NORDA PROJECT # 831

FINAL REPORT

In-Depth Testing of Pasture Management

1983-1984

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The constant help and support of my family, especially my daughters Nicola and Birgit, to collect samples and data, and to put this report together, is greatly appreciated.

Klaus Wand

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Introduction

When this farm of 80 hectares, 50 of which are workable, was purchased in April 1975, it was a typical dairy farm in the Powassan area, in the district of Parry Sound.

Cows and heifers had been pastured in the summer time. Hay was baled and stored for the winter, and some acres of oats were grown; this acreage was also reseeded. The dairy herddconsisted of 30 Holstein cows and 17 replacements. The BCA for milk production was 95, and 93 for butterfat.

Approximately 50% of the land is rolling, the other half is flat, low-lying land with a high water table, adjacent to a creek. The soil is clay loam. Some fields are well drained, others poorly drained.

There was a personal preference for this type of farm and its setting, since the family had lived and worked in a similarrfarm environment before coming to Canada.

To avoid grave mistakes in managing the farm, there were no major management changes in 1975 and 1976. The decision for the present farming system was made in the fall of 1976. As a result of late spring seeding, harvest was late and marginal. Plowing on the wet land would have been a problem. Other reasons were washouts over 2 Trans-Canada Pipelines, crossing the entire farm, spring flooding of the low land and my previous experience with grassland and pasture under similar circumstances.

Establishing of Permanent Pasture

Since there is no need for extra or special seeding to establish permanent pasture, only extra care has been taken to graze, clip, harrow, and fertilize the existing grassland in the right way. In gaining better knowledge of the local conditions over the years, yields and financial end results improved. When in the spring of 1983 the chance was given to document the viability of a pasture system for dairy cows under a NORDA project grant, it was a most welcome opportunity.

Test Fields

The basis for the pasture evaluation were fields which had not been plowed for at least ten years, maybe even 15 or 20 years. Since 1977 they had been part of a more and more intensive rotational grazing system which also included

the aftermath of those fields where a hay cut had been taken off. A second hay cut is not made because of the then prevailing unfavourable drying conditions. After several years of intensive fertilizing and grazing, quite a healthy population of grass species still exist, and despite general belief, legumes such as white and red clover and trefoil have not been eradicated (see Appendix D).

The present combination of species is far away from being ideal. Orchard grass is one problem because of its high percentage of the total population. As a bunch and upper grass it just matures and hardens too quickly, so that cows, even in the rotational grazing system, avoid it.

Fertilizing

The fertilizing has been done according to soil testing. To spread the workload, phosphorus and potassium are (if possible) applied in fall to strengthen the root system and to lower winter kill, while nitrogen is brought out in early spring. Spreading on lightly frozen ground from night frost with a thin snowcover, for accuracy in spreading is ideal. Early nitrogen application will improve yields and in a dry year will reduce the effects of the drought.

In the spring of 1983, a combination fertilizer of NPK was used as well as an only N fertilizer (see Appendix A). In the fall of 1983, and the spring and fall of 1984, a one nutrient fertilizer was applied (see Appendix A).

The early application of N had some negative results in the spring of 1984. The Orchard grass on fields Hill #4 and #5 grew under very favoufable conditions so fast that the cows refused to eat most of it. Heavy clipping had to be done.

The effects of manure in the fertilizing program are less obvious than those of commercial fertilizer. Manure is usually brought out onto fields which have been hayed. There, it helps to protect the roots of plants from being burned and partially prevents evaporation of water out of the ground. Cows will not graze on land that has been covered with manure; therefore those fields have to be excluded from the rotation of the pasture for cows. The results of manure application will be visible in late fall and also in spring. The condition of these fields is then outstanding, with a thick sod and a well developed root system. After normal rainfall and harrowing, the pasture season can be well extended until the beginning of heavy frost, still with fair gains per animal. It has been observed that light frost will have less damaging results on lush grass than on grazed-down fields.

In spring, fields with summer and fall manure application cannot be over-

looked because of their early and rank growth. As soon as seasonal grazing in fields for cows is finished manure will be applied, but with somewhat less noticeable effects in the same year.

The application rates for commercial fertilizer per hectare were, depending on the shape of the field: (see Appendix A)

N	1983	c. 60-65 kg/ha
	1984	c. 64-80 kg/ha
P	1983	c. 28-35 kg/ha
	1984	c/ 0 kg/ha
K	1983	c.c1~~1~~4~~4~~4204 kg/ha
	1984	c. 101-168 kg/ha

The variation in the amount of fertilizer was also because of driving conditions. The setting of the spreader was not changed.

Hay fields received the following amounts offcommercial fertilizer:

N	1983	c. 45-141 kg/ha
	1984	c. 51-103 kg/ha
P	1983	c. 29-88 kg/ha
	1984	0 kg/ha
K	1983	cc.137-180 kg/ha
	1984	c, 103-145 kg/ha

Variations in the amount of fertilizer spread were a result of the shapes of the fields and driving conditions (very dry or wet).

The heifer pasture was treated separately because of the different growing and ground conditions in various sections of ~~it~~.

N	1983	c. 26-53 kg/ha
	1984	c. 50 kg/ha
P	1983	c. 25-53 kg/ha
	1984	0 kg/ha

K	1983	c. 140-168 kg/ha
	1984	c. 993-355 kg/ha

The application rate of manure, wherever and whenever it was spread, was approximately 40-50 tonnes/ha.

Utilization

To harvest grass at the optimal ratio of CP and TDN, it has to be 20-25 cm high before turning the cows in. The cows also have to be prepared for the pasturing season. As soon as the weather is warm enough and the grazing begin forseeable, cows are let out into bush land with some grass on the open spots. Over several days,they gradually get used to the heat, the sunshine, and different feed. They are still fed their normal dairy ration alomg with hay ad. lib. This way, the danger of grass tetanie is greatly reduced.

To accomodate between 35 and 40 cows, 6 pastures of 1.06 to 1.66 ha size, according to natural geographical conditions, producing capability, and shade areas have been established. An electrical high voltage fencing system is used to contain the cows in these fields. Water is supplied through a portable stock tank.

Normally, cows graze for about 3 to 4 days in one field and are then turned into the next. In May and June the interval time is 18 to 22 days, June to July 22 to 35 days, July 35 to 45 days, and after July 45 to 64 days. In In 1983, the pasturing season started late because of cold, wet weather. It began on the 11th of June and lasted for 120.5 days (full 24 hours), until the 13th of October. In 1984, cows entered the first field on the 1st of June, late again because of excessive rainfall, and stayed on pasture for 131 days, until the 14th of October (see Appendix B).

To extend the grazing cycle in any given field over 4 days becomes very difficult, since cows get into a certain routine for change. They will become restless, especially on wet days, and will try to break the fence. The only way to prolomg the cycle is to go to strip grazing within a given field. As Appendix B indicates, this has been done in 1984, with the use of tumblewheels.

The tumblewheel, about 1.50 m high, consists of 6 spokes, of which 4, freestanding in the air, are electrically charged at all times through a patented metal centre plate on a plastic hub, through which the fence wire runs. The two spokes touching the ground remain neutral. The whole fence can be moved by one person by pulling the fence wire in the desired direction. The wheels will roll

over to the new position without being touched.

With the above mentioned system the number of grazing days per field was increased by approximately 20% over 1983 and selective grazing was reduced substantially.

To have the whole electric fencing system working properly, it is an absolute necessity to use a volt meter to ensure enough working voltage at all times. Through weakening insulation, corroding of wire connections, and changing ground conditions the voltage on the fence may change. A simple test light indicator will not clearly show these changes.

To keep up an even milk production during the pasture season, cows need various amounts of supplementary feed. The experience on this farm has been in the first 4 weeks of pasturing only the top producing cows will eat even one third of the normal amount of their ration. For the pasture season this ration is reduced to 14% CP. Then in July, with very hot days, cows will only graze in the evening, night, and early morning. At that time they start to eat more and more dairy ration. By August they will consume the full amount of the ration. Thumb rule: 1 kg dairy ration for 3 kg milk.

During the whole pasture season the intake of dairy ration has to be carefully observed: weather, temperature, quality of grass, etc. might require a change -- an increase or decrease in the amount of feed.

Along with the grain feeding, the grazing of the animals also has to be watched closely: overgrazing will not only be harmful to the sod, but will also lead to reduced production of milk and pasture growth. A 7-8 cm plant stem should be left to ensure fast and full regrowth; everything above that height should be clipped. To spread the manure left behind, a chain harrow is used. The harrowing also stimulates the plant growth.

When more and more regrowth time for the pasture is required and the 6 [illegible] not sufficient any more, the upcoming aftermath of hay fields will be taken into the rotational grazing. Usually the haying season starts around the 17-19th of June.

In 1983 and 1984 grass cutting did not start before the end of June because of unusually wet weather conditions. This created some problems for the timing in the rotation. To overcome the shortfall of regrowth in the cow pasture and to somehow keep up the rotating routine (as indicated earlier) of the cows, the whole herd had to go together with the heifers for 5-6 hours during the hottest part of the day, when grazing is usually very minimal. Figures in Appendix C

(average monthly milk production in 1983 and 1984) show that this procedure worked quite well. As pointed out in Appendix B all pastures had 3 grazing cycles, and a 4th was an 'open' one, when cows were not confined to one paddock but could graze the whole pasture area until the end of the season.

When night temperatures fall to the freezing point for several days, cows are kept intthe stable over night. They are fed their normal grain ration plus hay without limitation.

During the entire pasturing season a mineral mix, as recommended for the winter season, is force fed -- 2% of ration -- with the grain, while the same mix is offered free choice in a mineral feeder in the field.

Pasture and Hay Yields and Animal Production

From the first year on the farm, records were kept of hay yields in different fields. After changing to the permanent pasture system hay yields did not go down, but increased along with higher milk production and more cattle kept and raised. The only negative point in the system was the lower CP content in hay compared to other hay of grass-legume mixes.

To evaluate the performance of the pastures, some special way of collecting data had to be found.

It was decided to take sample cuts every time before the cows were turned into any field during the complete pasture season.

The sampling was done in the following way: Only a few hours or directly before cows were to start grazing, the technical team went into the field and cut at random 1 m^2 of grass on 5 differnt spots in any given field. To ensure the exact measurement of a m^2 some kind of self constructed compass was used. One end of the compass was pushed into the ground so that the other end could rotate freely around. All plants in reach of the compass pointer were cut by hand and collected into a bag. The cut was then weighed; the weight, cutting date and place recorded, and a representative for lab analysis taken. For later use the sample was then stored in a deep-freezer. All fields were treated in the same way.

To collect figures for hay production the following was done: The exact number of bales of hay per field was recorded. From each load of hay coming to the barn, 3 bales were sampled with a core drill sampler. Again, all samples were stored in the deep-freezer.

This way, a total of 72 samples were collected over the two year period.

To furhter assure accuracy of datasto be produced, all fields on the farm were measured and their size recorded.

During the winter season more than 1000 balesoof hay were weighed to establish an average weight per bale of hay, which was 13.5 kg. There was a plus difference of up to 130.4% compared to a minus of down to 69.6%.

At the end of each year's growing season all samples were went to the Agri-Lab in Guelph. The lab findings were used to produce those figures fnund on Appendix B/ All results are based on dry matter, otherwise a comparison would not be possible because pasture samples were taken early in the morning when the dew was still on the grass, of while it was raining, of after a night frost, or on a dry day.

The following table shows the different CP content of the various samples:

FIELD	1st CUT		2ndCCUT		3rd CUT		4th CUT	
	83	84	83	84	83	84	83	84
Under Garden	21.60	114.16	16.80	14.98	19.10	21.41	18.70	-
Hill #1	20.80	18.42	12.60	17.40	18.60	22.29	-	-
Hill #2	19.30	14.66	15.00	15.70	18.60	17.50	-	-
Hill #3	15.70	15.56	16.60	17.30	18.60	b16.03	-	-
Hill #4	13.70	11.82	14.80	20.33	17.10	14.68	-	-
Hill #5	12.00	17.79	19.20	21.32	18.80	15.74	-	-
Hill Right of Path	H 9.60	H 11.08	19.60	14.49	16.20	-	-	-
Middle Field	H 9.60	H 9.80	18.10	17.20	-	-	-	-
Spring Field	H 7.95	H 8.31	17.90	-	20.40	-	-	-
Road Flat #1 & #2	H 8.10	H 6.98	15.80	16.18	-	-	-	-
Road Flat #3	H 7.30	H 6.79	15.30	13.44	-	-	-	-
Below Barn #1	H 9.60	H 7.47	18.20	17.34	-	-	-	-

Below Barn #2	H 8.60	H 7.17	14.60	20.82	-	-	-	-
Below Barn #3 & #4	H 5.80	H 7.55	-	17.59	-	-	-	-

* NOTE: H denotes hay cut

TABLE A-1

The lab analysis clearly confirmed obsevations made during pasturing, and as was previously mentioned about fields Hill #4 and Hill #5 with their high percentage of Orchard Grass. It also demonstrates the drastic decrease in CP towards the maturity stage for grass as well as for hay cuts. A surprise are the figures for the 2nd cut: the highs and also the lows in the yearsa1983 and 1984.

Remarkable are the results for the 3rd cut: There is not that dramatic a decrease in CP toward the end of the pasture season, contrary to general belief, and the graph for average monthly milk production confirms that.

If a comparison is made between a fairly good oat crop of some neighbours' and yields of fields in this permanent pasture system the following results come up:

Oats: 80 bushel/acre = 3.087 tonnes/ha

* on dry matter basis 13.33% CP = 0.370 tonnes/ha CP

on dry matter basis 77.8% TDN = 2.162 tonnes/ha TDN

Hill # 1 1983 0.943 tonnes/ha CP

1984 1.299 tonnes/ha CP

On dry matter basis 1983

5.292 tonnes DM

x 67.85% TDN*

= 3.590 tonnes/ha TDN

On dry matter basis 1984

6.777 tonnes DM

x 67.85% TDN*

=4.598 tonnes/ha TDN

* NOTE: figures based on "Dairy Husbandry in Canada", Publication 1439, revised in 1977. Table 4-3, pages 80 and 83.

The previous figures (page 8) show that a well-managed pasture is well competetive with the yield of an average oat crop.

When dealing with a dairy herd and always dealing with the milk production, one can easily forget that the animals not only produce milk but also put on weight in the form of meat on the cow forming a calf. To find out about this 'side-line' of productivity of the pasture, all cattle, cows and heifers, were weighed before and after pasture season both years. Figures for this can be found in Appendix E. To make things less complicated, weights of cows and heifers that calved during the pasture seasons are stated in the table but are not included in the average gain. The same applies for any animals sold. The adjustment was made in order not to use negative gains. Appendix E for cows for 1983 shows a total gain of 49.9 kg/cow, or 0.479 kg/cow/day (just a little better than 1 lb./cow per day). The total gain per cow in 1984 was 36.8 kg or 0.346 kg/cow/day. The lower gains in 1984 are probably the result of the wet summer along with unusually cold nights in July. The table for heifers indicates a weight gain of 0.610 kg/heifer/day in 1983. The gain/heifer/day in 1984 was only 0.333 kg, or about half of 1983 figures. These findings are similar to figures gathered by other farmers.

The evaluation of productivity of pasture through milk production is very difficult, since several factors play an important rule, such as: genetic improvement, calving intervals, calving dates, etc.

Milk production avbrage/cow was:

1. January, 1983: (44 cows) - 5825 kg milk
   - 207 kg fat - 3.5%
   - 127 BCA for milk
   - 118 BCA for fat

31. December, 1983: (41 cows) - 6577 kg milk
   - 235 kg fat - 3.5%
   - 134 BCA for milk
   - 128 BCA for fat

31, December, 1984: (40)cows) - 6857 kg milk
   - 242 kg fat -03.5%
   - 147 BCA for milk
   - 139 BCA for fat

These figures demonstrate that milk production on these levels can be kept up or improved by good pasture.

Average Monthly Milk Production Per Cow

1983 & 1984

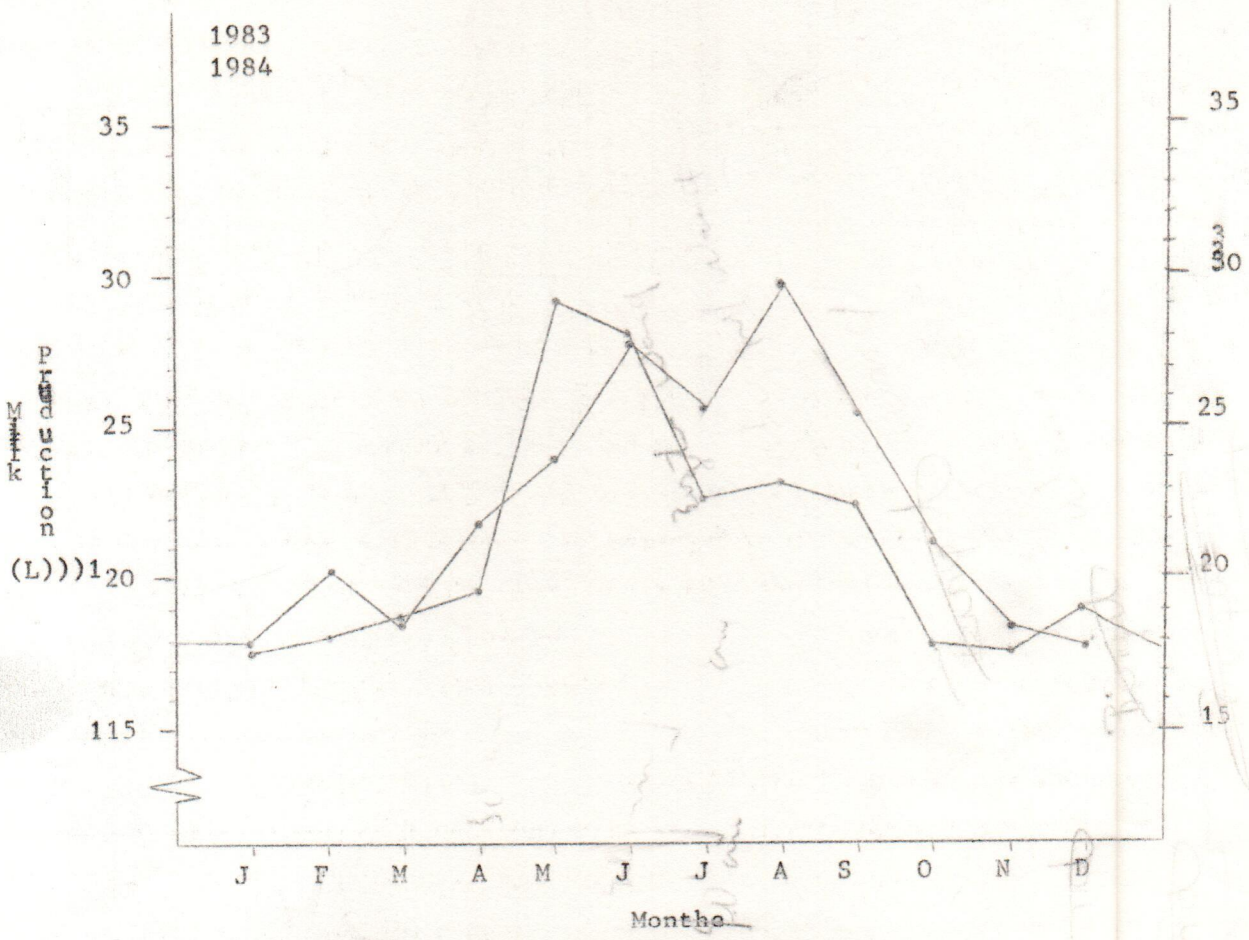


TABLE A-2

The highes as and lows in the graph should not be interpreted so much as how production varies, but rather what kind of production cows can achieve during the pasture season. It should be noted that for example, that in July and August 1984, more than 25% of the cows freshened and were peaking. Again, production levels of that height on pasture are possible.

The lower production levels during the winter months are a result of calving patterns over the years. The month of February always had either no cows or a maximum of 2 cows calving. This again results from low heat detection in May, and June when cows first go onpasture. Management has to be improved in this area.;

Work Management

Within the project, a study about the time consumption of various types of work related to pasture was to be carried out. The attempt was made but was only successful in a few areas.

To establish general time consumption per hectare for clipping was almost impossible because conditions were always changing; that is, type of grass, amount of grass, shape of field, etc. Hill #3, with a size of 1.21 ha, had the least problems. With a 65 hp tractor and a 6 foot, PTO driven, 3 point hitch flailmower, it took 1 hour and 55 minutes to clip 7-8 cm above the ground, or c. 95 minutes or c. 1½ hours/hectare. The flailmower was used to chop up the grass, contrary to a cutting bar, where the grass will, in its full length, fall to the ground and take up more time for decomposing.

It was relatively easy to establish time values for harrowing: with a 55 hp tractor and a 3½ m wide chain harrow, 1 ha could be finished within 16-17 minutes.

For the daily checking of the electric fence, small repairs and moving of the tumblewheels, 20 minutes per day for the entire pasture season had to be calculated.

Cost

To pinpoint certain costs to certain products is very difficult, since in this system everything is interconnected. Costs for spreading manure cannot only be attributed to cows of milk production, because the hay production is benefitting, and soil structure can be improved as well. Tractor costs have to be divided between crop cost and general management cost, etc., etc.

The investment into machinery is considered relatively low. Only basic machines and equipment are used, such as:

2 used tractors	$ 12000
1 mower/conditioner (½ of NV)	2100
1 flailmower (½ of NV)	1200
1 fertilizer spreader (½ of NV)	300
1 baler (½ of NV)	2500
1 hay rake (½ of NV)	650
1 chain harrow	300
1 manure spreader (½ of NV)	1000

3 hay wagons	1500
electric fencing equipment	700
1 posthole auger (½ of NV)	300
	$$22[illegible]550

The estimated $ 22550 represent approximately 50% or ½ of the New Value. The low usage of all the equipment does not warrant higher capital investment.

Feed costs are high because all grains have to beebought. Because of the lower CP content in the hay (lack of legumes), protein supplement has to be bought. The fertilizer bill has to be higher than on other farms.

The total cost forproduce 267777 litres of milk in 1983 was $ 95247.11, or 35.57¢ per litre. This includes depreciation for buildings and machinery depreciation, and interest payments on loans and mortgages.

In 1984, a cost of $ 92853.[illegible]was registered to produce a total of 276409 litres of milk. The cost per litre was 33.59¢. Again, this includes depreciation and interest payments.

Percentage of cost:	1983	1984
feed	33.56%	31.56%
wages	4.74	7.20
fertilizer, twine, seeds	6.84	5.49
machinery, car, tools, custom work, fuel, etc.	8.87	7.99
depreciation	12.94	11.77
vet, breeding	3.36	22[illegible]7
taxes, interest	19.23	18.89
insurance	2.35	2.81
milk testing, rgistration, office, etc.	1.47	1.82
telephone, hydro	2.49	2.98
livestock, supply, feed testing	3.47	3.40
miscellaneous, building, fence repair	0.68	3.42
	100.00%	100.00%

The costs previously listed are taken from the income tax statement. They indicate the weak points in the system (eg. interest payments and feed costs) and show where improvement is needed. They also point out where some flexibility is left, like in depreciation costs which are allowable maximums for tax pupposes.

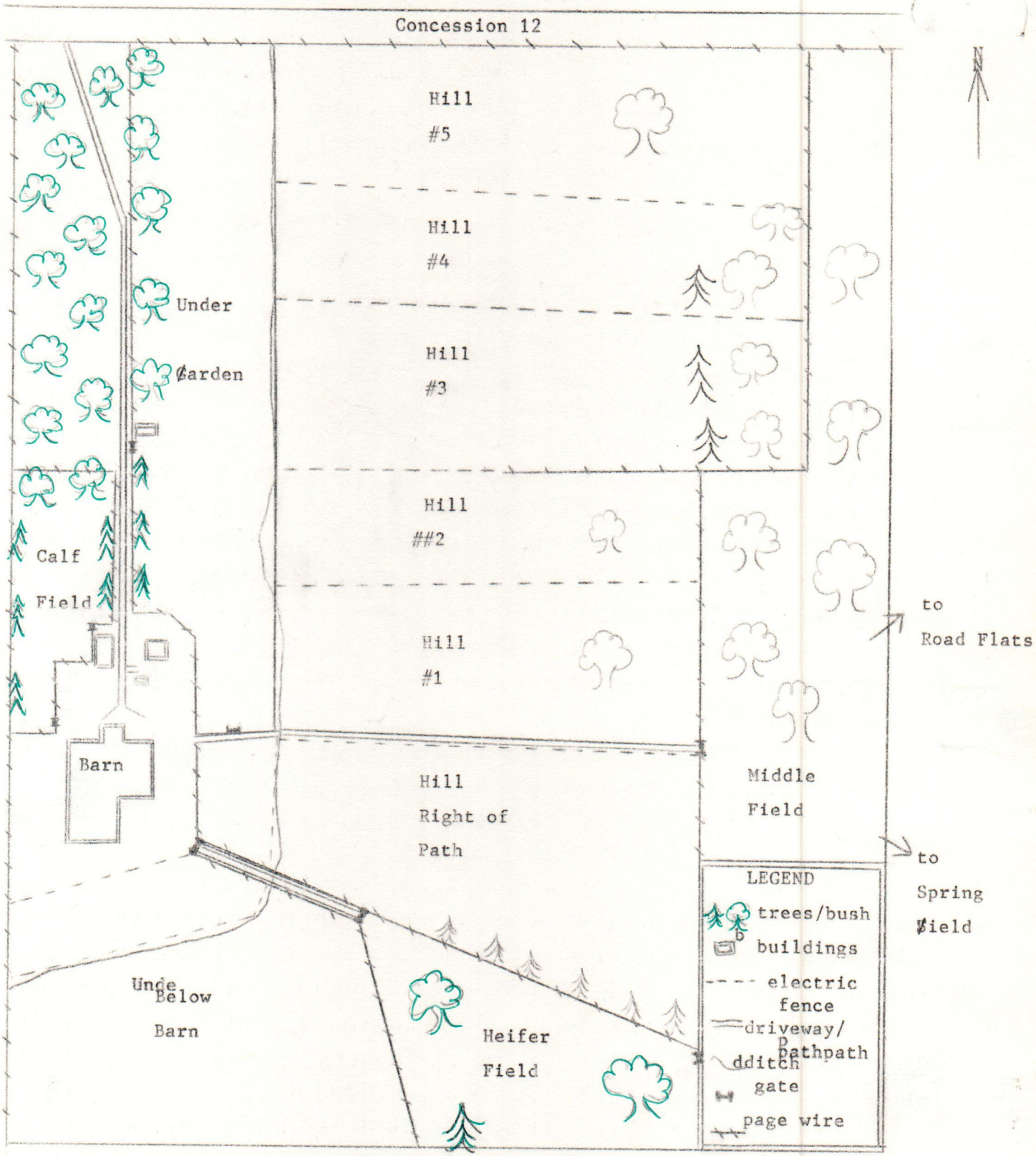
Summary

The permanent pasture system, as demonstrated throughout this report, appears to be the best one for this farm under present financial, economical, and local geographical conditions. It avoids high machinery investment, allows high efficiency and productivity in a simplified management system, makes erosion control in flood areas and over the pipelines possible at low cost, and offers some more benefits which are hard to put into figures: improved herd health and longevity through exercise by grazing, and a more natural way of feeding. A greater independency from a highly mechanized system gives the manager and his family a chance for some private life, and not being a slave on his own farm.(eg. On a Sunday, besides milking, one only has to bring the cows to and from the field, and the rest of the day is one's own).

Conclusion

If plant breeding for protein-richer grass species and better varieties, and research in pasture use and management could be improved, better chances and new opportunities for young farmers could be opened up. Efforts in that direction have recently been undertaken, The NORDA programs can take some credit for that.

MAP OF PASTURES



Appendix A

SOIL TEST ANALYSIS AND FERTILIZING

FIELD	PHOSPHORUS		POTASSIUM		pH		MAGNESIUM		kg/ha (# of applications per year)					
									N		P		K	
	83	84	83	84	83	884	83	84	83	84	83	84	83	84
Under Garden	16 (M)	14 (M)	100 (M)	89 (M)	6.4	6.6	200+ (H)	270+ (H)	59.7 (1)	79.5 (1)	35.8 (1)	0	204.2 (2)	168.4 (2)
Hill Right/ Path	16 (H)	11 (M)	72 (L)	40 (L)	6.3	6.7	200+ (H)	270+ (H)	92.2 (2)	65.6 (1)	32.6 (1)	0	141.9 (2)	108.6 (1)
Hill # 1	17 (H)	25 (H)	104 (M)	111 (M)	6.2	6.5	200+ (H)	200+ (H)	61.1 (1)	64.9 (1)	28.6 (1)	0 0	168.9 (2)	101.9 (1)
Hill # 2	17 (H)	15 (M)	104 (M)	143 (H)	6.2	6.6	200+ (H)	200+ (H)	61.1 (1)	64.9 (1)	28.6 (1)	0	168.9 (2)	101.9 (1)
Hill # 3	20c (H)	19 (H)	84 (M)	91 (M)	6.3	6.4	200+ (H)	200+ (H)	65.1 (1)	64.2 (1)	32.9 (1)	0	156.9 (2)	106.3 (1)
Hill #44	19 (H)	19 (H)	80 (M)	91 (M)	6.3	6.4	200+ (H)	200+ (H)	65.1 (1)	64.2 (1)m	32.9 (1)	0	156.9 (2)	106.3 (1)
Hill # 5	17 (H)	19 (H)	76 (L)	91 (M)	6.2	6.4	200+ (H)	200+ (H)	65.1 (1)	64.2 (1)	32.9 (1)	0	156.9 (2)	106.3 (1)
Middle Field	28 (VH)	14 (M)	64 (L)	54 (L)	5.5	5.8	200+ (H)	153 (H)	83.1 (2)	63.0 (1)	32.3 (1)	0	139.9 (2)	104.1 (1)
Road Flat # 1	30 (VH)	17 (H)	68 (L)	96 (M)	5.8	5.6	200+ (H)	200+ (H)	86.6 (1)	66.9 (1)	40.1 (1)	0	176.1 (2)	107.8 (2)
Road Flat # 2	-	14 (M)	-	66 (L)	-	5.9 5.9	-	200+ (H)	86.6 (1)	66.9 (1)	40.1 (1)	0	176.1 (2)	107.8 (1)
Road Flat # 3	-	14 (M)	-	52 (L)	-	6.1	-	200+ (H)	88.6 (1)	58.6 (1)	44.1 (1)	0	176.5 (2)	103.5 (1)
Spring Field # 1	24 (H)	13 (M)	64 (L)	65 (L)	6.0	6.1	200+ (H)	167 (H)	141 (2)	99.9 (1)	88.9 (2)	0	88.9 (2)	131.1 (1)
Spring Field # 2	24 (H)	10 (M)	64 (L)	53 (L)	6.0	5.9	200+ (H)	200+ (H)	93.3 (1)	62.6 (1)	41.3 (1)	0	180.8 (2)	131.1 (1)
Spring Field # 3	24 (H)	11 (M)	64 (L)	59 (L)	6.0	6.1	200+ (H)	200+ (H)	93.3 (1)	62.6 (1)	41.3 (1)	0	180.8 (2)	131.1 (1)

Appendix A (continued)

FIELD	PHOSPHORUS		POTASSIUM		pH		MAGNESIUM		kg/ha (# of applications per year) (N		P		K	
	83	84	83	84	83	84	83	84	83	84	83	84	83	84
Below Barn # 1	35 (VH)	14 (M)	96 (M)	72 (L)	5.7	6.3	200+ (H)	200+ (H)	93.8 (2)	64.2 (1)	31.7 (1)	0	135.7 (2)	102.0 (1)
Below Barn # 2	37 (VH)	15 (M)	68 (L)	70 (L)	5.5	6.3	185 (H)	196 (H)	81.1 (2)	67.3 (1)	29.0 (1)	0	180.5 (2)	109.9 (1)
Below Barn # 3	-	15 (M)	-	68 (L)	-	6.3	-	188 (H)	55.0 (1)	66.1 (1)	28.2 (1)	0	131.5 (2)	103.3 (1)
Below Barn # 4	-	15 (M)	-	68 (L)	-	6.3	-	188 (H)	49.6 (1)	103 (1)	37.2 (1)	0	37.2 (1)	145.9 (1)
Calf Field	11 (M)	10 (M)	100 (M)	129 (H)	6.1	6.1	200+ (H)	212+ (H)	37.5 (1)	60.8 (1)	37.5 (1)	0	126.9 (2)	0
Heifer Field # 1	20 (H)	11 (M)	64 (L)	112 (M)	6.0	5.9	200+ (H)	182 (H)	53.3 (1)	50.7 (1)	53.3 (1)	0	168.0 (2)	355.3 (1)
Heifer Field # 2	19 (H)	11 (M)	68 (L)	65 (L)	6.0	6.0	200+ (H)	200+ (H)	25.7 (1)	50.7 (1)	25.7 (1)	0	140.4 (2)	93.6 (1)
Heifer Field # 3	23 (H)	10 (M)	72 (L)	71 (L)	5.9	6.0	200+ (H)	270+ (H)	44.6 (1)	50.7 (1)	44.6 (1)	0	159.2 (2)	215.4 (1)

Appendix B (continued)

FIELD	SIZE ha	SAMPLE CUTS date 83	SAMPLE CUTS date 84	SAMPLE CUTS kg/5m² 83	SAMPLE CUTS kg/5m² 84	% DRY MATTER 83	% DRY MATTER 84	DRY MATTER YIELD t/ha 83	DRY MATTER YIELD t/ha 84	PROTEIN (dry matter) t/ha 83	PROTEIN (dry matter) t/ha 84
Hill # 5	1.6654	27/06	29/06	11.25	12.3	20.45	22.7	4.601	5.584	0.522	0.993
		30/07	01/08	2,65	3.5	24.96	15.8	1.323	1.106	0.254	0.236
		19/09	01/10	4.1	3.125	23.18	23.3	1.901	1.456	0.357	0.229
	TOTAL ~~TOTAL~~							7.824	8.146	1.133	1.458
Middle Field	4.1801	10/08	16/08	2.35	4.2	26.61	18.2	1.251	1.529	0.226	0.263
Road Flat # 1&2	5.8418	19/08	05/09	2.15	4.8	21.49	19,7	0.924	1.891	0.146	0.306
Road Flat # 3	3.6244	26/08	18/09	2.375	2.75	26.99	24.5	1.484	1.348	0.227	0.181
Spring Field	3.4325	11/08	-	2.3	-	27.35	-	1.258	-	0.225	-
		13/09	-	1.6	-	24.90	-	0.797	-	0.163	-
	TOTAL							2.055	0	0.388	0
Under Barn # 1	3.9694	01/09	28/08	4.25	3.55	23.60	20.6	2.006	1.463	0.365	0.254
Under Barn # 2	5,0496	18/09	05/09	4.8	3.35	21.47	19.3	2.061	1.293	0.301	0.269
Under Barn # 3&4	7.5635	-	27/09	-	3.5	-	21.5	-	1.506	-	0.265

FI: GRAZING CYCLE		NUMBER OF DAYS BETWEEN CYCLE		TOTAL DAYS		HAY % DRY MATTER		HAY DRY MATTER YIELD t/ha		HAY PROTEIN (dry matter)) t/ha	
83	84	83	84	83	84	83	84	83	84	83	84
27/06-2/07	29/06-4/07			4.5	6.0						
30/07-4/08	01-04/08	28	27	3.0	2.0						
19-25/09	03-04/10	46	60	4.0	1.0						
				11.5	9.0						
10-19/08	16-27/08			6.0	7.0	84.43	83.1	2.792	3.685	0.268	0.374
20-26/08	05-16/09			6.5	6.0	91.34	82.5	4.150	4.843	0.333	0.338
26-31/08	19-23/09			5.0	2.5	91.08	84.7	5.469	4.026	0.399	0.273
11-18/08	-			4.0	-	90.09	82.8	4.706	4.898	0.374	0.407
13-17/09	-	26		2.5	-						
				6.5	0						
01-08/09	28/08-4/09			5.5	8.0	84.43	81.9	3.340	3.546	0.321	0.265
20/09-4/10	05-27/09			5.5	14.5	80.86	84.7	4.886	6.001	0.420	0.430
-	28/09-8/10			-	5.5	91.15	82.2	4.998	5.348	0.290	0.404

Appendix B

PASTURE YIELDS

FIELD	SIZE ha	SAMPLE CUTS date 83	// 84	SAMPLE CUTS kg/5m² 83	84	% DRY MATTER 83	84	DRY MATTER YIELD t/ha 83	84	PROTEIN dry matter t/ha 83	84
Under Garden	1.0687	02/06	01/06	4.9	6.5	15.03	28353	1.473	2.353	0.318	0.333
		01/07	05/07	6.3	5.0	19.24	21.5	2.424	2.150	0.407	0.382
		06/08	12/08	1.1	3.1	30/36	21.0	0.668	1.302	0.128	0.279
		04/09	-	2.8	-	21.29	-	1.192	-	0.223	-
	TOTAL							5.756	5.805		
Hill Right/ Path	2.0718	04/08	05/08	2.7	3.2	28.23	22.9	1.524	1.466	0.299	0.212
		26/09	-	2.8	-	26.27	-	1.222	--	0.198	-
	TOTAL							2.746	1.466		
Hill # 1	1.2472	11/06	08/06	7.85	9.275	18.49	18.1	2.903	3.358	0.604	0.619
		06/07	12/07	2.7	3.3	32.59	25.2	1.756	1.663	0.221	0.289
		06/09	19/08	1.117	3.85	28.38	22.8	0.634	1.756	0.118	0.290 391
	TOTAL							5.292	6.777		
Hill # 2	1.1092	14/06	12/06	10.5	8.8	15.36	20.2	3.226	3.555	0.623	0.521
		10/07	16/07	3.5	3.9	27.01	19.9	1.891	1.552	0.284	0.244
		06/09	23/08	1.117	3.7	28.38	19.3	0.634	1.428	0.118	0.250
	TOTAL							5.751	6.535		
Hill # 3	1.2126	18/06	17/06	10.05	11.05	19.95	19.3	4.010	4.265	0.630	0.664
		15/07	22/07	3.2	3.65	32.48	22.9	2.079	1.672	0.345	0.289
		06/09	25/09	1.117	6.1	28.38	16.0	0.634	1.952	0.118	0.313
	TOTAL							6.723	7.889		
Hill # 4	1.3510	21/06	22/06	9.1	13.2	24.30	19.2	4.423	5.069	0.606	0.599
		23/07	26/07	3.2	3.6	24.62	17.9	1.576	1.289	0.233	0.262
		12/09	01/10	3.75	3.5	25.46	24.5	1.910	1.715	0.327	0.252
	TOTAL							7.908	8.146		

GRAZING CYCLE		NUMBER OF DAYS BETWEEN CYCLE		TOTAL DAYS		HAY					
						% DRY MATTER		DRY MATTER YIELD t/ha		PROTEIN (dry matter) t/ha	
83	84	83	84	83	84	83	84	83	84	83	84
02-11/06	01-08/06			5.0	6.5						
01-05/07	05-11/07	20	27	3.5	5.0						
06-09/08	12-17/08	32	32	2.0	2.5						
04-05/09	-	26	-	1.0	-						
				11.5	14.0						
05-09/08	05-11/08			2.5	3.5						
26/09-5/10	-	48	-	5.0	-	84.43	81.7	2.613	3.934	0.251	0.436
				7.5	3.5						
11-14/06	08-12/06			3.5	4.5						
06-09/07	12-15/07	22	30	2.0	2.0						
06-12/09	18-22/08	59	34	2.0	2.5						
				7.5	9.0						
14-18/06	13-16/06			4.0	4.0						
10-14/07	16-21/07	22	30	2.5	2.0						
06-12/09	23-26/08	54	33	1.5	2.0						
				8.0	8.0						
18-22/06	17-22/06			3.75	5.5						
15-22/07	22-26/07	23	30	2.5	2.0						
06-12/08	28-30/09	46	64	1.5	1.5						
				9.25	9.5						
22-25/06	22-28/06			3.75	6.5						
23-29/07	27-31/07	28	29	3.5	2.5						
12-18/09	01-02/10	45	62	3.5	1.0						
				10.75	10.0						

Appendix B1

FEED ANALYSIS--HILL # 1

	Protein %	Calcium %	Phosphorus %	Magnesium %	Potassium %	Manganese ppm	Copper ppm	Zinc ppm
1983 A.	20.80	0.71	0.42	0.18	2.56	43	5	28
1983 B.	12.60	0.49	0.29	0.13	2.27	45	5	20
1983 C.	18.60	0.71	0.38	0.21	2.74	62	6	26
1984 A.	18.42	0.35	0.41	0.24	2.71	37	4	21
1984 B.	17.40	0.54	0.45	0.30	2.83	83	6	20
1984 C.	22.29	0.34	0.41	0.24	2.97	51	5	21

*NOTE: A. = 1st cut
B. = 2nd cut
C. = 3rd cut

Appendix C

MILK PRODUCTION

MONTH	AVERAGE/COW/DAY		ODHIC AVERAGE/COW/DAY		% BF	
	83	84	83	84	83	84
January	17.7	17.9	17.8	19.9	3.7	3.7
February	18.1	20.3	18.6	20.8	3.7	3.6
March	18.9	18.7	21.3	21.2	3.7	3.5
April	19.8	22.0	-	22.6	3.7	3.6
May	29.4	24.1	22.1	24.2	3.6	3.6
June	28.3	28.0	26.3	25.3	3.4	3.5
July	22.8	25.9	25.5	26.2	3.4	3.3
August	23.5	29.9	22.7	24.6	3.5	3.4
September	22.8	25.3	22.0	23.6	3.4	3.5
October	17.8	21.6	21.4	22.8	3.6	3.4
November	17.7	18.7	19.1	20.1	3.7	3.6
December	19.1	17.9	19.6	20.2	3.8	3.6

*NOTE: Column # 1 is the milk production according to pick up slips, milk fed to calves and milk used for personal use.
Column # 2 is the milk production according to ODHIC records from test day.

Appendix D

Pasture Assessment

FIELD	Under Garden	Hill # 4	Hill Right of Path	Road Flat # 1 & 2	Hill # 1	Road Flat # 3
SOIL TEXTURE	clay loam		clay loam	clay loam	clay loam	clay loam
DRAINAGE	well drained		well drained to poor	imperfect	imper-fect	imperfect to poor
% OF BARE GROUND AT 10 cm	0	0	0	0	0	0
GRASSES % of cover	50	80	70	75	40	90
TIMOTHY	5	35	25	45	25	60
ORCHARD	20	35	30	10	35	10
SMOOTH BROME						
MEADOW BROME					1	5
REED CANARY						
CANADA BLUE						
KENTUCKY BLUE	25	10	15	5	4	15
TALL FESCUE			TR			
RED FESCUE			TR	5	3	5
MEADOW FESCUE						
SHEEPS FESCUE						
RED TOP						
BROWN TOP						
MEADOW FOXTAIL						
QUACKGRASS						
ANNUAL GRASSES						
PERENNIAL RYEGRASS				10	2	
LEGUMES % of cover	40	55	15	15	25	5
TREFOIL			5			
WHITE CLOVER	40	5	5	5	25	
ALSIKE						
ALFALFA						
RED CLOVER	TR		5	10		
VETCH			TR			
WEEDS % of cover	10	15	15	10	5	5
BROADLEAF		15		10	5	5
RUSHES						
WOODY						
PLANTAIN	2					
DANDELION	8		15			

Appendix E

WEIGHT GAIN PER COW DURING SUMMER GRAZING PERIOD

NAME	WEIGHT (kg) 1983 May 28	Oct. 29	WEIGHT (kg) 1984 Jun. 4	Oct. 27
Annie	510	600	535	580
Asta	483	568	509	605
Beatrix	584	637	634*	653
Brigitte	557**	–	–	–
Cinderella	436	525	560*	560
Dawn	587*	557	538*	537
Doddie	435	525	470	565
Dolly	541	652	562	663
Donna	587*	622	577	711
Dora	638	710	627	659
Dorothee	536	553	490	535
Else	645	640	763*	597
Elva	691	720	768* **	–
Emma	653**	–	–	–
Ester	563*	587	573*	595
Frieda	598	711	572	693
Hanni	713*	676	650	655
Heidi	565	624	650*	623
Heike	735*	676	690	670
Helga	597	611	580	585
Hella	580	660	–	–
Henrietta	417	495	–	–
Holly	641	674	618	658
Iris	608*	679	581	685
Jackie	601	672	666* **	–
Janet	515	602	515	570
Jolita	557	627	570* **	=
Jollie	462	552	498	585
Jutta	677	740	750*	695
Lene	589	613	672*	589
Lillie	700	775	687	737
Liz Ana	736*	685	–	–
Lorelei	379	429	458	544
Lucille	676**	–	–	–
Lucy53	533	582	–	–
Manuela	676	637	730* **	–
Margot	662	705	665	690
Marlis	495	555	534	605
Marylou	393	416	515	547
Monica	548	695	–	–
Natalie	501	621	555	652
Robin	495	554	490	571
Ronda	571	655	555	610
Theresa	635*	587	–	–
Vivian	613*	618	623*	653
Wendy	536	644	572	670
Lila	523*	517	555*	526
SUB-TOTAL	47	26873	22557	38
(cows gone)	– 3	– 1886	– 2734	– 4
TOTAL	44	24987	19823	34
		27183	21073	

∴ Total kg gained = $\frac{2196}{44}$ = 49.9 kg/cow

∴ Total kg gained = $\frac{1250}{34}$ = 36.8 kg/cow

Appendix E (continued)

WEIGHT GAIN PER HEIFER DURING SUMMER GRAZING PERIOD

NAME	WEIGHT((kg) 1983 May 28	WEIGHT((kg) 1983 Oct. 29	WEIGHT (kg) 1984 Jun. 4	WEIGHT (kg) 1984 Oct. 27	
Bessie	265	367	479*	474	
Barbara	405	459	516*	515	
Della	233	355	–	–	
Eleanore	221	321	455* **	–	
Flicka	287	380	502* **	–	
Hannelore	436	512	610*	568	
Lettie	465	581	–	–	
Lorraine	462	529	–	–	
Molly	368	405	550*	500	
Resi	218	355	446	529	
Wipke	215	321	450	508	
Anonymous	–	–	290	380	
Bambi	–	–	270	340	
Daphne	–	–	453	480	
Hazel	–	–	366	402	
Helma	–	–	463*	487	
Jetta	–	–	483*	421	
Joanne	–	–	355	375	
Liesel	–	–	285	330	
Marion	–	–	366	414	
Susi	–	–	405	460	
Tutti	–	–	346	405	
Vicky	–	–	350	368	
SUB-TOTAL	11	3575	4585	8430	7956	20
(heifers gone)	- 0	- 0	- 0	- 957	-0 0	- 2
(heifers calved)	- 0	- 0	- 0	-3101	-2965	- 6
TOTAL	11	3575	4585	4372	4991	12

∴Total kg gained = $\frac{1010}{11}$ = 91.8 kg/heifer
= 0.616 kg/heifer/day

∴Total kg gained = $\frac{619}{12}$ = 51.6 kg/heifer
= 0.333 kg/heifer/day

NOTE: * represents cow/heifer freshened during the summer grazing period of that year.

** represents cow/heifer sold/died during the summer grazing period of that year.