, permanent crops, common pastures and pastures

(in thousand hectares)

	1980	1990	1991	1992	1993	1994	1995	1996
Total	6,185	6,159	6,159	6,159	6,159	6,159	6,164	6,164
Arable land and permanent crops	4,665	4,643	4,643	4,643	4,643	4,643	4,694	4,694
of which:								
arable land	3,827	3,856	3,864	4,047	4,063	4,001	3,998	4,203
meadows	292	287	289	291	278	270	276	277
cultivated and complex pastures	196	204	197	26	57	156	215	138
permanent crops and berries	350	296	293	279	245	216	205	76
Common pastures and pastures	1,520	1,516	1,516	1,516	1,516	1,516	1,470	1,470

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.15 Share of arable land in private sector

(in per cent of Table 14)

	1980	1990	1995	1996
Total in private sector	9.7	11.6	39.1	43.4
Arable land and permanent crops	12.8	15.3	48.1	51.9
arable land	11.1	13.6	47.9	49.9
meadows	31.8	36.6	82.2	80.3
cultivated and complex pastures, permanent crops, berries and others	-	0.5	0.5	0.7
Common pastures and pastures	-	0	10.6	16.3

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.16 Number of cattle per 100 ha of arable land and total milk production in different countries

Country	Number of cattle			Total production of milk		
	1990 (no./100 ha)	1994 (no./100 ha)	1994/1990 (%)	1990 (t/100 ha)	1994 (t/100 ha)	1994/1990 (%)
Bulgaria	25.9	12.5	48.3	39.9	23.8	59.6
Hungary	24.7	16.4	66.4	44.8	31.7	70.8
Poland	53.5	41.1	76.8	84.3	65.3	77.5
Russia	27.5	22.3	81.1	26.1	20.1	77.0
Austria	73.2	68.9	94.1	96.0	91.0	94.8
Denmark	80.4*	77.4	96.3	170.1*	165.1	97.1
France	70.0	66.8	95.4	89.1	84.9	95.3
Germany	108.1*	91.8	84.9	161.4*	163.1	101.1
Switzerland	91.8	107.5	117.1	192.2	247.8	128.9
The Netherlands	245.6	234.9	95.6	559.6	546.7	97.7

Note: * 1991 figures.

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, FAOSTAT (1998).

Table A.17 Total milk and cow's milk production per capita in different countries

Country	Production of ...							
	total milk per capita ¹			cow's milk per capita ²				
	1990 kg	1994 kg	1994/ 1990 %	1990 kg	1994 kg	1996 kg	1994/ 1990 %	1996/ 1990 %
Bulgaria	282	173	61.3	241	133	124	55.2	51.5
Czech Republic	-	-	-	463	305	289	65.9	62.4
Hungary	280	189	67.5	275	191	197	69.5	71.6
Poland	416	317	76.4	415	317	304	76.4	73.3
Russia	375	297	79.2	375	282	239	75.2	63.7
Romania	157	173	110.2	147	188	206	127.8	140.1
Austria	431	400	92.8	435	411	374	94.5	86.0
Denmark	923	854	92.5	923	853	897	92.4	97.2
France	480	443	92.3	461	438	430	95.0	93.3
Germany	367*	346	94.3	394	343	351	87.1	89.1
Switzerland	579	560	96.7	566	547	535	96.6	94.5
The Netherlands	751	700	93.2	751	707	718	94.1	95.6

Note: * 1991 figures, ¹ Statistical Yearbook, ² FAOSTAT.

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria, FAOSTAT (1998).

Table A.18 Size structure of private farms according to number of breeding cows on 1st January 1995

Interval categories according to cow numbers	Number of farms	Share (%)
1 cow	178,968	80.93
2 cows	32,810	14.84
3-5 cows	7,909	3.58
6-10 cows	1,071	0.48
11-15 cows	178	0.08
16-20 cows	91	0.04
21-25 cows	20	0.01
26-30 cows	26	0.01
more than 30 cows	69	0.03
Total	221,142	100

Source: Based on NSI (1995).

Table A.19 Annual production of dairy foods

(in thousand tons)

Dairy products	1985	1990	1991	1992	1993	1994	1995	1996	1996/1990 (%)
Milk	196.9	222.5	132.4	105.1	70.5	56.3	-	-	-
Yoghurt	341.8	362.8	235.5	201.6	145.1	112.0	156.0*	143.0*	-75.6*
White cheese	101.9	111.4	94.7	67.8	51.8	48.6	43.3	33.1	-70.3
Yellow and other types of cheese	27.5	35.1	25.9	19.6	15.7	11.3	9.6	7.8	-77.8
Butter	24.6	21.6	12.4	8.7	4.6	2.2	2.9	2.3	-89.4

Note: * Total milk for consumption (milk and yoghurt).

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.20 Per capita household consumption of dairy foods

Dairy products	1985	1990	1991	1992	1993	1994	1995	1996	1996/1990 (%)
Liquid milk (litres)	49.7	55.7	52.6	41.9	40.4	38.9	35.2	34.7	-37.7
Yoghurt (kg)	60.6	65.5	50.0	36.4	30.1	30.8	27.1	26.2	-60.0
White cheese (kg)	10.2	11.0	9.5	11.4	10.2	10.0	9.2	8.8	-20.0
Yellow and other types of cheese (kg)	4.1	4.2	2.7	2.7	2.7	2.6	2.5	2.3	-45.2
Butter (kg)	-	2.1	1.7	1.5	1.1	1.1	0.8	0.7	-66.7

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.21 Purchasing power per capita of Bulgarian households

Dairy products	1990	1991	1992	1993	1994	1995	1996	1996/1990 (%)
Milk (litres)	9,400	3,794	4,348	3,342	3,729	2,705	2,583	-72.5
Yoghurt (kg)	6,743	2,698	3,109	2,385	2,499	1,859	1,580	-76.6
White cheese (kg)	1,010	448	545	448	432	403	337	-66.6
Yellow and other types of cheese(kg)	723	359	378	323	320	250	225	-68.9
Butter (kg)	567	273	283	299	336	266	204	-64.0

Note: The quantity of commodities to be obtained for total per capita income during the reference year.

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.22 Basic indexes of total household incomes, market prices and household consumption of selected dairy products

(Basis = December 1996)

		January	February	March	April	May	June
Total household income		81.0	140.3	244.3	375.1	491.6	534.1
Market prices	milk	131.9	388.0	527.7	469.1	425.1	408.5
	white cheese	165.7	751.8	689.1	548.1	497.4	456.9
Household consumption	milk	100.0	104.5	104.5	113.6	136.4	131.8
	white cheese	85.7	57.1	71.4	71.4	85.7	100.0

Source: Based on NSI (1997a, b).

Table A.23 Comparison of average procurement prices for agricultural products with average prices for agricultural inputs

(Basis = 1990)

	1991	1992	1993	1994	1995
Procurement prices for selected agricultural outputs					
Total	273.1	373.3	588.5	928.6	1,375.3
Crops	286.1	340.1	529.7	795.0	1,124.9
Livestock	260.6	398.6	638.4	1,107.7	1,775.6
Milk	234.9	369.6	680.5	1,144.3	1,841.2
Prices for selected agricultural inputs					
Water	590.0	1,120.0	2,990.0	5,670.0	10,950.0
Electricity	475.6	777.8	1,304.5	1,784.4	2,860.0
Fuel	460.0	683.5	927.1	1,637.6	1,982.4
Feed grain crops	292.6	335.0	587.5	667.6	945.3
Wages (agriculture)	281.7	467.5	686.9	1,038.6	1,601.7

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.24 Comparison of basic indexes of the average procurement price for raw milk with average consumer prices for selected dairy products

(Basis = 1990)

	1991	1992	1993	1994	
Basic index of purchase price of raw milk	234.9	369.6	680.5	1144.3	
Basic index of consumer prices	milk	627.8	1097.2	2211.1	3577.7
	yoghurt	669.6	1126.0	2147.8	3695.7
	white cheese	648.1	1083.8	2003.1	3583.9
	yellow cheese	556.0	1078.8	1891.5	3679.8

Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

Table A.25 Comparison of the standards for the production, classification and delivery of raw milk in Bulgaria and Germany

	Germany			Bulgaria			comment	
	raw milk classification		measuring methods and regulations	raw milk classification				
	1	2		E	1	2		
a) organoleptic characters								
consistency	-	not relevant according to the regulations	only closed tanks used and therefore no possibility for looking and tasting, no influence on the price setting	homogeneous liquid without sediments	daily sight control by the dairy plant		checked at the collection stations, at the production site or at the dairy plant according to the total production level and the delivery strategy of the raw milk producer	
colour	-	not relevant according to the regulations		white with light creamy colour	daily sight control by the dairy plant			
taste	-	not relevant according to the regulations		typical, nice, thin, without flavour defects	daily tasting control by the dairy plant			
smell	-	not relevant according to the regulations		typical, thin without foreign smell	daily smell control by the dairy plant			
b) compositional characters								
fat content (%)	3.7	min. 4 and max. 18 samples per month depending on average daily raw milk production	controlled by the LKV according to the samples schedule, only for the basic level price, but the additional price charges depend on the contracts ¹	≥ 3.6	≥ 3.4	≥ 3.4	daily control by the dairy plant	price setting depends on the contracts ¹
protein content (%)	3.4			≥ 3.2	daily control by the dairy plant		price setting depends on the contracts ¹	
solids-non-fat (SNF) (%)	-			not regularly - only for special products (cheese etc.)	≥ 8.5	daily control by the dairy plant		price setting depends on the contracts ¹

Table A.25 continued

	Germany			Bulgaria					
	raw milk classification		measuring methods and regulations	comment	raw milk classification			measuring methods and regulations	comment
	1	2			E	1	2		
c) physical and chemical characters									
density (g/cm ³) at 20 °C	-	not regularly - only for special products (cheese etc.)	controlled by the dairy plants and price setting depends on the contracts ¹	≥ 1.029			controlled daily by the dairy plant	price setting depends on the contracts ¹	
freezing point (°C)	≤ -0.515	at least 1 sample per month, controlled by the LKV according to the sample schedule	but price reduction depends on the contracts ¹	≤ -0.520			controlled fortnightly by the DVSK, the sample will be taken under the control of the milk producer ⁴	price setting depends on the contracts ¹	
active acidity (pH)	from 6.5 to 6.8	at every milk collection automatically controlled by the transportation service	no specific categories and regulations, price reduction depends on the contracts ¹	-	-	-	not specified	-	
titrable acidity (°T)	-	not specified	-	<18° T and >15° T	<19° T and >15° T	<21° T and >15° T	controlled daily by the dairy plant, character for the classification of raw milk	specific prices for the 3 categories, other milk is called “below standard” and price setting depends on the contracts ¹	
cooling temperature (°C)	8°C (6°C when milk collection only every 2 nd day)	at every milk collection automatically controlled by the transportation service	no specific categories and regulations, price reduction depends on the contracts ¹	≤ 4°C	≤ 8°C	≤ 10°C	controlled daily by the dairy plant, character for the classification of raw milk	specific prices for the 3 categories, other milk is called “below standard” and price setting depends on the contracts ¹	

Table A.25 continued

	Germany				Bulgaria					
	raw milk classification		measuring methods and regulations	comment	raw milk classification			measuring methods and regulations	comment	
	1	2			E	1	2			
continued c) physical and chemical characters										
cleanliness	-		not relevant	no price influence	no bits on the filter permitted	some bits are permitted	controlled daily by the dairy plant, character for the classification of the raw milk	2 categories with specific prices, price setting of other milk depends on the contracts ¹		
d) hygienic and safety characters										
number of somatic cells (in 1000 somatic cells per cm ³)	≤ 400		at least 1 sample per month (in East Germany 3 samples per month), controlled by LKV	0.02 DM per kg price reduction if the geometrical average of the last 3 months exceeds the limit ²	≤ 400	≤ 500	≤ 1,000	2 samples per month, controlled by the DVSK, the sample will be taken under the control of the milk producer ⁴	3 categories with specific prices, price setting of other milk depends on the contracts ¹	
number of germs (in 1000 germs per cm ³)	≤ 100	>100	at least 2 samples per month (in East Germany 3 samples per month), controlled by LKV, character for the classification	classification based on the calculation of the geometrical average of the last two months, 0.04 DM per kg price reduction on all milk delivered in the control period when 2 nd category ²	≤ 300	≤ 500	≤ 1,500	2 samples per month, controlled by the DVSK, the sample will be taken only with sterilised equipment under the control of the milk producer ⁴	3 categories with specific prices, price setting of other milk depends on the contracts ¹	

Table A.25 continued

	Germany			Bulgaria				
	raw milk classification		measuring methods and regulations	comment	raw milk classification		measuring methods and regulations	comment
	1	2			E	1		
d) hygienic and safety characters								
number of pathogen germs	not permitted	only in the case of a high total number of germs (more than 1 million) controlled by LKV,	milk delivery permitted if any pathogen germs found, farmer has to pay for this analysis	not permitted	2 samples per month, controlled by the DVSK, sample will be taken only with sterilised equipment under the control of the milk producer ⁴	no milk delivery allowed if pathogen germs found		
antibiotics and inhibiting substances	not permitted	at least 2 samples per month, controlled by the LKV (in East Germany daily controls by the dairy plants)	stop of milk delivery after 1 positive sample, price reduction of 0.10 DM per kg for all milk delivered in the month with the positive sample, milk delivery resumed after the next negative sample (min. delay 3-5 days) ³	not permitted	2 samples per month, controlled by the DVSK, sample will be taken under the control of the milk producer ⁴	no milk delivery allowed if antibiotics or other inhibiting substances found		
¹ contracts means the contracts between individual farmers and the dairy enterprise ² in the case of these characters the milk delivery will be stopped if the negative results cannot be changed in the period of the following 3 months ³ after one positive sample (including antibiotics) the farmer has to pay for the next analysis until the next negative sample (without antibiotics) ⁴ the sample will be divided into 3 parts: 1 part for the DSVK control, 1 part for the producer (farmer), and 1 part for the dairy plant; in the case of an objection against the results of the DSVK analysis, the other parts (of the producer and the dairy plant) will be analysed								

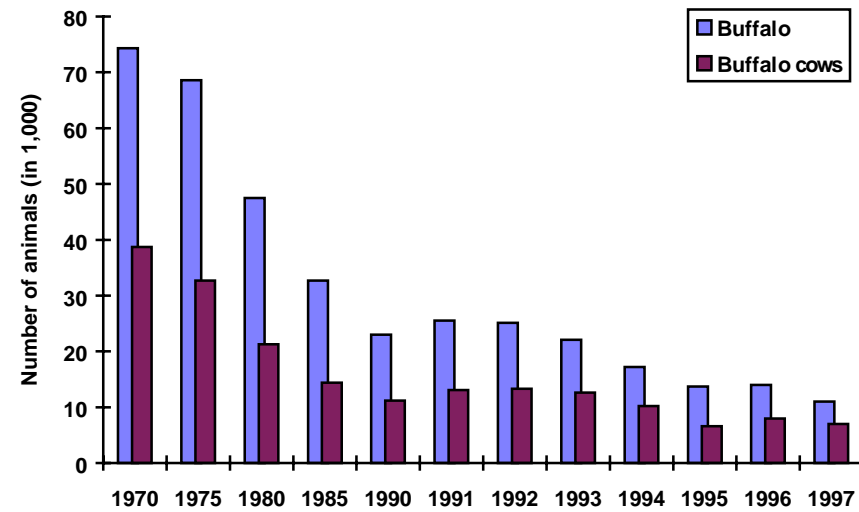
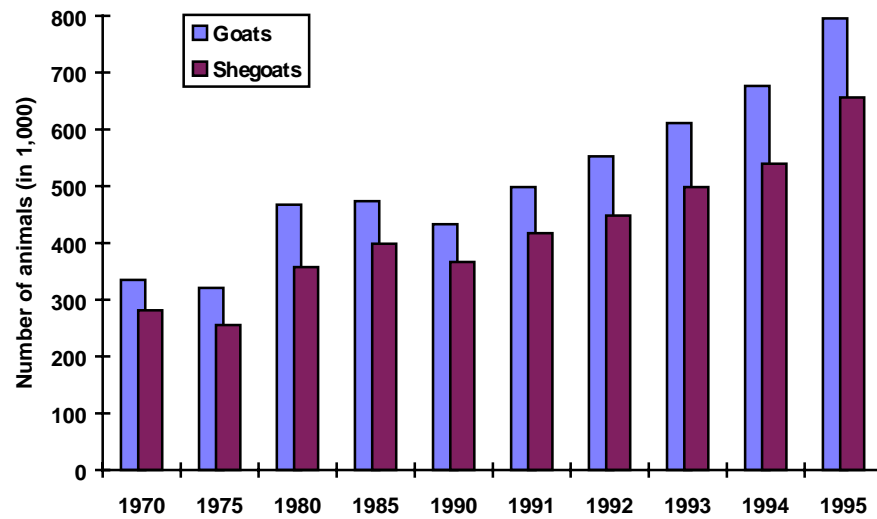
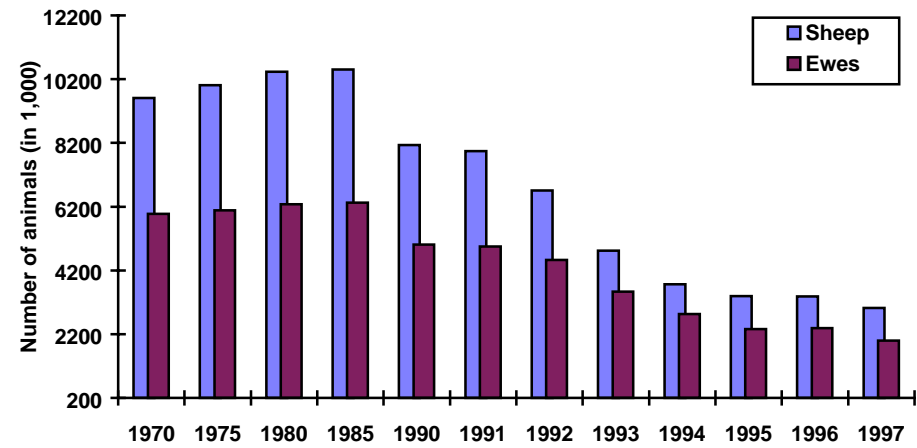
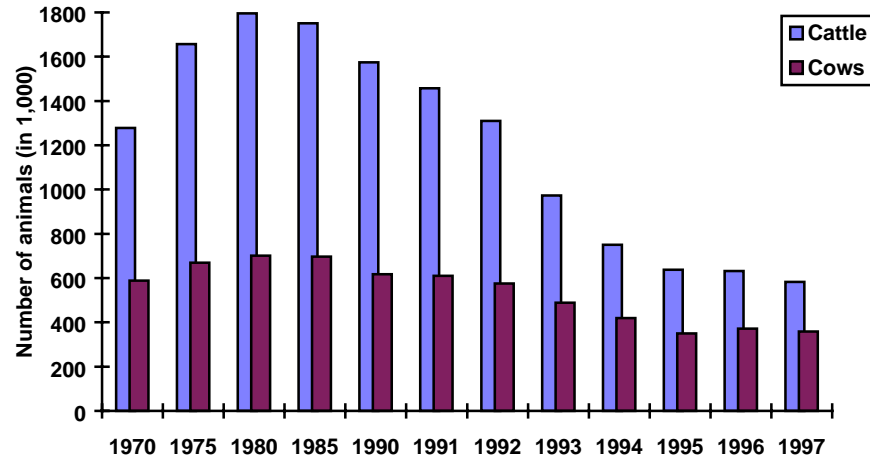
Source: Own figure.

Table A.26 Calculation of the optimal useful life of milk cows

lactation age		1	2	3	4	5	6	7	8	9	10
milk yield	kg/year	4,500	4,850	5,300	5,350	5,350	5,250	5,150	5,000	4,800	4,550
milk returns	DM	2,835	3,506	3,339	3,371	3,371	3,308	3,245	3,150	3,024	2,867
calf returns	DM	657	657	657	657	657	657	657	657	657	657
live weight of cull cows	kg	579	623	642	654	654	654	642	623	604	579
sales price	DM/kg	3.00	2.95	2.90	2.85	2.80	2.75	2.70	2.65	2.60	2.55
cull cow returns per year	DM	1,738	916	620	466	366	300	248	206	175	148
total returns	DM	5,230	4,631	4,616	4,494	4,394	4,264	4,149	4,013	3,856	3,671
replacement: (2,600 DM per heifer)	DM	2,600	1,300	867	650	520	433	371	325	289	260
costs for calf rearing	DM	117	117	117	117	117	117	117	117	117	117
concentrate costs	DM	212	271	346	355	355	338	321	296	263	221
costs for minerals	DM	65	65	65	65	65	65	65	65	65	65
other costs	DM	392	392	392	392	392	392	392	392	392	392
interest due for working capital	DM	130	133	134	134	133	132	130	128	125	122
total variable costs	DM	3,516	2,277	1,920	1,712	1,581	1,476	1,396	1,322	1,250	1,176
contribution margin I	DM	1,714	2,354	2,696	2,782	2,813	2,788	2,753	2,692	2,606	2,495
total costs for basic ration	DM	326	342	339	346	346	349	344	337	332	324
contribution margin II	DM	1,388	2,012	2,357	2,436	2,467	2,439	2,409	2,354	2,274	2,170
average of contribution margin	DM	1,388	1,700	1,919	2,048	2,132	2,183	2,216	2,233	2,237	2,231

Source: Based on STOCKINGER and STARK (1995).

Figure A.1 Number of dairy animals on 1st January



Source: Based on NSI (several issues): Statistical Yearbook of the Republic of Bulgaria.

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