CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

Department of Economics

B A C H E L O R T H E S I S

ECONOMIC ANALYSIS OF SMALL DAIRY FARM IN SUMAVA

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BACHELOR THESIS ASSIGNMENT

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Economics and Management

Thesis title

Economic analysis of small dairy farm in Sumava

Objectives of thesis

To do a complete economical breakdown of a small, privately owned dairy farm in the Bohemian Forrest in the Czech Republic. Looking at milk as an inelastic commodity, evaluate the future business outlook and potential profitability considering the growing population. Examine how to cut farming costs and maximize milk production in order to maximize profits.

Methodology

Calculate and examine all costs and all income. Calculate profit per hectare, per cow, and per liter of milk. Examine how profit changes when one or more of these variables also changes. Identify which farming practices can be reduced, replaced by a less expensive alternative, or even removed all together if they are uneconomical, by conducting experiments and creating alternate cost scenarios.

The proposed extent of the thesis

35 pages

Recommended information sources

Caldwell, G. The Small-scale Dairy: The Complete Guide to Milk Production for the Home and Market. 2014. Chelsea Green Publishing Co. 256 pages.
Eckles, C., & Anthony, E. Dairy Cattle and Milk Production. 2007. Daya Publishing House. 606 pages.
Sanders, D. Dr. Sanders' Guide to Boosting Dairy Profits. 1990. Mosby. 298 pages.
Throup, G. Making Profits with Dairy Cows and Quotas. 1994. Farming Press Books and Videos. 300 pages.

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Declaration

I declare under penalty of perjury that I myself elaborated the bachelor thesis "Economic Analysis of a Small Dairy Farm in the Bohemian Forrest" independently and all citations and sources are properly marked in the text. All used literature and background materials are cited in the references section. At the same time, I agree that this work may be accessed in the CULS library and used for educational purposes in accordance with copyright.

In Prague on …… ……

Dominik Vlasák

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I would like to thank Ing. Petr Procházka MSc, Ph.D. for the supervision of my thesis, the guidance he provided, and for believing in me. Furthermore, I would like to thank my grandfather; František Jarolím, my grandmother; Marie Jarolímová, and my uncle; Ing. František Jarolím, for their expert advice, the information they provided, and their help collecting data. Lastly, I would like to thank Bc. Lucie Podzimková for her nurturing care and support during the writing of this thesis, as well as for the assistance in translating the abstract from English to Czech.

Economic Analysis of Small Dairy Farm in Sumava

Ekonomická analýza malé mléčné farmy na Šumavě

Abstract

This bachelor thesis looks at the economics analysis of a small dairy farm in Šumava (the Bohemian Forrest) in the Czech Republic. In order to be most economically efficient at producing milk, one must have Holstein cows, the best milk producers in the world. With global milk production, global milk consumption (including global milk consumption per capita) steadily increasing, it is no wonder that the future of dairy farming looks positive. Along with the global population increasing and agricultural area decreasing, potential profitability is favorable. Even with European Union milk quotas coming to an end, they should not affect milk sales in Šumava because milk is an inelastic commodity and cannot be directly replaced. Total revenue of the farm for the year 2014 is 2,037,744 CZK. Total cost is 1,568,248 CZK, which leaves a profit of 469,496 CZK for 2014. Costs can be minimized by changing feed supplements suppliers, stopping the unnecessary idling of tractors, and by pre-cooling milk with tap water. Revenue can be maximized by increasing milk revenue and providing cows with artificial light in order to produce more milk, therefore maximizing profit.

Keywords: milk, small dairy farm, cost minimization, revenue maximization, profit maximization

Abstrakt

Tato bakalářská práce je zaměřena na ekonomickou analýzu malé dojné farmy na Šumavě. Pro nejvíce profitabilní a účinnou produkci mléka se farmy v této oblasti musí zaměřit na chov nejužitkovějšího mléčného plemene skotu - Holštýnský skot. Vzhledem k tomu, že spotřeba mléka napříč celým světem stoupá (včetně celosvětové spotřeby mléka na osobu), není divu, že vyhlídky do budoucna jsou v tomto odvětví pozitivní. S ohledem na neustálý prudký nárůst populace a na klesající rozlohu zemědělské půdy vypadá budoucnost vzhledem k ziskovosti také příznivě. I přesto, že mléčné kvóty Evropské unie se chýlí ke konci, odbyt mléka ze Šumavy by neměl být ohrožen a to díky faktu, že mléko je neelastická komodita, kterou není možno přímo nahradit. Celkové přijmy farmy za rok 2014 činí 2,037,744 Kč. Celkové náklady činí 1,568,248 Kč, z čehož vyplývá zisk 469,496 Kč pro rok 2014. Náklady lze mimnimalizovat změnou krmných doplňků, omezením zbytečných volnoběhů u traktorů, a předchlazováním mléka vodou z vodovodu. Přijmy lze maximalizovat zvyšováním příjmů z mléka a pro zvýšení produkce mléka poskytovat umělé světlo pro dojný skot.

Klíčova slova: mléko, malá dojná farma, minimalizace nákladů, maximalizace výnosů, maximalizace zisku

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1. Introduction

Milk is what makes the world go round, more specifically: cow's milk. Genuine cow milk must be produced the old-fashioned way, through the mammary glands of female cattle only after they have given birth to their first calf. On a small dairy farm in the Bohemian Forrest, milk is harnessed through blood, sweat, and tears. Also incorporated are several millions of Czech Crowns worth of machinery, structures, and farmland. Lastly, the whole farming operation would not be possible without the seemingly endless hours and never ending financial investments that the owners put in to the business.

In any privately held company, but especially on a dairy farm of such small magnitude, the owner can either make it or break it. There is a fine line between having a profit of 100,000 CZK; and having a loss of 100,000 CZK. All it takes is a few mistakes and this almost quarter million Czech Crown profit difference quickly becomes a reality.

Although it may seem obvious, it is important to mention and remember that this business deals with livestock on a day-to-day basis. This means dealing with *living, breathing* animals that are incapable of communicating what they need or what is wrong with them. This is where the invaluable knowledge of the farmer comes in to play, and is often the deciding factor in how successful the farm is. This thesis was formulated in order to do a full in-depth economic analysis to determine all costs and revenue in order to gain a better understanding of the farm's profit, and how to maximize it. This will not be a simple feat, given that the owner has been continuously attempting and fine-tuning the same task for over 20 years. This is much more than just merely summarizing the business and simply saying that it should use less fuel to reduce costs, or that it should produce more milk to increase revenue. This is making substantial discoveries and paving the road to be not only a more successful business, but to become a more profitable business at that.

2. Thesis Objectives and Methodology

2.1. Objectives

The objective of this thesis is to do a complete economical breakdown of a small, privately owned and operated dairy farm in the Bohemian Forrest in the Czech Republic. Looking at milk as an inelastic commodity and considering the growing population, the future business outlook will be evaluated in order to assess potential profitability in the forthcoming years. Also crucial to take into account and understand are the milk quota regulations in the European Union. It is essential to analyze the top producers in the European Union that are being limited by these quotas, and predict what will happen to the milk industry within the Czech Republic after the quotas are lifted. Nonetheless, the ultimate goal is to examine how to cut farming costs and maximize milk production and milk quality, in order maximize profits as much as possible.

2.2. Methodology

The methodology of this thesis consists of calculating and examining all costs and all revenue in order to gain understanding of which costs and revenue are responsible for affecting final profit. After it is determined which specific costs and revenue have the highest share of total costs and total revenue, it will become obvious which costs should be concentrated on to attempt to cut them down, and oppositely; which sources of revenue can possibly be increased. This will be executed by identifying which farming practices can be reduced, replaced by a less expensive alternative, or even discarded all together if they are uneconomical. Potential cost reduction and profit expansion will be carried out by conducting experiments and creating alternate cost and revenue scenarios. Finally; profit per hectare, per cow, and per liter of milk will be calculated as to examine *how* and *why* profit changes when one or more of these variables also changes.

3. Literature Review

3.1. Milk and Cattle Origin and Summary

3.1.1. Milk and Cattle Origin

Cow milk has been produced and consumed by human beings since the beginning of cattle domestication. Exactly when, where, and by whom cows were first domesticated and milked is unknown. This is due to the fact that it took place during prehistoric times. As with any domestic type of animal, there are countless different breeds of dairy cows, but the dairy producing breed is the Holstein-Friesian breed, simply referred to as "Holstein." The breed derives its name from its place of origin; it originated in the country of Holland, specifically in the province of Friesland. The Holstein breed is without a doubt the world's highest-production dairy breed. They are full of nervous energy (which is necessary for intensive dairy production), and they are also known for having the best disposition of any dairy breed, which makes them a pleasure to work with. [1]

3.1.2. Milk and Cattle Summary

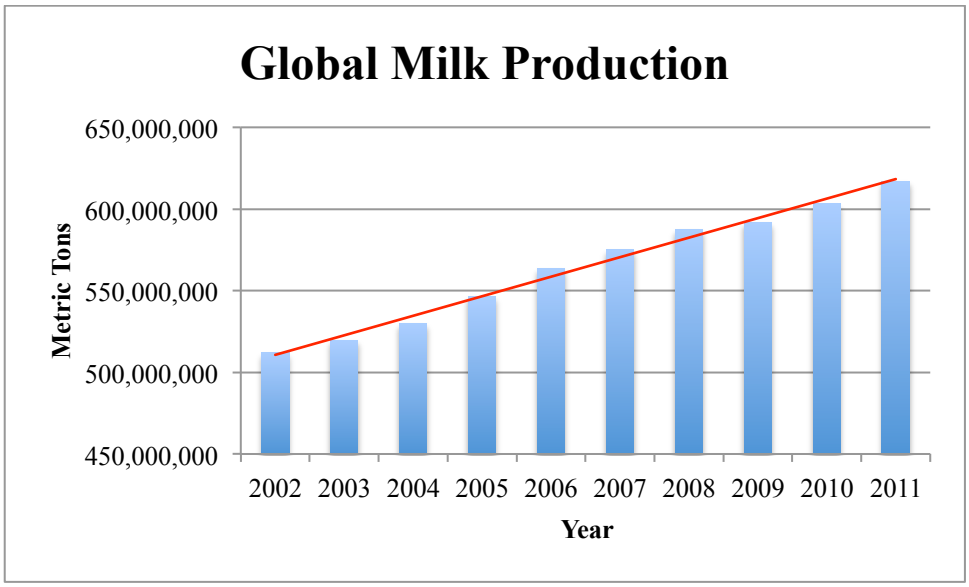
Not only is the Holstein the world's highest milk production cow of any dairy breed, it is also the most economical producer of milk. Another popular dairy breed is the Polled Jersey, simply known as "Jersey." Compared to Holsteins, Jersey cows are smaller and produce much less milk than Holstein cows. Although the milk Jersey cows produce has a slightly higher fat concentration, Holsteins produce more total kilograms of fat from milk per year than Jersey cows do, as has been proven in the past. An experiment conducted on 83 Holstein cows in America recorded an average of 3,986 kilograms of milk per year with an average fat content of 3.45%. This equates to roughly 137 kilograms of fat from milk per year. The Jersey breed on the other hand, recorded an average of 1,844 kilograms of milk per year, with an average fat content of 4.66%. This translates to only 86 kilograms of fat from milk per year. With this, Holsteins produce more milk on average and at a cheaper cost for 100 kilograms of milk than any other breed. [1]

3.2. Global Milk Production and Milk Consumption

3.2.1. Global Milk Production

In the year 2012, approximately 625,753,801 metric tons of whole fresh cow milk was produced globally. With a total market value of over 187 billion USD, this stands as the number one most expensive food and agriculture market commodities for 2012. The top five countries responsible for this production are the United States of America, India, China, Brazil, and the Russian Federation. [2]

Figure 1: Global Milk Production (2002-2011)



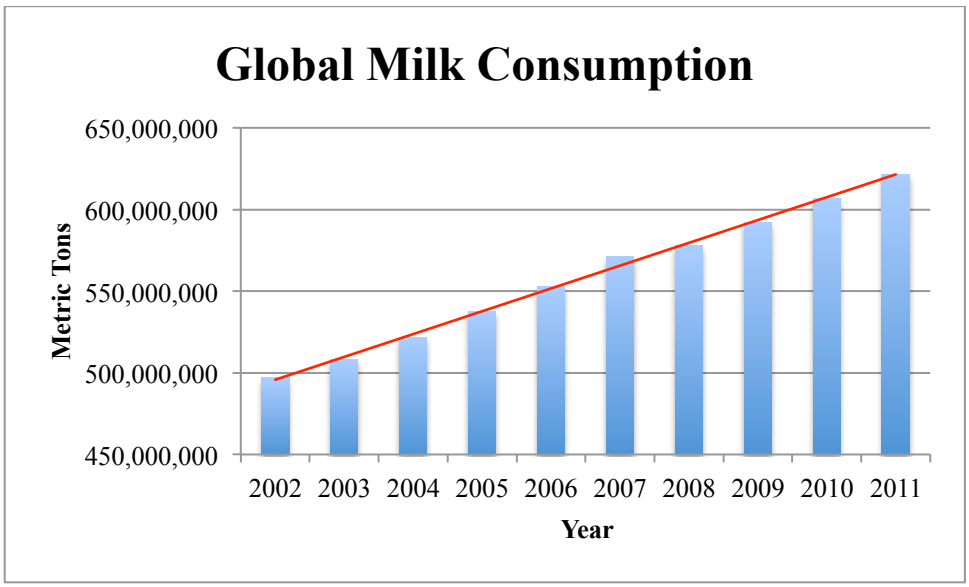
Source: FAOSTAT (2014, own creation)

As Figure 1 illustrates, global milk production has been steadily rising for at least the last 10 years.

3.2.2. Global Milk Consumption

In the year 2011, roughly 621,605,000 metric tons of cow milk (excluding butter) was consumed globally. [13] The top five milk-consuming countries as of 2007 are: Finland, Sweden, the Netherlands, Switzerland, and Greece. [3] The United States Department of Agriculture recommends at least 700 milliliters of dairy intake per day. [4]

Figure 2: Global Milk Consumption (2002-2011)

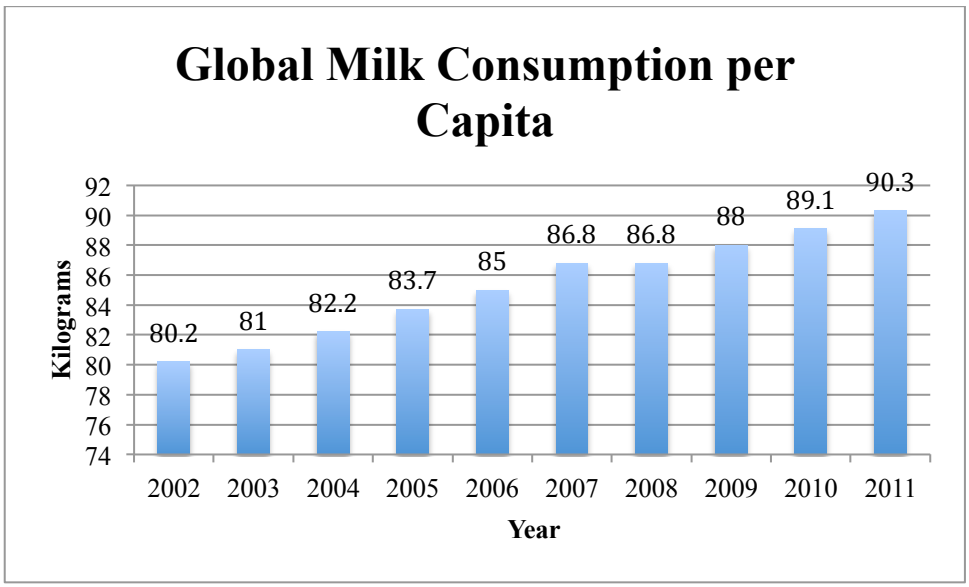


Source: FAOSTAT (2014, own creation)

As Figure 2 illustrates, global milk consumption has been consistently increasing for at least the last 10 years. Milk consumption has actually been rising at a faster rate than milk production itself.

Not only have milk production and milk consumption been increasing, milk consumption per capita has also been steadily rising. As of 2011, global milk consumption per capita is at 90.3 kilograms. This number has increased by more than one kilogram of milk per person since 2010, up from 89.1 kilograms per capita. [9]

Figure 3: Global Milk Consumption per Capita (2002-2011)



Source: Statista (2015, own creation)

3.3. Growing Global Population and Diminishing Availability of Agricultural Area

3.3.1. Growing Global Population

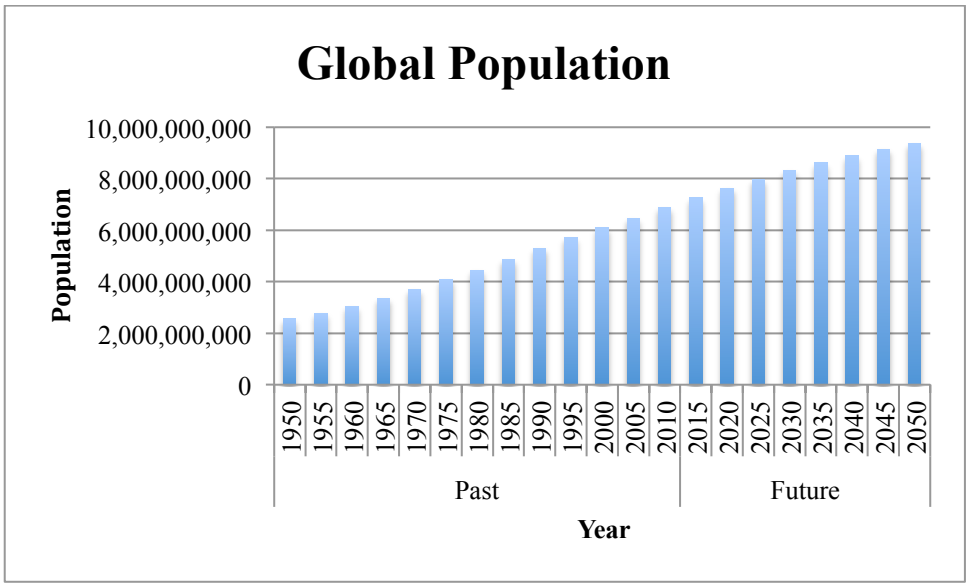
In just the short time that it takes to read this sentence, 48 people have been brought onto this planet, and 20 people have perished, leaving a net gain of 28 extra people. Every single day, approximately 381,000 human beings are born, roughly 157,000 pass away, resulting in a daily global population growth of 224,000 people. This equates to an annual worldwide population increase of 81,760,000 humans. [5]

During the mid of 2014, the worldwide population on Planet Earth was around roughly 7,176,023,055 beings. With Earth's land area at 132,061,547 square kilometers, this equates to a population density of 54.3 persons per square kilometer. [7]

At the time of this writing, the world population is almost 7,299,000 humans. [8] It is estimated that the eight billion person milestone marker will be reached in the beginning of the year 2026. The nine billion human milestone is to be reached approximately in the

summer of 2042. [7] Finally, the 10 billion person jubilee milestone should be reached in 2062. [5]

Figure 4: Global Population (1950-2050)



Source: United States Census Bureau (2015, own creation)

Population growth is defined in biology as the increase of the number of individuals in a given population, in this case, Planet Earth. Population growth is calculated by subtracting the number of perished individuals in a given time period (for example: one day, one year, etc.) from the number of born individuals during the same time period. If the number is positive, the population has grown. If the number is negative, the population has decreased. [6]

Equation 1-1: Population Growth

$$\boldsymbol{PG = B - D}$$

Where:

- B = births
- D = deaths

Population growth rate is defined as the rate at which the number of individuals in a population increases in a given time period as a fraction of the initial population. Population growth rate refers to the change in population over a unit time period expressed

as a percentage of the number of individuals in the population at the beginning of that period. [6]

Equation 1-2: Population Growth Rate

$$\boldsymbol{PGR = \frac{P(t_2) - P(t_1)}{P(t_1)}}$$

Where:

- $P(t_1)$ = population of time period one
- $P(t_2)$ = population of time period two

The one billion human being population mark was reached in the year 1804, with the two billion mark coming in 1927, which took a total of 123 years. Before one billion people had been reached, it had taken the whole era of human history, more than 8,000 years total. The six billion milestone was reached on July 22, 1999, and the seven billion milestone was reached on March 12, 2012. The same billion extra people that took 123 years in 1927, now took less than 13 years in 2012. [5]

While the population is steadily increasing, the rate at which the population is growing is actually slightly decreasing. The current population growth rate is currently at about 1.14% annually. The global growth rate reached its peak in 1963, at approximately 2.19%. Therefore, the rate of population increase has almost halved since 1963, and it is projected to continue to decline in forthcoming years. Currently, it is projected the global population growth rate will be less than 1% by 2020, and will continue to decrease to less than 0.5% by 2050. Most recent calculations state that the world population will nearly stabilize at just above 10 billion persons around 2062. [5]

3.3.2. Diminishing Availability of Agricultural Area

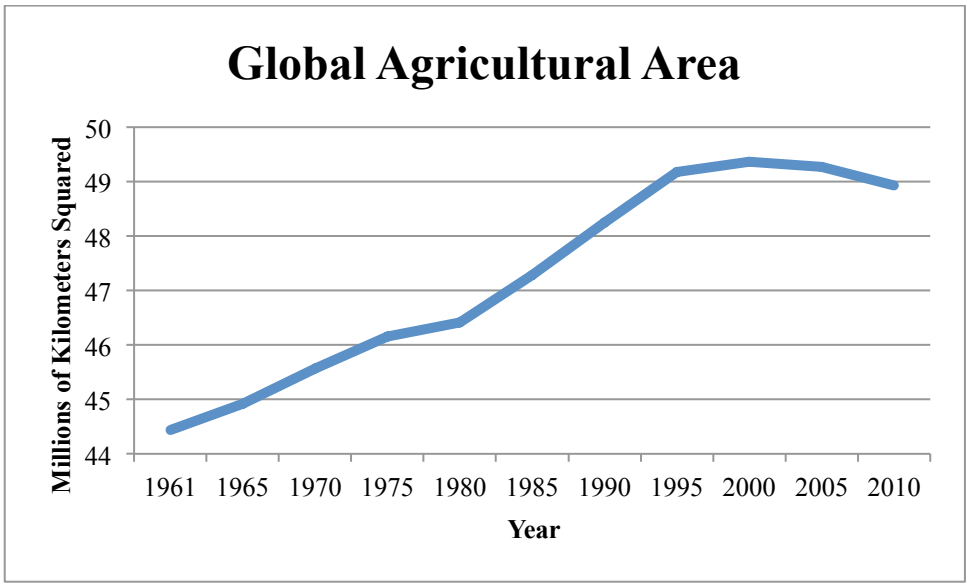
Making up about 29% of the surface, the land on Planet Earth is limited, and with the other 71% being water, this means that less than one third of Earth's surface is even *physically* capable of being used for agricultural purposes. [10]

Out of Earth's total approximate surface area of 510 million square kilometers, only around 149 million square kilometers is composed of land. Merely 11.58%, or about 17.25 million square kilometers, of this physical land has the characteristics and attributes of being used for agricultural purposes. [10]

Agricultural area is defined as land that includes:

a) Arable land (capable of being plowed) - land under temporary agricultural crops (typically less than five years)
b) Land under permanent crops - land cultivated with long-term crops which do not have to be replanted for several years
c) Land under permanent meadows and pastures - land used permanently (typically five or more years) [11]

Figure 5: Global Agricultural Area (1961-2010)



Source: FAOSTAT (2014, own creation)

From the year 1961 until about the year 2000, global agricultural area has been steadily expanding. However, it is not until recent years that it has started decreasing, with the years 2005 and 2010 exhibiting lower total worldwide farming area than was previously recorded. [12]

3.4. European Union Milk Quotas

A milk quota is defined as a supply control measure put in place to limit the volume of milk produced or supplied. Milk quantities up until a predetermined specified quota benefit from full market price support. Over-quota volumes may warrant penalty by a levy, as in the European Union, where the "superlevy" is 115% of the target price. [14]

Milk quotas were introduced in the European Commission on April 2nd, 1984. Quotas were allocated to farms producing milk or other milk products in order to restrain rising milk production. Originally they were introduced for a five-year period, but this has subsequently been extended many times. [15]

Previously, when milk quotas were introduced, they were allocated on the basis of a farmer's land holding. Farmers that wished to increase their milk sales without having to pay a levy were required to attain additional quota from other quota holders through either purchase or lease. If and when a farmer happened to acquire additional land to which a milk quota was attached, a new holding was formed comprising of the original land plus the newly obtained land, with enhanced quota. [15]

According to European Union Council Regulation No. EC 1234/2007, Articles 66 and 204 point 4, the continuation of milk quotas for seven additional years from April 1st, 2008, will officially and permanently be abolished on March 31st, 2015. [17] It is imperative to decipher what the end of milk quotas means for small dairy farms in the Bohemian Forrest.

4. Analysis and Interpretation

4.1. Costs

As shown in Table 1, a list of all farm costs for the year 2014 are itemized and listed. Because a tractor and some other expensive farming equipment were purchased in the last several years, the depreciation of fixed assets is relatively high. The second highest cost in 2014 however, is feed, followed by fuel, veterinary costs, and electricity.

Table 1: Cost Breakdown for 2014 (in CZK)

Depreciation of fixed assets	808,618
Feed	345,413
Fuel	127,885
Veterinary	72,883
Electricity	54,280
Repairs and maintenance	30,750
Netting and wrap	20,180
Molasses	19,581
Insurance	19,448
Artificial insemination	12,123
Artificial fertilizer	9,582
Brewer's yeast	9,280
Paperwork	7,900
Disinfectant	7,683
Minerals	6,460
Combine harvesting	6,004
Powdered milk	5,830
Seeds	4,348
Total costs	1,568,248

Source: own creation

4.2. Cost Minimization

4.2.1. Substituting Feed Supplements

Aside from depreciation of fixed assets, cattle feed is the most expensive cost per year. At almost 1,000 CZK per day, this is a roaring cost. That is why it was one of the most important costs to attempt to reduce.

After deciding that the cost of feed from the farm's original supplier was too high, it was decided to change to a different, less expensive supplier and begin feeding a completely different type of supplement. The name of this supplement is TMR Balance Mix, from a new company called De Heus. Not only would five separate supplements completely cease to be purchased and fed, but they would be replaced by this new, universal supplement, that would serve as a substitute for even more than just the five supplements that were being fed at the time of the supplier and supplement change.

Table 2: Total Daily Cost of Old Supplements (in CZK)

Old supplements	Cost per Kg. (CZK)	Kilograms	Cost per Day (CZK)
Brewer's draff	5.217	20	104.34
Citrus pellets	5.217	20	104.34
Groat (own)	3.913	50	195.65
Oilseed rape	7.826	30	234.78
Rye bran	1.739	20	34.78
Soy	1.303	20	26.06
Total		160	699.95

Source: own creation

As illustrated in Table 2, there were five mandatory supplements to be fed. On top of this, 50 kilograms of the farm's own-grown cereal grain must be added after it is milled (crushed) into groat. At a total of 160 kilograms of supplements per day, coming out to almost 700 CZK daily, this is a cost that must be tamed.

Table 3: Total Daily Cost of New Supplements (in CZK)

De Heus supplement	Cost per Kg. (CZK)	Kilograms	Cost per Day (CZK)
Groat (own)	3.913	50	195.65
TMR Balance Mix	8.609	110	946.99
Subtotal		160	1,142.64
Groat (own)	3.913	-15	-58.695
Total		145	1,083.95

Source: own creation

Despite the fact the new supplement feed is more expensive in the short-haul, as seen in Table 3, it may come as a big surprise in the long run. While the cost of the supplement itself is more expensive than all of the old supplements combined, the promises the feed brings are almost revolutionary. Not only should milk production and milk quality *both* increase, but overall general health of the herd should also improve.

As soon as the new supplement arrives, it slowly begins to be fed as the old, dwindling feed supplies run out, as to prevent the cows from becoming ill due to an abrupt diet change. Soon enough, the results are uncanny. After one month, there is a four to five liter increase in milk production per cow and the cows are visibly healthier. After a few months of milk production steadily rising, it finally tapers off at about an extra six liters of milk per cow. With the old supplements, the cows milked between 22 and 26 liters of milk per day per cow. With the new supplements, not only are the cows healthier, but they improve milk production to between 28 to 32 liters of milk per day per cow. With an increase in milk production of roughly six liters of milk per day per cow, with 16 cows, this equals roughly 96 extra liters of milk per day. Knowing the average milk price in 2014, this means an extra *daily* revenue of about 1,038 CZK.

Not only does milk production and milk quality increase, thereby increasing revenue, but costs also decrease. With the new feed supplement, it allows the farm to feed 15 kilograms of groat less than it did with the old supplements. With cereal grain at a price of almost 4 CZK, this saves almost 60 CZK per day just on groat.

Lastly, another benefit of the new supplement is that there is less of it being fed in total than there was before. Fifteen kilograms per day does not seem like much, but

annually this adds up to almost 5.5 tons of extra loading. With the new supplement, the farm will also save time and labor by not having to load as much groat.

All in all, the new feed supplement is 384 CZK more expensive per day than the old supplement. But after calculating the extra revenue from the milk, and lower costs thanks to less grain being fed, the increase of profit is 654 CZK per day. Annually, this means an extra profit of 238,710 CZK.

4.2.2. Stopping Unnecessary Tractor Idling

Although it may seem obvious to stop unnecessary tractor idling at a farm in Sumava, it is a common mistake that happens all too often. Experts say that idling alone can account for 15% to 20% of total fuel used. For example, letting a 75 horsepower tractor idle for an average of 10 minutes per day, is equal to 61 yearly hours of unnecessary idling. This means that about 117 liters of diesel are completely wasted every year. [18] Knowing the average diesel price for the year 2014, this means that 3,054 CZK was wasted last year alone.

4.2.3. Automatic Milk Pre-Cooling System

As a gift, a small dairy farm in Sumava received a device from an acquaintance in order to pre-cool the milk completely free of charge as it travels throughout the barn in the milk pipeline before it is dispersed into the milk tank.

Figure 6: Automatic Milk Pre-Cooling System

Source: Ing. František Jarolím

When the milk vacuum pump is turned on, there is an electronic activator switch that lets in cold water into a stainless steel chamber surrounding a separate chamber through which milk passes through. As the warm milk comes into indirect contact with the cold water, the milk temperature drops approximately 3º Celsius. This shortens milk-cooling time, which reduces electricity cost, which in turn maximizes profit.

In 1935, the municipality in charge of the village where the farm is provided them with a new and complimentary public water supply. With 88% of milk consisting of water, besides the fact that would milk production be impossible without Mother Nature's gift of water, it would be more expensive as well.

4.3. Revenue

As seen in Table 4, all farm revenue for 2014 is shown.

Table 4: Revenue Breakdown for 2014 (in CZK)

Goldsteig milk	1,562,628
Grants	342,303
Cattle	80,131
Private milk	47,600
Diesel excise tax return	5,082
Total revenue:	2,037,744

Source: own creation

By far, milk sold to the Goldsteig processing plant is without a doubt is the largest contributor of revenue on a small dairy farm in Sumava. For the year 2014, Goldsteig milk revenue was in the amount of 1,562,628 CZK for a quantity of 144,585 liters. This means that the average milk price per liter was 10.808 CZK.

As the second largest source of revenue, grants brought in 342,303 CZK for the year 2014. At a total of 25.04 hectares of land, this equates to about 13,670 CZK per hectare of land. This amount varies depending on a number of given factors including soil type, soil rockiness, and terrain type. Although the government gives farmers grants for land they farm on, there are certain regulations farmers must adhere to. One of these is that there are two specific calendar dates by which the grass must be cleared by; a first and second time. The government conducts remote aerial photographs and can tell if the grass is not cut or not. Yet another requirement in order to receive grants is livestock units. In order to qualify for the grant, farmers must have a livestock unit of 0.2 to 1.5 per hectare. For calves up to six months old there is a 0.3 livestock unit, for heifers six to 24 months old there is a 0.6 livestock unit, and for cows over 24 months old there is a livestock unit of one.

The third biggest source of revenue on the farm is thanks to cattle sales. The only instances in which cattle are sold are when there are male calves born (only female calves are kept and reared), when there are too many heifers or cows (unable to all fit in the barn),

or when a cow gets old and stops producing milk. Cattle sales in 2014 were responsible for 80,131 CZK of revenue for the farm.

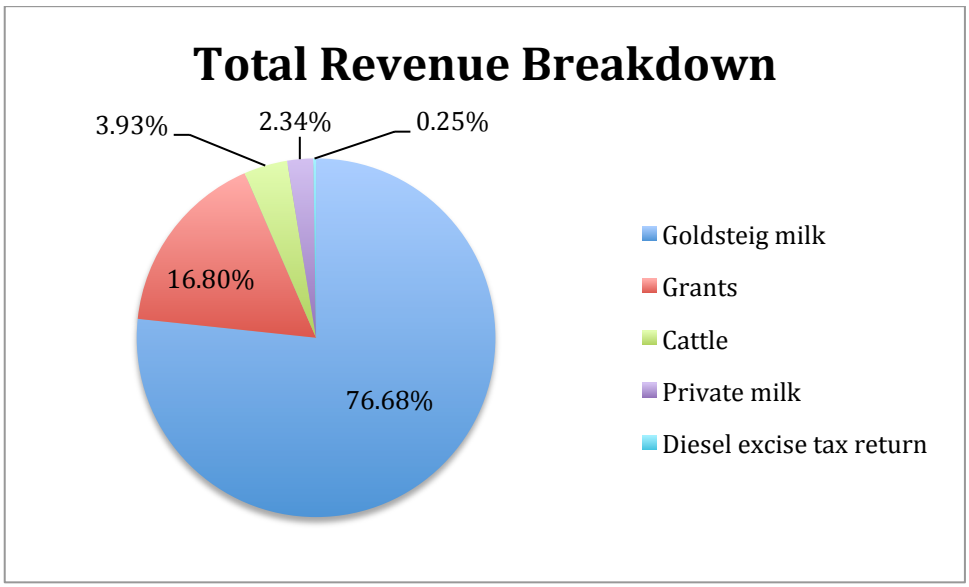
Annually, a revenue of 47,600 CZK is made through private milk sales, making it the fourth largest source of revenue. Although it is a relatively small share of revenue compared to Goldsteig milk sales for example, private milk sales are the only source of revenue that the farmer can directly affect, just by adjusting the price of milk per liter.

The final and fifth largest source of revenue is the diesel excise tax return. The diesel excise tax return in the Czech Republic is 10.95 CZK per liter of diesel. Of this 10.95 CZK, the farm is eligible for a 40% return, which means that 4.7961 CZK per liter is returned on eligible liters of diesel. Not all burnt diesel is eligible for the diesel excise tax return, only diesel burned during tractor fieldwork may be requested for a return. There are several complex exceptions as to what may or may not be included in fieldwork; for example, the transport of already prepared fodder to a storage location is forbidden to be included. On the contrary, the transport of already prepared fodder to a collection point is allowed to be included. On top of this, there are certain limits as to how much return may be filed for, depending on the total area of farming area being utilized.

Although the diesel excise tax return is the smallest source of revenue on a small dairy farm in Sumava, it is an important one, as it is worth more than a day's of Goldsteig milk revenue. Although it requires additional paperwork, thus labor, but it would be wasteful not to take advantage of this opportunity.

All together, the total revenue of the farm for the year 2014, was 2,031,535 CZK.

Figure 7: Total Revenue Breakdown (2014)



Source: own creation

As shown in Figure 7, more than three quarters of revenue on the farm is made from milk sales to Goldsteig. As nearly one-fifth of the farm's total revenue is dependent on government grants, they are a crucial part of the farming operation.

4.4. Revenue Maximization

4.4.1. Increasing Milk Revenue

Milk from a small dairy farm in the Bohemian Forrest in the Czech Republic is sold to a milk processing plant in Cham, Germany. Every morning, at precisely 7:15 AM, a milk lorry arrives to collect the already cooled milk and transport it to the processing plant, Goldsteig GmbH, about an hour and a half away. Goldsteig itself has no requirements or limitations as to how much milk is collected each day, whether it is one liter or a thousand liters is irregardless. This enables the farm to sell milk to neighbors, acquaintances, and other private customers. This is very advantageous, as it is the one and only instance in which the farm directly decides how much revenue is made per liter of milk, regardless of fat and protein values.

In the instance of selling milk to Goldsteig, the processing plant decides how much money is paid out per liter. The farmer has absolutely no say in how much the sale price per liter is. The only way in which the farmer can affect revenue from milk sold to the milk processing plant is by producing better quality milk. Milk quality that affects price per liter is determined by two means: fat and protein content, both measured in percentage. In order to provide neutrality and integrity, milk samples are collected by the milk lorries at intervals random and unknown to farmers, lorry drivers, and milk processing plants alike. The milk samples are drawn continuously and proportionately as the milk is sucked up by the lorry in order to ensure that the milk sample will be an average from all of the milk supplied by the farmer for that day. The milk sample is then stored in a refrigerated compartment and is processed later that afternoon, and immediately posted on the internet, where they can be accessed by the farmer. Samples are handled by Milchprüfring Bayern e.V., a third-party milk testing laboratory independent from the milk processing plant.

Higher quality milk supplied to Goldsteig means higher quality products that Goldsteig will then go on to produce, so milk quality is valued and farmers are subsequently either rewarded or penalized, depending on whether their milk falls above or below the predetermined percentage levels of fat and protein. Goldsteig has a milk quality minimum of fat and protein at 4.2% and 3.4% respectively. For every 0.05% above or below the fat content percentage, the farmer's milk price per liter is adjusted by 0.074 CZK. Similarly, for every 0.05% above or below the protein content percentage, the farmer's milk price per liter is adjusted by 0.112 CZK.

In all the years of existence of a small dairy farm in the Bohemia Forrest, private milk sales have always been sold at 10 CZK (before tax) per liter. In 2012, for the first time in existence, the sale price of milk was raised to 12 CZK (before tax) per liter. With an estimated amount of 3,910 liters being sold through private sales annually, this equates to an extra profit of 6,800 CZK per year. On January 1st, 2014, the sale price of milk was raised again, to 14 CZK (before tax) per liter. This translates into another 6,800 CZK of extra profit annually. Combined, this means that selling milk at a price of 14 CZK (before tax) per liter rather than 10 CZK (before tax) per liter, means an additional annual revenue 13,600 CZK of for the farm. In 2014, a revenue of 47,600 CZK was made through private

milk sales. Because of milk's inelastic quality, there has not been a noticeable difference in the amount of milk sold since the price increases.

4.4.2. Artificial Lighting to Increase Milk Production

Researchers have discovered that exposing dairy cows to 16-18 hours of quality light per day instead of 12 or less hours per day, increases dairy production by 7-10%. Long-day lighting has been found to increase gain, feed consumption efficiency, and growth of mammary parenchyma. [19] In the case of a farm in Sumava, a 7-10% increase in milk production equates to an extra 28 to 40 liters of milk per day. This equals an extra 110,458 to 157,797 CZK of revenue from milk production annually.

4.5. Profit

With a total revenue of 2,037,744 CZK and a total cost of 1,568,248 on a small dairy farm in Sumava, the year 2014 was very profitable. At a total profit of 469,496 CZK; it was a successful year of profit, with total profit equaling 23% of total revenue.

4.5.1. Profit per Hectare

With a total profit of 469,496 CZK and a total agricultural area of 25.04 hectares, the profit per hectare is 18,750 CZK. If the farm were to acquire or lose a single hectare, profit would remain relatively unchanged, due to the fact that none of the farm's profit comes directly from crops harvested in the meadow or field. It is possible that profit may slightly decrease due to burning more fuel to harvest crops from the field, but this feed ultimately serves as energy for the cows, which with they then produce milk. In this sense, if there is more feed available, it is possible for the cows to consume more food and have more energy, which is used to produce more milk. Of course with more milk comes more revenue, which leads to more profit. However, this scenario is strictly hypothetical due to the fact that the agricultural land that the farm in Sumava sits on has not changed for more than 30 years. Unfortunately, there have not been any chances to expand the farm by purchasing more agricultural land, so this concept is suppositional.

4.5.2. Profit per Cow

With a total profit of 469,496 CZK and an average of 16 cows for the year 2014, it is possible to calculate that the profit per one cow is 29,344 CZK. However, this amount of profit as a whole is not made solely because of the cow itself, due to the fact that the farm collects other forms of profit that are independent from profit that comes from cows via milk production. However, in the unfortunate event of a cow passing away, or oppositely; the event in which the barn is expanded and capable of housing more cows, it is possible to determine the estimated amount of profit change. This is solved by taking the amount of liters of milk produced, by the mean amount of cows, in order to discover the average amount of milk produced per cow, annually.

In 2014; 144,585 liters of milk were sold to Goldsteig, and 3,910 liters sold to private customers, combined to a total of 148,495 liters. Distributed among 16 cows, this means that the average cow milks 9,281 liters of milk per year.

In order to calculate milk production profit per cow, it must be determined what percentage of profit comes just from milk sales. By adding the Goldsteig milk sale percentage stake with that of the private milk sale stake, it is determined that 79.02% of revenue and profit is due to total milk sales. With total milk profit at 370,996 CZK and total milk sales at 148,495 liters, the average profit per liter of milk is 2.49 CZK.

With this, it is now possible to calculate about how much average annual profit is lost or gained when a cow passes away or is acquired. A cow that milks an average of 9,281 liters of milk per year at a profit margin of 2.49 CZK, produces a milk production profit of 23,187 CZK annually.

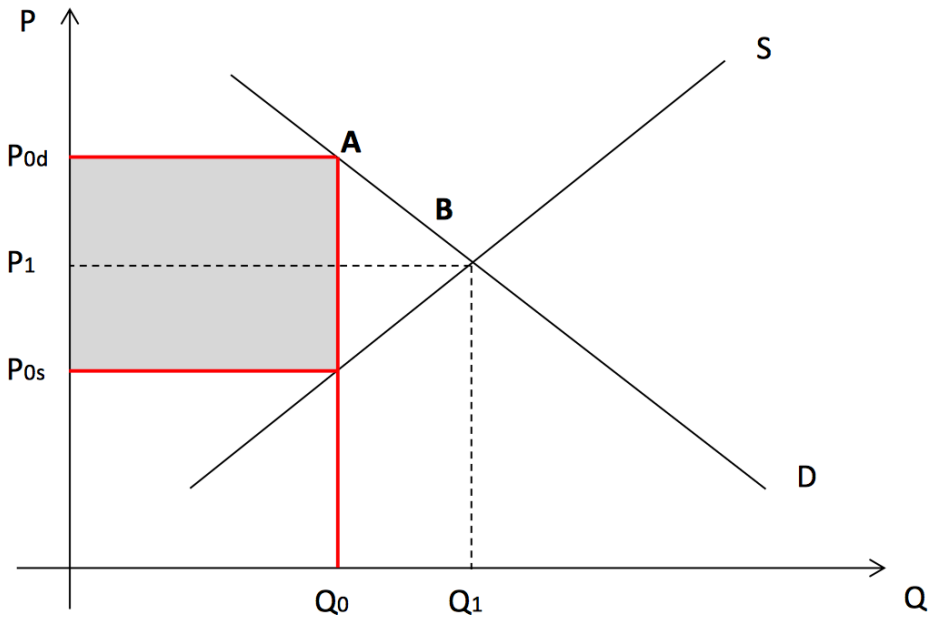
4.5.3. Profit per Liter of Milk

Average profit price per liter of milk is 2.49 CZK. This means that for every extra liter of milk that is sold, there is an extra profit of approximately 2.5 CZK.

4.5.4. Potential Profitability

The economic theory estimates that as soon as the European Union quotas are removed due to market forces, the market equilibrium will adjust with an increase in the quantity of milk supplied followed by a fall in prices (Figure 8). With the presence of quotas, the market cannot produce more than the quantity Q0, to which corresponds a given price P0d. If the quota is binding with its removal, the market would naturally adjust to the quantity and price determined by the intersection of demand and supply (P1), for which the respective quantity increases to Q1. It should be noticed that in Figure 8, it is referred to the market of raw milk, which is not traded on international markets due to the fact that it is highly perishable and costly to transport. [16]

Figure 8: Possible Effect of Removing Quotas on the Aggregate Milk Market



Source: Ernst & Young (2013)

5. Conclusion

In conclusion, a small dairy farm in Sumava is a profitable, successful, growing young farm, fully capable of sustaining itself given current and past conditions. With a total revenue of 2,077,744 CZK and total cost of 1,568,248 CZK, it left a total profit of 469,496 CZK for the year 2014.

With actions such as changing feed supplements suppliers, stopping the unnecessary idling of tractors, and by pre-cooling milk with tap water; the farm is able to cut expenses. With innovations such as increasing milk revenue and providing cows with artificial light in order to produce more milk, the farm can maximize revenue, and therefore profit as well.

With global milk production, global milk consumption, and global population all increasing, the future outlook of dairy farming looks positive. Although it is unknown what exact threat if any, the end of the European Union's milk quotas will present, there will always be a demand for milk, as it is an inelastic commodity.

Milk will always be a one of a kind, irreplaceable beverage and necessity that is consumed all over the world. Even if and when there is an alternative, it will never be a direct replacement.

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