Risk management in dairy farming

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Abstract: This paper applies an intelligent method for resource optimization on a livestock farm. This study is designed to provide information to dairy farmers who keep animals on pasture about the potential impact of triple milking on farm productivity and performance. To enhance milk production per cow, some dairy producers have started milking their cows three times a day.

The article shows a strategy to reduce financial risk. By increasing productivity on a cow farm, income is increased. Farm management is essential. If the farmer is familiar with cow farm risk management he can significantly increase his income, can reduce cow diseases and improve the overall functionality of the farm.

The idea behind triple milking is that it makes it possible to remove milk from the udder more frequently, which encourages the cow to yield more milk. Farmers try to optimize total milk production efficiency and maximize milk supply per cow by milking three times a day. It is proposed to increase milking from twice a day to three times a day, which increases milk yield and hence the profit of the cow farm. The annual income and costs of a cow farm are calculated and the benefits of the proposed method of increasing milk yield are shown. Advantages and disadvantages of three-fold milking are shown.

Key-words: triple milking, cow farm, milking, cow farm income, risk management

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1. Introduction

Evolving uncertainties, risks and crises related to the natural environment, technology, economic and political environment, as well as globalization, still pose a challenge to addressing risk management in the agricultural sector in Bulgaria. Risk management is often dependent on the economic activities and internal attitudes of farm managers. The methodological framework of the study includes a theoretical review of risk management in the agricultural sector, identifying sources of uncertainty and risk, the ability of farmers to use different risk management strategies, and the dependence of risk management on farmers' perceptions and government measures taken.

A risk is significant when there is a high probability that the risk event will occur and it is associated with high possible negative consequences (losses). The latter can take many forms - destroyed property and health of humans and animals, reduced yield and income, loss of market position. In a narrow sense, risk management involves individual, collective and societal action to reduce or eliminate a particular risk and its negative consequences.

Managing productivity on a farm is essential to risk management. High milk production, increases the farmer's profit. Choosing the right farm management strategy can increase profits, reduce costs and improve livestock health.

Cow's milk makes up about 85% of all milk produced worldwide; in some nations, including Austria, Great Britain, Denmark, Canada, etc., this percentage even reaches 99%. 82–88% of the milk produced in our nation comes from cows. The production of cow milk makes up 20% of livestock production and 9% of all agricultural production in our country. The production and utilization of cow's milk is advantageous because of its valued composition and high production efficiency. The world's most advanced dairy sector is derived from the intricate combination of several cow traits and the profitability of producing cow's milk:

- The highest feed to animal protein transformation efficiency is found in cow's milk production;
- Cattle are found almost everywhere in the world, growing under a variety of feed, environmental, and technological settings;
- The productivity of cow milk is at its peak (absolutely and relatively), which means that significant expenditures in structures, mechanization, and automation of production yield favorable returns. [12]

These facts allow for higher labour productivity in cow milk production compared to all other dairy animals. The economic performance of cow's milk farms depends on many production elements, but one of the main ones is the quantity (including average milk yield per cow) and quality of the milk produced.

The economic success of dairy cattle farms is influenced by a variety of factors, but when all else is equal, the volume of milk produced is quite important. This is mostly because a large number of what are known as "fixed costs" (such as buildings, equipment,

services, water, energy, etc.) go down as milk yield rises (for example, at 5,000 kg milk yield, the cost per kilogram of milk is nearly twice as low as at 2,000 kg milk yield). Feed is the other significant expense category, making up roughly 60% of the total. With a rise in cow milk yield, their proportional share and consumption per kilogram of milk likewise decline. This is because the amount of feed required to support life remains constant regardless of productivity, and the proportion of feed to output falls as milk yield rises. This is precisely the risk management strategy that leads to efficiency improvement. [12]

When the example in Table 2 is taken into consideration, the advantages of maintaining high-yielding cows become further clearer. It becomes evident that producing a certain volume of milk from fewer cows is more advantageous economically (for example, it is preferable to produce 9000 kg of milk from a single cow every year at a profit of 740 BGN as opposed to two cows at a profit of 186 BGN each, or 372 BGN total).

Table 1. Comparison of the financial results for the production of 6000 and 9000 litres of milk per year with different number of cows. (the data are based on n. Todorov, 2003)

Indicators	**6000 litres per year**		**9000 litres per year**	
	Two 3000 kg cows	**A cow with 6000 kg**	**Two 4500 kg cows**	**A cow with 9000 kg**
Feed costs, BGN/year	1320	1110	1717	1580
Other costs, BGN/year	980	800	1300	950
All costs, BGN	2300	1910	3017	2530
Cost per kg of milk	0,38	0,32	0,34	0,28
Income from milk	2100	2100	3150	3150
Income from calves	240	120	240	120
All income	2340	2220	3390	3270
Profit	40	310	373	740
Profit per cow	20	310	186	740

$$\text{All income} = \sum_{i=1}^{n} m \quad (1)$$

Where *m* is the individual income, *n* is the number of incomes.

$$\text{All costs} = \sum_{i=1}^{t} y \quad (2)$$

Where *y* is the individual costs, *t* is the number of costs.

$$\sum_{i=1}^{n} m - \sum_{i=1}^{t} y = profit \quad (3)$$

We find the profit by subtracting all expenses from all income. This gives us the profit per cow per year for three times and two times milking.

Some farmers find milking more frequently than twice a day to be an appealing alternative due to increased efficiency brought about by dairy automation and mechanization as well as the desire to take advantage of genetic selection advancements. The average reaction to raising the frequency from two to three times a day was 3.5-3.8 kg/day.[2]. In [4] is considered comparing twice-daily milking to three times in two days (3-in-2). Around the world, the majority of dairy cows are milked twice a day. To boost milk production, however, it is not unusual in intensive dairying systems to raise milking frequency to three to six times per day. Lowering the frequency of milking is much less usual; nonetheless, in major dairying countries where less emphasis is placed on milk production per cow, once-daily milking of dairy cows is not uncommon. [7]

One way to increase milk yield is triple milking. Increased milking has minimal effect in the early stages of lactation. Over time, the higher yields grew to the point that cows that were milked three times were 20% more productive than cows that were milked twice. [9]

On a German cow farm, they compared the current milk yield of their cows milked three times a day with last year's milk yield when they milked the cows twice a day. In the first week after switching from double to triple milking, the cows' milk yield increased significantly. By week 21, milk yields were rising and then stabilised at a higher level.

Cows milked three times produced 36.0 kg of milk per day, compared with a milk yield of 29.8 kg the previous year when milked twice. This corresponds to an increase in milk yield of 20 percent compared to last year's results. [11]

This growth is physiologically determined. Due to more frequent milking, the hormones responsible for milk production, especially prolactin, are stimulated more strongly. Consequently, the formation of secretory cells is stimulated and more milk is produced. Also, frequent milking reduces the internal pressure in the udder, thanks to which blood flows better through

the udder and this has a positive effect on milk synthesis. And in the very first weeks after the cows went back to double milking, the strongest drop in milk yield was recorded - by 2 kg per head per day. Milk quantity steadily declined until the last day of observation. Three daily milkings did not influence dry matter and calorie intakes, however three daily milkings of first lactation cows decreased weight increase over the lactation. The reproductive outcomes of cows milked twice a day and three times a day did not differ appreciably. Triple-milking herds will need strict nutrition and reproductive control. [3]

2. Material And Methods

At the same time, as milk intake increases, the fat and protein content decreases. On average, the protein content drops compared to the average from 3.83% to 3.43%. But due to frequent milking, the total fat increases by 11%. Milk production is also influenced by the method and number of milkings. This particularly affects the quantity of milk produced and its fat content. Thus, udder massage contributes to an increase in milk fat content. Fat content is also influenced by the time of milking - evening milk is fattier than morning milk. With the right risk management strategy, milk fat content can be increased. But if the intervals between milkings are small, morning milk may be fattier than evening milk. In addition, the first milk portions contain less fat than the last. [14]

The protein content increased by 3.38% to 3.23%. But total protein also increased by 16%.

Overall, cows improved fat and protein content in all lactations by 0.28 kg or 13%. With increased milking frequency, the total number of microorganisms in milk decreased by 21%. The presumed reason for this is that pathogenic bacteria were more rapidly "washed off" with more frequent milking.In early and late lactation, double milking decreases the secretion efficiency (units of milk per unit volume of the empty side of the udder) by 46% and 27%, respectively; this suggests that the mammary epithelium's decreased metabolic activity is at least partially to blame for the loss.[8]

Less milk is missed in the intervals between milkings and the risk of infection is reduced. As a consequence, there is significantly less mastitis disease. Mastitis affects 30 - 50% of dairy cows in European countries. They are the most costly disease in dairy cattle farming, with the causes of loss attributed to:

- Milk quantity losses - from reduced milk production of cows;
- From milk depreciation/scrapping due to lower milk quality;
- Treatment losses;
- From additional labour;
- From premature culling of cows.

The cost of medication and treatment on the farm for the last 6 months until the switch to triple milking amounted to €1500. For the same period after the switch to three times milking, only 410 euros were spent on udder treatment [13].

Farmers can also use milking robots. On dairy farms, milking robots can greatly boost productivity by automating the milking process. They eliminate the need for human work and enable farmers to better manage their time by enabling them to milk cows at any time of day or night. Robots that milk cows can enhance their well-being when used correctly. Because they may decide when to be milked, cows are less stressed and uncomfortable than they would be under strict milking schedules. Furthermore, early detection of health problems by robots improves the general health of the herd. The farmer receives data on the somatic cells of each quarter, which ensures that early measures can be taken to achieve a good health status of the cow. The sensors and software that milking robots are outfitted with track each cow's milk yield, frequency of milking, and other variables. [5, 6]

Better decisions about diet, breeding, and health care may be made by farmers with the use of this data, which will ultimately increase output and profitability. Although milking robots have a lot to offer, there is a hefty upfront cost. Robotic milking systems can be expensive to buy and install, and to keep them operating properly, regular software upgrades and maintenance are required.

The additional side effect of triple milking is better animal control. And this allows to react faster when a problem is found.

With the introduction of the third milking, there is also additional cleaning of the lying stalls and the aisles, which also improves the health of the cows.6]

Due to the increased milking rate, feed consumption increased by 13%. While before the transition cows consumed on average 18 kg of dry matter per day, after the transition consumption increased to 20.3 kg. A reduction in labor expenses, a drop in feed prices, and an increase in herd productivity all helped to reduce the percentage increases needed to cover the variable costs and feed of milking three times a day in order to match the income from this practice. [1]

3. Results and discussion

Many cattle farmers periodically switch from double to triple milking, as this increases the milk yield of their farm.

This increase is physiologically determined. Due to more frequent milking, the hormones responsible for milk production, especially prolactin, are stimulated

more strongly. As a consequence, the formation of secretory cells is stimulated and more milk is produced. Also, frequent milking reduces the internal pressure in the udder, thanks to which blood flows better through the udder and this has a positive effect on milk synthesis. In addition, cows milked 3 times are healthier.

Milk production remains at a higher level throughout the lactation period compared to cows milked 2 times. In young cows, lactation milk yield was only 625 kg, corresponding to an 8% increase in productivity. In the second lactation cows, this figure was 530 kg (+5.8%). [13]

Table 2 shows the annual costs of feed, medicine, fixed costs (buildings, mechanisation, services, electricity, water, etc.) per cow. The total annual cost per cow for two and three times milking is calculated. Feed costs are more for the three times milking, which is expected. The cost of drugs in double milking is twice as much as in triple milking due to reduction in incidence of mastitis in cows. Fixed costs are slightly higher in triple milking as more electricity, labour and water are used. The total annual costs for double milking are 7700lv and for triple milking 8750lv.

The additional third milking leads to an increase in costs of about 1100 BGN per cow per year: for water, electricity, disinfectants, repairs and staff costs.

Table 2. Double and triple milking costs (2023)

	Forage costs	**Medicines**	**Fixed costs**	**Total cost**
Double milking	3900	1300	2500	7700
Triple milking	4500	650	3600	8750

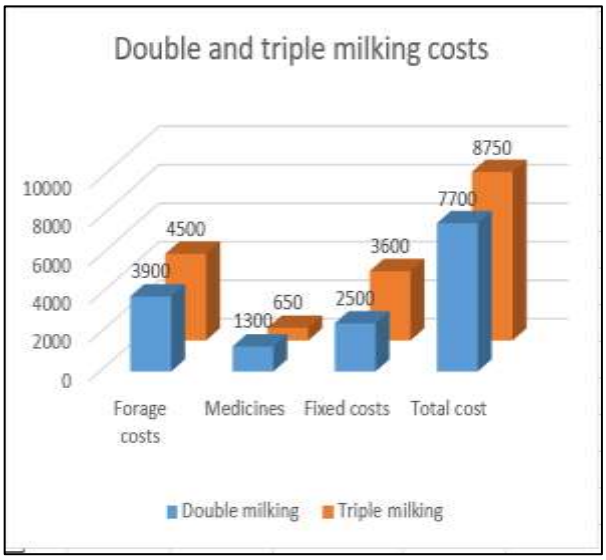

Diagram 1. Costs of double and triple milking

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Table 3 shows the income, expenditure and profit for one year per cow for triple and double milking. It can be seen that with three times milking the income is about 20% more than with two times milking.

Table 3. Income and expenditure for double and triple milking.

	Income	**Expense**	**Profit**
Double milking	8700	7700	1000
Triple milking	10500	8750	1750

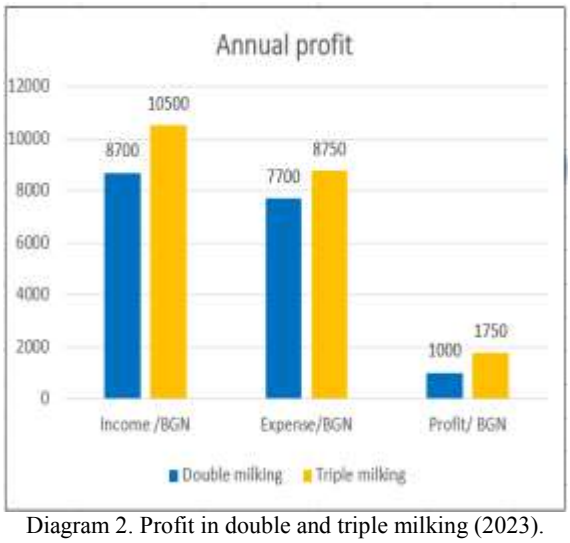

Diagram 2. Profit in double and triple milking (2023).

Taking these conditions into account, milking three times pays off with a 15-20% increase in milk yield. The condition for this is the right management, which is also mandatory for double milking.

4. Conclusion

As risk management is increasingly seen as an activity aimed at studying and managing both the positive and negative effects of an event. Risk management increases the likelihood of success and simultaneously reduces the likelihood of failure and uncertainty in achieving the overall objectives of the organization. Risk management should be a continuous and evolving process, an integral part of organisational strategy and its direct application. The purpose of risk management is to consistently examine the risks associated with the organisation's activities over its past, present and, most importantly, future. Once the risks have been analysed, they should be compared against the criteria that the farm has established. The risk criteria may contain associated cost and revenue estimates, regulatory requirements, socio-economic and environmental factors, stakeholder interests, etc. A qualitative risk assessment allows prioritising risks by their level of importance and determining for each risk whether it should be retained or transferred.

Triple milking entails more frequent milking sessions and more attention to the health and welfare of the cows, which means more work and resources are needed. Furthermore, careful planning and supervision are essential to guarantee that the more frequent milking does not cause overwork or stress in the cows.

Triple milking may increase the amount of milk produced per cow, but its viability and efficacy rely on a number of variables, including the breed of the cows, their health, their diet, and the farm's general management techniques. Before introducing triple milking into their dairy operations, farmers must carefully consider the advantages and potential disadvantages of this agricultural technique.

It is clear from the calculations that it is more economically viable to produce a certain amount of milk from fewer cows. Many cattle farmers periodically switch from double to triple milking as this increases the milk yield of their farm. Although there is an increase in some costs, triple milking increases milk production and therefore income for cow farmers. An even more important consequence of three-parlour milking is cow health; there is a reduction in disease incidence with this type of milking.

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