UNIVERSITY OF MANCHESTER

AGRICULTURAL ECONOMICS

Report No. 1

MANAGEMENT FOR MILK PRODUCTION

RESEARCH IN MANAGEMENT FOR MILK PRODUCTION.

The information contained in the following paper applies to seventeen farms in Lancashire and Cheshire. The farmers kept weekly records of the amount of purchased food they need in the production of milk, and of the cost of other operations and events in the management of their herds and fields. These form the basis of this study. Only on two of the farms was a small portion of land ploughed. For the rest, the farmers depended on their pastures and meadows and on provender, the concentrated foods purchased from manufacturers or merchants. Farmers wish to produce milk at as high a profit as they can, and the first step towards this object is to produce at a low cost. The cost of food being a large percentage of the total cost is a subject of supreme interest, and the question which the farmers and the economist kept constantly before them was whether the food necessary to obtain the amount of milk required could be obtained at a progressively lower cost.

Use is made in this report of an ingenious application of the Starch Equivalent formula adopted by Mr. Arthur Jones of the Midland Agricultural College. This method makes it possible to present a more instructive statement to the farmers, and also a comparison of results obtained in different parts of the country. Most dairy farmers are now so familiar with the theories of the maintenance and production rations, and these have worked so well in practice that they may be taken as trustworthy foundations of economic studies.

The figures in the following tables apply to the year from May 1st, 1932 to April 30th, 1933, except where a different explanation is given.

Table I gives the acreage of pasture and meadow on the farms, and the rent per acre.

Table No I.

Farm No.	Pasture acres	Meadow acres	Rent per acre shillings
2.	38	25	31
3.	24	33¾	40
4.	27	22½	64
6.	12	24	38
7.	20	27	44
9.	47	26	68
10.	43	31½	61
13.	34	31	40
14.	64	36	32
15.	4½	6½	74
16.	154	50	40
17.	27	26	60
20.	35	27	24
21.	10½	15	64
22.	19	23	41
41.	101	40	42½
42.	79	32	45

In constructing ~~this~~ table the farm stock have been reduced to a common unit. The unit chosen was one cattle unit and the following equivalents were used in the calculation.

1 cow	=	1 cattle unit
1 other beast	=	¾ cattle units
1 work horse	=	1 " "
1 young horse	=	2/3 " "
1 sheep	=	1/7 " "

Table II gives the number of cattle units carried on the acreage, and the area of land allowed for the grazing of each unit.

Table II.

Farm No.	Cattle units	Pasture acres	After-math acres	Pasture per cattle unit acres	After-math per cattle unit acres	Total Grazing per cattle unit acres
2.	26.5	38	25	1.43	.94	2.37
3.	27	24	33¾	.89	1.25	2.14
4.	34	27	22½	.80	.66	1.46
6.	22	12	24	.55	1.1	1.65
7.	17.5	20	27	1.15	1.54	2.69
9.	69	47	26	.68	.37	1.05
10.	66	43	31½	.65	.48	1.13
13.	48	34	31	.71	.65	1.36
14.	49.5	64	36	1.30	.72	2.02
15.	11.5	4½	6½	.39	.57	.96
16.	78	154	50	2.0	.64	2.64
17.	28	27	26	.96	.93	1.89
20.	26	35	27	1.35	1.04	2.39
21.	13	10½	15	.80	1.15	1.95
22.	25	19	23	.76	.92	1.68
41.	74	101	40	1.36	.54	1.90
42.	57	79	32	1.40	.56	1.96

The year was divided into two periods, the summer, representing roughly the grazing season, and the winter the time during which cows were chiefly dependent on purchased food. The summer period extended from the beginning of May to the end of September, or 22 weeks, the winter period from early October to the end of April, or 30 weeks.

Table III gives the requirements, maintenance, production and total with the yield of milk for each herd during the summer period. Distinctions in the maintenance requirements are made in Column 2 according to the type of cow kept. Irish Shorthorns, Ayrshires and various crosses are given a smaller requirement than the heavy type of Shorthorns.

The amount of purchased food consumed was obtained from weekly records which the farmer kept, or in a few cases

from the bills showing the actual amount of foodstuffs purchased and fed to the cows. There were only two farms on which even a small quantity of food from arable crops was used.

Summer Period

Week ending May 7th to week ending October 2nd - 154 days

Table 3.

Theoretical Requirements of Starch Equivalent

Farm No.	Maintenance Requirements per cow per day lb.	Total Maintenance Requirements per herd lb.	Yield of milk in Period gallons	Production Requirements per herd lb.	Total Requirements per herd lb.
2.	6.6	24800	7614	19035	43855
3.	6.9	28690	7833	19653	48343
4.	6.4	33510	9724	24310	57820
6.	6.4	21683	4620	11550	33233
7.	6.4	17248	4287	11078	28326
9.	6.9	63756	20789	51973	115729
10.	6.9	70132	12941	32352	102484
13.	6.9	48880	14146½	35366	84246
14.	6.4	31539	8259	20648	52187
15.	6.4	10349	2415	6038	16387
16.	6.4	38143	8200	20500	58643
17.	6.9	16364	6743	16858	33222
20.	6.4	19019	5676	14190	33209
21.	6.4	11827	3411½	8529	20356
22.	6.4	19712	5424	13560	33272
41.	6.4	49477	18091	45228	94705
42.	6.4	56179	17983	44958	101137

Table IV. gives the actual cost of the Starch Equivalent consumed by the cows. The information in Columns 2, 3, and 4 was obtained from the weekly feeding records. Column 5 was got by subtracting the figures in Column 2 from those in Column 6 of Table III. The cost of grazing was got from the rent per acre together with costs of fertilisers, cultivations and other expenditure on the fields.

Table IV.

Actual Consumption and Cost of Starch Equivalent.

Farm No.	S.E. fed excluding grazing per herd lb.	Cost £. s. d.	Cost per lb. S.E. pence	Deficiency in S.E. supplied by grazing lb.	Cost ~~of grazing for cows~~ £. s. d.	Cost per lb. S.E. ~~supplied by grazing~~ pence
2.	9245	47 19 2	1.25	34590	86 17 3	.60
3.	26731	119 16 7	1.08	21612	82 5 6	.91
4.	33989	167 10 11	1.18	23831	127 9 8	1.28
6.	13502	54 13 8	.97	19731	69 6 0	.84
7.	15526	71 15 3	1.11	12800	69 17 2	1.31
9.	47172	209 9 6	1.07	68557	236 4 6	.83
10.	57192	263 7 10	1.1	45292	202 16 2	1.07
13.	62610	314 4 5	1.20	21636	132 16 11	1.47
14.	19400	84 8 1	1.04	32787	98 4 5	.72
15.	5428	23 4 2	1.03	10959	31 12 9	.69
16.	17834	93 5 8	1.25	40809	174 12 8	1.03
17.	16097	79 12 1½	1.18	17125	71 9 10	1.00
20.	20225	86 16 5½	1.03	12984	50 14 11	.94
21.	7616	38 10 10½	1.21	12740	50 19 0	.96
22.	23783	107 5 6	1.08	9489	50 13 7	1.28
41.	5859	22 14 0	.93	88846	203 19 2	.55
42.	34345	137 12 4	.96	66790	236 11 11	.85
		AVERAGE	1.1		AVERAGE	.96

Every one of the seventeen farms represented in these tables is undergoing a process of improvement and the process is at different stages on the different farms. Comparative figures cannot be given for many, as the records have only recently been kept on the majority of farms. All those whose cost of Starch Equivalent per lb. is between ½d. and 1d, that is , between .6 and .96 in Column 7, have been improving their pastures and meadows for three, four or five years.

These figures do not compare favourably with those from the Midlands, where the cost of the lb. of Starch Equivalent from grazing varies from ¼d. to ¾d. But when it is remembered that improvement amounts almost to reclamation in Lancashire, that the fields are very heavily stocked, that farming conditions generally are more favourable in the unspoiled country in the south, reasons for the difference are easily found. And Lancashire farmers are not finished with the job they have undertaken.

Winter Period October 2nd to April 30th. - 211 days.

Table V

Theoretical Requirements of Starch Equivalent.

Farm No.	Maintenance Requirements per cow per day lb.	Total Maintenance Requirements per herd lb.	Yield of milk in period gallons	Production Requirements per herd lb.	Total Requirements lb.
2.	6.6	29523	10286	25715	55238
3.	6.9	35378	10221	25553	60931
4.	6.4	45913	13260	33150	79063
6.	6.4	29709	6300	15750	45677
7.	6.4	23902	6120	15775	39677
9.	6.9	87354	27441	68603	155957
10.	6.9	96089	16495	41237	137326
13.	6.9	66971	28470	71176	138147
14.	6.4	42403	13282	33205	75608
15.	6.4	12567	3889	9723	22290
16.	-	-	-	-	-
17.	6.9	27517	11258	28145	55662
20.	6.4	27276	7043	17608	44884
21.	6.4	13888	4416	11040	24928
22.	6.4	27548	7887	19718	47266
41.	6.4	65224	10508	26270	91494
42.	6.4	76973	12973	32433	109406

Table VI.

Comparison of Theoretical Requirements of Starch Equivalent with Actual Quantities Fed.

Farm No.	Theoretical Requirements of S.E. lb.	Actual Quantities of S.E. fed lb.	Excess or deficiency - of quantities fed over Theoretical Requirements lb. Total	Per Cow.
2.	55238	52942	- 2296	- 108
3.	60931	62588	+ 1657	+ 68
4.	79063	98799	+19736	+ 580
6.	45459	51203	+ 5744	+ 261
7.	39677	46662	+ 6985	+ 394
9.	155957	168437	+12480	+ 208
10.	137326	127431	- 9859	- 150
13.	138147	159275	+21128	+ 459
14.	75608	90138	+14530	+ 463
15.	22290	23592	+ 1302	+ 140
16.	-	-	-	-
17.	55662	50984	- 4678	- 247
20.	44884	63541	+18657	+ 924
21.	24928	26568	+ 1640	+ 159
22.	47266	54563	+ 7297	+ 357
41.	91494	95895	+ 4401	+ 91
42.	109406	116445	+ 7039	+ 123

It will be seen that on all the farms except three the amount of Starch Equivalent fed was in excess of the theoretical requirements of the cows. Most of the farmers concerned would probably say that they knew this, that they intended to over-feed, by this standard, but the results provide reasons for testing again the balance of their rations.

The application of the Protein Equivalent formula gives a similar result expressed in terms of the protein. In Table VII the theoretical requirements of Starch and Protein Equivalents are given with the actual amounts fed. The maintenance requirements of Protein have been taken at .65 lb. to .74 lb. according to type of cow, and .6 per gallon for production.

Table VII

Consumption of Starch and Protein Equivalent.

Farm No.	Starch Equivalent. Theoretical Requirements per herd 1	Amount fed per herd 2	Excess of 2. over 1. per cow	Protein Equivalent. Theoretical Requirements per herd 3	Amount fed per herd 4	Excess of 4. over 3. per cow
2.	55238	52942	-108	9214	10597	+ 65
3.	60931	62588	+ 68	9927	12894	+122
4.	79063	98799	+580	12619	19026	+183
6.	45459	51203	+261	6797	7353	+ 25
7.	39677	46662	+394	6100	7228	+ 64
9.	155957	168437	+208	25833	34308	+141
10.	137326	127431	-150	20202	24702	+ 68
13.	138147	159275	+459	24264	28717	+ 97
14.	75608	90138	+463	12276	17964	+181
15.	22290	23592	+140	3608	4237	+ 68
16.	-	-	-	-	-	-
17.	55662	50984	-247	8145	9845	+ 39
20.	44884	63541	+924	6996	12646	+280
21.	24928	26568	+159	4063	4836	+ 75
22.	47266	54563	+357	7530	8671	+ 56
41.	91494	95895	+ 91	12929	14218	+ 27
42.	109406	116445	+123	15602	15386	+ 7

Table VIII has been designed to test the balance of the ration. The ratio of the Protein Equivalent to the Starch Equivalent varies with the amount of milk produced. A cow weighing 1000 lb. and giving 1 gallon of milk requires 6 lb. of Starch Equivalent, including 0.6 lb. of Protein Equivalent for maintenance, and 2.5 lb. of Starch Equivalent, including 0.6 lb. of Protein Equivalent for production of 1 gallon. The ratio of this ration is 1.2 lb. of Protein Equivalent to 8.5 lb. of Starch Equivalent, that is 1:7. If a cow of the same weight was giving 4 gallons of milk per day the ration should contain 3. lb. of Protein Equivalent and 16 lb. of Starch Equivalent, a ratio of 1:5.3 Thus the ratio grows narrower as the yield increases.

Table VIII deals only with the ratio of the production ration. Maintenance requirements have been subtracted from the amounts fed in every case.

Table VIII.

Protein - Starch Equivalent Ratio in Production Ration.

Farm No.	Gallons per herd	Starch Equivalent available for Production	Protein Equivalent available for Production	Protein - Starch Equivalent Ratio
2.	10286	23419	7555	1 : 3.1
3.	10221	27210	9100	1 : 2.99
4.	13260	52886	14363	1 : 3.68
6.	6300	21494	4336	1 : 4.95
7.	6120	22760	4800	1 : 4.74
9.	27441	81083	24940	1 : 3.25
10.	16495	31342	14397	1 : 2.18
13.	20470	92304	21535	1 : 4.28
14.	13282	47735	13657	1 : 3.49
15.	3889	11025	2962	1 : 3.72
16.	-	-	-	-
17.	11258	23467	8442	1 : 2.78
20.	7043	36265	9876	1 : 3.67
21.	4416	12680	3423	1 : 3.7
22.	7887	27015	5873	1 : 4.6
41.	10508	30671	7594	1 : 4.03
42.	12973	39472	8068	1 : 4.88

The theoretical composition of a feed suitable for the production of 1 gallon of milk is 2.5 lb. of Starch Equivalent, containing 0.6 lb. of Protein Equivalent. The ratio of such a feed would be 1 : 4.2. A ratio wider than this indicates a deficiency in Protein, and one narrower an excess. The majority of the farms dealt with show the ratios too narrow, and therefore suggest that too much Protein was being fed, and Protein is the most expensive ingredient in the ration.

In table IX. figures for three years are given for two farms. On Farm 2 the farmer set about his fields with harrows, lime and phosphates in 1929 in a very generous manner. He brought down the cost of purchased food at once, and in 1931 his lb. of Starch Equivalent from the grass cost only .53 of a penny. It remains about there, but both pasture and meadow are still improvable to a great extent. On Farm 6 the improvement was begun in 1928, lime was used then phosphates. There was also a very limited experiment with potash, harrowing and clover seed. The first and great reduction in cost came after the use of nitrogen in 1932. The cost of the lb. of Starch Equivalent obtained from the grass fell from 1.44d. to .84d. Assuming that 2.5 lb. of Starch Equivalent is required to produce ¼ gallons of milk, this is a reduction of 1½d. in the cost per gallon.

Table IX.

Farm No 2.

Year	S. E. fed excluding grazing lb.	Cost of S. E. fed £. s. d.	Cost per lb. S. E. pence	Deficiency in S. E. supplied by grazing lb.	Cost of grazing £. s. d.	Cost per lb. supplied by grazing pence.
1930	11940	58 10 4	1.17	38764	84 6 1	.52
1931	15511	71 10 3	1.1	38381	86 4 0	.53
1932	9245	47 19 2	1.25	34590	86 17 3	.6

Farm No 6.

1930	21097	109 4 9	1.24	9115	53 16 8	1.42
1931	21760	92 16 11	1.02	8347	50 19 5	1.46
1932	13502	54 13 8	.97	19731	69 6 0	.84

One result of this research is that it provided a means of measuring the value of grass, an unknown factor, in terms of provender, a known factor. While there is ground for satisfaction in the spread of better farming methods, fuller consideration of the results show that progress cannot be sensationly rapid. It is true that a farmer can reduce his costs by a comparatively large amount, but it is also true that in Lancashire conditions the reduction is not great absolutely.

Table X.

Grazing. Value, Cost, Profit or Loss.

Farm No.	Value of grazing as measured in terms of provender.	Cost of grazing.	Difference.
2.	180 3 2	86 17 3	+ 93 5 11
3.	97 5 0	82 5 6	+ 14 19 6
4.	117 3 4	127 9 8	- 10 6 4
6.	79 14 11	69 6 0	+ 10 8 11
7.	59 4 0	69 17 2	- 10 13 2
9.	305 12 11	236 14 6	+ 69 8 5
10.	207 11 9	202 16 2	+ 4 15 7
13.	108 3 5	132 16 11	- 24 13 6
14.	142 1 6	98 4 5	+ 43 17 1
15.	47 0 7	31 12 9	+ 15 7 10
16.	212 10 11	174 12 8	+ 37 18 3
17.	84 3 11	71 9 10	+ 12 14 1
20.	55 14 5	50 14 11	+ 4 19 6
21.	64 4 7	50 19 0	+ 13 5 7
22.	42 14 6	50 13 7	- 7 19 1
41.	344 5 6	203 19 2	+140 6 4
42.	267 3 2	236 11 11	+ 30 11 3

Some of the keenest and most successful improvers have been unwilling to keep or give records of their results, but a large number will be available in future years. Those given, however, are sufficient to show the nature of the progress which can be made. High rents, for small heavily stocked farms, with dung dominating the management of pastures as well as meadows, make grazing dear. But a number of farmers have reached the stage in improvement where the contrast between the performance of unimproved and improved areas is so striking and powerful that they regard the former as notorious sources of loss, and their systematic and complete elimination as the minimium standard of good farming.