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IMPROVING FEED RATIONS IN THE DAIRY AND SHEEP INDUSTRIES

KOSOVO CLUSTER AND BUSINESS SUPPORT PROJECT

July 12, 2006

This publication was produced for review by the United States Agency for International Development. It was prepared by the KCBS project team of Chemonics International Inc. based on a Final Report prepared by Short Term Technical Advisor, Dr. Roy Chapin.

IMPROVING FEED RATIONS IN THE DAIRY AND SHEEP INDUSTRIES

THE REPORT BUILDS ON PREVIOUS VISITS BY THE CONSULTANT TO KOSOVO DURING WHICH HE DEVELOPED IMPROVED NUTRITIONAL FEED RATION MIXES FOR THE DAIRY INDUSTRY. ON THIS VISIT HE DEVELOPED FORMULATIONS FOR RATIONS FOR SHEEP, CALVES AND REPLACEMENT HEIFFERS.

Kosovo Cluster and Business Support project – Improving Feed Rations in the Dairy and Sheep Industries
Contract No. AFP-I-00-03-00030-00, TO #800

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PURPOSE OF ASSIGNMENT

There were two objectives to this assignment. The first was to provide rations for successfully starting and growing calves and heifers that will enter the productive milking herd at industry accepted ages of 23 to 26 months as well as to formulate rations for dry cows. The second objective was to assist the sheep industry in Kosovo to become more competitive by introducing better feed rations and feeding practices for lambs, ewes and rams.

BACKGROUND

Background for dairy assignment: A sustainable dairy industry depends on the continued availability of reasonably priced replacement animals for the herd in adequate numbers to allow accepted culling procedures from the milking herd.

KCBS provided the services of an animal nutritionist to show milk producers how to formulate lower cost feed rations for calves and dry cows using local or cheaper imported ingredients. This will generate high quality heifers with superior genetic capabilities that are acclimated to Kosovo at less cost than imported livestock within two years. Improper nutrition has been a segment of dairy production that has been identified by numerous consultants; little work has been done regarding the nutrition program for calves, heifers and dry cows. Proper dry cow rations need to be formulated for healthy calves. Dry cows need a separate ration if we are going to improve the health of the calves and the cows as well.

Emphasis needs to be placed on the first eight weeks of life of the calves. These first eight weeks have the most dramatic effect on the lifetime production capability of the animal. Proper nutrition promotes rapid calf growth and rumen development that will enable converting the heifer from a liability to an income-producing asset quickly.

Roy Chapin filled this assignment. He has been to Kosovo on two other consulting assignments. He worked with commercial dairy farmers on developing feed formulations for their specific needs; he also worked with Fauna in formulating a specific premix for dairy cows which is already available in the market at lower cost. His work is greatly appreciated by the farmers and the dairy sector. They are currently using his dairy rations formulated in the previous trips. The Kosovo Association of Milk Producers (KAMP) has also requested that Dr. Chapin return because many of their members have seen improvements in their milk output and want to take the next step in improving output further.

Background for sheep assignment: Kosovo is predominantly a rural society, with the rural population comprising over 60% of the general population of two million people. Historically, sheep breeding has represented an important branch of the economy, especially in the hilly mountainous and lowland areas of Kosovo. These areas make up about 165,000 hectares of natural, extensive pastures with low yields.

The purpose of this assignment is to help Kosovo sheep and lamb farmers develop a more profitable industry by balancing improved starter and grower rations for lambs and improved feeding rations for ewes to increase overall milk production.

This assignment is considered part of a bigger project to improve lamb and sheep milk production, which will include importing ewes of improved milking breeds for a pilot project.

EXECUTIVE SUMMARY

The majority of the work done on this assignment is reflected in the spreadsheets. They are an integral part of the deliverables, and pretty much stand alone. The rest of the report provides background and ties the spreadsheets together.

I have made multiple trips to the Balkans – Kosovo, Bosnia & Serbia – for various contractors (KBS, Care International, KCBS, USAID-LAMP, UNDP and Mercy Corps) to work on dairy and sheep nutrition. This was my fifth trip to Kosovo. The work done adds rations for sheep, calves and replacement heifers to those formulated on previous trips for lactating cows. Each trip builds on itself and is shared throughout the Balkans in the hope that it will improve the profitability of the dairy and sheep sectors and those industries that have links to it such as suppliers, processors, marketers and distributors.

This third assignment by me for KCBS (Kosovo) involved both the sheep & dairy sectors. Much more research data, software and written material are available for the dairy sector so I extrapolated known good dairy nutrition husbandry to the sheep sector.

FIELD ACTIVITIES TO ACHIEVE PURPOSES

Individual dairy farms were visited that included Dukagjini Data, Eurolina, Jetishi, Disa, Mujoto and Mazreku where I made feeding recommendations. Most of them were using rations that I had formulated for them during previous trips. Ration work was done for Mazreku. [Letter to Mazreku enclosed as Annex I].

We met with the KAMP staff in their Prishtina office and were pleased to find them distributing the KCBS dairy program including lactation rations that I had formulated during previous trips to the Balkans.

Several days were spent putting up calf hutches at individual farms.

We visited Dr. Idrizi of Fauna at his new offices at a former state operated grain and soybean meal warehousing facility in Fushe Kosova. The facilities are still owned by the state but Dr. Idrizi hopes to privatize them. Dr. Idrizi is one of the success stories for KCBS. I first visited him in October 2002 and have visited him on each trip to Kosovo since then, five times in all. His buying in bulk carloads has resulted in a drop in cost to farmers for soybean meal, corn and other ingredients. He is having Chapin Dairy Premix manufactured near Belgrade and making it available throughout Kosovo. This saves the dairymen over ten Euro cents per cow per day versus other options and allows adjustment of major minerals to fit individual situations. This in itself is a success story. He requested that I work with him to develop major mineral and vitamin mixes that he can make available to livestock raisers. This would be another big boost to the dairymen of Kosovo. Milk producers must have suppliers, processors and marketers of their product in order to prosper. KCBS is having wonderful success on all fronts. Fauna is an important supplier to the dairymen. Fauna may be a source of dried molasses, milk replacers, major minerals and other feed ingredients. He is also a supplier of semen and vet supplies.

TASK FINDINGS AND RECOMMENDATIONS

I. General

The objective of livestock farming is to make money, so if investing in better nutrition returns more than it costs it appears to be a good business decision to improve the ration. This runs counter to most of the prevailing sheep husbandry culture where too often the best ration is assumed to be the cheapest ration. Even those who write the scopes-of-work for USAID assignments worldwide fall captive to this orientation when they ask *that cheaper rations be formulated using locally produced ingredients so as to improve profit*. This orientation where the objective appears to be reducing feed costs seems like a blueprint for failure.

In most all cases my rations increase the cost per unit of feed but allow the realization of the objective of reducing the cost per unit of milk and meat through increased production. I don't care if the ingredient was grown by the user, by the neighbor next door, in a neighboring country, or on another continent, this is a global economy and the real question is whether feeding an ingredient makes you more money than it costs and specifically, whether an ingredient makes you more money than using other ingredient options. A good example of success through more expensive feeds is what we have seen in the Balkans by replacing sunflower meal (SFM) produced locally with soybean meal (SBM) produced elsewhere in diets fed to high producing dairy cows. Because of positive on-farm results, innovative milk producers in the Balkans have found that it makes them more money to feed SBM even if they have to spend over twice as much for it as SFM. As a result there is an increased use of SBM throughout the Balkans, at least among the dairymen that I have observed.

Livestock producers should make their choice of ingredient decisions by careful attention to expected marginal revenue over marginal cost. This requires that records be kept so that the manager can make decisions based on his own results rather than on tradition. The dairy industry has done a good job with dairy herd improvement record keeping programs, like the ones that USAID-LAMP (Bosnia) has introduced, and one that KCBS plans to introduce in Kosovo.

II.a Sheep

Historically sheep have been expected to survive and produce milk, meat and wool by living off the land, often in rather "bare-bones" conditions. It is a credit to them that they can survive under adverse living conditions. While it is admirable that sheep can adapt to rather extreme conditions of nutrient deprivation it doesn't follow that the correct objective is to see how little they can be fed and still survive.

The sheep industry appears to be a bigger challenge than the dairy industry to elicit change for reasons that include the inherent nature of the nomadic life of the shepherd, lack of good record keeping systems, intermittent cash flows, inadequate working capital, lack of professional leadership and extension programs and most importantly a mind-set that one shouldn't spend any money for feed, even if it will make money.

To counter these obstacles, KCBS is conducting sheep feeding trials on two sheep farms to determine the economics of:

- creep feeding a prepared feed to young lambs;
- feeding a lamb grower ration to growing lambs; and
- feeding a lactation ration to ewes that are producing milk for their lambs and also for hand milking and eventual sale.

The rations used in these on-farm feed trials are shown in Annex 2 - Sheep Mix spreadsheet under the "Mix Formulas for Sheep" tab at the top of the page.

The economic benefit of feeding creep and grower rations to lambs can be determined, of course, by weighing the lambs and comparing the economic benefit of the weight gain (marginal revenue) versus the cost of the feed (marginal cost). With lactating ewes the benefit of supplemental feeding can be determined by weighing the nursing lambs and if the ewes are milked also by changes in milk yield. If we could measure the weight change of the ewes it would be an important parameter to have.

In Srebrenica on a UNDP project we had sheep producers weigh lambs whose mothers were fed soybean meal versus control lambs nursing ewes not fed SBM. There was a marked positive response in weight gain of the experimental lambs versus the control. I think that there was a multiplier effect due to the ewes producing more milk and lambs using the increased milk for more muscle gain. In other words, there was a milk response from the ewes and growth response from the lambs that the lambs could have gotten if the SBM had been fed to them directly but the response would not have been as great since the ewes "multiplied" the favorable response to feeding SBM by first producing more milk.

The report of the UNDP feeding trial where we added SBM to the diet of lactating ewes is included as Annex 3.

One of the farms in Kosovo that will be conducting the feeding experiment on lactating ewes did not supply the ewes with any supplements. They were pastured and that was the only feed. On this farm lambs nurse their mothers and afterwards the ewe is milked. The farmer said he could sell any extra milk as fresh milk and particularly as cheese. He assured us that he had a market even if the ewes tripled their milk production.

When we conduct on-farm feeding trials we need to be very careful:

1. that we have only one variable, the feed,
2. that there is a control group of equal potential,
3. that the *within-group* variation is minimized so that any *among-group* variation due to treatment - feed - has a better chance of showing significance *if there is a treatment difference*,
4. that only the animals on treatment consume the feed (feed security) and not the controls as we are measuring the difference in performance; if both treatment and control groups consume the feed, they would be expected to perform similarly and show no *among-group* variation,
5. that accurate records be kept,
6. that it is clear what is to be recorded,
7. that the person conducting the on-farm feed trial knows what is going on, and
8. that the farmer wants to run the feeding trial so that he will have accurate data with which to make good economic decisions for improvements in his operation, and not just to rip off the donor for some free feed. Is he interested in sustainable long-term rather transitory short-term benefits?

It should be remembered that fallacious data is worse than no data as it can lead to making wrong decision. (I have attached as Annex 4, a long piece that I wrote in Bangladesh several years ago on conducting feed trials.)

It is anticipated that there will be a positive response in all three feeding groups (lamb creep, lamb grower and ewe lactation). For that reason I have included new more sophisticated rations that farmers can mix on their farms using a bigger variety of feedstuffs than we had available when mixing feed for our feeding experiment. These new rations use Chapin Sheep Premix (CSPM), which I formulated for this assignment. CSPM varies from Chapin Dairy Premix (CDPM) in that it contains less copper and some molybdenum in order to avoid a copper toxicity that could kill sheep if they consumed the dairy premix. Be sure the right

premix is used for mixing feed for sheep and dairy as using the dairy premix could kill sheep and using the sheep premix could leave dairy animals deficient in copper.

II.b Sheep Mix Spreadsheet

The Sheep Mix spreadsheet [Annex 2] shows the new creep, grower and lactation formulas in the tab marked “Mix formulas of Sheep” in the center of the page. At the bottom of the page is a handy interactive feature where you can enter the size of the feed mix you plan to make and the extended formula is presented immediately.

You will also see that you can enter the local ingredient costs (interactive feature) and the spreadsheet will calculate the ration cost. Using Chapin Sheep Premix will usually reduce ration cost versus buying a commercial sheep premix. This spreadsheet will let you compare prices and make informed decisions.

The formula for Chapin Sheep Premix is given in the tab marked “Chapin Sheep Premix” of the Sheep Mix spreadsheet. I suggest that this formula be sent to Fauna and have them have it custom mixed. They have Chapin Dairy Premix custom mixed and available for sale. I have sent Fauna an upgraded formula for CDPM as it is presented in the Calf & Heifer Rations spreadsheet that we will discuss later. These premix formulas are open formulas so that other custom mixers could manufacture it. They should not be mixed by those not in the premix manufacturing business due to the need for accuracy of ingredient additions and other quality control concerns.

III.a Calves & Replacement Heifers

After working extensively throughout the Balkans formulating rations, creating feed programs and developing spreadsheets (Milk Money Maker – MMM and field Milk Money Maker - fMMM) for lactating cows it was a pleasure to face a new challenge to develop rations, feed programs and a spreadsheet for new-born calves, growing calves and replacement heifers. This was a bigger undertaking than anticipated. These spreadsheets look pretty straightforward when they are completed but creating them can be frustrating with many false starts and revisions. It is definitely a time-consuming creative process with insights for improvement coming as one works on them, flies home, lies in bed, goes for a walk or works outside. They have a way of consuming your whole focus. After working at home doing a complete reworking and enlarging of the spreadsheet for calves and heifers that I roughed out in Kosovo I feel that we have a spreadsheet that can be used effectively throughout the Balkans to raise calves and replacement heifers. The spreadsheet is self-contained but I want to say a few things about its creation, development, uses and application.

One can go on the internet and find suggested calf starter and grower rations. I wanted to go behind this and create rations and recommendations from scratch using the U.S. National Research Council’s Dairy 2001 software to formulate rations that would supply adequate nutrition for animals at different ages (weights) fed a variety of forages. It was not surprising to find that different forages take different concentrate rations fed at different amounts to balance the forage if you want to meet growth goals that put a replacement heifer in the milking string at 23 to 24 months of age. You end up with a confusing array of hay and concentrate feeding recommendations.

I also wanted to have an economic component that could be used for decision making as to what forage is the most economical to feed when you enter forage and concentrate ingredient costs and whether it was cheaper to raise your own heifers or to buy replacements. I added this after returning home.

III.b Calf and Heifer Spreadsheet

At this point of our discussion it would be helpful for you to print out each of the 16 tabs (one page each) of the Calf & Heifer spreadsheet [Annex 5]. The first tab on the left labeled "instructions" will give the contents and general operating instructions so I won't duplicate those discussions here except as follows.

The second tab from the left is where you enter prices. Don't do it elsewhere in the spreadsheet in cells in red as this will disable the spreadsheet.

The third tab from the left gives formulas for nine concentrate feeds and their nutrient content. They will be identified later when amounts to feed are given by the percent crude protein of their dry matter.

When you pull up the forage intake tabs you will notice with the better forages that the entries are offset to the right and are in italics. This indicates that the amount of forage recommended to feed is less than what the animal can consume. In those situations feeding forage free-choice will result in over conditioned animals.

Moving on to the feeding guidelines your first impulse will be confusion with so many entries. You can bring understanding to the confusion by choosing just one forage, which would be a typical situation for an individual farm, and seeing that the number of rations becomes manageable with a calf starter, calf growers of different protein levels and a heifer grower ration. Since protein needs go down as the animal grows and since it would be logical to have animals of different ages (weights) at the same time, simplify the number of rations needed by mixing the grower ration with more protein shown for younger calves. The money saved by feeding a lower protein ration wouldn't be worth it compared to the stunting in growth of the frame of the lighter animals if they are fed rations deficient in protein.

Notice the economic information at the bottom of the guidelines page. Use it to choose forage and make management decision including to raise or buy replacement heifers.

There is a series of forage intakes and guidelines for feeding hay and for feeding hay and corn silage, so I think most forage options that occur in the Balkans are covered.

The eleventh tab to the right contains a lot of feeding and management information so please study it carefully. I tried to condense a lot of information into a small place. Note that calves need free choice water starting at day 3, getting calves to eat calf starter hastens the development of the rumen and hay should not be fed until after weaning.

Next comes a series of tabs that give goals for weight and height for different breeds and for different percentiles for Holsteins. Measure your replacement animals regularly to be sure that they are growing adequately and improve your feed program if they are not.

The last tab on the left gives the formula for Chapin Dairy Premix, which you can buy from Fauna or whoever makes it. This makes it possible to mix the rations as formulated.

As stated previously, this Calf & Heifer spreadsheet is self-contained and contains more information on growing calves and replacement heifers under different forage programs than you have probably ever seen complete with an economic component that allow you to enter your costs and see the feed costs to raise a heifer from three months to 22 months. You can add your cost to get it to three months of age and from 22 months to calving including the cost of the calf, feed and non-feed costs. I've never seen anything as complete as this. It took a lot of work and time (in Kosovo and at home) but I feel happy with it and hope dairymen use it to advantage. It will take some study but with some effort it will become understandable and usable. Most importantly it will give detailed feeding guidelines for various forage programs so that rations and feeding amounts can be adjusted for the actual forage situation "down on the farm" and if followed will put replacement heifers in the milking string at 23 to 24 months of age at a size conducive to maximum milk flow.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

The work KCBS is doing to promote improved pastures shows real promise. What I saw in the field was really impressive when one compared the appearance of improved versus unimproved pastures. This is a longer-term approach than introducing the feeding of prepared rations, but I think it should be a major part of KCBS's attempt to improve profitability in the sheep industry. Improve the forage and I'll formulate the concentrated diets to balance the forage.

Having a market for the product of course is essential. If it can be proven that there is a market for increased amounts of meat, milk and sheep cheese, working with the sheep sector to increase production could be a big opportunity for KCBS. Part of the initial market research could be to observe if the experimental farmer's ewes do produce more milk, can sell it. Being assured of a market is critical before KCBS devotes much time and resources to improve production in the sheep sector.

In summary I think the sheep sector can realize results from improved nutrition equal to or greater than we have see in the dairy sector of Kosovo. My impression is that the sheep industry is way behind in applying known nutrition principles. If it is ascertained that the sheep sector of Kosovo is viable, KCBS can use their dairy model to improve supply, production, processing and marketing in the sheep sector. In fact, this might be a sector of the agriculture economy of Kosovo that KCBS can help develop into a niche market that could be economically viable.

If there is a market for lamb and for ewe milk and sheep cheese, then we need to prove at the farm level that production and profitability can be improved by improving diets. Since sheep are ruminants that consume forage, I suggest that KCBS continue their work in improving pastures and forage. They don't have to reinvent the wheel here as the state-of-art techniques of good forage production that Dr. Undersander has presented for the dairy sector apply to the sheep husbandry. Concentrates need to be fed to make up deficiencies in the forage. I have formulated rations for starter lambs, growing lambs and lactating ewes as well as formulated a sheep vitamin – trace mineral premix, so we're set to go. I'm sure the same techniques that we used in the dairy sector will apply to the sheep sector. The next step is to prove the economic benefit of feeding improved rations at the farm level and spreading the word among sheep raisers just as KCBS has done successfully with the dairy industry. A Kosovo Association of Sheep Producers would help in the extension effort.

ANNEXES

Annex 1: Letter to Mazreku

Annex II: Sheep Mix spreadsheet

Annex III: Challenges & Suggestions for Commercial Development of Dairy & Sheep Production in Srebrenica, Bosnia. UNDP, May 2004

Annex IV: Experimental Protocol for Dhamrai Dairy Feeding Trial Testing Dairy Feeds from Saudi Bangla Fish Feeds Ltd. February 2001

Annex V: Calf & Heifer spreadsheet

2 June 2006. ***Letter to Mazreko Dairy with Present Dairy Ration Evaluation & Suggestions for Improved Rations for Simmental & Holsteins*** **from Roy Chapin**

Dear Sadri, Osman and Ossum.

It was good to see you yesterday. The calf hutches we delivered and helped assemble will help you improve your calf and heifer growing program and can be an important part of your long-term goal for high milk production and increased profitability. I am working on rations for calves and replacement heifers that KCBS will give to you.

Your present milk production is 19 liters per cow, which is a great improvement from when we first met a little over year ago when your average was 10.5 liters per cow. However, to a degree we're comparing apples to oranges as you've brought in Holsteins and they are raising your average milk production but your Simmentals are producing lots more milk than when we first met. Congratulations!

While your herd average is up let's not rest as there are some things that you can do that will raise your milk production and more importantly your profitability significantly within a week. As a casual walk through of your herd reveals to you and others, your Simmentals are in pretty good body condition and your Holsteins are thin. I understand that they arrived in better body condition than they are at present and unless their feed ration is improved they will drop in milk production and with it your herd average and profitability will decrease. Holsteins need to be fed better than Simmentals and if you do so, the Holsteins will reward you with much more milk and profit. If you feed Holsteins like you feed Simmentals you will say that the Holsteins are not adapted to Kosovo. We need to adapt your feeding program to allow the Holsteins to reach their milk potential.

If the Holsteins are not fed more energy than at present you can expect to have breeding problems. They need to consume more energy than at present to improve their body condition or you'll be in big problems due to problems getting them pregnant. They need more than the 7 kg of concentrate you are now feeding.

I'm glad that you agreed to put the Holsteins in a string of their own so that we can feed them differently than the Simmentals. I would urge you to arrange all the cows so that they are lined up according to their level of production so that they can be fed accordingly. Attention to feeding your cows differently based on their production will pay you big financial dividends. All cows in a herd (and particularly Holsteins versus Simmentals) should not be fed the same. Paying attention to the body condition of each cow and feeding accordingly is important. In addition to a basic ration fed to all cows, if a cow is thin, feed her more energy – corn – and if she is fat, feed her more protein – soybean meal – to try to convert some of that fat into milk. Arranging your cows based on production will make it easier to feed each cow based on her needs rather than selecting out individual cows along the string of many cows for special feeding.

I'm concerned that you are feeding sunflower meal (SFM) rather than all soybean meal (SBM). You are saving 20 cents a cow a day by feeding SFM in place of SBM but it is costing you much more than this is lost revenue due to decreased milk production. I think you would see an improved milk flow of two or three liters within a week or two by replacing SFM with SBM.

2 June 2006. ***Letter to Mazreko Dairy with Present Dairy Ration Evaluation & Suggestions for Improved Rations for Simmental & Holsteins*** **from Roy Chapin**

Your present ration is supporting 19 liters milk/cow/day, which is very close to what my computer software program predicts. Your present ration is also low or deficient in calcium and salt. You are feeding a little more Fauna dairy premix (formulated by me) than is necessary. According to what you told us yesterday you are feeding 28 grams per cow per day and 20 grams is enough.

We could make some simple changes to your present ration by replacing SFM with SBM so that you add 160 kg SBM per a 500 kg mix (no SFM), reduce the Fauna dairy premix to 1.5 kg/500 kg, increase limestone to 7.5 kg and salt to 5 kg. This would increase milk production but unless you feed more feed, your Holsteins would lose even more weight. Doing this simple change of replacing SFM with SBM would prove the value of SBM.

For the longer term I suggest that you mix two rations. The basic ration would be fed to all cows giving 15 liters of milk or less at rates of eight to 10 kg/cow/day and the high producer's ration would be fed to all cows giving more than 15 liters at rates of 12 to 14 kg per cow.

The formula for the basic ration fed to low producers (<15 liters) is:

200 Corn
100 Beet Pulp Pellets or grain of choice
100 Wheat Bran
115 Soybean Meal
1.3 Fauna Dairy premix
7.5 Limestone
4.5 Salt
528.3

Feed 8 to 10 kg of this mix to cows giving 15 liters of milk or less.

Ration for High Producers would be:

225 Corn
75 Beet Pulp Pellets or grain of choice
75 Wheat Bran
125 Soybean Meal
1 Fauna Dairy Premix
7 Limestone
4 Salt
512.

Feed 10 kg to cows giving 20 liters of milk, 12 kg to cows giving 25 liters, 14 kg to cows giving 30 liters, 16 kg to cows giving 35 liters. Increase the dairy mash from your present 7 kg/cow/day in half kg increments and watch cows to be sure that they aren't

going off feed or having stomach problems. It may be desirable to feed 50 to 60 grams magnesium oxide and 150 to 200 grams sodium bicarbonate to buffer the rumen.

You will notice that we're adding less SBM to a 500 kg mix than at present but the intake of SBM per cow will be greater since we will be feeding more kg of total feed. We are increasing the energy density of the ration so that cows, particularly Holsteins, will be gain weight.

9 June 2006

I'll see you tonight.

Sincerely,

Roy

Roy Chapin

Mix Formulas (kg) for Sheep Experiment - Tom Gjini - Kosova

KCBS Kosova	Lamb Creep (Starter)	Lamb Grower	Ewe Lactation	Totals all mixes	Ingredient Costs - Euro Per Kg	Total
Barley	50	50	50	150	€ 0.15	€ 22.50
Corn	100	100	100	300	€ 0.13	€ 39.00
SBM	80	60	60	200	€ 0.28	€ 56.00
Wheat Bran	25	25	50	100	€ 0.10	€ 10.00
Ovisan (Sano)	6.5	6.5	12	25	€ 0.84	€ 21.00
Limestone	5.0	5.0	3.0	13	€ 0.10	€ 1.30
Mix Totals	266.5	246.5	275	788		€ 149.80
Cost for Mix	€ 51.36	€ 45.26	€ 52.38			
Cost/kg	€ 0.193	€ 0.184	€ 0.190			

Sheep Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

E-mail: <roychapin@onlinemac.com>. 11145 Chapin Lane, Amity, Oregon 97101 USA. Telephone: 1-503-835-7317.

Concentrate Mixes (kg) with Chapin Sheep Premix if Concentrate 50% of Total Ration Dry Matter

KCBS Kosova	Lamb Creep (Starter)	Lamb Grower	Ewe Lactation	Enter Cost of Ingredient
Barley	10	10		€ 0.15
Corn	20	34.8	52.8	€ 0.13
Oats	10	10		€ 0.16
SBM, 44% solvent	30	23	20	€ 0.28
Beet Pulp Pellets	10	10	12.5	€ 0.13
Wheat Bran	10	10	12.5	€ 0.13
Molasses, dried or wet	6.4			€ 0.20
Chapin Sheep Premix*	0.20	0.20	0.20	€ 1.50
Mono Calcium Phosphate	1.00	0.50		€ 0.39
Limstone	2.00	1.00	1.00	€ 0.10
Salt	0.40	0.50	1.00	€ 0.10
Totals	100.00	100.00	100.00	
Cost/100k	€ 18.91	€ 17.31	€ 16.21	
Cost/kg	€ 0.189	€ 0.173	€ 0.162	
** See next tab for formula*	*Enter Mix Size to See Formulas*			
Interactive Mix Size	250	250	250	
Barley	25	25	0	
Corn	50	87	132	
Oats	25	25	0	
SBM, 44% solvent	75	57.5	50	
Beet Pulp Pellets	25	25	31.25	
Wheat Bran	25	25	31.25	
Molasses, dried or wet	16	0	0	
Chapin Sheep Premix*	0.50	0.50	0.50	
Mono Calcium Phosphate	2.50	1.25	0.00	
Limstone	5.00	2.50	2.50	
Salt	1.00	1.25	2.50	
Totals	250.00	250.00	250.00	

Formula for Chapin Sheep Premix. Feed at 0.1% of Dry Matter Intake

Chapin Sheep Premix formulated by Roy E. Chapin, Ph.D, Animal Nutritionist

11145 Chapin Lane, Amity, Oregon 97101 USA, E-mail: <roychapin@onlinemac.com>

Nutrient: Vitamin & Trace Mineral	Potency/kg of Premix IU or mg;kg	Formula for 100 kg Mix Kilograms	Ingredient that Supplies Nutrient	Assumes Potency/gm
Vitamin A	6,500,000 IU	1.300 kg	**Vitamin A** Premix	500,000 IU
Vitamin D	2,000,000 IU	0.400 kg	**Vitamin D** Premix	500 000 IU
Vitamin E	65,000 IU = mg	13.000 kg	**Vitamin E** Premix	500 = 50%
Copper	5,000	2	**Copper** Sulfate	25% **Cu**
Cobalt	500 mg	0.250 kg	**Cobalt** Sulfate	20% **Co**
Zinc	125,000 mg	35.714 kg	**Zinc** Sulfate	35% **Zn**
Selenium	400 mg	0.89 kg	Sodium **Selenite**	45% **Se**
Manganese	40,000 mg	13.333 kg	**Manganese** Sulfate	30% **Mn**
Iodine	2,000 mg	0.267 kg	Potassium **Iodide**	75% **I**
Molybenum	2,500	To Be Determined	Manufacture's Choice & Calculations	
			Antioxident	
MagOx = to 1 kg		25.647 less Moly	Magnesium Oxide	
		100.000		

NOTE: Sodium Selenite should be premixed with another trace mineral before adding.

Be sure that it is Chapin Sheep Premix (CSPM) & not Chapin Dairy Premix (CDPM) that is added to sheep rations as CDPM is 5 times too high in copper and can (will?) kill sheep.

The amount of Chapin Sheep Premix to add to the concentrate portion of sheep mixes based on the percentage the concentrate is of the total ration dry matter.

Shown below are the amounts of vitamins & trace minerals (concentrations) that Chapin Sheep Premix will add to the Total Ration Dry Matter (TRDM) if added at 0.1% of TRDM.

Nutrient: Vitamin & Trace Mineral	Potency/kg of Chapin Sheep Premix	Concentration of TRDM if 0.1% added to TRDM	Nutrient Density in Concentrate if Conc. 50% of TRDM	
Vitamin A, IU	6,500,000	6,500	13,000	***It is not feasible***
Vitamin D, IU	2,000,000	2,000	4,000	***to mix Chapin***
Vitamin E, IU = mg	65,000	65	130	***Sheep Premix***
				on the farm.
Copper, mg	5,000	5	10	***Have it custom***
Cobalt, mg	500	0.5	1.0	***manufactured by***
Zinc,mg	125,000	125	250	***an established***
Selenium, mg	400	0.4	0.8	***vitamin-mineral***
Manganese, mg	40,000	40	80	***premix***
Iodine, mg	2,000	2.0	4.0	***manufacturer.***
Molybdenum	2,500	2.5	5.0	

It is possible to add other microingredients such as niacin, biotin, etc.

1 May 2004. ***Challenges & Suggestions for Commercial Development of Dairy & Sheep Production in Srebrenica, Bosnia.*** **Roy Chapin, Ph.D., Animal Nutritionist**

UNDP in Srebrenica, Bosnia has performed the humanitarian service of supplying 170 dairy cows and some sheep to selected returnees and inhabitants left in the area following the war of over ten years ago. This is a ***transfer*** of wealth and is not sustainable. Hopefully, it will provide food for the recipient and help make it possible for a family to survive off the land. The goal of my work is to look at how (or if) dairy and sheep production can be done commercially in Srebenica so that there is a ***creation*** of wealth, thus making it sustainable. After three weeks of work, I am (1) recording observations and suggestions in this report, (2) creating an interactive Milk Money Maker spreadsheet formulated for local conditions giving rations that will support milk production up to 60 liters per cow per day in five liter increments for dairy cows fed grass forage (top quality pasture, immature hay, mid-maturity hay, mature hay and wheat straw), legume forages (at different stages of maturity), corn silage and various combinations, (3) spreadsheet showing the effects of forage maturity on dry matter intake and milk production for various breeds of dairy cows and (4) suggested feed rations for sheep. The interactive Milk Money Maker spreadsheet for dairy cows can be used by UNDP extension workers to suggest rations for their clients based on the forage being fed. Local prices can be entered to determine income over feed cost. I appreciate the opportunity UNDP has given me to do this work. Being here is a privilege.

One of the challenges in Srebrenica is to get the locals to start ***thinking commercial production*** rather than expecting to receive humanitarian aid (grants) indefinitely. An effective way to change this attitude is to show through local feed trial demonstrations that a profit can be made by producers in the dairy and sheep industries that are using state-of-art animal nutrition technology.

In order for the sustainability of commercial production of any product, there must be a market for the product produced so that it can be sold at a market price that is sufficient to encourage the producer to continue production. At present there is no commercial market for milk in Srebrenica, particularly for people living in off-road areas. The milk market at present is limited to one's own family and neighbors. Until there is a market for milk, commercial dairy production will not happen and should not be encouraged.

The Srebrenica office of Land O'Lakes is promoting family production of soft cheese that they hope to transport out of the area and sell at a profit for the producer. This would encourage value adding (a potential profit center) to milk as well as providing a market for the raw product. This is a particularly attractive option in the off-road areas of the high mountain area. LOL expects production to start this summer.

Another option for creating a market for milk is to establish Milk Collection Centers (MCC's) that pool milk into amounts that are economical to transport to dairy processors in neighboring regions. Finding a milk processor that will take (regularly) all milk supplied and pay an acceptable market price for it in a timely fashion (such as early in the month following delivery) is a challenge. For MCC's to be economical, they and the milk producers must be on a decent all-weather highway system. This eliminates much of the Srebrenica area from being attractive for commercial dairying. Preliminary work

has begun on developing MCC's, but at present there is no viable market for milk in the Srebrenica area.

There is no justification for promoting dairy production in the area unless a program that is expected to establish a market ***ahead*** of the commercial production of milk accompanies the initiative for increased milk production. A milk market and commercial production of milk must be developed in unison for either to be viable. Various well-meaning donor programs have violated this basic business concept by encouraging production of milk for which there is no market. It may be necessary for a donor program to help organize MCC's and subsidize collection and transportation (in the short run) to a milk processor in order to stimulate commercial milk production.

Milk quality will be important for sustainable sales, so a milk quality program should be included. Quality should be reflected in the purchase price to give an economic incentive to the producer to produce quality milk. Milk of low quality has a decreased shelf life and lower consumer acceptance.

Sheep appear to be a more favorable economic alternative than dairy for much of the Srebrenica area as sheep are more adapted to graze the rather steep terrain, they can be walked or hauled to a market at the end of the growing season (as opposed to daily marketing of milk) and there is a market for lambs. Grazing is seasonal, as is the production of lambs, which fits the high country growing season nicely. Dairying usually is not seasonal, requiring more winter supplies of forage than a wintering ewe flock pregnant with next year's lamb crop.

Milk production supplies a ***continual cash flow***, while raising lambs provides a ***seasonal cash flow***. There may be a cash flow benefit from doing dairy and sheep production together. Money invested in feeding for more milk production can be expected to produce an improved cash flow in less than a week (time it takes for the cow to respond with more milk to consuming improved nutrition) plus the time it takes to be paid for the increased milk. Raising animals for the meat market (lambs) takes more investment capital as the payback is delayed until the lamb is sold at the end of the growing-fattening period. Therefore, improvements in feeding lactating cows usually can be self-financing while improving the feeding of sheep requires a capital investment with a longer delay for payback.

There is a predator problem with sheep.

Sheep raisers here have reported that there is no market for wool, which is a world-wide problem. I understand that one UNDP funded project has created a modest market for wool. A local woman buys wool, mechanically combs and cleans it with a machine financed by UNDP and employs knitters to make wool garments from the yarn produced from this wool. UNDP can help bring wool buyers and sellers together. Finding a wool market is just like finding money for these sheep raisers.

1 May 2004. ***Challenges & Suggestions for Commercial Development of Dairy & Sheep Production in Srebrenica, Bosnia.*** **Roy Chapin, Ph.D., Animal Nutritionist**

There is not a well-developed ingredient supply market for dairy and sheep producers, as too few producers exist to make it profitable to be a supplier. As a result, feed programs are primitive with endemic nutrient deficiencies limiting the economical commercial production of milk and meat. I saw no commercial dairy operations in the area (How could there be with a lack of a market for their milk?), but there are several commercial sheep producers (lamb market) who have indicated an intention to increase flock size.

Suspecting that a protein deficiency situation exists locally for dairy and sheep producers, even during the spring (last of April) green grass season, UNDP supplied 50 kg of 44% solvent soybean meal (SBM) to two dairy producers and to two sheep producers. These four producers were asked to read a three page experimental protocol written especially for them and a 31 page narrative on ruminant nutrition and were given enough soybean meal to conduct an ***on-farm feeding experiment***. **All four producers reported a positive increase in milk/meat production after feeding SBM for a week.**

A diversionary thought: There is a tendency, particularly among sheep breeders, not to buy feed, accepting whatever production results from feeding local forage and feedstuffs. Our on-farm feeding test results suggest that there is big money to be made by feeding better. There is a fixed cost to maintain an animal. Increasing production of an animal spreads the cost of maintenance over more units produced. Another way to look at it is to feed to get more milk from fewer cows (sheep) and reduce the maintenance burden. Since deficient cash flow is a debilitating disease, this is an opportunity for micro-finance organizations to come to the rescue with cash for improved feed, for the benefit of both lender and borrower. Increased wealth can be generated by feeding to meet the nutrient requirements of animals rather than expecting them to get by on whatever is available and cheap. Profit oriented managers realize that the objective is to maximize marginal revenue over marginal cost and not just to feed the cheapest ration possible. Good financial managers conduct on-farm feeding tests to give them the data needed for decision making on what makes them the greatest profit. Making technical information available to them that is relevant to their local situation will help improve livestock profitability. I will supply a lot of it on feeding for improved meat and milk production.

Back to our experimental results: **One dairyman** reported an increase in milk production of three liters from feeding 1 kg of SBM. The response was almost immediate, being observed during the first two or three days and remained so during the seven days for which I have data. The SBM cost 0.60 Km/kg. Milk is valued at 0.50 Km/liter (plus state payment of 0.15 Km) so there was a return of 1.5 Km on an investment of 0.60 Km, for an immediate 2.5 times return on the investment.

The **second dairyman** fed about 500 grams/day of SBM (two cupped hands full – I said this was primitive but I confirmed later that two cupped hands hold about 500 grams) to his Simmental cow. She responded immediately (within two days) with three liters of milk, for a 5/1 economic return. This young dairymen volunteered that the milk tasted different, comparing it to the taste of goat milk. I suspect that this was a taste response to a higher protein content in the milk. (A 1200 cow dairy I'm working with in Krasnodar,

Russia reported an increase in milk protein from 2.7% to 3.2% when they supplemented their winter feeding program with soybean meal.)

Increasing the protein level in milk increases the cheese yield of course. I was appalled in our visit with another dairyman that made cheese that he had no idea of his cheese yield. Protein content and therefore cheese yield is affected by the nutrient adequacy of the ration. Without records of cause and effect, how can a person make decisions that maximize profit? This is the same dairyman who wanted UNDP to give him another cow but wasn't interested in how to increase milk production of the ten cows he already had.

Our young dairyman doing the SBM feeding test had an inquisitive mind. He wondered what would happen if he stopped feeding SBM for one day. His cow dropped one liter in production the next day, recovering when 500 grams of SBM was fed. Unfortunately, both dairymen didn't know what to do with the increased milk, except to feed it to their calves and dogs. They have no incentive to spend money to produce more milk.

Our **two sheep producers** reported even more favorable economic responses (calling it more favorable economic results assumes that milk can be sold) to feeding SBM than our two dairy producers. With them we had control animals so we could record the ***difference*** in weight gain from lambs suckling ewes supplemented or not supplemented with 150 grams/day of SBM.

One sheep producer reported that in seven days, lambs whose mothers had consumed 1 kg of SBM during the week of the feeding test experienced 2 kg greater weight gain (4 kg) than lambs whose mothers did not receive SBM (2 kg gain). The other participant reported 2.5 to 3 kg gain in seven days from the experimental lambs opposed to only 0.5 kg gain for the control animals. Live lambs sell for 4 to 5 Km/kg. Therefore, 0.60 Km worth of SBM resulted in 8 to 10 Km value of improved weight gain, which is a 13+ return on investment.

The economic return on lamb growth was about 5 x the economic return on increased milk production of dairy cows. This greater return with lambs than with lactating dairy cows suggests that the lambs were protein deficient. Weight gain from muscle growth is 77% water while weight gain from fat deposition is only 10% water. When the caloric requirement difference to produce protein or fat is considered (10.6 Mcal to produce a gram of pure protein versus 10.5 Mcal to produce a gram of pure fat in swine), it takes 4.6 times as much feed to produce a unit of gain from fat tissue deposition than from muscle growth. It is important economically to feed enough protein for an animal to realize its potential for muscle growth, since fattening (which is only 10% water) is a caloric and monetarily expensive proposition compared to muscle growth (77% water).

One could question whether the lambs multiplied the benefit of receiving ***more*** grams of milk containing ***higher percent protein*** **(**therefore consuming substantially more protein**)** into more muscle growth (77% water) instead of fat tissue (10% water)? If so, the lamb carcass would be higher in muscle and lower in fat, which would be attractive in the retail market, I would think. If lambs are sold on the basis of carcass quality (which they will

be eventually), feeding supplemental protein could be even more economically beneficial than the value realized from just more body weight gain.

In some situations, getting faster weight gain and therefore getting lambs to market earlier in the season brings a premium in price per kg. If this is not so, if it just takes longer to get a lamb to market, is it really worth 4 to 5 KM per kg of body weight to get it faster from SBM supplementation or just take a little longer and get it from the pasture? This isn't a question with dairy cows for milk produced per day results in more milk sold for the lactation.

It should be noted that producing more milk isn't without an energy cost. By adding protein (SBM), nursing ewes went up in milk production and probably went down in body weight and condition (not measured). Adding an equal amount of corn and SBM would balance the energy needs. Also, since with a ruminant we're feeding a microbial population of bacteria and protozoa in the rumen that require degraded protein (ammonia, amino acids and peptides) and a source of sugar and starch, feeding more grain could give a response greater than would be expected from just feeding more energy since grain could support greater growth of the rumen microbes, allowing then to capture more of the degradable protein, which is abundant when animals are on lush pasture. Growing more microbial bodies (protein) that are digested in the small intestine to supply amino acids to the animal will result in greater growth and milk production. This is true for both dairy and sheep. Therefore, an improved experimental design would be to feed one group of ewes (or cows) just grain, another group of ewes just SBM and a third group both grain and SBM. These three groups could be compared against a control group to note growth (milk) response and to evaluate the economics of grain and/or SBM supplementation. Soybean meal supplies rumen by-pass protein plus rumen degradable protein.

It would be informative if the experimental ewes could be milked to see the difference in their milk production and then feed the entire production of milk from each ewe to her lamb(s) to record their growth response. This would separate milk production response from growth response and help answer the above question of whether the lambs multiplied the benefit of feeding SBM by producing muscle rather than fat and thus gained more weight partly by incorporating more water in muscle than in adipose tissue. For a really good experiment, it should last until slaughter and carcass quality evaluated. Does UNDP want to become a research station for sheep?

(Perhaps the young dairyman, who has a 1.5 year old son, will see faster height and weight gain of his boy from feeding him milk with a higher protein content. There could be a human health implication from this study, particularly since the majority of the cows in the area are kept to produce milk for the family.)

Soybean meal was used to supply protein rather than sunflower meal (SFM) for we needed to supply more rumen undegradable protein (RUP – also called rumen by-pass protein) to animals consuming green grass and/or alfalfa pastures (both high in rumen degradable protein - RDP). SFM is high in RDP. SBM, compared to SFM, contains four

times more digestible RUP. (More discussion of RDP and RUP is available in my narrative.) SBM (2.03 Mcal/gram) is as high as corn (1.90) in Net Energy for Lactation.

It should be pointed out that this response to SBM occurred during the time of year when forage is highest in protein, so during the rest of the year when dairy and sheep are consuming forage that is lower in protein content, there is an even greater need for supplemental protein. (Please study the tables and graphs I have prepared to demonstrate the influence on stage of maturity of grasses and legumes on the production of milk.)

At present, it makes a lot of economic sense to supplement SBM to ewes suckling lambs. Based on our rather primitive short-term on-farm data, lambs responded dramatically in weight gain when their dams were fed 150 grams per day of 44% solvent extracted SBM. Fortunately, there is a market for lambs, making the supplementation of their dams attractive. Ewes should be supplemented until they peak in milk production as measured by growth of their lamb(s). Finding the amount (grams) of desirable supplementation (SBM and grain) could be the basis for further studies and will vary with the quality of the forage consumed. After the response to milk production is maximized, there may be added benefit to feeding SBM (and grain) to the lamb to increase its protein intake directly. This is the basis for another experiment – or two or three. Since forage will deteriorate as the seasons progress from spring to summer to fall to winter, the level of SBM (and grain) that elicits a favorable economic response should be tested continually.

An economical source of protein is essential for the development of a livestock industry. When the European Union reduced import restrictions on SBM, their meat, milk and egg production, supply and processing industries flourished. **And their consumers benefited!** Proteins must be supplied to the Srebrenica area if commercial dairy and sheep industries are expected to develop. Our SBM feeding trials prove that. Government should not impede the free flow of protein supplements (or any inputs) by man-made import restrictions. The goal is to promote local production, not hinder it.

Another area of concern is the quality of forage produced, harvested, stored and fed. I have prepared tables and graphs that show the drop in milk production that occurs as forages go from top quality pasture to hays of different maturity (immature, mid-maturity and mature) to wheat straw. See my narrative for more discussion on this effect. I will suffice it to say that a cow can consume 0.009 x body weight of ***forage*** neutral detergent fiber (NDF measures the lignin, cellulose and hemi-cellulose of the forage) so that as the NDF of forage goes up with maturity, cows can eat less dry matter of the forage. Milk production drops of course. Cows can eat more legumes than grasses at the same stage of maturity since legumes are lower in NDF than grasses.

Animals need vitamin – mineral supplementation to keep their biochemical machinery working optimally. I did not see evidence of vitamin-mineral supplements being fed but I did see evidenced of mineral deficiencies. Vitamin-mineral premixes are available from suppliers in Tuzla, Sarajevo, etc. This is a big opportunity for suppliers and customers to generate wealth!

The beneficial effect on the immune system is another major reason to feed protein, vitamins and minerals. Good nutrition helps the animal protect itself from pathogens.

Breed of dairy cow should be considered. If the feeding programs remain primitive, Simmentals are the breed of choice, but if one is serious about developing the dairy industry, Holsteins should be introduced along with the proper technology on how to feed them properly. This means having adequate protein, energy, vitamin and mineral sources and producing, harvesting, storing & feeding the highest quality forage possible.

Association and cooperative building should be encouraged among dairy and sheep producers. Improved market information would be helpful for decision making. Production technology information adapted for local conditions is needed. I am developing detailed interactive Milk Money Maker spreadsheets for cows that show formulas, income over feed cost and many nutrient parameters for grass or legume or a mixture of both plus corn silage based rations that will support milk production from minimum production up to 60 kg/cow/day in 5 liter increments. I will supply rations for sheep also. These items will be important products of my activity here and will be useful for Extension personnel and producers. From the attention shown by the approximately 18 sheep and dairy producers who attended our final seminar, there are serious producers in the Srebrenica area.

So what can be done? For UNDP to assist in the development of a commercial sheep and dairy industry in Srebrenica, an integrated assistance program is necessary. In the past, dairy cows and sheep have been given to recipients without money budgeted to fund follow up to help recipients with livestock technology or even to see if the animals gave more milk or meat, died, were sold or eaten for lunch. When I talked to producers about improving nutrition, they all told me that they knew they should be feeding better but they didn't have any money and the animals would have to get by consuming the local forage. Therefore, I suggest UNDP divide the money budgeted for commercial livestock production between animals and feed for the animals. While there is status to having more animals, it is more profitable to match the number of animals with the amount of feed available to maximize profitability. Other animal support functions, such as animal health, breeding, forage improvement and market development should be included in UNDP's financial commitment. It will take an ***attitude adjustment*** for people to feed their animals properly but with economic success, attitudes will change. Our four primitive feeding experiments are a start in this direction. If UNDP is going to fund the livestock industry, fund an integrated program that will help assure success. Some previous donor programs supported only part of the production and value added chain and ended up with poor or no results and sometimes even negative results.

The mechanism for being sure the animals receive adequate feed (or other inputs) should be designed to promote the establishment of commercial suppliers, for this makes it more sustainable than a "warm and fuzzy" one-time gift. We are interested in sustainable long-term ***generation*** of wealth, not an unsustainable one-time ***transfer*** of wealth.

1 May 2004. ***Challenges & Suggestions for Commercial Development of Dairy & Sheep Production in Srebrenica, Bosnia.*** **Roy Chapin, Ph.D., Animal Nutritionist**

The easiest sector to help is the **sheep industry** because they can market their lambs. The marketing mechanisms may be improved through associations, cooperatives, market information, improved quality, etc. I will supply information on how to improve the nutrition of sheep consuming pastures and winter forage and UNDP can determine how to get these suggested improvements to the sheep. Records need to be kept by producers and UNDP for dissemination to other sheep producers. Farm field day demonstrations and the written word will help preach the gospel of the economic value of improving nutrition.

The emphasis on sheep production will be most effective in the hill country off the main roads where dairying is not a good option. Dairying has its greatest chance of success in the flatter areas on a main road system. Economics, working in a free market, will determine where these commercial animal production operations develop.

Any program put in place to develop a **commercial dairy industry** must focus initially on developing a market for milk. A visit by a high level UNDP person to neighboring milk processors (Zvornic, Tuzla and Sarajevo) will determine if they are in position to buy more milk and at what price. Part of the contribution of UNDP may be to help an established dairy processor become more competitive and increase its capacity so as to desire milk from MCC's. If a processor is identified that can take more milk at an acceptable price on an everyday basis and pay soon after collection (critical to establish a dependable market so producers are encouraged to invest in cows), the next step is to establish milk collection centers located with large dairy producers (probably helped into the dairy business by UNDP). This may take two lacto-fridges at each MCC; one for the large dairy producer to use and one to collect milk from his neighboring small producers. Large producers don't like to take the chance of a small producer contaminating the entire cooler of milk. After the milk is collected it must transported to market on a daily or every-other-day schedule. This will require a truck, which may be UNDP's responsibility to provide initially. Hopefully, the dairy processor already has a truck. Subsidies are anticipated here until the MCC's are up and running and the truck can run unsubsidized at an economical capacity. UNDP will need to guarantee economical hauling during the start-up period of a year or two. Whatever program that is set up should be designed to become economically sustainable when the commercial dairy industry in the area is developed. This will require a two or three year time frame. It will take a business minded person familiar with the dairy industry to design and implement a successful program. If UNDP includes a commercial milk industry development project in its portfolio, the budget should be large enough to help in the supply of cows (consider which breed), their proper care and feeding, establishment of MCC's and the entire integrated infrastructure necessary for a sustainable milk industry. Solving only part of the problem may lead to major disconnects that will damage rather than help people. No half-baked projects should be started. I'd be glad to help.

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3 February 2001. ***Experimental Protocol for Dhamrai Dairy Feeding Trial Testing Dairy Feeds from Saudi Bangla Fish Feeds Ltd.*** **Roy Chapin**

Objective: In order to test the economic viability in Bangladesh of feeding a dairy feed concentrate made by Saudi Bangla Fish Feed Ltd. to lactating cows, it is proposed that Dhramai Dairy Limited run a feeding experiment with feed supplied *free gratis* by SBFFL in return for Dhamrai Dairy collecting certain experimental data. In addition, feeding tests on SBFFL calf feeds and SBFFL replacement heifers are proposed. Mr. Md. Hasibur Rahman is also interested in improving his home mixed dairy ration and I will work on that as another experimental ration with his present ration as the control. Dhamrai Dairy is one of the most prominent dairies in Bangladesh. Mr. Rahman, the owner, is president of the Bangladesh Dairy Association and is prominent in the dairy industry of Bangladesh. He is also the executive directory of Acme Laboratories, which is a major pharmceutical house in Bangladesh. The results of this experiment will have far reaching effects among the 29,000 dairy producers in Bangladesh. The positive contributions to the Bangladesh dairy industry if this experiment is run properly are significant. The feeding trials must be run by the scientific method (one variable) and without bias so as to record accurate and statistically provable results. The purpose of this paper is to discuss topics to be considered in order to obtain honest and reliable experimental data.

In the simplest terms, for the lactation study we want to (1) Feed lactating dairy cows a prepared dairy pellet formulated to balance the forage available to them. This is ***experimental*** ration #1. Experimental ration #2 will be a reformulated home mixed ration. (2) Measure the milk response of the experimental cows in comparison to control cows eating the present dairy ration. The present dairy ration is the ***control*** ration. We will want that defined nutritionally as exactly as possible so that we can evaluate nutrient differences among the three treatments. (3) Determine if cows fed the experimental rations produce more milk than similar cows fed the control ration. (4) Determine the economics – marginal revenue vs. marginal cost of the experimental rations. Does feeding the experimental rations (SBFFL dairy concentrate and reformulated home mixed ration) make the dairyman more money than feeding the present (control) home mixed ration? We may also test some other feed ingredients including Chlorella and a microbial product thought to improve rumen function.

We also want to test a calf starter ration and a heifer growing ration produced by SBFFL against the conventional feed being fed. Our objective is to see if we can get them to breeding weight by15 months and into the milking string by 24 months of age. At the minimum, we want to see if we can make a significant improvement over the present replacement heifer feeding program. We of course want to see if the experimental rations are economical in comparison to the present feeding program.

Too often, the on-farm results that are reported are merely ***anecdotal*** in that there is no control group with which to compare the changes observed when the feed ration is changed. For example a dairyman tries a new feed that is fed to all the cows and claims that the changes observed were due to the feed. They may have been due to the feed but the production changes may have been due in whole or in part to weather changes (seasonal changes), change in the stage of the lactation cycle if all animals calved at about the same time, changes in forage, changes in milkers, a change in the presence or absence of disease, method of feeding (how often is grain fed), availability of water, etc. It is even more anecdotal and more unreliable if there are only a few cows being observed. It is difficult to be sure what caused a milk production change if only one or two cows are involved. You can have ***feelings*** but you don't have ***proof*** and thus your observations are *anecdotal* and not *experimental.* Anecdotal observations don't have the credibility that you need to prove (and convince others) that the feed change caused the observed production change. You're not in a good position to make the correct economic decision as to whether to change feeds if you base your decision on ***unreliable*** *anecdotal observations* rather than on ***reliable*** *experimental data*. We're interested in helping dairymen make more money and this requires accurate data in order for decision-makers to make correct economic decisions. Getting accurate data, even if it isn't what we want or expect, is what we are striving to accomplish by conducting a feeding trial at Dhamrai dairy. We want to measure milk production of (1) experimental cows fed (a) a dairy concentrate formulated for Dhamrai Dairy and made by Saudi Bangla Fish Feed Ltd. and (b) reformulated home

mixing ration and compare the milk response of the experimental cows to (2) cows of similar milk producing potential fed the control ration (present ration) under similar environmental and management conditions.

In order to determine if there are economic benefits from feeding the SBFFL dairy concentrate, cost and revenue data must be collected so that we can compare marginal revenue from the extra milk produced (if any extra is produced) to the marginal cost of feeding the SBFFL feed. We may get a favorable milk response but it may cost more to achieve than the extra milk is worth. Considerations other than milk production that affect profitability, such as animal health, breeding performance, weight maintenance, etc. also will need to be considered and put into the economic equation.

Running such a feeding experiment appears to be a fairly straightforward procedure, but there are many factors that must be considered in order for us to obtain meaningful data. **Basically, we want to determine if feeding the SBFFL experimental dairy concentrate and the reformulated home mixed ration will make the dairyman more money than feeding his present control ration.**

The major concern in order for us to obtain meaningful experimental data is to have only one variable. The experimental method attempts to equalize all conditions except for the one variable that is being tested so that any difference in results between the control and experimental treatments can be attributed to this one variable. In our case, we're testing the ability of dairy feed made by two different methods to support improved milk production over the standard ration. Conditions must be standardized so that we're testing ONLY the feed. If there is a difference in milk production between the experimental and control groups, we want to know what caused the difference. If there is more than one variable, we can't determine with certainty the cause of any response that we see between experimental and control rations. Limiting the experiment to one variable is harder to accomplish than it would seem at first glance. There will be many other variables besides feed that we must try to reduce, such as age of cows, milk producing potential, stage of lactation, body size, health, differences in forages fed, housing, milkers, managers, animal health, etc.

Because of inherent differences in cows and their environment, we expect some variation in milk production response among cows being fed the same feed. We know they won't all respond the same way even when all conditions appear to be similar. This variation among animals under the same apparent experimental conditions is called the ***within group variation.*** We'll measure within group variation for all groups of animals on the experiment. In this case, that means the (1) experimental group fed SBFFL feed, the (2) cows fed the reformulated home mix and (3) control group fed the present ration.

The purpose of our experiment is to measure any variation in milk production that may exist between cows fed the (1) experimental diets and those fed the (2) control diet. This difference in response (if any) is called the ***among group variation.*** Said again, it is the difference in response measured between the cows on the experimental rations and the cows being fed the control ration.

There are statistical methods to compare the ***within*** **group variation** and the ***among*** **group variation** to determine if there is a **statistically significant difference** between treatments. If the *within* group variation is high, the *among* group variation must be greater in order to show a *significant difference* than if the *within* group variation is low. Said another way, if there is a lot of difference in milk response *within* each group (both within the experimental and within the control groups), there is an increased possibility that any difference *between* (*among)* groups is due to *chance* rather than the *variable* that is being testing (SBFFL feed). If the difference in milk production due to feeding the experimental diet exists but is not very great (low among group variation), it will be difficult to show that the difference due to the experimental diets is significant, even though a difference may exist. Statisticians use statistical methods to determine the probability that the among group difference is due to chance and express it as P

<xxx, where xxx is the probability that the difference among groups is due to chance and not the experimental variable being tested. P can be expressed as P <0.05 (5%) or P <0.01 (1%), etc. Unless there is a P <0.05 that the variation is due to chance, the among group variation is not considered to be significant and any difference among groups cannot be ascribed to the variable being tested. When I receive the test results I will upgrade my statistical analysis skills and try to show whether the results are statistically significant or not. I'm sure there are wonderful computer tools to help in this analysis. I used to do it with a calculator.

One obvious way to reduce *within* group variation is to have all the cows *within* the group be as similar as possible so that their milk production response to the same diet will be the same. Obviously**, care must be taken that each *group* of cows** (not only cows within a group but cows among groups**) has similar production potential** so that the experiment is not biased towards either the experimental or control group. **We'd like all cows in both groups to be similar in milk production potential.** This is sometimes done by pairing cows so that each cow in one group has a twin (pair) in the other groups in order to compare response. This is sometimes done if there is quite a variation among all cows on the experiment. While the within group variation may be fairly high, by pairing cows you are in a better position to show statistically that any difference observed is due to treatment (the variable being tested).

Another way to reduce the probability that any difference among groups is due to chance rather than the single variable being tested is to increase the number of animals in each group. There is always the chance that you will get a cow in a group that gives an atypical response (very high or very low milk production). If there are only a few cows in each group, this atypical cow can reduce the chance to show a significant difference due to the variable being tested, even if there is a real difference. By increasing the number of cows in each group, the effect on the total group response of the atypical cow is reduced.

Statistically, there is an increased chance of showing a *significant difference* if the total number of animals available for the experiment are divided into an equal number of animals in each group. If you have twenty animals available, put ten in each of two groups to test one variable. If you are comparing a control group to each of three different levels of concentrate feeding, put five animals in each of the four groups. You are now testing one variable (feed fed at one level) in experimental group #1, another variable (same feed but more of it) in experimental group #2 and still another variable (same feed but lots of it) in experimental group #3. Then you can compare the three levels fed of concentrate to each other and all levels of concentrate to the control group. There of course can be a significant difference (P <0.05) between none or each of all four groups or among just one group with another. There may be a significant response to all three levels of concentrate feeding compared to the control group, a significant difference between the low and medium levels and no significant difference between the medium and high levels of concentrate feeding (even if the high level of concentrate feeding appears to support more milk production). By applying cost data you may decide that your profits can be optimized by feeding concentrate at the medium level rather than at higher or lower levels. When the percentage of concentrate of the total ration dry matter is determined, the total ration should be re-formulated to reflect the actual concentrate/forage ratio so that the supplemental vitamins and minerals are in the concentrate at the appropriate level to balance both the forage and the concentrate.

A dairy cow consumes both forage and concentrate. The total ration dry matter consumed during 24 hours is called the *dairy ration* and needs to contain all the nutrients required by the cow to produce at her most profitable level of milk production. Forage quality varies and thus the concentrate portion of the ration needs to be formulated to balance the forage being fed so that the total ration dry matter contains the needed nutrients. A concentrate ration formulated to be fed with corn silage will be very different from one formulated to balance alfalfa hay, even if both total rations (concentrate and forage) supply the same level of nutrients and support similar levels of milk production. Feeding the above two concentrate rations with the wrong forage will cause the rations to be nutritionally unbalanced and milk production

will suffer. This will shrink the amount of money in your pocketbook, so pay attention to feeding a concentrate ration formulated for the forage you are feeding. The ratio of concentrate to forage expected to be fed must be determined before formulating the dairy concentrate and the concentrate must be fed at the assumed levels if milk production and profitability are to be optimized.

Forage should make up at least 40% of the total ration dry matter and probably 50 to 60% or even 70%, depending upon the forage quality and the relative costs of the forage and the concentrate and the price of milk. The forage and concentrate can be combined in a total mixed ration (TMR) and fed continuously, which is good for improved rumen function and higher milk production, particularly if higher percentages of concentrate are fed. In the absence of a total mixed ration, the forage and concentrate portions of the ration should be fed in such a way as to approximate a total mixed ration as far as the rumen is concerned. This means feeding the forage prior to feeding the concentrate and feeding the concentrate in four or more feedings during 24 hours. No more than 0.5% of the animal's body weight should be fed as concentrate at one feeding. For a cow weighing 200 kg this would be 1 kg of concentrate. For a cow weighing 600 kg, it would mean 3 kg of concentrate maximum per feeding, etc.

I have written a spreadsheet program in Microsoft Excel that facilitates these ration calculations. Besides allowing the total ration dry matter to be divided into whatever percentage of forage and concentrate desired, there is a supporting (1) Dairy Premix Formulation Program that is linked to the main (2) Feed Formulation Spreadsheet so that the vitamin and trace mineral premix can be calculated. The Feed Formulation Spreadsheet program is supported by a (3) Feedstuffs Ingredient Data Base (FIDB) that stores analytical values for 19 selected nutrients for as many ingredients as you want to include. There is also an (4) Ingredient Price Sheet that is linked to the FIDB. Changing these values in the Feed Ingredient Data Base changes them in all the Feed Formulation Spreadsheets that are in the same file.

These computer spreadsheets will be used to formulate the concentrate portion of the ration for Dhamrai Dairy based on the type, quality and amount of forage being fed. This is our experimental ration #1. If there are other feeds being fed at Dhamrai dairy, such as algae and/or duck weed or various milling by-products, etc., they will be included in the total ration dry matter formulation in the section supplied by the dairymen with the SBFFL dairy concentrate formulated to deliver to the cow all the other needed nutrients not supplied by Dhamrai dairy that she needs in order to optimize milk production and profit.

Experimental dairy ration #2 will be a reformulated home mixed ration. I've done a lot of formulation work with home mixing dairies in the USA. Our usual experience has been when a dairyman goes to home mixing, the milk production and profit go up as the ration is improved and improved rations, even though more expensive, usually make the dairyman more money. I'm looking forward to working with the feedstuffs that Mr. Rahman has at Dhamrai Dairy to see if we can increase the profitability over what he is now doing. I'm also looking forward to seeing how the dairy concentrate we have put together will perform against the present home mixed dairy and the reformulated one. Since most of the 29,000 dairyman in Bangladesh have only a few cows and don't have the option of home mixing on the scale of Dhamrai Dairy, if both the SBFFL dairy pellets and the reformulated home mixed support equal but greater production than is now being obtained and do so with an economical advantage, we'll feel that the feeding trial has been successful. Mr Rahman can feed his reformulated dairy ration and small producers can buy their dairy concentrate from SBFFL.

For dairy producers with smaller herds, dairy concentrate rations that will balance various forages will be formulated and produced to meet the nutritional needs of milk cows fed traditional feeds. For example, I envision a dairy concentrate that will balance rice straw and another one that will balance Napier grass. It is obvious that before formulating these rations I need to ask a lot of questions of Dhamrai Dairy (and others for whom I'll formulate rations) about the forage they feed in order to formulate a nutritionally complementary dairy concentrate using feedstuffs available and competitively priced (least cost formula

that meets the nutrient requirements of the lactating dairy cows) at Saudi Bangla Fine Feeds Limited. Since forages change seasonally and the price and availability of feedstuffs change, there will be a need to reformulate the feeds on a regular basis in order to optimize the profit of the dairyman. Our objective is to produce milk at the lowest possible cost and not to produce the cheapest feed possible. Good feeds cost less! The Feed Formulation Spreadsheets will allow the formulation of feeds with a minimum of labor input and a maximum of accuracy. While these spreadsheets took a lot of time (labor) to create, they will facilitate improved labor efficiency in the formulation and pricing of feeds as the type and quality of roughage and the price and availability of feedstuffs change. These spreadsheets are fairly simple to operate if the formulator has some knowledge of MS Excel and dairy nutrition. The spreadsheet programs are accompanied by a detailed instruction sheet that addresses the mechanics of formulating with these spreadsheets with enough basic dairy nutrition information presented to allow the formulator to understand what we're trying to accomplish. For more information on dairy nutrition, please refer to the 13-page review of applied dairy nutrition that I wrote for a seminar I gave in Dhaka in March of 2000.

Now we need to address specific issues that need to be resolved in order to run a meaningful scientific experiment at Dhamrai Dairy that will evaluate fairly the ability of (1) SBFFL's Dairy concentrate and (2) a reformulated home mixed ration, both of which are formulated specifically for Dhamrai Dairy, to support economical milk production in comparison to what is being fed at present. On farm experiments are fraught with obstacles to measure only one variable.

1. Selection of the Animals and Identification of Both Experimental and Control Cows

Management's objective is to (1) maximize the level of peak milk production and to (2) sustain the lactation curve for as long as is economically viable.

For each liter increase of milk at the peak of lactation, the dairyman can expect an additional 225 liters of milk during a 305 day lactation. For animals to peak high in production, they must consume ample quantities of **protein**. For them to sustain their lactation curve at a high level takes **energy**. Animals will peak in production about eight weeks after calving and then gradually decline in milk production. It is easier to raise the lactation curve during early lactation than during the latter part. In fact, it is very difficult to raise the production curve if you wait to introduce good nutrition until after the cow has been lactating for 150 days. Improved nutrition at that time may help **sustain** the lactation curve but raising it is best done by feeding quality feed early in lactation. The ideal time to put dairy cows on a feeding test of a new concentrate is at the time of parturition so as to give them every advantage to reach the highest peak milk production possible. We would expect cows fed SBFFL dairy concentrate and the reformulated home mixed ration to peak higher in milk production and to sustain their production at higher levels than animals fed the conventional diet with the net result being increased production of milked during a 305 day lactation period for cows fed the experimental diets. We would expect that the longer (up to 305 days) that lactating cows are on SBFFL's dairy ration, the greater would be the difference between the experimental group and the control group.

Said another way, there should be a difference in peak lactation and sustainability of the lactation curve for cows fed the experimental rations. If we wait until all cows have peaked in lactation before starting the feeding experiment, we would expect to be able to measure only a difference in sustainability instead of also being able to measure a difference in peak lactation. The next goal would be to determine if it is more profitable to feed SBFFL dairy concentrate than continuing to feed the present (control) ration?

Therefore, we would like to begin our feeding experiment with cows that have just freshened. I'm suggesting that a minimum of five pairs of three cows (15 total) be selected so that we will have at least five cows each on the experimental diets and five cows on the control diet. If Dhamrai Dairy is willing to allocate more than fifteen cows to this experiment and if SBFFL is willing to contribute the associated

increased amount of feed, that would be even better. We don't need to decide on how long the experiment will last at this time but it should continue for at least three months so that we can see how high the cows in each group will peak. Ideally, the experiment would continue until the cows are dried up so that we have data for an entire lactation and have a chance to measure the difference in sustainability of milk product throughout the lactation. That may be more than can be expected from Dhamrai Dairy and from SBFFL. They will need to decide that themselves.

To the extent possible, cows should be paired prior to calving so that as they calve a cow goes to one or the other of the experimental rations and one to the control ration. Since it will take some time for enough cows to freshen to reach our desired experimental number, having them paired will help reduce among group variation due to weather, forage and other changes beyond our control. Care needs to be taken that we're pairing cows of equal milk potential, so in pairing cows we should look for animals of similar size, body condition (we don't want one cow fat and the other skinny), age and genetic potential to produce milk. Heifers should be paired with heifers and mature cows with mature cows. After selecting the pairs, each animal within a pair should be assigned by a flip of the coin or by some other random basis to a specific group so as minimize any bias towards one group.

Since production records were kept on prior productions, one important type of control for this experiment would be to compare the results of this lactation with previous ones to see if animals on the experimental rations or control ration produced more, less or the same amount of milk as previously. This difference in production from previous lactations by the same cow will be a valuable parameter. This would tend to balance out other changes as all cows would come from the same situation during the last lactation. This makes the last lactation the control against what we measure this lactation. This will give us a second method of evaluating if the experimental treatments make a difference in milk producton. Care must be taken to be as fair as possible in the selection of animals so that no bias exists among groups.

It is obvious that we need a way to identify each cow. This is already being done. We must know the identification of each cow so that no mistakes are made as to which is an experimental cow and which is a control cow during the feeding and milk collection periods and during other times of evaluation.

2. Security of the feed program so that experimental cows get only the correct experimental ration and control cows consume only their present ration with no cross contamination.

It is obvious that if the three groups have access to each other's feed that the performance of the three groups will tend to equalize and we won't be able to evaluate differences due to the experimental variable. The experimental rations may be doing their job but if the control cows eat some of them, meaning the experimental cows were cheated out of eating as much as expected, we'll not be able to tell if the experimental feed works or not. Therefore, we need to review the method of feeding. Are the cows tied in stanchions? Will the experimental feed be placed in front of the cow on top of the forage and will the experimental cow be able to eat the entire amount fed or will neighboring cows scavenge some of the experimental ration? Is the neighboring cow a control cow or on another experimental ration (that would be really bad news if she scavenged some experimental concentrate) or just another cow in the herd helping herself to the experimental concentrate and thus reduces the amount that the experimental cow consumes? How many times a day will concentrate be fed? How much will be fed at one feeding? Can total concentrate and forage intake be recorded per cow? Recording concentrate intake will be easier than measuring forage intake.

What is the situation with forage? Is the same forage available to both experimental cows and control cows? Will the type and quality of forage change during the experiment and if so, will it change equally for all groups of cows? Will the change be great enough so that we need to reformulate the concentrate?

Is there always forage available or are the cows hungry some of the time? Do we know the nutrient analysis of the forage to aid in the formulation of the correct dairy concentrate to balance the forage?

What other feedstuffs, such as algae, duck weed and milling by-products are available at Dhamrai Dairy? Are they equally available to both groups of cows?

Do all cows have feed available *ad libitum* throughout each 24 hour period? We want to maximize dry matter intake so that we can get as much energy consumed above the maintenance requirements as possible so that we can maximize production.

Do all cows have free choice availability to clean water through 24 hours? Reduced water availability and consumption will reduce dry matter intake and this will reduce milk production.

Are of animals housed under similar conditions? Will one group be more heat stressed than another? Fly stressed? People stressed?

Are all groups managed by the same employees and milked by the same milkers and with the same equipment or is there a variable here for which we need to account? Do you expect any personnel changes during the experiment?

Are there any variables among groups that can be identified and eliminated before the experiment starts?

Who is responsible at the dairy level for the security of this feeding program so that we are evaluating the results from only one variable rather than several?

3. What are we going to measure, who is going to do it and how and how often?

Milk Production – This is the primary result from our one variable (SBFFL dairy concentrate or reformulated home mixed ration) that we want to measure. We want to determine (1) how high each cow peaks and (2) how well she sustains production. This measurement doesn't have to be made every day but it would be nice if it were. I understand that each day's milk is measured, so we're in great shape to have accurate records. We want to be able to show when peak milk production occurs during the lactation curve. We will want to plot the lactation curve for each cow. Who will collect these milk production figures, how will the measurement be made, how will they be recorded, who receives these data and transmits them to me (<roychapin@onlinemac.com>) so that I can do the statistical analysis, how often will the quantity of milk produced be measured? If all milk produced is measured we don't need to concern ourselves with being sure that both the morning and evening milk is collected on test day, etc. Measurement of milk should start three days after calving or whenever milk for sale is collected after the colostrum has been milked from the udder.

Milk Components

Is it possible to measure percent butterfat, solids not fat, milk protein, somatic cell count, etc. on a regular basis? How often can these measurements be made? It is anticipated that there will be significant differences in these milk parameters between treatments, between cows within each group and during the course of the experiment. Is all the milk sold as standardized fluid milk or is some of it made into cheese so that we could measure the cheese yield from each group. It could be a difficult measurement to keep cheese yield separate between groups so we'd need to estimate it by measuring the milk components. If cheese is made, there is of course a real advantage to have a high SNF or protein level in the milk as that will increase the yield of cheese from a given quantity of milk.

Animal Appearance

Cow body condition scoring (BCS) done by a qualified person who doesn't know to which treatment group each cow is assigned would be very helpful. Is it possible to weigh the cows prior to, during and at the end of the experiment? If no scale is available, we could approximate a cow's weight with a tape designed for such a measurement. It is anticipated that cows that are fed better will maintain a better body condition. High producing cows commonly lose weight during early lactation. It would be possible that cows fed more protein might produce more milk while losing body weight as compared to control cows. Not all the changes we expect to see will be reflected in milk production and components. Keeping an animal in better body condition is a plus and needs to be determined and recorded on a regular basis, such as every two weeks to a month. A cow that has recovered its body condition by the time it is dried up is in a better position to milk well the next lactation.

It would be anticipated that cows fed adequate vitamins, minerals, protein and energy in relation to those cows not so fed would have shinier coats and look different. Can we record the appearance with a camera by taking a picture of each animal prior to, at various times during and at the end of the experiment? I have a throw-away camera with me for such purposes and I will get more such cameras if someone will take the pictures. An ID card should be visible for each picture so that cow identification is shown with each photo. Visual observations should be done at the time of body condition scoring and recorded along with the body condition score.

Breeding Performance

The date of the first heat after calving should be recorded along with when each cow is bred, how may ampules of semen does it take to get a cow pregnant (or is she bred with a bull), stage of lactation when the cow becomes pregnant, any observations concerning the recovery (involution) of the reproductive system for breeding, etc. should be recorded. An improved breeding performance is a by-product of good nutrition that can be offset by the stresses of greater production and we need these data. Measuring the breeding performance is another reason for starting the feeding experiment just after calving so that there is time for the cow to respond to good nutrition before she is bred.

Animal Health

Animal health is closely associated with the adequacy of the nutrition program. My previous experience with tens of thousands of cows is that when the nutrition program is improved, there is an improvement in animal health that may take a year or longer to express fully. Veterinary bills should go down. Recording this information for all treatment groups is an important economic parameter that we would like to have measured. Who will do it, how often and how will it be recorded? The status of animal health should be recorded for each animal and anything unusual noted. If there are some standard medical procedures followed for disease prevention, such as various shots etc., all cows on both treatments should receive the same treatment so that we don't have a medically induced variable in our experiment.

Appearance of the Manure

This may seem like a strange request but the manure is one of your windows to the digestive system. It is common for lactating cows fed poor quality forage and/or inadequate protein and energy to have firm manure that looks like dry cow manure. What may be accepted as normal here is not normal for cows that are adequately fed. In fact, there was some concern earlier that the manure of cows fed SBFFL dairy concentrate became too loose. The feeder was concerned for animal health and quit feeding the experimental grain. Too much grain can cause a lot of digestive problems so I don't want to minimize the

feeder's concern but we need to define what is normal appearance for high producing cows fed properly. Manure from lactating cows should "platter" and not be piled up and convex in shape like horse manure or dry cow manure. You don't want the manure splattery but you don't want it too thick either. Taking pictures of typical manure for each group during the trial would be helpful. A rating score should be devised from measuring too loss to too firm with regular recordings for each cow.

Economic Considerations

The real parameter we're after is economic. This is the most important measurement we will make. It will be determined in part by the other parameters we measure and putting economic value to what we see. This is fairly easy for milk produced but may be more of a challenge for measuring the value of an improved body condition score. Which feeding program makes the owner more money: Experimental or control? To determine this we need to know the amount of concentrate and forage consumed and the cost of each so that we can compare costs for each treatment.

We also need to know the value of milk so if we get more milk from the experimental cows we can evaluate the marginal revenue compared to the marginal cost of the SBFFL feeding program. Since Dhamrai Dairy processes and sells its own production in upscale markets, extra milk may be worth more to them than other dairy producers. Milk components also may be more important for Dhamrai Dairy.

Calves and Replacement Heifers

In addition to the above, we want to test SBFFL's (1) calf starter and (2) heifer grower concentrate pellets. There are charts showing typical growth in height and in weight that calves must meet in order to be at breeding weight by 15 months of age and in the barn milking at 24 months. It won't take us the entire time to see if our feeding program is on track or not. By starting with young calves and also older heifers, we'll be able to get some good data. Since feeding a calf properly will take a sizeable investment before she calves and returns income from milk, it is important that we know comparative costs. If we do a good job of feeding the replacement, she may be in the barn in half the time as is standard and returning income much earlier than at present. We need these economic comparison data in order to make recommendations to the 29,000 dairymen in Bangladesh.

Feedstuffs can be broken into various Net Energy components such as Net Energy for (1) Maintenance, (2) Gain and (3) Lactation. While straws, properly supplemented, have enough energy for maintenance and modest lactation, the level of net energy for gain from straws is very low. It is important to feed quality forages to calves and heifers in order to get good gain. I know this is a challenge in many areas.

Publishing and Use of Results

Our objective is to improve the earnings of dairymen in Bangladesh and help them produce more milk for the population. If the results of this study shown that we have a way to do that, we will want to publish the results and help 29,000 dairymen improve their production. The consequences of what we're doing can be very significant to the people of Bangladesh.

What other considerations should we address before starting this experiment? What I've prepared is the rough draft for us to consider for making additions and modifications before starting the experiment.

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Instructions for use of calf & heifer ration spreadsheet, *which is probably the most detailed you have ever seen.*

Calf & Heifer Rations Formulated (using U.S. NRC Dairy 2001 Software) & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

E-mail: <roychapin@onlinemac.com>. 11145 Chapin Lane, Amity, Oregon 97101 USA. Telephone: 1-503-835-7317. Fax: 1-503-835-3333.

There are 16 tabs, one page each, in this spreadsheet.

It is suggested that you print out each tab & follow along with the following comments. Also, enter various prices to see effect on feed cost to raise replacements.

Color Coding. Please pay attention to the color of the entries in cells to avoid disabling the speadsheet.

Black: Data entry. These entries should be changed only by Roy Chapin. These contain formulas.

Red: Cells with red entries contain equation or linkages. Typing in them will destroy these & disable this part of the spreadsheet, so don't touch.

Blue: These are the independent variables that the operator changes to make the spreadsheet interactive. Prices & formula extensions. Please Change!

Following is a list of the tabs with comments & instructions for use.

1. Instruction sheet that you are reading. Data show the need to balance concentrate formula & quantity fed with forage & animal age & weight. ***One formula doesn't fit all*** .
2. Price sheet. All ingredient prices (& a few other inputs that will make the spreadsheet universally useful) are to be entered here. They are linked thoughout the spreadsheet.
3. Calf & Heifer Rations. Here are the "magic formulas" with nutrient levels that will be used later in the spreadsheet to show where they are to be fed based on weight & forage.
4. Estimated maximum forage intake based on animal's body weight & forage neutral detergent fiber & dry matter. Also shows weight, height & DMI intake goals for various ages.
5. Shows kg concentrate animal can eat in addition to forage. If given the chance animal will usually consume concentrate & reduce forage intake to maximim D.M. intake.
6. Forage intake needed in addition to concentrate (next tab) needed for 800 grams/day gain. With excellent forage animal needs less than it can eat (see offset values in italics).
7. Kg & identity of ration needed to reach 800 grams/day gain for each forage for various weights . Ration shown in tab 3 identified by % protein of dry matter. Also, see economic data at bottom of page that show intake & cost of concentrate & forage. Change ingredient prices in price sheet; not on this tab. Note how ration needs vary with forage & age. The data portion of this tab allows you to see which type & quality of forage will mimimize your feed costs for 800 g/day gain when you enter your feed costs. Budgeting tool. Don't be overwhelmed by feeding guidelines presented. Each farm usually has one forage type so go to this column to see rations recommended. Simplifies recommendations.
8. Shows maximum forage intake if half neutral detergent fiber (NDF) comes from hay & half from corn silage. Corn silage often fed to heifers so thought we needed this series.
9. Forage intake needed in addition to concentrate (tab 10) if half NDF from corn silage. With good hays it takes less hay than maximum for 800 g/day gain. See offset & italized #'s.
10. Shows kg concentrate identifed by % C.P. of D.M. needed with forage of tab 9 for 800 gm/day gain. Economic data at bottom allow choosing most profitable forage & budgeting.
11. Calf raising guidelines & comments. This tab contains lots of information. Please study it as formulating & feeding the appropriate concentrate isn't as simple as it looks.
12. Desired heifer weights vs. age for major dairy cattle breeds. On right enter size of your breed & see weights desired for each age. Useful for smaller breeds than shown.
13. Median weights found for Holsteins for 5th, 25th, median, 75th & 95th percentile from 1991/92 USDA survey. Aim for 75th percentile or higher.
14. Same as tab 12 except for height at withers desired for various breeds. For breeds smaller than shown, enter data at right & read desired height vs. age.
15. Same format as tab 13 but for height for various percentiles for Holsteins. Use to set growth goals for your replacement heifers. Measure regularly & make changes if necessary.
16. Gives formula & nutrient guarantees for Chapin Dairy Premix (CDPM) that is used in formulas given in tab 3. Have CDPM custom made by a commercial premix manufacturer.

Price Sheet for Dr. Roy Chapin's *Interactive Calf & Heifer Raiser* (Budget Tool)

Kosovo - KCBS

Previous Update On:	4-Jul-06	Price Sheet Printed On:		New Prices As Of:	

Forage Feedstuffs	Euro/Kg	New Price	Use Y/N
Grass Pasture			
Grass Hay - immature	0.050		
Grass Hay - mid-maturity	0.050		
Grass Hay - mature	0.050		
Legume Pasture			
Legume Hay, immature	0.050		
Legume Hay, mid-maturity	0.050		
Legume Hay, mature	0.050		
Mixed Grass/Legume Hay, mid-maturity			
Mixed Grass/Legume Hay, mature			
Corn Silage, normal	0.030		
Wheat Straw	0.050		
Rice Straw			
Value of 1 Kg Body Wt.	1.10		

Test of Fiber NDF Intake = 0.009 x Body Wt.			
Enter Animal Weight, Kg		Kg	

	M.U.	Per Kg	
Enter Monetary Unit (MU)	Euros	Euro/Kg	

Enter Sale Price of Milk by Season			
Fall			
Winter			
Spring			
Summer			

Energy Feedstuffs	Euro/Kg	New Price	Use Y/N
Barley	0.15		
Oats	0.16		
Corn Grain (Maize)	0.13		
Wheat			
Wheat Bran	0.10		
Rice Bran (Rice Polish)			
Beet Pulp (If fed wet, = kg x 6)	0.13		
Triticale (Wht/Rye)			
Molasses, sugarcane			
Molasses, Dried	0.20		
Liquid Feed, 30% CP + V-M P/M			
Peas & Rye			
Beet Pulp - Wet (=concentrate portion)			

Components for Chapin Dairy Base Mix			
Chapin Dairy Premix - 20 gm	1.50		
Limestone	0.10		
Salt	0.10		
Mono-Calcium Phosphate	0.39		
Di-Calcium Phosphate			
Tri-Calcium Phosphate			
Dynamate KMgSO4			
Sodium Bi-Carbonate			
Magnesium Oxide			
Magnesium Sulfate (Epsom Salts)			

Protein Feedstuffs	Euro/Kg	New Price	Use Y/N
Sunflower Seeds			
Sunflower Meal w/hulls, solvent			
Sunflower Cake, expeller, REC			
Soybean Seeds, raw, grd			
Whole Soybeans - roasted			
Soybean Meal, 44% solvent	0.28		
Soybean Cake, 44% expeller			
Soybean Meal, 48% solvent			
Cottonseed Meal, 44%, solvent			
Cottonseed Cake, 44%, expeller			
Canola Seeds, grd			
Canola Meal = Rapeseed			
Linseed Meal			
Corn Gluten Meal			
Fish Meal, Menhaden			
Malt - Wet Brewers Grains (= Conc.)			
Dried Brewers Grains, Dried Malt			
Urea			

Calf Starter & Grower Rations, Heifer Grower Rations & Heifer Premix Formula

Calf & Heifer Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

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		Calf Starter	Calf Grower Rations				Heifer Grower Rations			Heifer P/M.
% Crude Protein (Dry Matter Basis) =		22.50%	22%	20%	18%	16%	14%	12.5%	10.5%	Feed at
% Crude Protein (90% Dry Matter) =		20.25%	19.8%	18.0%	16.1%	14.4%	12.6%	11.25%	9.5%	0.00015xBW
	Euro/kg	*Rations formulated using U.S. National Research Council's 2001 Dairy Nutrition software.*								Feed Chapin
*Barley	0.15	10	10	10	10	10	10	10	10	*Heifer Premix*
*Corn	0.13	20	29.95	34.8	39.25	44	48.4	52.3	57.25	*(CHPM) when*
*Oats	0.16	10	10	10	10	10	10	10	10	*forage alone*
**SBM, 44% Solvent	0.28	30	28	23	18.4	13.5	9	5	0	*supplies*
Beet Pulp Pellets	0.13	10	10	10	10	10	10	10	10	*adequate*
Wheat Bran	0.10	10	10	10	10	10	10	10	10	*energy &*
***Molasses, dried	0.20	6.45								*protein.*
Chapin Dairy Premix	1.50	0.15	0.15	0.20	0.25	0.30	0.35	0.40	0.45	15.00
Mono-Calcium Phosphate	0.39	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	25.00
Limestone	0.10	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	25.00
Salt	0.10	0.40	0.40	0.50	0.60	0.70	0.75	0.80	0.80	35.00
Total		100	100	100	100	100	100	100	100	100
Euro/kg of finished feed		€ 0.185	€ 0.177	€ 0.170	€ 0.164	€ 0.157	€ 0.151	€ 0.146	€ 0.139	€ 0.383
		Nutrient Composition on Dry Matter Basis, %								
Crude Protein		22.5	22.0	20.0	18.0	16.0	14.2	12.5	10.5	
Rumen Degradable Protein		7.0	7.1	7.0	6.5	6.0	6.3	5.7	4.8	
Rumen Undegradable Protein		15.6	14.9	13.0	11.5	10.0	7.9	6.8	5.7	
Calcium		1.35	0.76	0.74	0.73	0.71	0.69	0.68	0.66	13.60
Phosphorus		0.73	0.62	0.60	0.58	0.55	0.54	0.52	0.50	5.40
Magnesium		0.33	0.28	0.28	0.28	0.28	0.28	0.28	0.28	3.00
Chlorine		0.38	0.38	0.44	0.51	0.58	0.61	0.64	0.64	21.24
Potassium		1.31	1.08	0.99	0.91	0.82	0.74	0.67	0.58	0.05
Sodium		0.25	0.23	0.28	0.32	0.36	0.38	0.41	0.40	13.80
Sulfur		0.30	0.26	0.25	0.24	0.23	0.22	0.21	0.20	1.84
Vitamin A (1000 IU)/kg		22.0	11.0	14.6	18.2	21.9	25.5	29.2	32.9	975
Vitamin D (1000 IU)/kg		3.4	3.4	4.5	5.6	6.7	7.9	9.0	10.1	300.0
Vitamin E - mg or IU/kg		110	110	146	182	220	255	292	328.6	9750

* It is best to roll grains. Oats & Barley could be fed whole with corn coarse ground.

** It is OK to use 48% solvent soybean meal if a little more protein is desired.

*** Dried (or wet) molasses added to improve palatability & increase early acceptance.

For concentrate feeding guidelines see tab 4. Hay intake tab 2.

Young calves need lots of protein or growth (height) stunted.

Don't feed hay until after weaning. Supply water by 3rd day.

NOTE: If these rations are fed to sheep, Chapin Dairy Premix must be replaced with Chapin Sheep Premix that is lower in copper. Chapin Dairy Premix contains enough copper to kill sheepl These rations will work for sheep but do not feed to sheep if they contain high copper Chapin Dairy Premix.

Estimated Maximum Forage Intake based on Body Weight, % Forage Neutral Detergent Fiber (NDF) & % Dry Matter

Calf & Heifer Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

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Values for large breeds: Holstein / Brown Swiss / Simmental	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your Forage #'s
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	*IMGH*	*MMGH*	*MGH*	*Wht. Str.*	*IMLH*	*MMLH*	*MLH*	*Normal C.S.*	
	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	
	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	*Kg Forage Intake Possible Estimated by Body Weight x 0.009/% Forage Neutral Detergent Fiber/% Dry Matter.* Grass Hay Intake, kg			Intake, kg	Legume Hay Intake, kg			Intake, kg	Intake, kg
0	44	74	2.1	*Forage should not be fed until after weaning (*eight weeks of age*) or later. Feed ad lib calf starter.*								
1	60	82	2.5	*Some recommend not to feed forage until calf is 12 weeks of age or after it is consuming 2 kg calf starter/day.*								
2	83	87	2.7	1.79	1.54	1.28	1.10	2.44	2.08	1.75	4.73	
3	106	92	3.2	2.29	1.97	1.64	1.41	3.12	2.65	2.24	6.04	
4	130	96	3.8	2.81	2.42	2.01	1.73	3.83	3.25	2.74	7.41	
5	153	100	4.3	3.31	2.85	2.36	2.03	4.51	3.83	3.23	8.72	
6	177	104	4.7	3.82	3.29	2.73	2.35	5.21	4.43	3.73	10.09	
7	200	107	5.2	4.32	3.72	3.09	2.66	5.89	5.00	4.22	11.40	
8	224	110	5.7	4.84	4.17	3.46	2.98	6.60	5.60	4.73	12.76	
9	247	113	6.1	5.34	4.60	3.81	3.29	7.27	6.18	5.21	14.07	
10	271	115	6.5	5.85	5.04	4.18	3.60	7.98	6.78	5.72	15.44	
11	295	118	7.0	6.37	5.49	4.55	3.92	8.69	7.38	6.22	16.81	
12	318	120	7.4	6.87	5.92	4.91	4.23	9.36	7.95	6.71	18.12	
13	342	122	9.2	7.39	6.37	5.28	4.55	10.07	8.55	7.22	19.49	
14 - Breed	*365*	*124*	9.7	7.88	6.79	5.63	4.85	10.75	9.13	7.70	20.80	
15 - Breed	*389*	*125*	10.2	8.40	7.24	6.00	5.17	11.45	9.73	8.21	22.17	
16 - Breed	*412*	*127*	10.6	8.90	7.67	6.36	5.48	12.13	10.30	8.69	23.48	
17	436	128	11.1	9.42	8.12	6.73	5.80	12.84	10.90	9.20	24.84	
18	460	130	11.5	9.94	8.56	7.10	6.12	13.55	11.50	9.71	26.21	
19	483	131	12.0	10.43	8.99	7.45	6.42	14.22	12.08	10.19	27.52	
20	506	132	12.4	10.93	9.42	7.81	6.73	14.90	12.65	10.68	28.83	
21	530	133	12.8	11.45	9.87	8.18	7.05	15.61	13.25	11.18	30.20	
22	553	135	13.2	11.95	10.29	8.53	7.35	16.28	13.83	11.67	31.51	
23 - 150 Days	577	136	12.7	12.46	10.74	8.90	7.67	16.99	14.43	12.17	32.88	
24 - 210 Preg	600	138	10.1	12.96	11.17	9.26	7.98	17.67	15.00	12.66	34.19	

Estimated Added Concentrate Intake (as fed) Possible if Maximum Hay intake (% NDF of hay determines) is allowed.

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Values for large breeds: Holstein / Brown Swiss / Simmental	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	IMGH	MMGH	MGH	*Wht. Str.*	IMLH	MMLH	MLH	*Normal C.S.*	*Forage #'s*
	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	0.00%
	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	0.00%

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	*Kg Forage Intake Possible Estimated by Body Weight x 0.009/% Forage Neutral Detergent Fiber/% Dry Matter.* Even though animal eats the maximum forage DMI possible, it doesn't mean animal's nutrient needs are met.								
0	44	74	2.1	*If concentrate offered, animal will eat less forage if necessary so as not to exceed maximum total DM intake possible.*								
1	60	82	2.5	*Enter % DM of Conc.*		90.0%	to see kg of concentrate intake possible if maximum forage intake.					
2	83	87	2.7	1.33	1.56	1.80	1.86	0.71	1.07	1.37	1.16	3.00
3	106	92	3.2	1.42	1.72	2.02	2.10	0.64	1.08	1.47	1.20	3.56
4	130	96	3.8	1.60	1.97	2.34	2.44	0.64	1.19	1.67	1.33	4.22
5	153	100	4.3	1.69	2.13	2.56	2.68	0.56	1.21	1.77	1.38	4.78
6	177	104	4.7	1.65	2.15	2.66	2.80	0.35	1.10	1.74	1.29	5.22
7	200	107	5.2	1.75	2.31	2.88	3.04	0.27	1.12	1.85	1.33	5.78
8	224	110	5.7	1.82	2.45	3.09	3.26	0.16	1.11	1.93	1.36	6.33
9	247	113	6.1	1.80	2.50	3.20	3.39	-0.03	1.02	1.93	1.29	6.78
10	271	115	6.5	1.76	2.53	3.30	3.51	-0.24	0.91	1.90	1.20	7.22
11	295	118	7.0	1.83	2.67	3.51	3.74	-0.35	0.90	1.98	1.22	7.78
12	318	120	7.4	1.81	2.71	3.62	3.87	-0.54	0.81	1.97	1.16	8.22
13	342	122	9.2	3.33	4.30	5.27	5.54	0.80	2.25	3.50	2.62	10.22
14 - Breed	365	124	9.7	3.42	4.45	5.50	5.78	0.72	2.27	3.61	2.67	10.78
15 - Breed	389	125	10.2	3.49	4.59	5.70	6.00	0.62	2.27	3.69	2.69	11.33
16 - Breed	412	127	10.6	3.47	4.64	5.82	6.13	0.43	2.17	3.68	2.62	11.78
17	436	128	11.1	3.54	4.78	6.02	6.36	0.32	2.17	3.77	2.64	12.33
18	460	130	11.5	3.50	4.81	6.12	6.48	0.11	2.06	3.74	2.56	12.78
19	483	131	12.0	3.60	4.96	6.34	6.72	0.03	2.07	3.84	2.60	13.33
20	506	132	12.4	3.58	5.01	6.46	6.85	-0.16	1.98	3.84	2.53	13.78
21	530	133	12.8	3.54	5.04	6.55	6.96	-0.38	1.87	3.81	2.44	14.22
22	553	135	13.2	3.52	5.08	6.66	7.09	-0.57	1.78	3.80	2.38	14.67
23 - 150 Days	577	136	12.7	2.48	4.11	5.76	6.21	-1.78	0.66	2.78	1.29	14.11
24 - 210 Preg	600	138	10.1	-0.87	0.82	2.54	3.00	-5.31	-2.76	-0.57	-2.11	11.22

Forage Intake needed for 800 grams/day gain. Figures maximum forage DMI possible or less if needed.

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Values for large breeds: Holstein	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	*IMGH*	*MMGH*	*MGH*	*Wht. Str.*	*IMLH*	*MMLH*	*MLH*	*Normal C.S.*	*Forage #'s*
Brown Swiss	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	
Simmental	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	*Kg Forage Intake Possible Estimated by Body Weight x 0.009/% Forage Neutral Detergent Fiber/% Dry Matter.* Grass Hay Intake, kg			Intake, kg	Legume Hay Intake, kg			Intake, kg	Intake, kg
0	44	74	2.1	*Forage should not be fed until after weaning (*eight weeks of age*) or later. Feed ad lib calf starter.*								
1	60	82	2.5	*Some recommend not to feed forage until calf is 12 weeks of age or after it is consuming 2 kg calf starter/day.*								
2	83	87	2.7	1.79	1.54	1.28	1.10	2.44	2.08	1.75		
3	106	92	3.2	2.29	1.97	1.64	1.41	2.20	2.40	2.24		
4	130	96	3.8	2.81	2.42	2.01	1.73	2.80	2.80	2.74		
5	153	100	4.3	3.31	2.85	2.36	2.03	3.50	3.60	3.23		
6	177	104	4.7	3.82	3.29	2.73	2.35	4.20	4.30	3.73		
7	200	107	5.2	4.32	3.72	3.09	2.66	4.30	4.80	4.22		
8	224	110	5.7	4.84	4.17	3.46	2.98	4.50	5.00	4.73		
9	247	113	6.1	5.34	4.60	3.81	3.29	7.00	6.00	5.21		
10	271	115	6.5	5.85	5.04	4.18	3.60	7.30	6.50	5.72		
11	295	118	7.0	6.37	5.49	4.55	3.92	7.90	7.00	6.22		
12	318	120	7.4	6.87	5.92	4.91	4.23	8.30	7.50	6.71		
13	342	122	9.2	7.39	6.37	5.28	4.55	8.80	8.00	7.22		
14 - Breed	*365*	*124*	9.7	7.88	6.79	5.63	4.85	9.20	8.30	7.70		
15 - Breed	*389*	*125*	10.2	8.40	7.24	6.00	5.17	9.60	8.80	8.21		
16 - Breed	*412*	*127*	10.6	8.70	7.67	6.36	5.48	10.10	9.30	8.69		
17	436	128	11.1	9.00	8.12	6.73	5.80	10.50	9.80	9.20		
18	460	130	11.5	9.40	8.56	7.10	6.12	10.90	10.30	9.71		
19	483	131	12.0	9.90	8.99	7.45	6.42	11.40	10.70	10.19		
20	506	132	12.4	10.30	9.42	7.81	6.73	11.70	11.20	10.68		
21	530	133	12.8	10.70	9.87	8.18	7.05	12.20	11.70	11.18		
22	553	135	13.2	11.95	10.29	8.53	7.35	14.20	13.83	11.67		
23 - 150 Days	577	136	12.7	12.46	10.74	8.90	7.67	16.99	14.43	12.17		
24 - 210 Preg	600	138	10.1	12.96	11.17	9.26	7.98	17.67	15.00	12.66		
Forage intake from three thru 22 months, kg				4,308	3,792	3,144	2,710	4,973	4,694	4,299	0.00	*Offset forage*
Forage Cost Euro/kg				€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	*Don't feed*	*#'s = < Max.*
Forage cost from three thru 22 months, Euro				€ 215	€ 190	€ 157	€ 135	€ 249	€ 235	€ 215	*just corn S.*	*kg possible*

Concentrate feeding guidelines (in addition to feeding free choice hay of type shown) needed for 800 gm/day growth

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Values for large breeds: Holstein / Brown Swiss / Simmental	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	IMGH	MMGH	MGH	*Wht. Str.*	IMLH	MMLH	MLH	*Normal C.S.*	*Forage #'s*
	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	0.00%
	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	0.00%

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	Even though animal eats the maximum forage DMI possible, it doesn't mean animal's nutrient needs are met. *If concentrate offered, animal will eat less forage if necessary so as not to exceed maximum total DM intake possible.*														
0	44	74	2.1	*Start feeding hay at 3 months. If free choice hay feeding starts at 2 months, kg calf starter approximates kg shown for 3 months.*														
1	60	82	2.5	First number shown for each forage is kg of concentrate/head/day (90% D.M.). *Second # identifies the concentrate by % protein of D.M..*														
2	83	87	2.7	2.1	*22.50*	2.1	*22.50*	2.10	*22.50*	2.10	*22.50*	2.1	*22.50*	2.1	*22.50*	2.1	*22.50*	
3	106	92	3.2	1.0	*22.50*	1.4	*22.50*	1.70	*22.50*	2.00	*22.50*	1.0	*22.50*	1.0	*22.50*	1.3	*22.50*	Don't Feed
4	130	96	3.8	1.0	*22.50*	1.5	*22.50*	1.90	*22.50*	2.30	*22.50*	1.0	*22.50*	1.2	*22.50*	1.5	*22.50*	Don't Feed
5	153	100	4.3	1.1	*22.50*	1.7	*22.00*	2.00	*22.00*	2.60	*22.00*	1.0	*22.50*	1.3	*22.00*	1.5	*22.00*	Don't Feed
6	177	104	4.7	1.2	*22.00*	1.7	*22.00*	2.20	*22.00*	2.70	*22.00*	1.0	*22.00*	1.1	*22.00*	1.6	*22.00*	Don't Feed
7	200	107	5.2	1.1	*22.00*	1.8	*22.00*	2.40	*20.00*	3.00	*20.00*	1.0	*22.00*	1.0	*22.00*	1.7	*18.00*	Don't Feed
8	224	110	5.7	1.0	*22.00*	1.9	*16.00*	2.50	*18.00*	3.40	*18.00*	1.3	*16.00*	1.3	*14.00*	1.9	*10.50*	
9	247	113	6.1	1.1	*14.00*	2.0	*14.00*	2.70	*16.00*	3.50	*18.00*	0.037	*CHPM*	1.0	*10.50*	2.0	*10.50*	If corn
10	271	115	6.5	1.1	*12.50*	2.1	*12.50*	2.80	*16.00*	3.70	*18.00*	0.041	*CHPM*	1.0	*10.50*	2.0	*10.50*	silage is
11	295	118	7.0	1.1	*10.50*	2.1	*10.50*	3.00	*14.00*	3.90	*18.00*	0.044	*CHPM*	1.0	*10.50*	2.1	*10.50*	fed, feed a
12	318	120	7.4	1.0	*10.50*	2.2	*10.50*	3.10	*14.00*	4.20	*16.00*	0.048	*CHPM*	1.0	*10.50*	2.1	*10.50*	calf grower
13	342	122	9.2	1.0	*10.50*	2.2	*10.50*	3.30	*12.50*	4.30	*16.00*	0.051	*CHPM*	1.0	*10.50*	2.2	*10.50*	with more
14 - Breed	365	124	9.7	1.0	*10.50*	2.3	*10.50*	3.40	*12.50*	4.50	*16.00*	0.055	*CHPM*	1.1	*10.50*	2.2	*10.50*	protein
15 - Breed	389	125	10.2	1.0	*10.50*	2.3	*10.50*	3.50	*12.50*	4.70	*16.00*	0.058	*CHPM*	1.1	*10.50*	2.3	*10.50*	than shown.
16 - Breed	412	127	10.6	1.0	*10.50*	2.4	*10.50*	3.80	*10.50*	4.90	*16.00*	0.062	*CHPM*	1.1	*10.50*	2.3	*10.50*	
17	436	128	11.1	1.1	*10.50*	2.4	*10.50*	3.70	*10.50*	5.10	*16.00*	0.065	*CHPM*	1.1	*10.50*	2.3	*10.50*	Percent
18	460	130	11.5	1.1	*10.50*	2.4	*10.50*	3.80	*10.50*	5.30	*16.00*	0.069	*CHPM*	1.1	*10.50*	2.4	*10.50*	protein
19	483	131	12.0	1.1	*10.50*	2.5	*10.50*	3.90	*10.50*	5.50	*16.00*	0.072	*CHPM*	1.1	*10.50*	2.4	*10.50*	needed
20	506	132	12.4	1.1	*10.50*	2.5	*10.50*	4.00	*10.50*	5.60	*16.00*	0.076	*CHPM*	1.1	*10.50*	2.4	*10.50*	depends on
21	530	133	12.8	1.1	*10.50*	2.5	*10.50*	4.10	*10.50*	5.80	*16.00*	0.080	*CHPM*	1.1	*10.50*	2.5	*10.50*	kg corn
22	553	135	13.2	1.7	*10.50*	3.6	*10.50*	5.30	*14.00*	6.90	*18.00*	0.083	*CHPM*	1.1	*10.50*	3.5	*10.50*	silage fed.
23 - 150 Days	577	136	12.7	*Feed a dry cow ration for a month starting two months before calving.* CHPM = Chapin Heifer Premix.														
24 - 210 Preg	600	138	10.1	*Feed a close up ration with no salt the last month & feed a transition ration the last two weeks before calving.*														

Summary	C.P. of DM	CP 90% DM	Euro/Kg	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost
data at right	22.50%	20.25%	0.185	159	€ 29	153	€ 28	174	€ 32	195	€ 36	156	€ 29	131	€ 24	149	€ 28
give kg intake	22.00%	19.80%	0.177	101	€ 18	159	€ 28	201	€ 36	162	€ 29	61	€ 11	104	€ 18	95	€ 17
& cost of each	20.00%	18.00%	0.170		€ 0		€ 0	73	€ 12	92	€ 16		€ 0		€ 0		€ 0
concentrate.	18.00%	16.10%	0.164		€ 0		€ 0	76	€ 12	653	€ 107		€ 0		€ 0	52	€ 8
Enter feedstuff	16.00%	14.40%	0.157		€ 0	58	€ 9	168	€ 26	1522	€ 239	40	€ 6		€ 0		€ 0
cost in tab on	14.00%	12.60%	0.151	34	€ 5	61	€ 9	348	€ 53		€ 0		€ 0	40	€ 6		€ 0
left marked	12.50%	11.25%	0.146	34	€ 5	64	€ 9	311	€ 45		€ 0		€ 0		€ 0		€ 0
"price sheet".	10.50%	9.45%	0.139	406	€ 56	897	€ 125	711	€ 99		€ 0		€ 0	454	€ 63	1055	€ 147
Note hay quality.	CHPM =Chapin Heifer Premix		0.383		€ 0		€ 0		€ 0		€ 0	26	€ 10		€ 0		€ 0
Kg of concentrate fed from weaning thru 22 months				732		1391		2062		2623		282		729		1351	
Total concentrate cost from weaning thru 22 months					€ 114		€ 209		€ 316		€ 426		€ 56		€ 112		€ 200
Forage Intake, kg, from three thru 22 months				4,308		3,792		3,144		2,710		4,973		4,694		4,299	
Forage Cost, Euro, from three thru 22 months					€ 215		€ 190		€ 157		€ 135		€ 249		€ 235		€ 215
Feed Intake *(forage & conc.)* weaning thru 22 months				5,040		5,183		5,206		5,333		5,255		5,423		5,650	
Feed Cost *(forage & conc.)* weaning thru 22 months					€ 329		€ 398		€ 473		€ 562		€ 304		€ 346		€ 414

Estimate Maximum Forage Intake if One-Half from Hay & One-Half from Corn Silage. (One-half NDF from each.)

Calf & Heifer Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

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Values for large breeds: Holstein / Brown Swiss / Simmental	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your Forage #'s
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	*IMGH*	*MMGH*	*MGH*	*Wht. Str.*	*IMLH*	*MMLH*	*MLH*	*Normal C.S.*	
	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	
	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	*Kg Forage Intake Possible Estimated by Body Weight x 0.009/% Forage Neutral Detergent Fiber/% Dry Matter.* Grass Hay Intake, kg			Intake, kg	Legume Hay Intake, kg			Intake, kg	Intake, kg
0	44	74	2.1	*Forage should not be fed until after weaning (*eight weeks of age*) or later. Feed ad lib calf starter.*								
1	60	82	2.5	*Some recommend not to feed forage until calf is 12 weeks of age or after it is consuming 2 kg calf starter/day.*								
2	83	87	2.7	0.90	0.77	0.64	0.55	1.22	1.04	0.88	2.36	
3	106	92	3.2	1.14	0.99	0.82	0.70	1.56	1.33	1.12	3.02	
4	130	96	3.8	1.40	1.21	1.00	0.86	1.91	1.63	1.37	3.70	
5	153	100	4.3	1.65	1.42	1.18	1.02	2.25	1.91	1.61	4.36	
6	177	104	4.7	1.91	1.65	1.37	1.18	2.61	2.21	1.87	5.04	
7	200	107	5.2	2.16	1.86	1.54	1.33	2.94	2.50	2.11	5.70	
8	224	110	5.7	2.42	2.08	1.73	1.49	3.30	2.80	2.36	6.38	
9	247	113	6.1	2.67	2.30	1.91	1.64	3.64	3.09	2.61	7.04	
10	271	115	6.5	2.93	2.52	2.09	1.80	3.99	3.39	2.86	7.72	
11	295	118	7.0	3.19	2.75	2.28	1.96	4.34	3.69	3.11	8.40	
12	318	120	7.4	3.43	2.96	2.45	2.11	4.68	3.98	3.35	9.06	
13	342	122	9.2	3.69	3.18	2.64	2.27	5.04	4.28	3.61	9.74	
14 - Breed	*365*	*124*	9.7	3.94	3.40	2.82	2.43	5.37	4.56	3.85	10.40	
15 - Breed	*389*	*125*	10.2	4.20	3.62	3.00	2.59	5.73	4.86	4.10	11.08	
16 - Breed	*412*	*127*	10.6	4.45	3.83	3.18	2.74	6.07	5.15	4.35	11.74	
17	436	128	11.1	4.71	4.06	3.36	2.90	6.42	5.45	4.60	12.42	
18	460	130	11.5	4.97	4.28	3.55	3.06	6.77	5.75	4.85	13.11	
19	483	131	12.0	5.22	4.50	3.73	3.21	7.11	6.04	5.10	13.76	
20	506	132	12.4	5.47	4.71	3.90	3.36	7.45	6.33	5.34	14.42	
21	530	133	12.8	5.72	4.93	4.09	3.52	7.80	6.63	5.59	15.10	
22	553	135	13.2	5.97	5.15	4.27	3.68	8.14	6.91	5.83	15.75	
23 - 150 Days	577	136	12.7	6.23	5.37	4.45	3.84	8.50	7.21	6.09	16.44	
24 - 210 Preg	600	138	10.1	6.48	5.58	4.63	3.99	8.83	7.50	6.33	17.09	

Actual hay & corn silage intakes where one half maximum forage intake from corn silage with up to half from hay.

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Values for	Forage Type =	Grass Hay			Wheat	Legume Hay			Corn	Enter
large breeds:	Forage Maturity =	Immature	Mid-Mature	Mature	Straw	Immature	Mid-Mature	Mature	Silage	Your
Holstein	Forage Code =	*IMGH*	*MMGH*	*MGH*	*Wht. Str.*	*IMLH*	*MMLH*	*MLH*	*Normal C.S.*	*Forage #'s*
Brown Swiss	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	
Simmental	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	

Age	Weight	Wither Ht.	Dry Matter	*Kg Forage Intake Possible Estimated by Body Weight x 0.009/% Forage Neutral Detergent Fiber/% Dry Matter.*								
Month	Kg	cm	Intake, kg	Grass Hay Intake, kg			Intake, kg	Legume Hay Intake, kg			Intake, kg	Intake, kg
0	44	74	2.1	*Forage should not be fed until after weaning (*eight weeks of age*) or later. Feed ad lib calf starter.*								
1	60	82	2.5	*Some recommend not to feed forage until calf is 12 weeks of age or after it is consuming 2 kg calf starter/day.*								
2	83	87	2.7	0.90	0.77	0.64	0.55	1.22	1.04	0.88		
3	106	92	3.2	1.14	0.99	0.82	0.70	1.56	1.33	1.12		
4	130	96	3.8	1.40	1.21	1.00	0.86	1.91	1.63	1.37		
5	153	100	4.3	1.65	1.42	1.18	1.02	2.25	1.91	1.61		
6	177	104	4.7	1.91	1.65	1.37	1.18	2.61	2.21	1.87		
7	200	107	5.2	2.16	1.86	1.54	1.33	2.94	2.50	2.11		
8	224	110	5.7	2.42	2.08	1.73	1.49	3.30	2.80	2.36		
9	247	113	6.1	*2.20*	2.30	1.91	1.64	*2.50*	*2.80*	2.61	7.04	
10	271	115	6.5	*2.50*	2.52	2.09	1.80	*2.60*	*2.90*	2.86	7.72	
11	295	118	7.0	*2.80*	2.75	2.28	1.96	*2.70*	*3.00*	3.11	8.40	
12	318	120	7.4	*2.80*	2.96	2.45	2.11	*2.80*	*3.20*	3.35	9.06	
13	342	122	9.2	*2.90*	3.18	2.64	2.27	*3.00*	*3.30*	3.61	9.74	
14 - Breed	*365*	*124*	9.7	*3.00*	3.40	2.82	2.43	*3.20*	*3.50*	3.85	10.40	
15 - Breed	*389*	*125*	10.2	*3.10*	3.62	3.00	2.59	*3.30*	*3.60*	4.10	11.08	
16 - Breed	*412*	*127*	10.6	*3.20*	3.83	3.18	2.74	*3.40*	*3.80*	4.35	11.74	
17	436	128	11.1	*3.50*	4.06	3.36	2.90	*3.60*	*3.90*	4.60	12.42	
18	460	130	11.5	*3.60*	4.28	3.55	3.06	*3.70*	*4.10*	4.85	13.11	
19	483	131	12.0	*3.70*	4.50	3.73	3.21	*3.80*	*4.20*	5.10	13.76	
20	506	132	12.4	*3.80*	4.71	3.90	3.36	*3.90*	*4.30*	5.34	14.42	
21	530	133	12.8	*3.90*	4.93	4.09	3.52	*4.00*	*4.40*	5.59	15.10	
22	553	135	13.2	5.97	5.15	4.27	3.68	*5.80*	*6.40*	5.83	15.75	
23 - 150 Days	577	136	12.7	6.23	5.37	4.45	3.84	8.50	7.21	6.09	16.44	
24 - 210 Preg	600	138	10.1	6.48	5.58	4.63	3.99	8.83	7.50	6.33	17.09	
Forage intake from three thru 22 months, kg				1,786	1,896	1,572	1,355	1,955	2,038	2,149	4872	*Offset forage*
Forage Cost Euro/kg				€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.050	€ 0.030	*#'s = < Max.*
Forage cost from three thru 22 months, Euro				€ 89	€ 95	€ 79	€ 68	€ 98	€ 102	€ 107	€ 146	*kg possible*

Concentrate feeding guidelines needed for 800 gm/day growth when half NDF from hay & half from corn silage

Calf & Heifer Rations Formulated (using US NRC Dairy 2001 software) & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist
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Values for large breeds: Holstein / Brown Swiss / Simmental	Forage Type =	Grass Hay			Wheat Straw	Legume Hay			Corn Silage	Enter Your
	Forage Maturity =	Immature	Mid-Mature	Mature		Immature	Mid-Mature	Mature		
	Forage Code =	IMGH	MMGH	MGH	Wht. Str.	IMLH	MMLH	MLH	Normal C.S.	Forage #'s
	Neutral Detergent Fiber, % =	49.60%	57.70%	69.10%	73.00%	36.30%	42.90%	50.90%	45.00%	0.00%
	Forage Dry Matter, % =	84.00%	83.80%	84.40%	92.70%	84.20%	83.90%	83.80%	35.10%	0.00%

Age Month	Weight Kg	Wither Ht. cm	Dry Matter Intake, kg	Even though animal eats the maximum forage DMI possible, it doesn't mean animal's nutrient needs are met. If concentrate offered, animal will eat less forage if necessary so as not to exceed maximum total DM intake possible.
0	44	74	2.1	Start feeding hay at 3 months. If free choice hay feeding starts at 2 months, kg calf starter approximates kg shown for 3 months.
1	60	82	2.5	First number shown for each forage is kg of concentrate/head/day (90% D.M.). Second # identifies the concentrate by % protein of D.M..

Grass Hay Immature		Grass Hay Mid-Mature		Grass Hay Mature		Wheat Straw		Legume Hay Immature		Legume Hay Mid-Mature		Legume Hay Mature		Hay only (no corn silage) until after calf is eight months old. See hay tab for kg hay.
2.1	22.5	2.1	22.5	2.1	22.5	2.1	22.5	2.1	22.5	2.1	22.5	2.1	22.5	
1.0	22.5	1.4	22.5	1.7	22.5	2.0	22.5	1.0	22.5	1.0	22.5	1.3	22.5	
1.0	22.5	1.5	22.5	1.9	22.5	2.3	22.5	1.0	22.5	1.2	22.5	1.5	22.5	
1.1	22.5	1.7	22.0	2.0	22.0	2.6	22.0	1.0	22.5	1.3	22.0	1.5	22.0	
1.2	22.0	1.7	22.0	2.2	22.0	2.7	22.0	1.0	22.0	1.1	22.0	1.6	22.0	
1.1	22.0	1.8	22.0	2.4	20.0	3.0	20.0	1.0	22.0	1.0	22.0	1.7	18.0	
1.0	22.0	1.9	16.0	2.5	18.0	3.4	18.0	1.3	16.0	1.3	14.0	1.9	10.5	
1.1	18.00	1.4	20.00	1.70	22.00	2.20	22.00	1.00	10.50	1.00	10.50	1.2	12.50	Ninth month
1.1	14.00	1.4	20.00	1.80	20.00	2.20	22.00	1.00	10.50	1.00	10.50	1.2	12.50	is start of
1.1	12.50	1.3	20.00	1.70	20.00	2.20	22.00	1.00	10.50	1.00	10.50	1.2	12.50	equal NDF
1.1	12.50	1.3	18.00	1.70	20.00	2.20	22.00	1.00	10.50	1.00	10.50	1.2	10.50	from hay &
1.1	10.50	1.2	18.00	1.70	20.00	2.20	22.00	1.00	10.50	1.00	10.50	1.2	10.50	corn silage.
1.1	10.50	1.2	16.00	1.70	20.00	2.30	22.00	1.00	10.50	1.00	10.50	1.1	10.50	Feeding
1.1	10.50	1.1	16.00	1.70	20.00	2.30	22.00	1.00	10.50	1.00	10.50	1.1	10.50	corn silage
1.1	10.50	1.1	14.00	1.70	18.00	2.30	22.00	1.00	10.50	1.00	10.50	1.0	10.50	earlier may
1.1	10.50	1.1	14.00	1.70	18.00	2.40	20.00	1.00	10.50	1.00	10.50	1.0	10.50	limit dry
1.1	10.50	1.1	12.50	1.70	18.00	2.40	20.00	1.00	10.50	1.00	10.50	1.0	10.50	dry matter
1.1	10.50	1.1	12.50	1.70	18.00	2.40	20.00	1.00	10.50	1.00	10.50	1.0	10.50	intake &
1.1	10.50	1.0	10.50	1.70	16.00	2.40	20.00	1.00	10.50	1.00	10.50	1.0	10.50	stunt
1.1	10.50	1.0	10.50	1.70	16.00	2.50	20.00	1.00	10.50	1.00	10.50	1.0	10.50	growth.
1.1	10.50	2.0	22.00	2.80	22.00	3.90	22.00	1.00	10.50	1.00	10.50	1.9	10.50	

23 - 150 Days	577	136	12.7	Feed a dry cow ration for a month starting two months before calving. CHPM = Chapin Heifer Premix.
24 - 210 Preg	600	138	10.1	Feed a close up ration with no salt the last month & feed a transition ration the last two weeks before calving.

Summary	C.P. of DM	CP 90% DM	Euro/Kg	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost	Kg	Cost
data at right	22.50%	20.25%	0.185	95	€ 18	88	€ 16	110	€ 20	131	€ 24	92	€ 17	67	€ 12	85	€ 16
give kg intake	22.00%	19.80%	0.177	101	€ 18	220	€ 39	265	€ 47	827	€ 146	61	€ 11	104	€ 18	95	€ 17
& cost of each	20.00%	18.00%	0.170		€ 0	125	€ 21	387	€ 66	461	€ 78		€ 0		€ 0		€ 0
concentrate.	18.00%	16.10%	0.164	34	€ 5	76	€ 12	207	€ 34	104	€ 17		€ 0		€ 0	52	€ 8
Enter feedstuff	16.00%	14.40%	0.157		€ 0	128	€ 20	104	€ 16		€ 0	40	€ 6		€ 0		€ 0
cost in tab on	14.00%	12.60%	0.151	34	€ 5	67	€ 10		€ 0		€ 0		€ 0	40	€ 6		€ 0
left marked	12.50%	11.25%	0.146	67	€ 10	67	€ 10		€ 0		€ 0		€ 0		€ 0	110	€ 16
"price sheet".	10.50%	9.45%	0.139	336	€ 47	61	€ 8		€ 0		€ 0	427	€ 59	427	€ 59	439	€ 61
Note hay quality.	CHPM =Chapin Heifer Premix		0.383		€ 0		€ 0		€ 0		€ 0		€ 0		€ 0		€ 0
Kg of concentrate fed from three thru 22 months				665		833		1074		1522		619		637		781	
Total concentrate cost from three thru 22 months					€ 102		€ 138		€ 183		€ 266		€ 93		€ 96		€ 118
Hay Intake from three thru 22 months, kg				1,786		1,896		1,572		1,355		1,955		2,038		2,149	
Corn Silage Intake from three thru 22 months, kg				4,872		4,872		4,872		4,872		4,872		4,872		4,872	
Forage Cost, Euro, from three thru 22 months					€ 235		€ 241		€ 225		€ 214		€ 244		€ 248		€ 254
Feed Intake (forage & conc.) fed three thru 22 months				7,323		7,601		7,518		7,749		7,446		7,547		7,802	
Feed Cost (forage & conc.) three thru 22 months					€ 338		€ 379		€ 408		€ 480		€ 337		€ 344		€ 372

Concentrate feeding guidelines (in addition to feeding free choice forage of type shown) needed for 800 gm/day gain

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Summary Comments on Calf & Heifer Rations Presented & Suggestions on How to Use this Information

Hay quality & animal weight determine the kg of concentrate to feed & % protein needed . Therefore, standard recommendations are not specific enough when hay quality varies.

As hay matures animal eats less of it (NDF goes up & protein goes down). Therefore kg of grain fed needs to be increased. Percent crude protein in grain may need to be increased.

Note the different kg grain required between grass & legume hays. Young calves need lots of protein or growth of frame decreased. Protein needs decrease rapidly with age.

Weigh calves & measure height regularly to see if growth guidelines are being met. If not, change feed. Feed either a concentrate or heifer premix to supply vitamins & minerals.

The quantity of dry matter that pregnant heifer can eat goes down rapidly the last two months before calving. Therefore increase nutrient density & concentrate intake.

Concentrate feeding quidelines can be confusing. Since only one type & qualitity of forage is usually available for replacements, choose concentrate program that balances forage.

For example, looking at mid-mature grass hay it can be seen that a 22.5% (D.M. basis) calf starter should be fed until calf weighs 100 kg. Then a 20% calf grower should be fed for three months following by rations with decreasing protein until at 270 kg weight the calf grower concentrate need contain only 10.5% protein. Since ususally calves of different weights will be fed on a farm at one time, divide them so they can be fed propertly or supply more protein than needed by some calves to be sure young calves not protein deficient.

The money saved by feeding too little protein is not worth it if heifer growth in weight & height is compromised. By looking at the rations recommended for the forage fed (includes various types & quality of hay & corn silage) you can see how much of each concentrate presented should be fed & when. This spreadsheet presentation allows you to adjust your concentrate feeding based on the forage fed. These recommendations are much more specific than you generally see. In addition, since you can enter the actual prices of ingredients including forage of different quality, you can determine which forage available to you will be the cheapest to raise a replacement animal. These data show that improving forage quality reduces the amount of concentrate needed to raise replacements. Relative forage cost will let you decide what is most economical for you.

In addition to protein & energy, be careful to feed adequate vitamins & minerals. While care has been taken to formulate rations that are adequate in vit-minerals, some reduction of vitamins & mineral addition to the concentrate formulas as given is advised if feeding poor quality forage (straw) that requires lots of concentrate to meet energy & protein needs.

A workable approach is to feed all heifers Chapin Heifer Premix (BW x 0.00015) plus enough grain & soybean meal to meet growth guidelines, but it takes careful management.

The formula for Chapin Dairy premix (vitamins & trace minerals) is given in the last tab. This should be custom made by a commercial mixer of premixes & not by individual farmers.

All other formulas presented can be home mixed. It may be advisable to buy a prepared calf starter (formula given) that can be pelleted, extruded or rolled to improve palatibility.

The interactive economic capability of this spreadsheet can be a valuable budgeting tool & aid in decision making, including whether you should raise or buy your replacements.

By studying norms presented for various breeds you can determine weight & height goals for replacements. You can enter mature norms for smaller breeds & view growth goals.

Research has shown that 800 gm/day gain before breeding will result in better milk production than gaining more or less. The rations given support 800 gm/day gain from weaning.

Calf & heifer rations given in tab #3 & rations used to compile the concentrate feeding guidelines were formulated using U. S. National Research Council Dairy 2001 software.

Good Feed Management Calf & Replacement Heifer Raising Considerations

When a calf is born it is a race between the good & the bad. Gut will absorb what is fed so feed colostrum & not filth. Calf does not need to nurse cow. Milk colstrum & hand feed 3 to 4 liters colostrum to calf as soon after birth as possible (within first hour) when antibodies in colstrum can be absorbed. Feed colostrum for three days for gut protection.

The quality of colostrum varies so antibody titers should be evaluated. Feeding adequate rations, including vitamins & minerals, to the pregnant cow will improve colostrum quality.

The antibody titer of colostrum is greater if dam is fed adequate protein, energy, vitamins & minerals. It takes a 3 to 4 week dry period to concentrate antibodies in colostrum.

The antibody titer of colostrum can be measured with a colostometer (really a hydrometer). Colostrum of high titer cows can be pooled & fed to calves needing better colostrum.

Feed calf 500 gm dry milk powder (8 to 1 dilution = 4 liters)/day plus free-choice water. Clean utensils daily. For the first three weeks milk replacer should be made of milk products.

Calf a monogastric until 2 weeks of age, after which rumen structure & function (microbial fermentations) begin to development. If grain is fed, good rumen function by 3 to 4 weeks.

After rumen functioning, rumen microbes synthesize B-vitamins, vitamin K & rumen volatile fatty acids (acetete, propionate & butyrate). Start feeding calf starter end of first week.

Introduce calf starter grain during first week. Wean when calf eating 1 to 1.5 kg calf starter/day. Keep calf clean so it doesn't consume filth. Do not feed forage until after weaning.

Rumen microbes convert grains to propionic & butyric volatile fatty acids, which stimulate rumen development. Hays produce acetate which does not promote rumen development.

The sooner calf starter intake starts the sooner the rumen develops, the faster calf grows & can be weaned so it is important to get maximum calf starter intake as early as possible.

Calf relies on milk or a milk replacer first three weeks of age until rumen functioning, after which concentrate should supply most to all of nutrients. Eventually forage at 2 to 3 months.

Making fee choice water available starting at three days of age is important so calf can regulate hydration & osmotic pressures. Free choice water encourages intake of calf starter.

Extra milk consumption may promote faster gain but feeding more than 500 grams dry milk powder/day will reduce intake of calf starter & thus reduce development of the rumen.

The goal is to have replacement animals calve at 22 to 24 months of age weighing 600 kg before calving. During the last two months pregnant heifers should be fed special rations.

For animals to calve at 22 to 24 months of age they must be of breeding weight at 13 to 15 months. Measure to see if calves will meet this goal. Change management if necesssary.

Calves should not be fed so much free choice corn silage, high quality hay or grain that they become fat prior to breeding as this reduces the development of milk secretory tissue.

Over conditioning after breeding does not appear to reduce mammary gland development. The feeding guidelines presented should allow 800 gm/day gain, which is ideal.

Special dry cow (far off & close-up) & transition cow rations should be fed to reduce health problems & to aid high peak lactation. That will be the subject of another spreadsheet.

Feeding an ionophere (Bovatec of Rumensin) will improve growth rate 50 to 100 gm/day & improve feed efficiency by increasing propionic acid production & reducing production of acetic & butyric acid in the rumen. For rations balanced for 800 gm/day gain the intake of concentrate &/or forage should be reduced so that animal doesn't become fat.

The body condition score (BCS) of calves should be 2.0 to 2.5 increasing to 3.0 to at breeding & 3.5 to 3.7 at calving so in addition to measuring weight & height, observe BCS's.

Heifer Weights for Various Breeds. 75th Percentile for Holsteins. 67th Percentile for other Breeds. Penn State 1998.

Holstein data compiled from a nationwide USDA study conducted during 1991 to 1992. Heifers on today's well managed farms do a little better than this.

Calf & Heifer Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

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Month of Age	Number of Holsteins observed	Holstein			Milking Shorthorn		Brown Swiss		Ayrshire		Guernsey		Jersey			Your Choice	
		Pounds	Kg	% of Mature	Pounds	Kg	Pounds	Kg	Pounds	Kg	Pounds	Kg	Pounds	Kg	% of Mature	Pounds	Kg
																Enter Mat. Wt., lbs.	
Mature Wt.		1500	682	Weight	1250	568	1500	682	1200	545	1100	500	1000	455	Weight	330	150
1	27	136	62	9%	160	73	163	74	154	70	143	65	108	49	11%	36	16
2	267	189	86	13%	210	95	223	101	205	93	193	88	146	66	15%	48	22
3	996	234	106	16%	262	119	283	129	256	116	233	106	177	80	18%	58	27
4	1202	284	129	19%	315	143	343	156	307	140	299	136	217	99	22%	72	33
5	997	339	154	23%	370	168	403	183	357	162	354	161	278	126	28%	92	42
6	683	422	192	28%	425	193	462	210	407	185	434	197	321	146	32%	106	48
7	523	468	213	31%	482	219	521	237	457	208	448	204	362	165	36%	119	54
8	420	530	241	35%	539	245	580	264	506	230	503	229	412	187	41%	136	62
9	380	596	271	40%	596	271	637	290	554	252	568	258	436	198	44%	144	65
10	293	653	297	44%	653	297	694	315	602	274	588	267	483	220	48%	159	72
11	242	712	324	47%	709	322	750	341	650	295	662	301	499	227	50%	165	75
12	203	760	345	51%	765	348	805	366	697	317	674	306	548	249	55%	181	82
13	240	809	368	54%	820	373	859	390	743	338	756	344	571	260	57%	188	86
14	237	878	399	59%	874	397	912	415	789	359	803	365	602	274	60%	199	90
15	238	931	423	62%	926	421	963	438	834	379	866	394	640	291	64%	211	96
16	200	988	449	66%	977	444	1013	460	878	399	899	409	661	300	66%	218	99
17	199	1026	466	68%	1025	466	1061	482	922	419	950	432	696	316	70%	230	104
18	214	1066	485	71%	1071	487	1107	503	965	439	1001	455	753	342	75%	248	113
19	195	1086	494	72%	1115	507	1152	524	1007	458	1015	461	769	350	77%	254	115
20	189	1170	532	78%	1155	525	1194	543	1049	477	1046	475	813	370	81%	268	122
21	205	1191	541	79%	1192	542	1235	561	1089	495	1112	505	827	376	83%	273	124
22	176	1235	561	82%	1226	557	1273	579	1129	513	1123	510	860	391	86%	284	129
23	182	1279	581	85%	1256	571	1309	595	1168	531	1177	535	878	399	88%	290	132
24	197	1301	591	87%	1281	582	1343	610	1206	548	1178	535	893	406	89%	295	134
25	*Weight shown before calving*				1303	592	1374	625	1244	565	*Weigh calves to see if they are on target. If not, change feed & Mgmt.*						

Median Weights (Holsteins) by age with 5th, 25th, Median, 75th & 95th percentiles. National Dairy Heifer Evaluation Project. Penn State.

Holstein data compiled from a nationwide USDA study conducted during 1991 to 1992. Heifers on today's well managed farms do a little better than this.

Calf & Heifer Rations Formulated & this Spreadsheet Created by Roy E. Chapin, Ph.D., Animal Nutritionist

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Month of Age	Number of Holsteins	5th Percentile		25th Percentile		Median			75th Percentile			95th Percentile		Your Choice (Uses 75 Percentile)			
		Pounds	Kg	Pounds	Kg	Pounds	Kg	% of Mature	Pounds	Kg	% of Mature	Pounds	Kg	Pounds	Kg	Pounds	Kg
														Enter Mature Weight, lbs.			
Mature Wt.	observed	1500	682	1500	682	1500	682	Weight	1500	682	Weight	1500	682	330	150	880	400
1	27	82	37	102	46	119	54	8%	136	62	9%	143	65	30	14	80	36
2	267	113	51	149	68	161	73	11%	189	86	13%	238	108	42	19	111	50
3	996	149	68	182	83	211	96	14%	234	106	16%	284	129	51	23	137	62
4	1202	189	86	234	106	258	117	17%	284	129	19%	339	154	62	28	167	76
5	997	218	99	275	125	311	141	21%	339	154	23%	411	187	75	34	199	90
6	683	266	121	320	145	369	168	25%	422	192	28%	480	218	93	42	248	113
7	523	301	137	369	168	422	192	28%	468	213	31%	542	246	103	47	275	125
8	420	330	150	422	192	468	213	31%	530	241	35%	603	274	117	53	311	141
9	380	379	172	468	213	530	241	35%	596	271	40%	705	320	131	60	350	159
10	293	422	192	517	235	575	261	38%	653	297	44%	776	353	144	65	383	174
11	242	445	202	556	253	638	290	43%	712	324	47%	776	353	157	71	418	190
12	203	504	229	596	271	682	310	45%	760	345	51%	843	383	167	76	446	203
13	240	504	229	660	300	728	331	49%	809	368	54%	913	415	178	81	475	216
14	237	542	246	697	317	776	353	52%	878	399	59%	1026	466	193	88	515	234
15	238	582	265	744	338	843	383	56%	931	423	62%	1067	485	205	93	546	248
16	200	653	297	826	375	913	415	61%	988	449	66%	1096	498	217	99	580	263
17	199	682	310	860	391	931	423	62%	1026	466	68%	1191	541	226	103	602	274
18	214	744	338	895	407	969	440	65%	1066	485	71%	1191	541	235	107	625	284
19	195	776	353	913	415	1007	458	67%	1086	494	72%	1279	581	239	109	637	290
20	189	776	353	950	432	1066	485	71%	1170	532	78%	1302	592	257	117	686	312
21	205	792	360	988	449	1086	494	72%	1191	541	79%	1372	624	262	119	699	318
22	176	843	383	1026	466	1148	522	77%	1235	561	82%	1420	645	272	124	725	329
23	182	809	368	1066	485	1148	522	77%	1279	581	85%	1420	645	281	128	750	341
24	197	776	353	1026	466	1170	532	78%	1301	591	87%	1545	702	286	130	763	347
25	*Weight shown before calving*			*Weigh calves monthly to see if they are on target. If not, change feed & management. Don't wait until calving to find you missed it.*													

Heifer Heights at Withers for Various Breeds. 75th Percentile for Holsteins. 67th Percentile for other Breeds. Penn State.

Holstein data compiled from a nationwide USDA study conducted during 1991 to 1992. Heifers on today's well managed farms do a little better than this.

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Month of Age	Number of Holsteins observed	Holstein			Milking Shorthorn		Brown Swiss		Ayrshire		Guernsey		Jersey			Your Choice	
		Inches At Withers	cm At Withers	% of Calving	Inches At Withers	cm At Withers	Inches At Withers	cm At Withers	Inches At Withers	cm At Withers	Inches At Withers	cm At Withers	Inches At Withers	cm At Withers	% of Calving	Inches Enter Calving Below	cm Enter Calving Below
Calving Ht.		55	140	Height	52	132	57	145	53	135	55	140	50	127	Height	30	76
1	27	33	84	60%	32	81	34	86	32	81	33	84	32	81	64%	19	49
2	267	34	86	62%	34	86	36	91	34	86	35	89	33	84	66%	20	50
3	996	36	91	65%	36	91	38	97	36	91	37	94	34	86	68%	20	52
4	1202	38	97	69%	38	97	40	102	38	97	38	97	36	91	72%	22	55
5	997	39	99	71%	39	99	42	107	39	99	41	104	38	97	76%	23	58
6	683	41	104	75%	41	104	44	112	41	104	42	107	39	99	78%	23	59
7	523	43	109	78%	42	107	45	114	42	107	43	109	40	102	80%	24	61
8	420	44	112	80%	43	109	46	117	43	109	44	112	41	104	82%	25	62
9	380	45	114	82%	44	112	48	122	44	112	45	114	42	107	84%	25	64
10	293	46	117	84%	45	114	49	124	45	114	46	117	42	107	84%	25	64
11	242	47	119	85%	46	117	50	127	46	117	47	119	43	109	86%	26	66
12	203	48	122	87%	47	119	51	130	47	119	48	122	44	112	88%	26	67
13	240	49	124	89%	47	119	52	132	48	122	48	122	45	114	90%	27	69
14	237	50	127	91%	48	122	52	132	48	122	49	124	45	114	90%	27	69
15	238	51	130	93%	49	124	53	135	49	124	50	127	46	117	92%	28	70
16	200	51	130	93%	49	124	54	137	49	124	51	130	46	117	92%	28	70
17	199	52	132	95%	50	127	54	137	50	127	52	132	47	119	94%	28	72
18	214	52	132	95%	50	127	55	140	50	127	52	132	47	119	94%	28	72
19	195	52	132	95%	50	127	55	140	50	127	52	132	47	119	94%	28	72
20	189	53	135	96%	51	130	56	142	51	130	53	135	48	122	96%	29	73
21	205	54	137	98%	51	130	56	142	51	130	53	135	48	122	96%	29	73
22	176	54	137	98%	51	130	56	142	52	132	54	137	49	124	98%	29	75
23	182	54	137	98%	52	132	57	145	52	132	54	137	49	124	98%	29	75
24	197	55	140	100%	52	132	57	145	52	132	55	140	50	127	100%	30	76
25	*Some growth after calving*				52	132	57	145	53	135	*Weigh calves to see if they are on target. If not, change feed & Mgmt.*						

Median Heights (Holsteins) by age with 5th, 25th, Median, 75th & 95th percentiles. National Dairy Heifer Evaluation Project. Penn State.

Holstein data compiled from a nationwide USDA study conducted during 1991 to 1992. Heifers on today's well managed farms do a little better than this.

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Month of Age	Number of Holsteins	5th Percentile At Withers		25th Percentile At Withers		Median At Withers			75th Percentile At Withers			95th Percentile At Withers		Your Choice (Uses 75 Percentile) Enter Mature Height, cm., below			
		Inches	cm	Inches	cm	Inches	cm	% of Calving	Inches	cm	% of Calving	Inches	cm	Inches	cm	Inches	cm
Mature Wt.	observed	48	122	52	132	53	135	Height	55	140	Height	57	145	40	102	30	76
1	27	29	74	30	76	31	79	58%	33	84	60%	33	84	24	61	18	46
2	267	30	76	32	81	33	84	62%	34	86	62%	37	94	25	63	19	47
3	996	31	79	34	86	35	89	66%	36	91	65%	38	97	26	67	20	50
4	1202	33	84	35	89	36	91	68%	38	97	69%	40	102	28	70	21	53
5	997	34	86	37	94	38	97	72%	39	99	71%	42	107	28	72	21	54
6	683	36	91	38	97	40	102	75%	41	104	75%	44	112	30	76	22	57
7	523	37	94	40	102	41	104	77%	43	109	78%	45	114	31	79	23	60
8	420	38	97	41	104	43	109	81%	44	112	80%	47	119	32	81	24	61
9	380	39	99	42	107	43	109	81%	45	114	82%	47	119	33	83	25	62
10	293	41	104	43	109	45	114	85%	46	117	84%	49	124	33	85	25	64
11	242	42	107	44	112	46	117	87%	47	119	85%	49	124	34	87	26	65
12	203	43	109	45	114	47	119	89%	48	122	87%	51	130	35	89	26	67
13	240	43	109	46	117	47	119	89%	49	124	89%	51	130	36	91	27	68
14	237	44	112	47	119	48	122	91%	50	127	91%	52	132	36	92	27	69
15	238	43	109	47	119	49	124	92%	51	130	93%	53	135	37	94	28	71
16	200	46	117	48	122	50	127	94%	51	130	93%	53	135	37	94	28	71
17	199	46	117	49	124	50	127	94%	52	132	95%	54	137	38	96	28	72
18	214	47	119	49	124	51	130	96%	52	132	95%	54	137	38	96	28	72
19	195	48	122	50	127	51	130	96%	52	132	95%	54	137	38	96	28	72
20	189	47	119	50	127	51	130	96%	53	135	96%	57	145	39	98	29	73
21	205	48	122	50	127	52	132	98%	54	137	98%	56	142	39	100	29	75
22	176	49	124	51	130	52	132	98%	54	137	98%	57	145	39	100	29	75
23	182	49	124	51	130	53	135	100%	54	137	98%	57	145	39	100	29	75
24	197	48	122	52	132	53	135	100%	55	140	100%	57	145	40	102	30	76
25	*Height shown at calving*			*Measure calves monthly to see if they are on target. If not, change feed & management. Don't wait until calving to find you missed it.*													

Formula for Chapin Dairy Premix (Kosovo). Feed 20 gm/600 kg cow*.

Chapin Dairy Premix formulated by Roy E. Chapin, Ph.D, Animal Nutritionist
11145 Chapin Lane, Amity, Oregon 97101 USA, E-mail: <roychapin@onlinemac.com>

Nutrient: Vitamin & Trace Mineral	Potency/kg of Premix IU or mg;kg	Formula for 100 kg Mix Kilograms	Ingredient that Supplies Nutrient	Assumes Potency/gm
Vitamin A	6,500,000 IU	1.300 kg	**Vitamin A** Premix	500,000 IU
Vitamin D	2,000,000 IU	0.400 kg	**Vitamin D** Premix	500 000 IU
Vitamin E	65,000 IU = mg	13.000 kg	**Vitamin E** Premix	500 = 50%
Copper	25,000 mg	10.000 kg	**Copper** Sulfate	25% **Cu**
Cobalt	500 mg	0.250 kg	**Cobalt** Sulfate	20% **Co**
Zinc	125,000 mg	35.714 kg	**Zinc** Sulfate	35% **Zn**
Selenium	400 mg	0.89 kg	Sodium **Selenite**	45% **Se**
Manganese	40,000 mg	13.333 kg	**Manganese** Sulfate	30% **Mn**
Iodine	2,000 mg	0.267 kg	Potassium **Iodide**	75% **I**
			Antioxident	
MagOx = to 1 kg		25.647	Magnesium Oxide	
		100.000		

NOTE: Sodium Selenite should be premixed with another trace mineral before adding.

When Chain Dairy Premix is fed at 20 grams per day per 600 to 650 kg large breed cow there are enough vitamins and trace minerals supplied to support high milk production. Calculations for Chapin Dairy Premix are based on cows giving >30 liters of milk and >25 kg dry matter consumption per day.

Shown below are the amounts of vitamins and trace minerals that 20 grams of Chapin Dairy Premix will supply per cow per day.

Nutrient: Vitamin & Trace Mineral	Potency/kg of Chapin Dairy Premix	20 grams CDP/M supplies IU or mg	Concentration Added/kg of feed if 25 kg DM fed
Vitamin A, IU	6,500,000	130,000	5,200 IU/kg
Vitamin D, IU	2,000,000	40,000	1,600 IU/kg
Vitamin E, IU = mg	65,000	1,300	52 IU or mg/kg
Copper, mg	25,000	500	20 = ppm*I93*
Cobalt, mg	500	10	0.40 = ppm
Zinc,mg	125,000	2,500	100 = ppm
Selenium, mg	400	8	0.32 = ppm
Manganese, mg	40,000	800	32 = ppm
Iodine, mg	2,000	40	1.6 = ppm

It is not feasible to mix Chapin Dairy Premix on the farm. Have it custom manufactured by an established vitamin-mineral premix manufacturer.

It is possible to add other microingredients such as niacin, biotin, etc.

*20 grams intake of Chapin Dairy premix per 600 kg cow = 0.001 x Dry Matter Intake.

** Do not feed Chapin Dairy Premix to sheep as this level of copper may kill sheep
It is OK to feed Chapin Dairy Premix to goats.