Dairying

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

FARM LABOUR STUDIES No. 9

PIPELINE MILKING IN SOUTH-WEST SCOTLAND

R. Turner and R. D. Murray

Economics Department
178 Bothwell Street, Glasgow, C.2.

Research Bulletin No. 35
1965

PIPELINE MILKING IN SOUTH-WEST SCOTLAND

CONTENTS

PIPELINE MILKING IN SOUTH-WEST SCOTLAND

R. Turner and R. D. Murray

SUMMARY

Following a study of bucket milking in byres in South-West Scotland, a further investigation was made on farms where round-the-byre pipelines had been installed. The milking performance on these farms was not significantly better than on bucket milking farms, but the work was made easier and workers were relieved of some of the drudgery. Evidence is presented which suggests that some of the pipeline equipment was not working correctly and the view is put forward that more frequent inspection of the equipment by a skilled engineer might be to the farmer's advantage. It is suggested that the proper co-ordination of efficient equipment with improved work methods would lead to lower costs of milk production.

INTRODUCTION

The increasing shortage of farm labour and the need to reduce the costs has caused many farmers to examine their traditional methods of milk production. Some old fashioned byres were very wasteful of labour, and on a number of farms they have been replaced by a yard and parlour. On other farms, where the byres were modern or in good condition, round-the-byre pipelines have been installed in conjunction with bulk milk tanks.

In order to obtain information on the organization and methods of milking, an investigation was made, during 1965, on farms where pipelines and bulk tanks had been installed. This followed the lines of the recent Study of Byre Milking (1). Nine farms were visited; two each in the counties of Ayr, Lanark, Dumfries and Kirkcudbright and one in Renfrew, and the work at an evening milking was studied. One farm was common to this and the Study of Byre Milking (bucket units), a pipeline and bulk tank having been installed since the previous observations. The average size of herd was about 65 cows of which about 50 were in milk.

---

(1) West of Scotland Agricultural College, Economics Department, Research Bulletin No. 33. 1964. A Study of Byre Milking in S.W. Scotland. R. Turner and R. D. Murray.

ORGANISATION OF MILKING

Basic Information

The basic data obtained from each farm is shown in Table I.

TABLE I

BASIC DATA

Farm No.	No. of Cows in Herd	No. of Cows milked	No. of Workers	No. of Units in use	Duration of Milking hrs.	min.	Overall Man-time man min.	Overall Man-time per Cow milked man min.
K	56	52	2	6	1	54	163	3.14
L	51	37	1	4	1	39	89	2.40
M	50	43	2+1 part time	8	1	5	134	3.11
N	68	57	2	6	1	47	178	3.13
O	80	56	1+1 part time	5	1	42	166	2.96
P	56	34	2	4	1	13	117	3.44
Q	84	50	2	8	1	40	168	3.36
G2	74	53	2	6	1	23	143	2.69
R	71	63	1+1 part time	5	1	13	110	1.74

Farms K, M, G2, and R were family farms where the work was carried out by the farmer and members of his family. On the other farms milking was done by a dairyman, assisted, usually, by his wife; and of these P and Q were on a contract system of payment.

The time taken for the whole job - preparation, milking and washing up equipment - is shown as Duration of Milking. Overall Man-time shows the total time, in man minutes, taken by all persons engaged in milking, but it does not include time spent on jobs not directly concerned with milking, such as feeding calves. The Overall Man-time per Cow milked gives a measure of comparison between the times taken on the different farms. The range, 1.74 to 3.36 man minutes per cow is fairly wide, which suggests the need for further investigation. Farm G2 is the same farm as G in the earlier Study of Byre Milking.

Overall Man Time

This includes the time spent on feeding cows during milking, preparing and washing up dairy equipment and milking proper. The times taken for each of these operations is shown in Table II.

TABLE II

ANALYSIS OF OVERALL MAN TIME

Time taken - in man minutes

Farm No.	Overall	Feeding Cows	Washing Dairy Equipment	Milking only	No. of Cows milked per man hour
K	163	-	21	142	22
L	89	-	12	77	29
M	134	-	24	110	23
N	178	-	28	150	23
O	166	-	24	142	24
P	117	-	14	103	20
Q	168	-	31	137	22
G2	143	-	18	125	25.5
R	110	12	5	93	36 (including feeding)

Feeding Feeding during milking was done on one farm only. The farmer himself fed cake to each cow according to yield, by pail from a "cooler" or cake barrow.

Washing Dairy Equipment This consisted of scrubbing the clusters and tubes, adjusting the circulation of water in the pipelines and clusters, cleaning the milk pump and filters and changing filter pads. The practice varied widely, but on most farms, after the evening milking, two rinses were given, the first with warm or cold water and the second with cold water with or without sterilant. Sometimes the worker was able to attend to some other work while circulation cleaning was in progress. On farm Q three bucket units were used to milk three newly calved cows and washing these accounted for 3 minutes of the time taken for cleaning equipment.

Milking Milking proper includes the preparation of washing water, washing udders, operating units and small additional operations such as removing dung

from standings during milking. On farms M, P and G2, the units were taken to the byre hung on a trolley, so that they were all conveyed in one journey.

The last column of Table II shows the throughput of cows on each farm, which gives a measure by which the milking performance of the herds may be compared. It is not suggested that there is any merit in rushing through the milking to get an apparently high performance irrespective of yield, but rather that there is an advantage in having working methods, equipment and number of units in use so integrated that, for a particular milk yield, a high performance is automatically achieved.

FACTORS AFFECTING PERFORMANCE

Efficiency of Extraction

For efficient milking the aim should be to milk cows quickly and completely, so that all the milk available is extracted in as short a time as possible. Some pointers to the efficiency of extraction are shown in Table III.

TABLE III

EFFICIENCY OF EXTRACTION - AT AN EVENING MILKING

Farm No.	Av. Yield per cow lb.	Av. Unit-on Time per cow min.	Av. Rate of Production lb./min.	Calculated Unit-on Time per cow min.	Increase of Actual over Calculated Unit-on Time per cow min.
K	11.5	6.7	1.7	4.1	2.6
L	13.5	7.5	1.8	4.5	3.0
M	11.3	6.2	1.8	4.1	2.1
N	8.9	6.4	1.4	3.7	2.7
O	14.1	6.7	2.9	4.5	2.2
P	13.8	5.7	2.4	4.5	1.2
[illegible]	13.8	8.5	1.6	4.5	4.0
G2	11.5	6.1	1.9	4.1	2.0
R	12.5	4.5	2.8	4.3	0.2

The average rate of production of milk from the cows was 2.0 lb. per minute which is almost the same as that for bucket milked herds - 2.1 lb. per minute.

The average time a unit would be expected to remain on a cow can be calculated from the average herd yield, and if it is compared with the actual

average time units are on the cows, an indication can be obtained of the efficiency of extraction. The last column of Table III shows this. Only on farm R was the actual unit-on time close to the calculated time; on the others it was some 50% higher.

The average unit-on time of a herd may be higher than the calculated time for any of the following reasons.

(1) The herd in question may have a high proportion of slow milking cows.

(2) Poor methods of working may result in a long work routine time which in turn may lead to overmilking i.e. the units remain on the cows' udders after milk flow has ceased.

(3) Faulty equipment may reduce the rate of extraction, so that the cows take longer to milk than when the equipment is functioning correctly.

On the farms studied, it is unlikely that all had a high proportion of slow milking cows, and there is no evidence that this was the primary reason for the high unit-on times. It is possible that they were caused by poor working methods, and that there was some overmilking, but on some of the farms, there is evidence to suggest that faulty milking equipment may have been primarily responsible for lowering the rate of extraction from the udder.

Milking Equipment

In order to pursue the matter, details of the milking equipment must be considered and these are shown in Table IV.

TABLE IV

MILKING EQUIPMENT

Farm No.	Make of Machine	Vacuum Gauge Reading		Pulsation Rate pulses per min.	
		Farm Gauge ins. of Mercury	Test Gauge ins. of Mercury		
K	Gascoigne Electronic	18	19	56	Fullwood clusters
L	Alfa Laval "	$15\frac{1}{2}$-16	$15\frac{1}{2}$-$15\frac{3}{4}$	50	
M	" " "	15	15 -$15\frac{1}{2}$	n.a.	Fullwood clusters
N	" " "	$14\frac{1}{2}$-15	n.a.	n.a.	
O	Gascoigne "	$15\frac{3}{4}$	13 -$14\frac{1}{2}$	52	Alfa Laval teat cups and synchro-pulse
P	" "	15	$14\frac{1}{4}$-$14\frac{1}{2}$	60	
Q	" "	$14\frac{1}{2}$	14 -$14\frac{1}{2}$	n.a.	6 Gascoigne and 2 Alfa Units. Alfa synchro-pulse
G2	Alfa Laval "	$15\frac{1}{2}$-16	$15\frac{1}{2}$-$15\frac{3}{4}$	52	
R	" " Pneumatic	16	$15\frac{1}{4}$-$15\frac{1}{2}$	n.a.	

On farm R the pneumatic pulsators were located near the claw of the unit. The pulsation rate should be between 50 and 60 pulses per minute and in this respect the machines were normal.

Farm G2 Some evidence to show that milking equipment was faulty comes from a comparison of Farm G2 (pipeline) with the same farm when bucket milking (G). This shows that the performance with the pipeline was poorer than with bucket. The following figures make this clear.

Farm G	Bucket	Pipeline
Duration of Milking	1 hr. 21 min.	1 hr. 23 min.
Overall man time per cow milked	2.9 min.	2.7 min.
No. of cows milked per man hour	25	25.5
No. of units	5	6
Machine stripping time per cow	0.77 min.	1.03 min.
Av. rate of production of milk	2.8 lb./min.	1.9 lb./min.
Increase of actual over calculated unit on time	0.4 min.	2.0 min.

The time spent washing dairy dishes was reduced by 5 minutes with pipeline equipment, but in spite of this and in spite of the addition of an extra unit the total time taken for milking was no less than before, although the work was less fatiguing. Machine stripping also took longer with pipeline milking and it seems possible that unnecessary stripping may have been done to fill in time because the cows had not finished milking. These conclusions suggested that the equipment might not be working correctly, so that the rate of extraction of milk from the cow was less than normal.

A study of the milking equipment on the farm by Mr. J. Fyfe of the College Dairy Technology Department, showed that this was indeed the case. The vacuum pump was rather old and was not capable of extracting vacuum at a high enough rate, while the motor driving it was under-powered. The regulator had been adjusted to show a high vacuum at the gauge but this was not being attained at the teat cups. Because of the low rate of vacuum extraction, the pulsators were not working properly so that the milking phase was not fully effective.

Other Evidence of faulty Equipment On the farms studied, the level of vacuum showed a variation of from 13 to 19 inches of mercury. The normal vacuum is from 13 to 15 inches but 5 of the farms showed over 15 ins. It is sometimes found that a regulator has been adjusted to give a high level of vacuum in an attempt to compensate for an inadequate rate of extraction by the pump.

On one farm, trouble was experienced with teat cups falling off and on two others, back cords had to be used on most of the cows to prevent this. While this could be due to unsatisfactory teat cup liners, a more probable cause was that the vacuum reserve or rate of extraction was insufficient. The use of back cords wastes time and on farms N and O, it accounted for 13 minutes and 14 minutes respectively at the evening milking.

There is, therefore, conclusive evidence from farm G2 that, the milking installation was not functioning correctly, and the evidence from farms K to Q is sufficient to raise doubts as to whether the equipment on these farms was operating as it should.

Working Methods

Improvement in working methods is bound up with the correct functioning of the installation in so far as the best methods cannot be used with faulty equipment. Table V gives figures for two measures of the effectiveness of the working methods.

TABLE V

Farm No.	Work Routine Time Man min. per Cow	Machine Stripping Time Man min. per Cow
K	2.74	0.85
L	2.09	0.95
M	2.56	0.58
N	2.63	0.82
O	2.53	0.58
P	3.04	0.43
Q	2.74	0.71
G2	2.35	1.03
R	1.48	0.39

The Work Routine Time is the average time per cow available for all the operations which have to be carried out at milking. With a pipeline installation, 2 man minutes per cow should be ample time for this. Only on farms L and R is the work routine time near this figure. The time is high on farm P because the milking team was not well balanced. The dairyman's assistant was unskilled and spent about 30% of her time waiting. However this method suited the workers and enabled the best use to be made of the labour available.

One of the components of the work routine is machine stripping. If this cannot be eliminated altogether it should be reduced to a minimum, subject always to the production of milk of good quality, and should not occupy more than an average of 0.3 min. per cow. All the farms studied have figures above this, but the lowest is farm R, which also has the lowest work routine time.

On some farms, it is possible that one of the causes of high machine stripping time may be faulty equipment. Machine stripping is sometimes

carried out, not so much because the cow is ready for, or needs stripping but because otherwise, the worker would be standing idle waiting for the cow to finish milking. If then, the milking equipment is not working correctly and cows take longer to milk, the worker may have time to wait, which may be reflected in longer machine stripping times.

COMPARISON OF BUCKET AND PIPELINE MILKING

It is tempting to compare pipeline milking with bucket milking as found in the study quoted. There is a danger in this, because the number of farms studied was too small to generalise from the results, and, with one exception, the farms in both studies were different, so that differences between studies could be due to differences in management rather than in method. However, with these provisos in mind, it may be interesting to examine the comparative figures given below.

	Bucket Milking Average of 9 Farms	Pipeline Milking Average of 9 Farms
No. of cows in herd	50	65.5
Overall man time per cow milked	3.7 min.	2.9 min.
No. of cows milked per man hour	20	25
Work routine time per cow	2.9 min.	2.5 min.
Machine stripping time per cow	0.8 min.	0.7 min.
Unit-on time per cow	6.6 min.	6.5 min.
Increase of actual over calculated unit-on time per cow	2.2 min.	2.2 min.

The results of the studies appear to show a slight increase in throughput of cows with pipeline milking compared with buckets, but the similarity of the figures in each of the last three factors in the table suggests that the methods used in pipeline milking were no better than those in bucket installations.

The range of times taken for dairy work at the evening milking for pipeline installations was from 5 to 28 minutes and this is very similar to that for bucket machines - from 4 to 24 minutes. It might however be expected that there would be a saving in dairy work in the morning or forenoon, and a previous study (1) has shown that, in an average day's work, the time taken for dairy work with bulk tanks was about half that required for surface coolers and churns. On the bucket milking farms, during milking, an average of about 0.4 min. per cow was spent emptying buckets and carrying milk, and this time would be saved in pipeline milking, e.g. 20 minutes for a 50 cow herd.

---

(1) West of Scotland Agricultural College, Economics Department, Report No. 48, 1958. Bulk Milk Tanks on Farms. R. Turner.

Discussion

The pipeline installation itself is liable to certain disadvantages which do not apply to bucket systems to the same extent. The length of pipeline required is more than double that of the bucket plant so there is a greater risk of vacuum leaks. Leaks are also liable to occur at the connection of the milk tube with the pipeline. The greater length of piping under vacuum together with the lift of milk from udder to pipeline make added demands on the vacuum pump, so that a larger pump is required than with a corresponding size of bucket plant. Under certain conditions, a shortage of vacuum could have a more serious effect on the operation of a pipeline plant than a bucket plant, and it would be wise for farmers to have more frequent maintenance inspections of their equipment by a skilled engineer to ensure that it is functioning correctly.

When the equipment is working properly, there may still be room for improvement in methods to ensure that time is not wasted and that the work can be carried out with the minimum of effort.

In pipeline milking, in order to ensure cleanliness, rather more care has to be taken in washing and preparing the udders, and more of the pipeline farms studied used the strip cup and dipped the clusters in disinfectant between stalls. It would seem that, with pipeline milking, the use of the strip cup is essential to safeguard the quality of the milk.

Certain processes, which entail extracting and keeping separate milk from a single cow, are difficult with the pipeline and require special arrangements. Milk recording is usually done by reverting, for a day, to bucket milking. Newly calved cows have to be milked by bucket. Cows which have mastitis or have been treated with an antibiotic may have to be milked by bucket, but where only one-quarter is affected a special plastic jar can be attached to the cluster, into which milk from the affected quarter is passed.

With pipeline milking the need for recording is greater than for bucket plants. With the latter, even if recording is not carried out, the milker may be able to gauge the approximate yield of a cow from the quantity in the bucket. With the pipeline this is not possible, so that rationing according to yield becomes impracticable.

There are a number of advantages of pipeline milking which do not apply to the bucket system. The introduction of a pipeline and bulk tank may give a new lease of life to an old byre and even if little or no time is saved at milking, some of the drudgery is removed from the work and the whole job is made easier for the workers. This is especially true in byres where narrow passages make the handling of bucket machines difficult.

Generally speaking, the pattern of work is more uniform on pipeline farms, because milk is conveyed to the dairy by vacuum, with the result that many of the operations of the bucket system are eliminated. This simplifies the work, so that it should be easier to adopt efficient work routines and good milking

practices.

Special attention to hygiene is required in pipeline installations, because the milk virtually goes into bulk as soon as it leaves the cow's udder. However, provided the pipeline is thoroughly clean, once the milk is in the system, there is less chance of external contamination than with a bucket plant.

Bulk tanks fit in well with pipeline equipment. They require less labour to operate than surface coolers and are more effective than churns in preventing deterioration during storage.

From this study there appears to be little significant difference in performance between pipeline and bucket systems, nevertheless, if all the equipment were functioning correctly, the performance of the pipelines could probably be improved. If, under such circumstances, the opportunity were taken of introducing better work routines, the co-ordination of efficient equipment with improved methods would lead to lower costs of milk production.

Acknowledgements

The authors wish to thank the farmers concerned for their ready co-operation in this investigation. They also wish to express their gratitude to Mr. J. Fyfe of the College Department of Dairy Technology for technical assistance and advice, and to the members of the County Advisory Staff for selecting suitable farms.