A FEASIBILITY STUDY OF OPERATING A SHEEP DAIRY IN CENTRAL IOWA

by

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ABSTRACT

The sheep dairy industry in the United States is small. Producers are concentrated in a few areas geographically with the greatest demand for sheep milk products located on the east and west coasts. The purpose of this analysis is to determine if a family-run sheep dairy located in Central Iowa could produce an annual profit of $40,000 without utilizing labor hired outside the family.

Budgets were created and used to determine the revenues and costs of operating a sheep dairy, and producing and selling three different end products for sale: fluid milk, cheese and bars of soap. Microsoft Solver was used to determine the product mix that would maximize the total profit of the enterprise.

The profit of the enterprise depends on a number of factors including the cost of feed, the number of ewes milked and the amount of milk each ewe produces. A maximum profit of $66,993 could be generated by selling 74% of the milk as fluid milk, 25% of the milk processed into cheese and 1% of the milk processed into soap. The diversification of products would help buffer the enterprise from volatility in the product markets.

While the budgets show that this enterprise is profitable, local markets for these products must be identified and/or developed for the profits to be realized.

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CHAPTER I: OBJECTIVES AND METHODOLOGY

Dairy sheep production in the United States was first established in the mid-1980s. There are few records kept on dairy sheep population and production in the US at either the state or national level (BANR). Berger et al estimated the number of sheep milk producers in the United States in 1998 was 100, but the Board on Agriculture and Natural Resources states that only 44 farms were milking ewes in the United States in 2003.

Sheep dairies in the US are concentrated in the upper Midwest and in New England. Those in the upper Midwest are located mainly in West Central Wisconsin and East Central Minnesota (BANR). In addition to being known as the "dairy state" of the United States, Wisconsin is the home of the first cooperative of sheep milk producers, the Wisconsin Sheep Dairy Cooperative (WSDC). Also in Wisconsin, the University of Wisconsin-Madison Spooner Agricultural Research Station in Spooner, WI is where most scientific research on dairy sheep is currently being done in the United States. Most sheep milk goes into the production of cheese. Dairies located in New England have situated themselves where there is greatest demand for sheep's milk cheeses. This demand is greatest in the highly populated coastal areas where fine dining and gourmet restaurants are located.

When the WSDC began in 1996, it was composed of 26 farms. At that time six were milking sheep and the remaining 20 were in some phase of construction. Ten years later, in 2006, only six farms remained as active, milking members of the WSDC. Three of the original 26 farms were still milking sheep, but were independent producers. Seventeen of the farms exited the sheep dairy industry entirely (Kieffer and Guertin). There were

various reasons that the 17 farms stopped milking sheep, but the failure rate of 65% could deter new farmers wanting to enter the industry.

There are several challenges as well as opportunities facing the dairy sheep industry in the United States. The United States is the largest importer of sheep milk cheese in the world. Companies in the US import half of the total world exports. It is estimated that in 2005, the domestic US sheep dairy industry supplied only about 1.3% of the sheep milk cheese consumed in the US (BANR). Sheep milk cheese is imported into the United States from Spain, France, and Italy. In another study of the economics of a North American sheep dairy, it was estimated that a dairy could realize a return to labor and management of $107 per ewe (Berger, et al). At first glance, these numbers indicate that there is potential for growth in the sheep dairy industry.

Despite demand for sheep milk cheese and the apparent positive return per ewe, the attrition rate among sheep milk producers in North America has been reported at 65-70% (Kieffer and Guertin). This number suggests there are factors within the industry that new entrants are unaware of, or that returns are overstated. Low milk production and lack of dairy sheep knowledge base as well as lack of financing are some limiting production factors (Berger, et al.). Limitations in marketing include no organized sheep milk marketing system and few sheep milk processors (Berger, et al.).

The dairy sheep industry faces a marketing challenge in that individual sheep do not produce a large quantity of milk daily when compared to the daily production of a Holstein dairy cow. A ewe with 50% East Friesian breeding can produce 2.5-3 pounds of milk a

day (Berger, et al.) while a Holstein cow can produce 70 or more pounds each day. That means larger on farm milk storage or transportation of smaller amounts of milk is necessary which present challenges to producers not in close proximity to processors. To solve that problem, many sheep producers in the northeast process their own milk into cheese. Another option is to have someone custom process the milk into cheese or other products.

There is a wide variety of dairy sheep production systems in use, ranging from confinement type operations to grass-based operations as well as mixing pasture and confinement in varying combinations. Farms also use different types of lamb weaning and rearing systems (BANR). When the financial statements of four different sheep dairies were compared the net income per ewe ranged from -$178 to $241. In three of the examples, at least one of the farm family members had a part time off-farm job. The fourth couple had retired from a previous career (Delaney and Kauppila). In none of the examples was the sheep dairy totally supporting the families financially.

Iowa is a good location for a sheep dairy due to the ready availability of feedstuffs. However, the Midwest lacks markets for fluid sheep milk. This paper will examine the feasibility of operating a sheep dairy in Boone County, Iowa which is located in Central Iowa. It will examine different sheep milk product markets available in the United States as well as discuss possible market development for sheep milk products in the Midwest. This paper will also determine if a family-run dairy can provide the family with at least $40,000 of net profit annually. To determine this, a budget will be developed to assess the

profitability of the enterprise. The budget will include all operating expenses as well as the revenue produced from the sale of dairy products and the sale of market lambs.

Estimated expense data will be gathered from information published about the dairy sheep industry as well as firsthand knowledge of the dairy and sheep industries. Because the farm is currently operating a sheep business, some budget numbers will be based on actual expenditures. Once the potential revenue from the sale of different types of dairy products and market lambs is determined and the total expenses are specified, sensitivity analysis will be used to look at various enterprise combinations to determine the optimal configuration to maximize profit.

The enterprise analysis will be based on an existing 20-acre commercial sheep operation located in Boone County, Iowa. The flock currently consists of 80 head of purebred Romanov ewes. Romanov sheep are prolific sheep which commonly have litters of three, four and five lambs at a time. They are fertile year round where most breeds of sheep will are only fertile during times of the year with short day lengths. Romanov sheep are used to cross breed with meat type sheep to produce commercial breeding ewes. Purebred and crossbred ewe lambs from this flock are being sold as breeding ewes. Purebred rams are being sold as breeding rams and/or market lambs and crossbred castrated male lambs are fed to market weight and sold as fat lambs. The family currently has one adult working out of the home at a full time non-farm job with a salary of $45,000. If this off-farm income were to be eliminated, some of the family's expenses, such as gasoline, would be reduced. However, there would be additional out-of-pocket expenses, such as health insurance. Current annual farm-related expenditures include: $20,300 in mortgage

loan payments, farm insurance, and property taxes. These expenses would need to be covered by income from the sheep dairy. The income from the dairy would also need to cover capital expenditures such as milking equipment.

To determine the feasibility of operating a sheep dairy in Iowa it will be determined if the income received from selling fluid milk and/or other products can cover all enterprise expenses and generate a reasonable profit. Also determined will be the optimal flock size and product marketing mix. The Excel program Solver will be used for the analysis.

While this thesis does not discuss economic theory per se, it is an application of economic theories relating to investment analysis. Specific analytical techniques used include; sensitivity analysis to determine the affect of key variables on profitability, the use of liner programming to determine optimal product mix, and net present value analysis to determine the overall viability of the investment alternative.

CHAPTER II: SHEEP MILK MARKETS

2.1 Cheese

Most of the sheep milk produced in the United States is processed into cheese. There were 11 cheese plants listed on the Iowa Dairy Industry List when last updated on December 7, 2006. These 11 plants are operated by 10 different companies and process cow and goat milk. Half of the companies are producing products made from milk produced by their own herd of animals. Cheese produced by creameries using milk produced by their own animals is typically referred to as farmstead cheese. These cheeses are usually produced in small quantities and marketed locally. The average retail price of sheep milk cheese in October 2008 is approximately $20 per pound of cheese in various locations across the United States including Wisconsin, New Jersey and Tennessee. The price depends on the type of cheese, location of the market, as well as the reputation of the cheese maker. It is a highly competitive market and a proven prize winner in competitions such as those run by the American Cheese Society, will bring a premium price. The amount of cheese yielded from sheep's milk varies between 16-21% (Jaeggi, et al.). This means for every 100 lbs of sheep milk processed, 16-21 pounds of cheese would result. Cheese is not the only dairy product made from sheep's milk. Some creameries have had success selling yogurt and ice cream and fudge made from sheep milk. Others have specialized in producing body soaps and lotions containing sheep milk.

2.2 Cultured and other milk products

The shelf life of yogurt, ice cream and other products is short when compared to that of cheese. Sheep milk production tends to be seasonal because most breeds of sheep are only fertile during periods of short daylight lengths. This in turn causes products with a

limited shelf life to be unavailable when the ewes are not lactating, and available in great abundance at peak milk production. This can lead to high rates of wastage if all products cannot be sold before they expire. If a strong seasonal customer base is developed for these products however, they can bring a premium price and can be a profitable addition to a creamery's product line.

2.3 Soaps and Lotions

The shelf life of soaps containing sheep milk is nearly unlimited; however lotions can have a short or long shelf life depending on the ingredients they contain. Only a small amount of sheep milk is necessary to produce these products. This makes them attractive to small farms who only keep a few sheep, or those that are allowing their sheep to raise lambs and milking them part time. Another advantage to producing and selling these types of products is in the ease of marketing and shipping to the customer. There are several internet websites selling handmade bath and body products, such as www.ebay.com and www.etsy.com. The finished product can be promptly shipped through the US mail or faster courier services. The prices of bath and body products vary as much as the number of products that are being offered for sale. Prices of $1.00 per ounce of finished product or $16.00 per pound were found to be conservative at online sources for handmade soaps in October 2008.

2.4 Fluid Milk

The dairy product requiring the least amount of labor and no further processing is fluid milk. Sheep milk producers in Wisconsin need only join the WSDC to gain access to a market for fluid milk. Sheep milk producers on the East and West Coasts are near large

markets for sheep milk cheese and there are many cheese makers. However, there are some obstacles to selling fluid milk in Iowa. The first is finding a processor or other buyer that will regularly buy milk throughout the milking period. If local buyers cannot be found, shipping fluid milk across the country may not be economical, especially with high fuel costs. Some dairies have frozen milk in bags. These frozen bags of milk are then accumulated throughout the milking period and shipped in refrigerated trucks. This however requires the capital cost of building a freezer capable of storing a large amount of milk or renting freezer space. The dairy would also need to find a customer who wants to buy truck load quantities of frozen milk which they would then process. Milk from sheep is more nutrient dense than the milk of cows or goats and some people with allergies to cow's milk find they can tolerate sheep's milk (Berger, et al.). Consumers with allergies or those wanting a more nutrient dense alternative to cow's milk may purchase bottled milk.

CHAPTER III: ASSUMPTIONS

There are two main breeds of sheep in the United States that produce large amounts of milk when compared to most domestic breeds available in the United States. These are the East Friesian and Lacaune. East Friesian ewes typically produce a larger volume of milk and they have a more valuable fleece when compared to Lacaune ewes. However, Lacaune ewes are reported to have fewer respiratory problems in the US climate and have higher component levels in their milk which will give higher cheese yields. Dairies in the US have had success milking ewes that are at least 50% dairy breed. While there are individual animals of all breeds that have proven to be exceptional milking animals, these two breeds are specialized for milk production.

The farm would need to purchase two rams, East Friesian, Lacaune or a mix of the two breeds. The rams would be bred to the existing flock of Romanov ewes to provide approximately 100 ewe lambs suitable for milking. (80 ewes * 250% lambing rate [1] / 2). The farm will not need to purchase any ewes. The flock would be "bred up" by increasing the percentage of dairy blood in the ewe flock over time using dairy rams. The lambing percentage of the flock would be expected to decrease as the ewes contain less Romanov blood. Because sheep of dairy breeding are still not prevalent in the United States, quality dairy ewes can demand higher prices than those of more common domestic breeds. Purchasing only rams will also reduce the number of outside animals entering the flock which makes quarantine easier to manage as well as minimizing the potential exposure to

[1] Lambing rate is the number of lambs born to one ewe on average. For example; In a flock with a 250% lambing rate, each ewe will produce 2.5 lambs on average at each lambing.

disease. An objective is for the farm to maintain a milking flock of approximately 400 ewes which the enterprise could reach in its fourth year of production. (See Table 3.1)

Table 3.1 Flock size increase

Year	Number of ewes lambing	Lambing Percentage	Number of ewe lambs born	Number of additional ewe lambs available to breed the next year (death/cull loss of 5%)
1	80	250	100	95
2	175	220	192	182
3	357	220	392	373
4	730	220	803	762

The profits of the farm would be expected to be substantially lower in the early years while flock size is in the growth phase. There would be fewer pounds of milk processed as well as fewer lambs sold as market lambs.

Ewes would be kept in a dry lot during the winter and allowed access to pasture during the growing season in the spring and summer. Ewes would be fed grain during a two week flushing period just prior to breeding, in mid and late gestation and during the milking period. During the milking period, ewes would be fed grain in the milking parlor.

The farm would follow a Day One weaning lamb rearing system. In this system the lambs are removed from the ewe after 24 hours and the ewe is milked and the colostrum fed to the lamb for the first day or two. The lamb would then be fed milk replacer for 30

days during which time the lamb is started on dry grains and roughage with a goal of weaning the lamb from milk at approximately 30 days. This type of lamb rearing system is labor intensive, but it also allows the dairy to get the maximum amount of milk from the ewes because 25-30% of the ewe's total milk production is in the first 30 days of lactation (Berger, et al.).

CHAPTER IV: SOURCES OF INCOME

4.1 Market Lambs

Any lamb not kept as a replacement ewe would be sold as a market lamb. The lambs would be sold weighing approximately 120 lbs. The revenue produced from the sale of market lambs would vary according to the market price on the day of sale but would provide a significant amount of the enterprise's overall revenue.

4.2 Milk Products

In addition to the sale of market lambs, the other major source of revenue for the farm would be the sale of milk or products made from milk. As would be expected, processing milk into finished products will add value to each pound of milk produced. However, to determine which product or mix of products would be the most profitable the cost of processing must also be considered.

4.2.1 Cheese

In October 2008 an average price of domestically made, 100% sheep milk cheese, for sale via the internet is $20.00 per pound. The cheeses used in this average price were produced in Wisconsin, New Jersey and Tennessee.

4.2.2 Soap

The amount of milk used to produce soap varies according to the recipe used. In an average hard bar of handmade soap, milk makes up 25% of the weight of the recipe. During the curing process however, most of this weight is lost due to evaporation, leaving a finished product weight approximately 75% of the beginning weight. In October 2008 the retail price of handmade cold processed soaps for sale on the internet was $1.00 per ounce or higher.

4.2.3 Fluid Milk

Fluid milk would require no processing. It would be stored in a bulk tank and sold directly from the bulk tank. In October 2008, the price received for fluid milk sold directly to cheese makers in Wisconsin and Tennessee ranged from $0.75 to $1.50 per pound. An average of the range will be used in the budget.

4.3 Breeding Stock

This analysis does not consider selling any sheep as breeding stock.

CHAPTER V: ENTERPRISE EXPENSES

5.1 Fixed Costs

5.1.1 Property and Buildings

The property and buildings have been recently purchased for approximately $200,000. The farm has approximately 20 acres of pasture land. The main buildings that would be used for the sheep dairy include a 50' by 100' open front metal building and an enclosed 50' by 100' metal building. The enclosed building would be renovated to include the milking parlor and milk house. The annual mortgage payment, property taxes, insurance and depreciation will be subtracted from the farm's revenue.

5.1.2 Milking equipment

Milking equipment required for milking a large flock of sheep includes: the milking parlor, or area where the sheep stand while being milked, milking units, including the piece that attaches to the udder, the pipeline which transports the milk to the bulk tank, and the bulk tank which is a large stainless steel tank that cools and stores the milk. Also needed are a vacuum pump, pulsators and a sink for cleaning. When establishing a new milking operation, Berger et al. estimates the cost of milking equipment, including a walk-in freezer, to be $50,000 for a parlor capable of a throughput of up to 250 ewes per hour. This equipment would allow a flock of up to 500 ewes to be milked in the recommended 2-hour time frame (Berger, et al.). An operating loan would be secured for this equipment. For the purposes of this analysis the cost of the milking equipment will be divided over the first 10 years of use. The amount the enterprise would actually pay would depend on the interest rate and length of the loan.

5.1.3 Milk Processing Equipment

The fixed costs of milk processing supplies will vary depending on the finished products sold. If the farm is only selling fluid milk, no milk processing equipment will be necessary. The milk will only need to be stored in a bulk tank until it is picked up. If cheese and other edible products are going to be produced on the farm, a pasteurizer will be necessary to produce these products in accordance with Iowa Statute 192.103. A used vat pasteurizer would cost approximately $15,000. Similar to the cost of the milking equipment, this cost would be divided over ten years of use and will only be included in the enterprise expenses if the milk is processed. The actual payment will vary according to the interest rate and length of the loan secured.

Based on interviews with current cheese producers in the Midwest United States, the cost of cheese making equipment was estimated to be approximately $18,000. This number is within the range provided by Delaney and Kauppila of $10,000 to $50,000 depending on the amount of labor and the scale of the operation. Again, this cost will be divided over ten years and only used as an enterprise expense if cheese is produced.

Soap making does not require a pasteurizer because the product is not intended for human consumption. Processing equipment required for making soap includes a heat source such as a stove, stainless steel pots for mixing the soap, and molds for forming soap pieces. Soap can be easily made on a small to medium scale in a home kitchen or small area of a home, shed or garage designed specifically for the use. Total equipment cost can be $2,000 or less. This equipment cost will be divided over ten years and will only be included in the enterprise expenses if soap is produced.

5.1.4 Vehicle

The farm would utilize an older pickup truck as a farm vehicle. The cost of vehicle registration and insurance is $200 and $500 respectively each year.

5.2 Variable Costs

5.2.1 Milking Supplies

The process of milking will utilize several supplies that need to be replenished regularly. These include inflation liners and milk tubing replaced about twice per year. Milk line filters must be replaced at each milking. Acid and detergent are used to clean the pipeline and milking units after each milking. Udder wash and teat dip are also used at each milking. Paper or washable towels are used to clean teats.

5.2.2 Milk Processing Supplies

Cheese making requires a variety of input products depending on the types of cheese produced. Cheese making also requires the purchase of cultures and rennet. The prices of cultures and rennet differ depending on the type of cheese made. For this analysis, a cost of $0.003715 per pound of milk for cultures and $0.005821 per pound of milk for rennet were used. These numbers were based on the directions for use on the cultures and rennet. More information about prices and usage rates can be found at the web site of Dairy Connection Inc., http://www.dairyconnection.com.

Soap making requires the purchase of oils, sodium hydroxide, and other ingredients such as essential oils and fragrances. For a basic olive oil-based soap, the oil and sodium

hydroxide costs about $0.1836 per ounce of soap produced[2]. Packaging material is estimated at $0.04 per pound of soap produced.

5.2.3 Feed

Feed for the ewes and lambs would be the largest variable cost for the enterprise. This analysis assumes the feeding methods that the farm is currently utilizing for its flock would continue. It is a concentrate based feeding system supplemented with pasture while in season and baled hay when the pasture is not producing.

5.2.3.1 Grain

For the purposes of this analysis, fat lambs and replacement ewe lambs would be fed pelleted commercial growing and finishing diets. When the operation grows in size, feed costs could be reduced by purchasing grain in bulk and utilizing processed grain by-products available to the livestock feeding industry.

Lambs will be started on straight soybean meal offered free choice at approximately one week old to accustom them to eating solid feedstuffs. Each lamb consumes at maximum 2 pounds of soybean meal over about one week. Soybean meal would cost about $0.125 per pound. Once lambs are readily consuming soybean meal they will be switched to a 20% protein commercial lamb starter pellet. Lambs would consume approximately 100 pounds of the 20% protein starter that in October 2008 cost $0.286 per pound. Lambs will consume the starter diet for approximately 50 days. For the finishing phase, lambs would be fed a 16% finisher diet consisting of a concentrated protein pellet

[2] Olive oil at $0.15625 and 68% of the soap formula. Lye at $0.21875 and 8.5% of the formula and the formula yielding 68% of the finished product. (Columbus Foods, Snow Drift Farm)

mixed with whole shelled corn. Lambs would consume this finishing diet for approximately 115 days until they go to market weighing about 120 pounds. The finishing diet cost $0.145 per pound in October 2008 and each lamb would consume approximately 275 pounds.

Ewes would be fed a mixture of corn and soybean meal in late gestation and in the milking parlor through lactation. Ewes would consume approximately 1.8 pounds of corn per day and 0.25 pounds of soybean meal each day during this time (Berger, et al.)

5.2.3.2 Roughage

The enterprise does not have enough pasture to support more than 100 head of ewes for an entire grazing season. Therefore the milking ewes would be fed hay for the entire year. Ewes would consume approximately 4.4 pounds of hay each day. (Berger, et al.). Ewe lambs would consume approximately 2.5 pounds of hay each day and lambs being fattened for market would consume about one pound of hay each day. The price of hay used is $108 per ton. This is the average price of hay in Iowa in 2007 as reported by the National Agricultural Statistics Service.

5.2.3.3 Mineral

All ewes and lambs would have free choice access to a complete sheep mineral at all times. The cost of the mineral is $0.30 per pound and consumption should average 0.03125 pounds per head per day.

5.2.4 Sheep health costs and supplies

5.2.4.1 Vaccinations

Ewes and lambs would be vaccinated with Bar-Vac CD-T. This vaccination is given to prevent disease caused by Colostridium Perfengins Types C and D and includes a Tetanus toxoid to help prevent Tetanus infection. Lambs would be given two doses. The first dose is given at approximately 21 days of age and the second 3-4 weeks later. Ewes would be given an annual booster during their dry period. This vaccine costs $0.24 per dose in October 2008 (Premiere Sheep Supplies).

5.2.4.2 Deworming

Ewes would be dewormed once a year as a preventative measure during the dry period. The dewormer used would be Ivermectin which costs approximately $1.07 per ewe per dose (Premiere Sheep Supplies). Lambs would also be de-wormed once a year as a preventative measure. Ivermectin would be used and costs approximately $0.46 per lamb per dose (Premiere Sheep Supplies). Occasionally some lambs or ewes would need additional deworming due to higher internal parasite loads than the rest of the flock. These animals would be dosed on an as-needed basis.

5.2.5 Lamb Rearing Costs

5.2.5.1 Milk Replacer

A lamb normally consumes approximately 18 pounds of dry milk replacer from birth to weaning. The current retail cost of milk replacer varies by product but one such product is $1.88 per pound, resulting in a cost of $33.84 per lamb. The current retail price will be used for this analysis; however this is one cost that can be reduced by purchasing the product directly from the manufacturer. A sheep dairy raising over 500 lambs per year

would use approximately 9,000 pounds of milk replacer each year. That is enough milk replacer to make cost reducing bulk purchases directly from a manufacturer possible.

5.2.5.2 Milk feeding supplies

Materials needed for raising lambs were estimated from the information provided in Berger et al. pages 125-126 and adjusted for the number of lambs the enterprise would raise.

5.2.6 Miscellaneous Sheep Supplies

Lambs will be tagged with a lamb tag at the time they leave the lambing jug, the pen the ewe and lambs are kept in for the first few days, and enter the mixing pens, larger pens that house groups of similarly aged lambs. An annual loss and replacement rate of 5% for the lamb tags will be assumed. This rate is based on the replacement rate the farm is currently experiencing in the flock. A swivel tag from Premiere Sheep Supplies would be purchased at a price of $0.275 per tag in October 2008 (Premiere Sheep Supplies). Replacement ewes will receive a Leader brand tag at the time of their first lambing. The annual loss and replacement rate for ewe's tags will be assumed at 2%. The cost of Leader tags is $0.30 per tag (Premiere Sheep Supplies). Fat lambs and cull ewes will be tagged with tags that are provided by the USDA at no cost to the operation and include the farm's ID number at the time of sale.

CHAPTER VI: ANALYSIS

The budget spreadsheet was set up to allow the user to change the cost of inputs and quickly see the effect that change has on the return to labor and management. The variables that will be first analyzed are: corn and soybean meal price, flock size, lambing percentage and pounds of milk per ewe.

6.1 Sensitivity Analysis

Table 6.1 shows the change in total profit when corn and soybean meal prices are increased or decreased 10% from the current price when selling fluid milk only.

Table 6.1 Change in Profit as Corn and Soybean Meal Prices Change[3]

	Profit in $	Corn Price in $ per bu	SBM Price in $ per ton
Current Corn and SBM prices	29,322	3.88	250
Corn and SBM prices increased 10%	27,034	4.268	275
Corn and SBM prices decreased 10%	31,611	3.492	225

For each ±10% move in corn and soybean meal price, the profit of producing and selling fluid milk appears to move approximately ±$2,300.

[3] 400 ewes, 220% lambing percentage, 350 pounds of milk per ewe

Profit is also influenced by flock size, lambing percentage and pounds of milk produced. Tables 6.2, 6.3, and 6.4 show how total profit is affected when these three factors are changed. The profit is based on selling fluid milk only.

Table 6.2 Change in Profit as Flock Size Changes[4]

Profit in $	Flock Size in number of head
97,450	600
63,386	500
29,322	400
-4,741	300

As the flock size increases, so does the total profit of the enterprise. However, this analysis only takes the labor of 2 employees into consideration. Milking is the largest time requirement for a sheep dairy. It is typically recommended that the time for milking from set up to wash down is kept within 2 hours to limit worker fatigue. With a modern parlor set up, two milkers should be able to milk 500 ewes in two hours (Berger, et al). So the practical upper limit on flock size is 500 ewes. If the dairy wanted to increase its flock size it would need to account for the additional cost of labor.

[4] $3.88/bu corn, $250/ton SBM, 220% lambing rate, 350 pounds of milk per ewe

Table 6.3 Change in Profit as Lambing % Changes[5]

Profit in $	Lambing %
32,107	250
31,179	240
30,251	230
29,322	220
28,394	210
27,466	200

As the lambing percentage changes 10%, the return on labor and management changes approximately $925. Both East Friesian and Romanov sheep typically have lambing percentages above 200%. The farm would want to maintain a high lambing percentage in order to maximize the revenue from selling market lambs.

[5] $3.88/bu corn, $250/ton SBM, 400 ewes, 350 pounds of milk per ewe

Table 6.4 Change in Profit as Pounds of Milk per Ewe Changes[6]

Profit in $	Lbs of milk/ewe
74,322	450
51,822	400
29,322	350
6,822	300
-15,678	250

Pounds of milk produced per ewe can have a very large impact on the total profit of the enterprise. As the dairy begins operations it would save ewe lambs to increase the size of the flock. Overtime the percentage of diary breed blood would increase in the flock. However, the Romanov sheep that the dairy is beginning with tend to produce a small amount of milk, therefore the first generation of 50% Romanov and 50% dairy bred ewes would be expected to produce less than a typical dairy crossbred ewe.

6.2 Linear Program Model

Microsoft Solver was used to find the most profitable product mix for the dairy. Figure 6.1 shows the spreadsheet that included the Microsoft Solver problem. The

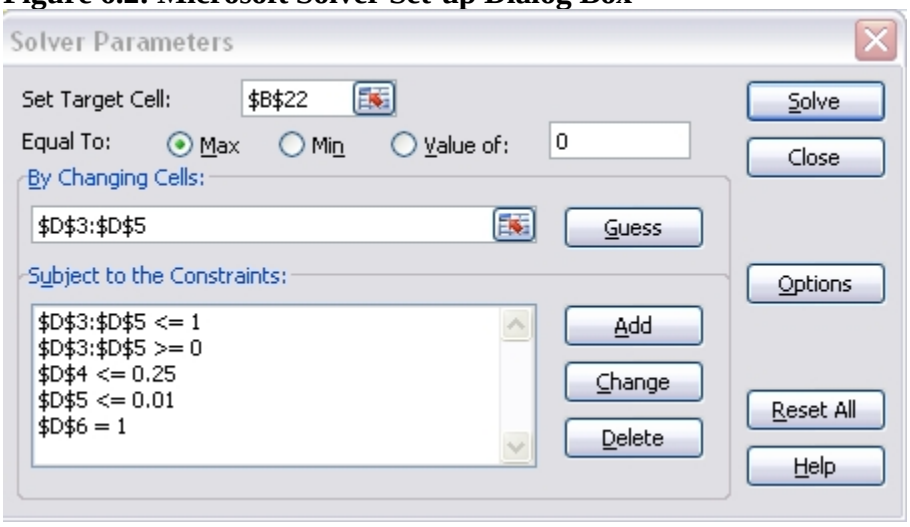
[6] $3.88/bu corn, $250/ton SBM, 400 ewes, 220% lambing rate

variables analyzed previously were set at 400 ewes producing 350 pounds of milk per head and a 220% lambing rate. The objective function maximized is the return to labor and management (cell B22 in figure 6.1). The variables the problem changes are the amounts of milk sold as fluid milk, processed into cheese and processed into soap as percents (cells D3, D4, and D5 in figure 6.1). Some constraints needed to be added to the model. Constraints include: requiring the percentage of milk sold or processed to be between 0% and 100%, the sum of the percentages of each product must equal 100%, the total amount of milk processed into soap must be less than or equal to 1% and the total amount of milk processed into cheese must be less than or equal to 25%. Figure 6.2 shows the Microsoft Solver problem set up dialog box.

Figure 6.1: Return to Labor and Management Spreadsheet

	A	B	C	D	E	F	G
1	Milk Products						
2		% yeild	$/lb of finished product	% milk used for product	Milk Processing Supplies Expense	Cost of Milk	Extended income
3	Fluid/Frozen Milk	100%	1.125	74%	0.00	0	116550
4	Cheese	18%	20	25%	3633.76	39375	82991.24
5	Soap	300%	16	1%	12705.92	1575	52919.08
6				100%	Total		252460.32
7	Lamb sales						
8	# of fat lambs	average wt	Price/lb	Total market lamb income			
9	792	130	0.93	95752.8			
10							
11	Cull ewes						
12	# of cull ewes	average wt	Price/lb	Total Cull ewe income			
13	80	180	0.26	3744			
14							
15	Wool						
16	Annual lbs of wool	$/lb		Total Wool income			
17	6720	0.76		5107.2			
18							
19			**Present Value**				
20	**Grand Total Income**	357064	**282,828**				
21	**Grand Total Operating Expenses**	290071	**229,764**				
22	**Return on Labor and Management**	66,993	**53,065**				

Figure 6.2: Microsoft Solver Set-up Dialog Box



Without the constraint on total soap production the solver result would indicate producing 100% soap with a profit of over 3.5 million dollars. This is unrealistic within the scope of the analysis, however because of the assumption that the soap would be made by hand. When this restriction is added to the analysis, the revised most profitable product mix is 99% of the milk processed into cheese and 1% into soap. This product mix results in a total profit of $88,327. This level of cheese production is also unrealistic because this model only uses the labor of two adults. This level of production would also require a larger scale of cheese processing equipment than was budgeted for and may require the enterprise to hire additional labor. A more comfortable level of cheese production, especially in the early years of production is estimated at 25% of the milk produced. Adding this restriction to the model results in 74% of milk sold as fluid milk, 25% processed into cheese and 1% processed into soap. This combination returns a profit of $66,993.

The profit derived from producing 100% of the milk into soap prompted an additional query on the model not originally intended. At what flock size is a profit of $40,000 generated when producing soap only? By eliminating the production of milk for human consumption the cost of the milking equipment is reduced. A simple bucket milking unit can be used where only one ewe can be milked at a time, and a specifically designed milking barn or milking parlor would not be necessary. The model shows that a profit of $46,650 can be made by milking seven head of ewes. Seven ewes giving 350 pounds of milk would total 2,450 pounds of milk each year. When making soap the yield of soap is about three times that of the amount of milk used due to the oils added to the milk when producing soap. The 2,450 pounds of milk would be processed into approximately 7,350 pounds of soap. Processing about 140 pounds of soap per week would be feasible for two adults. Milk for soap making can be frozen, allowing a consistent supply of milk throughout the year.

6.3 Price of Milk

The price of milk also affects the profit generated by the enterprise. Using the combination of 74% fluid milk, 25% cheese and 1% soap, Table 6.5 shows how the profit changes with different prices for fluid milk.

Table 6.5 Change in Profit as Fluid Milk Price Changes[7]

Fluid Milk Price $ per lb	Total Profit in $
0.75	55,443
1.00	63,143
1.125	66,993
1.25	70,843
1.50	78,543

The price of milk would also change the results that Microsoft solver returns. When the price of milk is at $1.50 per pound, selling 99% fluid milk and selling 1% of the milk as soap produces a profit of approximately $117,000. However, producing 99% of the milk into cheese and 1% into soap produces a loss of approximately $16,500.

6.4 Time Value of Money

Because these numbers are based on the enterprise running for four years, it is necessary to determine if the net present value (NPV) of the enterprise is positive or negative. The NPV analysis will be based on the assumption that the enterprise would sell 74% of the milk as fluid milk at a price of $1.125 per pound, 25% of the milk would be sold as cheese and 1% would be sold as soap. Using a discount rate of 6% per year, the

[7] 74% fluid milk, 25% cheese, 1% soap

present value of the cash outflows is $229,764 and the present value of the cash inflows is $282,828. The net present value of the enterprise is $53,065 ($282,828-$229,764). Since the NPV is positive, the enterprise is a viable alternative.

CHAPTER VII: CONCLUSIONS

The analysis leads to the conclusion that operating a sheep dairy in Central Iowa can yield a profit; the realization of that profit depends on the ability of the enterprise to find viable markets for their products. The profit also depends on the price that can be received for the fluid milk.

From the enterprise analyzed, profit could range from approximately $25,000 to $80,000 depending on several factors including: the price of feed ingredient commodities, the number of ewes milked, lambing percentage, milk production of the flock, and the price received for fluid milk. The mix of products sold also affects the total profit of the enterprise.

Feed costs are the highest expense for the enterprise. The profit could be increased by reducing the cost of feeding the fat lambs as well as the ewe flock. Feed costs could be reduced by utilizing processed grain by-products and buying feedstuffs in bulk. Feed costs could also be reduced by moving to a grass based feeding program. The farm would either need to maintain the flock size near 100 ewes or rent or purchase more pasture. Any pasture intended for use by the milking flock would need to be within a distance of the parlor that the ewes could walk twice a day every day while they are lactating.

The opportunity cost of the farm owners' labor should also be taken into consideration. If the owner's earnings at an off-the farm job is higher than that of the net income, the enterprise could be more profitable if labor was hired at a typical farm workers rate. The owner could then act as a farm manager when not working off the farm.

The challenge of identifying or creating a local market for the product remains; otherwise the enterprise will incur transportation costs. For selling fluid milk, the enterprise will need to locate individuals or companies willing to purchase the sheep milk. Fluid sheep milk is typically marketed to and purchased by cheese makers. To expand the opportunities of selling fluid milk the enterprise could investigate the cost of bottling the milk and selling it directly to consumers for drinking or cooking.

The market for cheese exists. However, domestically produced sheep milk cheese cannot compete with imported cheese due to the high price of sheep milk in the US. The value of the milk in domestically processed cheese exceeds that of the price of the finished imported product when sold in the US (BANR). The owners of the enterprise would need to be able to produce a high quality cheese and have the ability to stimulate the demand for the cheese. Consultants could be hired to help develop and market the cheese but this additional expense would need to be accounted for.

Local farmers markets and food festivals could serve as outlets for the sale of the cheese as well as grocery stores that specialize in selling locally grown and produced food. There are several farmers markets that operate through the spring, summer and fall near the farm. Those that are the least distance from the farm include the Boone, Ames, and Des Moines, Iowa farmers markets. Omaha, Nebraska and Iowa City, Iowa are also within one day's driving distance and could be potential markets for the farm. Expanding the farm's marking area could help prevent saturation of the market for the cheese.

Financially, the production of soap appears to be the most promising. Soap can be sold at farmers markets and craft shows. The internet also provides several examples of how soaps are marketed, either on an individual website or though auction sites. Grocery stores and other boutique shops that carry locally produced items would also be good outlets for marketing soap. A drawback is this type of niche market can be very volatile. Competition is strong in the soap market. Not only does the product need to compete with mass produced commercial products, there are also many hand made products being sold.

If the regional marketing challenges are overcome, a sheep dairy in Central Iowa can be a profitable venture for a farm family.

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APPENDIX A: BUDGET SPREADSHEETS

The following is a description of the budget spreadsheets used in this analysis. The spreadsheets were set up within one workbook in Microsoft Excel.

LIST OF WORKSHEETS

Return on Labor and Management
Sheep Operations Costs
Sheep
Feed
Vaccinations
Deworming
Tags
Wool
Milking Supplies
Lamb Rearing Supplies
Property and Equipment
Labor
Vehicle

WORKSHEET SCREEN SHOTS

The cells shaded green have individual worksheets containing more information. The cells shaded yellow are variables that can be changed.

Return on Labor and Management

	A	B	C	D	E	F	G
1	Milk Products						
2		% yeild	$/lb of finished product	% milk used for product	Milk Processing Supplies Expense	Cost of Milk	Extended income
3	Fluid/Frozen Milk	100%	1.125	74%	0.00	0	116550
4	Cheese	18%	20	25%	3633.76	39375	82991.24
5	Soap	300%	16	1%	12705.92	1575	52919.08
6				100%	Total		252460.32
7	Lamb sales						
8	# of fat lambs	average wt	Price/lb	Total market lamb income			
9	792	130	0.93	95752.8			
10							
11	Cull ewes						
12	# of cull ewes	average wt	Price/lb	Total Cull ewe income			
13	80	180	0.26	3744			
14							
15	Wool						
16	Annual lbs of wool	$/lb		Total Wool income			
17	6720	0.76		5107.2			
18							
19							
20	**Grand Total Income**	357064					
21	**Grand Total Operating Expenses**	290071					
22	**Return on Labor and Management**	66,993					

Sheep Operations Costs

	A	B	C	D
1		Fluid Milk	Cheese	Soap
2	**Feed**			
3	Grain	71,370.70		
4	Roughage	49,515.84		
5	Mineral	1,971.00		
6	Lamb Rearing	29,999.20		
7	**Total**	**122,857.54**		
8				
9	**Health**			
10	Vaccination	518.40		
11	Deworming	833.65		
12	**Total**	**1,352.05**		
13				
14	**Misc.**			
15	Ear Tags	**291.40**		
16				
17	**Supplies**			
18	Lamb Rearing Supplies	1,348.60		
19	Milking Supplies	212.00		
20	Cheese Making		333.76	
21	Pasteurizer		1,500.00	
22	Soap Making			12,505.92
23	**Total**	**1,560.60**	**1,833.76**	**12,505.92**
24				
25	**Milk Processing Equipment**			
26	Cheese Making		1,800.00	
27	Soap Making			200.00
28				
29	**Property and buildings**	**28,600.00**		
30				
31	**Labor**	**72,800.00**		
32				
33	**Vehicle Costs**	**5,320.00**		
34				
35	**Grand Total Expenses**	**232,781.59**	**3,633.76**	**12,705.92**

Sheep

	A	B	C	D	E	F
1						
2						
3	Number of ewes	Average Lambing rate	%ewe lambs saved	% lambs fed out	Average lbs of milk produced per ewe	Annual lbs of milk
4	400	220%	20%	90%	350	140000

Feed

	A	B	C	D	E	F	G	H	I	J
1	Feed									
2	Grain			Grand Total	71370.7					
3										
4	Ewes	$/lb	#/hd	Days Fed	Annual Cost					
5	Corn	0.0693	1.8	180	8981.28	Principles of sheep dairying in NA				
6	SBM	0.125	0.25	180	2250	Principles of sheep dairying in NA				
7				Total	**11231.28**					
8										
9	Lambs	$/lb	#/hd		Annual Cost					
10	20% Creep	0.286	100		25168	Principles of sheep dairying in NA				
11	16 % Finisher	0.14451	275		34971.42	Principles of sheep dairying in NA				
12				Total	**60139.42**					
13										
14										
15	Roughage									
16		$/ton	#/hd/d	Days fed	Annual Cost					
17	Hay									
18	Ewes	108	4.4	365	34689.6					
19	Ewe Lambs	108	2.5	300	7128					
20	Fat Lambs	108	1	180	7698.24					
21				Total	**49515.84**					
22										
23	Mineral									
24		$/lb	#/hd/d	Days fed	Annual Cost			Finished Feed Price Calculations		
25	Ewes	0.3	0.03125	365	1368.75			16%		
26	Ewe Lambs	0.3	0.03125	365	602.25		Corn	70%		
27	Fat Lambs	0.3	0.03125	180	1336.5		39% Pellet	30%		
28				Total	**1971**		Price	0.14451		
29										
30	Lamb Rearing									
31		$/lb	#/hd		Annual Cost					
32	Milk Replacer	1.88	18		29779.2					
33	SBM	0.125	2		220					
34				Total	**29999.2**					
35										
36										
37	*Lamb milk #/hd from 2007 spooner sheep day proceedings									

Vaccinations

	A	B	C	D	E
1	Vaccinations				
2					
3	Vaccination		Cost/dose	# of Doses	Annual Cost
4	CDT	Ewes	0.24	1	96
5		Lambs	0.24	2	422.4
6				Total	**518.4**

Deworming

	A	B	C	D	E	F	G
1	Deworming						
2							
3	Dewormer		Cost/ml	dosge rate	ml/animal	# of doses	Annual Cost
4	Ivomectin	Ewes	0.053125	3ml/26 lbs	20.19231	1	429.09
5		Lamb	0.053125	3ml/26 lbs	8.653846	1	404.57
6						**Total**	**833.65**

Tags

	A	B	C	D	E	F	G
4	Lambs	Premiere Swivel Tags	0.275	880	10%	24.2	266.2
5	Replacement Ewes and ewe flock	Leader Tags	0.3	80	1%	1.2	25.2
6						**Total**	**291.4**

Wool

	A	B	C
1	Wool		
2		#/hd	Total
3	Ewes	8	3200
4	Lambs	4	3520
5		Total	**6720**

Milking Supplies

	A	B	C	D
1	Milking Supplies			
2				
3	Item	Quantity	Price/Unit	Total
4	Filters	240	0.05	12
5	Bleach	20	3	60
6	Detergent	20	5	100
7	Towels	20	2	40
8			**Grand Tot**	**212**

Lamb Rearing Supplies

	A	B	C	D
1	Lamb Rearing Supplies			
2				
3	Item	Quantity	Price/Unit	Total
4	Pritchard Teats	220	1.5	330
5	Rubber nipples	105.6	1.25	132
6	Large Milk Cooler	17.6	25	440
7	Small Milk Cooler	8.8	15	132
8	teat units	88	2.5	220
9	tubing (feet)	88	1	88
10	Castration Bands	440	0.015	6.6
11			**Grand Tota**	**1348.6**

Property and Equipment

	A	B	C
1	Property		
2	16800	Annual Mortgage	
3	2100	Annual Property Taxes	
4	1400	Annual Farm Insurance	
5			
6	Depreciation-Year 4		
7	3300		
8			
9			
10			
11			
12	Milking Equipment		
13	50000		
14	5000		
15	Total	28600	
16			
17	Cheese Making Equipment		
18	18000		
19	1800		
20			
21	Soap Making Equipment		
22	2000		
23	200		

Labor

	A	B	C	D
1	**Total Labor**	72800		
2				
3	# of Employees	Wage	Hours	
4	2	10	70	72800

Vehicle

	A	B
1	Vehicle Total Costs	5320
2		
3	Registration	200
4	Insurance	500
5	Maintenance and Repair	1500
6	Fuel	3120
7		
8	Fuel	
9	Gallons/week	20
10	Price of fuel ($/gallon)	3
11	Total Fuel/week	60

APPENDIX B: BUDGET CALCULATIONS

The budget spreadsheets utilize many calculations and cell references to allow the user to change key inputs and easily see what the new return on labor and management is. Some of these calculations are detailed below.

Income of fluid/frozen milk

This calculation is found in cell G3 of the "return on labor and management" tab. The Excel formula is =Sheep!$F$4*D3*C3. This calculation simply takes the total amount of milk produced (cell F4 on the Sheep tab of the worksheet), multiplied by the percentage of milk sold as fluid milk (cell D3 on the return to l&m tab), multiplied by the selling price of fluid milk (cell C3 on the return to l&m tab).

Income of Cheese and Soap

The income of selling cheese and soap, found in cells G4 and G5 of the "return on labor and management" tab, need to take the percentage yield into account, as well as the additional costs of processing and price of the milk used that could have otherwise been sold. The Excel formula for the income of cheese is =(((Sheep!$F$4*D4)*B4)*C4)-(E4+F4). This calculation first determines the amount of milk going into cheese production by taking the total amount of milk produced multiplied by the percentage of milk processed into cheese (Sheep!$F$4*D4). It multiplies that amount of milk by the % yield to determine the amount of finished product produced (*B4). The amount of finished product produced is multiplied by the selling price of the finished product (*C4). Finally the costs of the milk processing supplies and cost of milk used are subtracted (-(E4+F4)). The calculation for income from soap is the same as that of cheese using the cell references that contain the data on soap income and expenses.

Cost of Cheese Making Supplies

This calculation is found in cell C20 of the "sheep operation costs" tab. The Excel formula reads =((Sheep!$F$4*0.003715)+(Sheep!$F$4*0.005821))*'Return on Labor and Management'!D4. This calculation gives us the cost of the cultures and rennet used to produce cheese. The costs of cultures and rennet given were 0.003715 and 0.005821 per pound of milk processed respectively. This calculation first determines the cost of producing 100% of the milk into cheese (((Sheep!$F$4*0.003715)+(Sheep!$F$4*0.005821))). Then multiplies that number by the percentage of milk actually processed (*'Return on Labor and Management'!D4).

Cost of Soap Making Supplies

This calculation is found in cell D22 of the "sheep operation costs" tab. The Excel formula reads =Sheep!F4*'Return on Labor and Management'!D5*'Return on Labor and Mangement'!B5*2.9776. This calculation takes the total amount of milk produced (Sheep!F4), multiplied by the amount of milk processed into soap (*'Return on Labor and

Management'!D5), multiplied by the percentage of soap yielded by that milk (*'Return on Labor and Mangement'!B5) and finally multiplied by the processing supply costs per pound of soap produced (*2.9776). The value of 2.9776 was derived by the costs given above in chapter 5.2.2 of $0.1836 per ounce for oil and sodium hydroxide and $0.04 per pound for packaging. (0.1836*16 = 2.9376 per pound + 0.04 = 2.9776)