Silage
Cost of production

UNIVERSITY COLLEGE OF WALES
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SILAGE-MAKING IN WALES, 1949.
THE PRESENT POSITION AND COSTS OF PRODUCTION.

by

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FOREWORD.

Many changes have taken place in farming practice since the outbreak of the war. In peace-time the greater proportion of the feeding-stuffs required for winter feeding of livestock was imported and comparatively little was produced at home. Farmers then considered that it was more economical to purchase imported feeding-stuffs than to grow on their own farms the food required to feed their stock. This practice was justified by the comparatively low prices at which imported foods could be obtained.

Now the position is entirely different. No longer are supplies of imported feeding-stuffs unlimited, nor are they still cheap; and farmers during the war years and since have had to rely to a large extent on home-grown foods for feeding their stock. Although more meals have been imported of late, there is no guarantee that the increase will be maintained; and farmers would be wise to continue to grow on their own farms the bulk of the food required. Moreover, even if purchased meals were freely available there would still be an advantage in using as large a proportion as possible of home-grown foods in order to keep down production costs. This point is of special importance now in view of the increase in the price of imported feeding-stuffs. Shortages of carbohydrate feeds have been largely overcome by an increased production of cereals, but particular difficulty has been and is being experienced in obtaining adequate supplies of protein foods. Home-grown crops fairly rich in protein (beans and peas) have limited possibilities, especially in Wales. Lateness in ripening, unfavourable soil conditions and the uncertainty of the crops often discourage farmers from extending acreages. Cabbage and kale are very valuable sources of protein and should be used as widely as possible; but the conservation, in the form of silage, of summer grass or of a tillage crop cut when immature appears to be the real solution to the winter feeding problem. Silage, as well as being a rich and valuable food, is inexpensive to produce. Its feeding value will of course depend directly on the quality of the herbage ensiled: it is hardly to be expected that good silage can be made from poor herbage. Where the quality is good, however, about 20-25 lb. of grass silage is able to replace the $3\frac{1}{2}$ lb. of balanced concentrates fed to dairy cows in pre-war days for every gallon of milk produced. Again, the value of silage made from legume-cereal mixtures for milk production is evident from the fact that a ration composed of 8 lb. of good meadow hay, 30 lb. of oats-and-vetch silage and 35 lb. of mangolds contains enough nutriment for the maintenance of an average dairy cow and the production of the first gallon of milk. Silage is also of special value for feeding to fattening and store cattle, and its use for these classes of stock will enable substantial reductions to be made in the quantities of meals required.

In Wales, very little silage was made in pre-war years; but with the growing scarcity of imported foods more attention has been and is being given to its use. There are, however, a large proportion of farmers who have yet to realise the value of silage as stock feed, especially at a time when the question of home-produced protein is of such importance. Furthermore, silage can be made almost irrespective of weather conditions; and this is an

important consideration in a country like Wales, where the heavy rainfall often makes the harvesting of crops such a troublesome and costly business. Indeed, the harvesting conditions experienced in Wales this year should make farmers realise more than ever that too much emphasis cannot be laid on the necessity for making silage.

Silage has the advantage that it can be fed to all classes of livestock. It is comparatively easy to make, provided a few principles are observed; and with careful planning the work can be spread over the summer before and after harvest. Grass can be ensiled while it is still young and leafy, and at a stage when it is quite unsuitable for hay-making in a climate like that of Wales.

At a time when alternative supplies of feeding-stuffs are difficult to obtain and expensive to buy, there can be little doubt as to the economy of the process when, as shown by the results of this investigation, production costs on the farms surveyed averaged 31s.3d. per ton for grass silage and 56s.4d per ton for cereal-legume silage.

This study was made possible by the ready collaboration of the farmers concerned. The Department gratefully acknowledges their help and support.

October, 1950. J. Pryse Howell.

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Introduction.

During the last few years British farmers have been confronted with the necessity of achieving greater self-sufficiency in order to combat the curtailment in the importation of animal feedingstuffs. The shortage has been particularly severe with regard to the protein-rich feeds. This policy of greater self-sufficiency in feedingstuffs has been embodied in the Agricultural Expansion Programme launched in 1947, which included the grassland development campaign with its target of 20 per cent increase in the output of grassland. Again, the need for greater self-sufficiency has been accentuated of late by the steep rise in the price of concentrates, which has brought home to the individual farmer the necessity of applying national agricultural policy within the framework of his own farm organisation.

The problem has thus been how to achieve greater self-sufficiency with regard to home-grown protein on the individual farm, and the solution in many cases has been the conservation of young grass or arable crop herbage in the form of silage.

Silage-making cannot be looked upon as a new process in British farming, but it is an operation that has not generally roused the enthusiasm of the farming community and one that is still regarded with suspicion by many farmers. The process was first introduced into this country from the Continent during the last quarter of the 19th Century, but for a multitude of reasons it waned in popularity and by the turn of the century had virtually disappeared. During the 1st World War and in the early 1920's there was a certain amount of revival of interest and quite a large number of permanent tower silos were erected, largely for the ensilage of forage crops with the assistance of cutter and blower equipment. This method of silage-making made slow headway, partly/ a fact which can be attributed/to the high cost of erecting permanent tower silos, and it can be said that generally speaking ensilage was practised only by a handful of enthusiasts up to the beginning of the 2nd World War.

In 1940, the seriousness of the feedingstuffs situation resulted in the launching of the National Silage Campaign, a feature of which was the use for ensilage purposes of portable structures made of wire and paper, concrete blocks or wooden panels. A large amount of attention has been focussed on the process since that date, but, nevertheless, the success of the campaign was not as great as had been hoped. Although more silage was made this method of crop conservation did not catch the imagination of the farming community in the way anticipated. The relative failure of the silage-making campaign and the relative lack of enthusiasm on the part of the farmers can be attributed largely to the excessive amount of waste which most silage-makers experienced and which is difficult to eliminate in portable silos. For instance, in the case of 64 silos examined in North Wales in 1941, the waste amounted on an average to 20 per cent.* Other reasons that can be put forward to explain the

*W. McLean, "Silage-Making in North Wales". Journal of the Ministry of Agriculture, May 1943. P. 77.

lack of popularity of silage-making at this time include the labour problem; the drudgery of handling heavy wet material for ensilage; the costliness of the container and of other equipment necessary to mechanise the process; and, lastly, the unpleasant and clinging smell which is characteristically associated with silage.

The new silage-making campaign launched in 1947 has had a far greater success than the earlier one, and for the first time it can be said that ensilage is gaining steadily in popularity. "About 725,000 tons of silage were produced in Great Britain in 1948, which is more than double the quantity made in 1947." * At the same time this amount is considerably less than the objective of 2,000,000 tons set as the target for 1952. Briefly, the reasons for the increase in silage-making can be stated as follows:-

(1) There has been a change of emphasis in official circles regarding the type of silo to be used. The earlier silage campaign was based on the use of containers for silage-making, while pit-type silos were not favoured to any extent. The present campaign, on the other hand, has been based on the use of pits, trenches, clamps or stacks - all relatively inexpensive methods of storage which do not rely on the investment of large sums in permanent or temporary containers.

(2) The elimination of the need for expensive, permanent tower silos and the swing-over towards pit and semi-pit silage has, similarly, reduced the need for cutter blowers and forage harvesters. Again, where required these have normally been obtainable on hire from the County Agricultural Executive Committees.

(3) Although the pit technique has reduced capital requirements for storage there has still been the question of equipment for the fieldwork to be faced, and here again a step forward has been made by the appearance of the inexpensive Paterson buckrake. The heavy work of handling the green material has also been eased by the appearance of larger numbers of green crop loaders of better design. Mechanisation has thus played a part in stimulating silage-making; but at the same time the greater ease with which a pit can be filled, compared with the difficulties of filling a container, has accelerated the spread of silage-making to non-mechanised farms.

Some indication of the advance in the mechanisation of ensilage can be found by an examination of the Censuses of Agricultural Machinery - figures from which are shown in Table I.

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* The Rt. Hon. Tom Williams, M.P., Minister of Agriculture, opening address to N.F.U. Crop Conservation Conference, London, May, 1949.

Table I.

Numbers of Green Crop Cutter-Collectors, Green Crop Loaders, Silage Cutters and Blowers, and Grass Driers in Wales and in England and Wales, January 1948 and January 1950.

Implement.	Wales.		England & Wales.	
	1948(1)	1950(2)	1948(1)	1950(2)
Green Crop Cutter-Collectors	90	104	802	1136
Green Crop Loaders	44	352	1005	4100
Silage Cutters and Blowers	89	104	1053	1216
Grass Driers	19	48	319	663

(1) Agricultural Machinery. Results of January, 1948 Census. Ministry of Agriculture & Fisheries Statistics.
(2) Agricultural Machinery. Results of January, 1950 Census. Ministry of Agriculture & Fisheries Statistics.

Even allowing for the fact that some of the increase in the numbers of green crop cutter-collectors and green crop loaders can be attributed to the need for more field equipment for grass drying, it is still evident that mechanisation of silage-making is on the increase.

(4) A better understanding has been reached of the whole process of ensilage. Fermentation and temperature control by the use of molasses and by consolidation are now more readily secured, with a consequent reduction in the amount of waste. In the case of pits, the ease with which consolidation can be carried out with the aid of tractors has been a big factor in this reduction of waste. It is safe to say that farmers are becoming more proficient in the technique of ensilage and are more fully aware of the potentialities of the process.

The Survey.

This report deals with the costs of silage-making on 29 farms in Wales during the summer of 1949. Actually, it had been hoped to collect information from a considerably larger sample of farms, but 20 of these did not eventually make any silage at all. In practically every case the reason for this was the exceptionally dry weather experienced during the 1949 summer. Many of the farmers who had hoped to make silage had to turn stock into fields which had previously been provisionally reserved for cutting. Again, there was a certain amount of reluctance not to make hay during good

haymaking weather, while the lack of aftermath on most farms made late season silage out of the question. It was lack of grass rather than lack of interest which was the main limiting factor in the majority of cases.

Altogether, 1,935 tons of silage were made on these 29 farms, and of this 1,205 tons were grass or lucerne silage and the remaining 730 tons were cereal and legume silage. The average total quantity of silage available per farm was 67 tons. Four of the 29 farms made both grass and cereal-legume silage; 13 farms made only grass silage; while 12 farms made only cereal-legume silage. The range in production of silage per farm is shown in Table II.

Table.II.

Range in Production of Silage per Farm.

Silage Production. Tons.	Grass and Lucerne Silage. No. of Farms	Cereal and Legume Silage. No. of Farms
	No.	No.
Under 25	3	6
25 and " 50	3	2
50 " " 75	5	5
75 " " 100	1	3
100 " " 125	2	-
125 " " 150	1	-
150 " " 175	2	-
Total	17	16

In the case of practically all of the farms where grass silage was made, only one cut was ensiled, although in one instance a lucerne field was cut three times for silage. On some of the farms, grass fields were cut more than once, in some cases for hay and in others for grass drying. The average yield of grass and lucerne silage was 4.3 tons per acre over the 283¼ cutting acres, while the cereal-legume silage averaged 6.3 tons per acre over the 115¾ acres.

The Silos.

On the farms costed there were in all 45 silos. These varied considerably in type. Moreover, the manner in which they were sited to suit the particular circumstances of the individual farms showed considerable ingenuity. The predominant types of silo found on these farms were the pit, trench or clamp, which accounted for 28 out of the total of 45 silos. It is difficult to give an exact definition of the terms "pit", "trench" or "clamp" as they tend to be synonymous and are loosely used to refer to the same general type of silo. Broadly speaking, however, they

are used here to mean either shallow or deep trenches normally open at one or both ends. In some cases, where the farmer had desired to sink a pit, difficulties were encountered which made this practically impossible. On a few farms the water-table was found to be too near the surface and consequently a clamp was constructed above ground. In other cases, the rocky nature of the ground made digging extremely difficult. In three cases stack or clamp type silos were constructed within the farm buildings, e.g. in stone barns. This was a method adopted on upland farms in areas of heavy rainfall, where the rocky nature of the land made the construction of a pit a course beset with difficulties. There was only one example of a true stack silo on the farms visited, and in this particular case 54 acres of ley were ensiled in one stack. As far as other types of silo were concerned, there was one example of a wire-mesh paper-lined silo and a total of twelve tower-type silos of either a portable or permanent nature. These were constructed of concrete, concrete panels, wooden panels or galvanised iron sheets.

Table III.

Types of Silo Used.

Type.	Number.
Pit, Trench or Clamp	28
Indoor Stack or Clamp	3
Stack	1
Concrete Tower	9
Wooden Tower	2
Galvanised Iron Tower	1
Wire Mesh and Paper	1
	45

On most of the farms surveyed one silo only was in use. This was the number found on 20 farms, while another four farms used two. There were three farms where silage was made in three silos, while, on another two farms, four silos were utilised.

Two main considerations were borne in mind regarding the actual siting of the silos. These were, firstly, the distance from the fields being cut for ensilage, and, secondly, the distance from the point where the silage was to be fed, which in most cases was the shippon - most of the silage was fed indoors. Over 85 per cent of the silos were situated in the stackyard, close to the buildings, or within 100 yards of the shippon, while very few were sited at a distance. Again, the fields for cutting were selected as near to the buildings as possible, the object being to eliminate a long haul.

The majority of the pit silos were of recent origin, 26 out of the 28 having been constructed either in 1948 or 1949. Some of the makers of pit

silage had attempted silage-making previously in wire mesh type silos, but in most cases they were new recruits to this method of conservation. The tower type silos dated back in many cases to the early war years, but some were purchased more recently. Their users tended to have more experience of the technique of ensilage than the makers of pit silage.

The Costs.

Analysis of Costs. The costs of making silage can be examined conveniently under the following three headings:-

I. The Costs of Herbage Production.
II. The Direct Costs of Cutting and Ensiling.
III. The Charges for Capital Equipment and Overheads.

I. The Costs of Herbage Production. This was one of the main items of cost in silage production, amounting to 43.5 per cent of the total costs in the case of grass and lucerne silage and to as much as 67.4 per cent of the total costs in the case of cereal and legume silage.

(a) Rent. The amount charged to silage was based on the use made of each field during the year. In the case of grass fields the apportionment was based on the number of cuts taken, whether for silage-making, grass drying or haymaking, and in addition the amount of grazing provided was also taken into consideration. In the case of special mixtures of cereals and legumes grown for ensilage, a full year's rental was charged against silage production.

(b) Cultivations. In some cases the grass silage production costs included a proportion of the costs of seeding leys down, but in the case of permanent grass fields the only charges would be an apportionment for harrowing, rolling and applying fertilisers and manures. A considerably higher cost was incurred on cultivations in the case of cereal and legume silage.

(c) Fertilisers and Manures. A fair amount of top-dressing was practised in the case of the grass fields, while the cereal and legume crops received about the average amount of dressing for that type of crop. The cost of the fertilisers and manures applied was adjusted to take into account manurial residues.

(d) Seeds. The cost of seeds amounted to 4.7 per cent and 25.0 per cent of grass and lucerne and cereal-legume silage respectively.

(e) Overheads. A figure of 12½ per cent was added to the herbage production costs to cover the cost of maintaining ditches, gates, hedges, etc., and other herbage overheads.

II. The Direct Costs of Cutting and Ensiling. Although the direct costs per ton of cutting and ensiling amounted to very nearly the same figure

for grass and lucerne as for special mixtures, their relative importance in relation to total costs was very different. In the case of the former they accounted for 47.2 per cent of the total costs of silage production while in that of the latter they accounted for only 26.4 per cent.

(a) Labour Preparing Silos. In the case of most of the pit silos which were not in their first year of use, a certain amount of time was generally spent in tidying up the pit walls and cleaning out the bottoms of the pits before filling. The amount of time spent on these tasks was generally slight.

(b) Cutting, Carting, Filling and Consolidating. The cutting and carting of the herbage and the filling and consolidating of the silos were distinguished by the variety of systems and methods employed. Practically every farm practised a system, both in the field and at the silo, which differed in some respect from that of its neighbour. The degree of mechanisation varied considerably from farm to farm. Again, the size of the labour force was by no means constant, while other factors such as type of herbage and type of silo also resulted in varying methods of tackling the collection of the herbage and the filling of the silo. Some idea of the diversity of methods employed in the field is given in Table IV.

Table IV.

Harvesting Methods Employed for Silage-Making.

Harvesting Method Employed.	Grass and Lucerne Silage.		Cereal and Legume Silage.		All Crops.	
	No. of Farms.	Cutting Acres.	No. of Farms.	Cutting Acres.	No. of Cases.	Cutting Acres.
Manual	4	51½	11	68¼	15	119¾
Green Crop Loader	9	168	4	33	13	201
Buckrake	3	27¾	-	-	3	27¾
Forage Harvester	1	36	1	14½	2	50½
Total	17	283¼	16	115¾	33	399

On most farms it was the practice to restrict the acreage of herbage cut to that quantity which would be sufficient for the daily work of ensilage. Quite often the herbage would be cut in the evening in readiness for the following day's work. About one-third of the cereal and legume silage was cut by binder, but all the remaining crops were cut by mowing machine. A large proportion of the acreage was gathered into rows with the aid of swathe-turners, two, three or four rows being gathered into one. As far as the actual loading and hauling of the green material was concerned, it was possible by all four systems to handle the

herbage satisfactorily. The buckrake worked well, but where it was employed the haulage distance to the pit was relatively short. Doubts were expressed as to whether the system would justify itself where the pit was situated at a considerable distance from the crop. It was estimated that the quantity of green material carried by the buckrake on each journey was less than 5 cwt., and it appeared that to obtain the best results with this system it was beneficial to have two buckrakes operating at the same time. Green crop loaders and pick-ups of various makes also worked well, but necessitated larger work-teams and either a higher capital investment on special equipment or alternatively a hire charge. Nearly half of the green crop loaders in use were hired from the County Agricultural Executive Committees. There was only one instance of a forage harvester being used and, in this case, it was a hired machine. Where the process of gathering the crops for ensilage was not mechanised to any extent, the type of vehicle most favoured was a low trailer which helped to ease some of the drudgery attached to handling heavy green material.

On most farms the same labour team was used in the field and at the silo, although occasionally in the case of pit silos an additional tractor was used for consolidating. Cutter-blowers were used for four cereal-legume crops and in three cases they were hired from the Committees. On one other farm, the cereal and legume crop was chaffed, while a 'blower' was used for filling the silos on the farm where the forage harvester was employed. Where cereal and legume crops were cut with a binder, the sheaves were sometimes fed into a cutter-blower; sometimes their bands were cut and the material fed into the silo loose; and sometimes they were put into the silo without being untied.

Practically all the motive power for hauling etc. was provided by tractors, while horses were little used. In the same way tractors were largely relied upon for the consolidation work at the pits.

The costs of cutting, carting, filling and consolidating include charges for man, horse and tractor labour based on appropriate rates on an hourly basis. Where overtime charges have been incurred or where casual labour has been employed at rates above the minimum, allowance has been made. Again, the charges for tractor labour have been varied to take into account the type of tractor used. Finally, these costs include any hiring charges for implements which may have been incurred during the process of making silage.

(c) Topping-off Silos. The majority of the silos were well consolidated and then finally sealed with a layer of soil of between six inches and one foot in thickness. In some cases a preliminary layer of straw, sacks or paper was placed on top of the silage

prior to the final sealing with soil, but the majority of farmers considered that this buffer-layer was unnecessary so long as an adequate thickness of soil was used for covering. Where soil was not used for sealing, other methods were employed to eliminate waste on top of the silo. For instance, in the case of two of the pit silos haystacks were built on top, while in other cases hedge-cuttings, thistles, straw bales, zinc sheeting etc. were used. In all cases, the cost of topping-off silos was slight and averaged only $1\frac{1}{2}$-2 per cent of the total costs of making silage.

(d) Molasses and Other Materials. In order to assist in lactic acid formation a number of farmers added molasses to the ensiled material as the silos were being filled. This was done by thirteen farmers in the case of young grass and by six in the case of cereal and legume silage. Where added, the usual rate of application was 1-2 gallons per ton of green material. Some farmers added molasses not so much because of its possible effect on the fermentation process, as for its contribution towards the increased palatability of the silage.

III. The Charges for Capital Equipment and Overheads. These accounted for only a very small proportion of the total costs of silage-making, amounting to 9.3 per cent in the case of grass and lucerne silage, and to 6.2 per cent in the case of cereal and legume silage.

(a) Depreciation on Silos and Special Equipment. It was decided to vary the depreciation charge on silos according to the type used. The concrete, wooden or galvanised iron silos were depreciated at the rate of 5 per cent of their initial cost, while for wire type silos a depreciation charge of 15 per cent of initial cost together with a charge for the paper used was made. In the case of pit type silos the cost of construction was spread over ten years, a charge equivalent to one-tenth of the cost of construction being levied. Quite a few of the pits were excavated on contract by the County Agricultural Executive Committees, the cost per pit in all cases being lower than £20. Other pits were dug by farm labour sometimes with the aid of a tractor-scoop. It was found that the majority of pits were improved slightly after the first year and in many cases it was the intention to make them into more permanent structures by bricking or cementing the sides. The idea of constructing permanent concrete pits appealed to a number of farmers as an ideal for the future.

The depreciation charge on special silage-making equipment such as buckrakes, green crop loaders, cutter-blowers etc. quite often exceeded the depreciation charge on the silos. Where special silage-making equipment was used for other tasks besides

silage-making its annual depreciation charge was appropriately allocated.

(b) Overheads. An addition was made to cover the cost of overheads during the actual process of ensilage. This was based on a percentage of the cost of man, horse and tractor labour during the time silage was being made and was additional to the charge for overheads incurred in herbage production.

One of the difficulties encountered in this investigation was that of estimating the total quantity of silage made on the individual farms. Eventually, it was decided to base this calculation on the cubic quantity of silage in relation to the weight per cubic foot in silos of varying depth.* The difficulty in many cases, however, was to obtain an accurate measurement of the cubic capacity of pit silos of irregular shape, especially when these were filled unevenly.

The Costs per Ton. A total of 16 cereal and legume silage costs and 17 grass and lucerne silage costs was obtained from the 29 farms, and the costs per ton for the two groups are given in Appendix A.

The cost per ton of grass and lucerne silage amounted to £1.11. 3, compared with a cost of £2.16. 4 for cereal and legume silage. The fact that the cost of producing silage from cereal and legume crops was 80 per cent higher than that of making grass and lucerne silage can be accounted for almost entirely by the higher costs involved in growing special mixtures for ensiling. For instance, the cost of producing the herbage for making one ton of grass and lucerne silage amounted to £0.13. 7, compared with a figure of £1.18. 0 for cereal-legume crops. Although the yield per acre of herbage was higher in the case of cereal-legume silage than in the case of grass and lucerne silage (6.3 tons compared with 4.3 tons) the higher yield was not sufficient to reduce the costs per ton to a comparable level.

The range of costs per ton is shown in Table V.

Table V.

Range of Costs per Ton.

	Lowest Costs per Ton.	Highest Costs per Ton.
	£. s. d	£. s. d
Grass and Lucerne Silage	0.14. 3	4.15. 6
Cereal and Legume Silage	1. 9. 4	10. 1. 2

* S. J. Watson, "The Science and Practice of Conservation: Grass and Forage Crops." Vol. II. Table CCCXXI. Appendix. P. 788.

The Costs per Acre. The costsper acre of silage production have been analysed for 16 farms making cereal-legume silage and for 16 farms where one cut only of grass was taken for silage. The costs are set out in Appendix B.

The cost per acre of grass and lucerne silage production amounted to £7. 1. 6 compared with a cost of £17.14.11 for cereal and legume silage. It will be seen that the costs were over two and a half times greater in the case of cereal and legume silage, the difference being largely accounted for by the higher herbage production costs. At the same time it should be remembered that the average yield was also higher by 2 tons per acre.

The wide range in costs per acre is shown in Table VI.

Table VI.

Range of Costs per Acre.

	Lowest Costs per Acre.	Highest Costs per Acre.
	£. s. d	£. s. d
Grass and Lucerne Silage	2.14. 7	20.13. 7
Cereal and Legume Silage	8.17. 9	30. 9. 1

The Labour Requirements of Silage-Making.

One of the problems facing those farmers who desire to make silage is that of fitting the operation into the general farm organisation. On many farms it was felt that silage-making tended to interfere unduly with the general farm routine, although on others the feeling was that the operation could be fitted quite easily into one of the relatively slack periods that occur from time to time during the summer. Much depended on the general attitude towards the process and on whether it was regarded as an integral part of the farm organisation or not. On most farms it was the practice to make grass silage before hay harvest commenced, though a certain amount of aftermath was also made into silage during September. In the case of cereal and legume silage it was generally possible to ensile the crop in between the hay and corn harvests. Table VII shows the distribution of silage-making during the season according to the month of cutting, and it is apparent that the spreading of silage-making over a period of six months enables it to be fitted into the farm organisation without involving any serious clash with other peak labour demands.

Table VII.

Acreages Cut for Silage-Making During Different Months.

Month of Cutting.	Grass & Lucerne Crops.		Cereal & Legume Crops.	
	Acres.	%.	Acres.	%.
May	62	21.9	$14\frac{3}{4}$	12.7
June	118	41.6	12	10.4
July	$32\frac{1}{2}$	11.5	$68\frac{1}{2}$	59.2
August	2	0.7	$20\frac{1}{2}$	17.7
September	$63\frac{3}{4}$	22.5	-	-
October	5	1.8	-	-
Total	$283\frac{1}{4}$	100.0	$115\frac{3}{4}$	100.0

As far as demands on labour are concerned, the actual requirements of silage are not excessive and compare fairly favourably with those of the hay crop. The figures shown in Table VIII again conceal wide variations in labour requirements from farm to farm. These variations depend on the labour set-up and organisation; on the degree of mechanisation; on the length of haul; on the yield per acre; and on a number of other factors, all of which have some effect on man-hour and tractor-hour requirements.

Table VIII.

Labour Requirements for Silage-Making (Cutting and Carting the Herbage and Filling and Consolidating the Silo), with Comparative Figures for Hay Harvesting.

	Grass and Lucerne Silage		Cereal and Legume Silage.		Meadow Hay*		Seeds Hay*	
	Hours per Ton.	Hours per Acre.	Hours per Ton.	Hours per Acre.	Hours per Ton.	Hours per Acre.	Hours per Ton.	Hours per Acre.
Man	3.2	14.1	3.2	20.5	7.6	9.6	7.8	11.4
Horse	-	-	-	0.1	1.0	1.2	1.0	1.5
Tractor	1.3	5.7	1.1	7.2	2.4	3.0	2.2	3.2

* Unpublished data relating to 1949 Hay Crops. Department of Agricultural Economics, University College of Wales, Aberystwyth.

The labour requirements for silage-making under the different systems of harvesting are shown in Appendix C, but it should be noted that the groups are too small to justify any dogmatic conclusions.

Harvesting Methods.

The merits and demerits of the different systems of handling green crops have aroused a considerable amount of discussion of late. Some expcnents of the art of silage-making very strongly advocate the buckrake system; others support the idea of handling the green material by means of a green crop loader; while others again contend that a non-mechanical system of raking and hand-loading can work very satisfactorily without the necessity of incurring capital expenditure on mechanical equipment. Probably all three systems have a part to play in the organisation of the handling of green material on different farms, but it is undeniable that this heavy task can be considerably lightened by employing mechanical aids. These aids may not necessarily lower the cost of harvesting, but they will at any rate make the task of silage-making less arduous and the whole question of ensilage more attractive.

In Table IX the labour cost of harvesting the green material is analysed according to the type of system employed. It should be stressed, however, that the sample of farms employing any one particular method is so small that it would be unfair to draw from it any hard-and-fast conclusions regarding the relative economy of the different systems. Again, the figures relating to the labour cost of harvesting do not include any charge for implement hire or for the use of special silage-making equipment, both of which would bear more heavily on the mechanised systems than on the non-mechanised.

Table IX.

The Labour Cost of Harvesting the Green Material.

Harvesting Method Employed.	No. of Farms.	Cutting Acres.	Total Tonnage.	Yield per Acre.	Labour Costs of Harvesting (Man, Horse & Tractor Labour). Per Acre.	Per Ton.
Grass and Lucerne Silage:	No.	Acres.	Tons.	Tons.	£. s. d	£. s. d
Manual	4	51½	173	3.4	1. 5. 8	0. 7. 8
Green Crop Loader	9	168	748	4.4	2.13. 7	0.12. 1
Buckrake	3	27¾	154	5.5	2. 3. 3	0. 7. 9
Forage Harvester	1	36	130	3.6	1.14. 9	0. 9. 8
Cereal and Legume Silage:						
Manual	11	68¼	456	6.7	3.14. 6	0.11. 1
Green Crop Loader	4	33	209	6.3	3.13. 6	0.11. 8
Forage Harvester	1	14½	65	4.5	2. 3. 3	0. 9. 8

Conclusions.

This investigation has shown that a big renewal of interest in silage-making has taken place and that a large number of new recruits are being attracted to the practice in Wales. The widespread interest shown in this method of grass conservation has not been confined to any particular area, but has ranged from the upland farms to the lowlands. It has predominated on dairy farms, although it is now spreading to some stock-rearing farms as well.

Even though a considerable increase in silage-making has taken place, however, ensilage cannot yet be regarded as an integral part of farming activity. On the majority of the farms where it was practised its importance as a method of grass conservation has not yet equalled that of haymaking. It is still generally regarded as a supplementary method of conservation which has to be fitted in to the farm routine if and when circumstances permit. Again, the 1949 season has shown that it is not completely unaffected by weather conditions. The good haymaking weather that was experienced in that year was not an incentive to the making of grass silage, while the subsequent scarcity of grass caused many farmers to forgo the idea of making aftermath silage.

Four distinct trends were apparent, however, with regard to the practice of silage-making:-

(1) There was a tendency for more and more dairy farmers to make silage.

(2) There was an infiltration of silage-making to many hill farms, where the high rainfall makes hay-making an anxious and laborious task and often results in considerable waste.

(3) More and more farmers were growing special cereal and legume mixtures for ensiling.

(4) A number of farmers were envisaging the time when their haymaking would be either drastically curtailed or completely eliminated and replaced by silage-making. This change over in the method of grass conservation has nearly been completed on a number of farms and on these ensilage had attained a definite position in the farm routine.

The process of ensilage offers opportunities for the employment of a very large number of different systems, ranging from simple non-mechanised ones requiring the minimum of equipment to highly mechanised ones requiring the latest equipment of an expensive nature. Silage can be made quite satisfactorily with those implements which are already in use on practically every farm-mowing machine, side delivery rake and trailer - but, at the same time, the task can be made much easier by the employment of buckrakes and green crop loaders. There is great scope for the development of more satisfactory systems

of work organisation in relation to silage-making, and the wide range in labour costs from farm to farm illustrates the gulf between those farmers who have evolved labour-saving systems and those who still operate on labour set-ups that are expensive. Even where mechanisation is practised its full benefits will not be secured unless care is taken in the organisation of the labour for the fieldwork. It was found, for example, that many of the mechanised set-ups were wasteful of labour, while some of the farms that relied entirely on manual methods of harvesting had low labour demands. (See Appendix C). The importance of labour costs in relation to total costs calls for the employment of ingenuity in arriving at a system of handling the allow/ green material which will/full play for a reduction in man hours per ton.

It was apparent that far too many silage-makers fed silage to their stock without any knowledge of the protein analysis of the material. Relatively few of the farmers visited had samples of their silage taken for analysis and it is probably true to say that a good deal of wastage consequently occurred in the actual feeding. Silage can be a relatively high-protein feed, but without analysis and care in feeding there is little chance of achieving economy in its use. Owing to this lack of analysis it is impossible in this report to relate costs to feeding values.

The evolution of the pit technique and the general appearance of pit-type silos, together with the increased knowledge of the science and art of silage-making, mark a turning-point in the history of this method of conservation in Britain. Welsh farmers seem eager to test the process as an alternative to the anxieties and difficulties of the traditional haymaking practice of the area, and it is to be hoped that more and more of them, particularly those in upland areas, will try their hands at ensilage in the future.

APPENDIX A.

Costs per Ton of Silage Production.

	Grass and Lucerne Silage (17 Farms).		Cereal and Legume Silage (16 Farms).	
	Cost per Ton. (1205 Tons)	Per-centage.	Cost per Ton. (730 Tons)	Per-centage.
Herbage Production:-	£. s. d	%	£. s. d	%
Rent	0. 3. 3	10.4	0. 4. 6	7.9
Cultivations	0. 2. 0	6.5	0. 7. 3	12.8
Fertilisers & Manures	0. 5. 4	17.1	0. 8. 0	14.2
Seeds	0. 1. 6	4.7	0.14. 0	25.0
Overheads	0. 1. 6	4.8	0. 4. 3	7.5
	0.13. 7	43.5	1.18. 0	67.4
Direct Costs:-				
Labour Preparing Silos	0. 0. 4	1.1	0. 0. 2	0.2
Cutting, Carting, Filling and Consolidating	0.11.10	37.9	0.12. 6	22.2
Topping-off Silos	0. 0. 8	2.0	0. 0.10	1.5
Molasses & Other Materials	0. 1.11	6.2	0. 1. 5	2.5
	0.14. 9	47.2	0.14.11	26.4
Charges for Capital Equipment and Overheads:-				
Depreciation on Silos and Special Equipment	0. 1. 6	4.8	0. 1.11	3.5
Overheads	0. 1. 5	4.5	0. 1. 6	2,7
	0. 2.11	9.3	0. 3. 5	6.2
Total Costs	1.11. 3	100.0	2.16. 4	100.0

APPENDIX B.

Costs per Acre of Silage Production.

	Grass and Lucerne Silage (16 Farms).		Cereal and Legume Silage (16 Farms).	
	Cost per Acre. (252¾ Acres)	Per-centage.	Cost per Acre. (115¾ Acres)	Per-centage.
Herbage Production:-	£. s. d	%.	£. s. d	%.
Rent	0.14.11	10.5	1. 8. 2	7.9
Cultivations	0. 8. 6	6.0	2. 5. 6	12.8
Fertilisers & Manures	1. 3.10	16.8	2.10. 5	14.2
Seeds	0. 6. 4	4.5	4. 8. 7	25.0
Overheads	0. 6. 8	4.8	1. 6. 7	7.5
	3. 0. 3	42.6	11.19. 3	67.4
Direct Costs:				
Labour Preparing Silos	0. 1. 4	1.0	0. 0.10	0.2
Cutting, Carting, Filling and Consolidating	2.15. 2	39.0	3.18.10	22.2
Topping-off Silos	0. 3. 0	2.1	0. 5. 2	1.5
Molasses and Other Materials	0. 8. 4	5.9	0. 9. 0	2.5
	3. 7.10	48.0	4.13.10	26.4
Charges for Capital Equipment and Overheads:-				
Depreciation on Silos and Special Equipment	0. 6.10	4.8	0.12. 5	3.5
Overheads	0. 6. 7	4.6	0. 9. 5	2.7
	0.13. 5	9.4	1. 1.10	6.2
Total Costs	7. 1. 6	100.0	17.14.11	100.0

APPENDIX C.

Labour Requirements for Silage-Making (Cutting & Carting the Herbage and Filling and Consolidating the Silo).

Harvesting Method Employed.	Man Hours Harvesting.		Horse Hours Harvesting.		Tractor Hours Harvesting.	
	Per Acre.	Per Ton.	Per Acre.	Per Ton.	Per Acre.	Per Ton.
Grass and Lucerne Silage:-						
Manual	9.9	2.9	-	-	3.2	1.0
Green Crop Loader	15.2	3.4	-	-	6.4	1.4
Buckrake	10.9	2.0	-	-	6.3	1.1
Forage Harvester	11.5	3.2	-	-	3.4	0.9
Cereal and Legume Silage:-						
Manual	22.4	3.3	0.2	0.04	8.2	1.2
Green Crop Loader	19.6	3.1	-	-	6.8	1.1
Forage Harvester	13.4	3.0	-	-	3.9	0.9