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# Economic Aspects of Selecting and Growing Silage Crops

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# ECONOMIC ASPECTS OF SELECTING AND GROWING SILAGE CROPS [1/]

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## Introduction

Forage crops are of major importance in dairy and beef feeding as they account for 25 to 30 percent of the cost of producing milk and 40 to 50 percent of the cost of producing beef. Forage and concentrates together add up to 45 to 75 percent of all livestock costs. Cost of forage in a livestock ration can be minimized either by (1) reducing unit costs, (2) by increasing quality which may result in higher production of milk or beef or reducing protein supplement needs,(3) by substituting to lower cost forage crops. Unit costs of producing a ton of forage dry matter can usually be reduced by increasing yields, reducing harvest and storage losses and changing to higher yielding forage crops.

## Factors influencing choice of system

System selection is dependent upon an individual farm's resources. The forage crop or crops to grow or buy should usually be those that provide the largest net return to the farm business. [3/] The overall organization of the business should be such that it maximizes returns to the total farm.

Many combinations of technology are possible for growing, harvesting, storing and feeding forages. Today's concern is to select the inputs and machinery that will enable one to store the greatest amount of nutrients consistent with the added cost of the additional nutrients.

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1/ Paper presented at International Silage Research Conference, Washington, D. C., December 1971. (Agricultural and Applied Economics Staff Paper P 71 - 23).

2/ The author is indebted to C. R. Hoglund, G. D. Schwab and M. B. Tesar as their report and other research data and comments from Professor Hoglund formed the basis for this paper.

3/ Farmers are often told to maximize returns to livestock, forages or labor rather than to the business.

Methods of forage handling vary from highly mechanized to very labor intense systems. Generally the high capital systems require less labor relative to low capital-high labor systems. Equipment that substitutes capital for labor may make work easier for the operator. He must also realize that it will result in less profit to him if the labor freed by the machine is not employed elsewhere in the farm business.

To maximize returns requires sound business and production management. Forage production decisions involve determination of crop yield goals, input levels and their associated costs in addition to determination of price relationships between nutrients grown and purchased. For example, a ten percent increase in the price of fertilizer may require a cut back of the optimum amount to be applied, depending on the marginal yield relationship.

When selecting a system one should examine the complete systems of harvesting, storing and feeding, since all three are interrelated. The annual cost, labor and capital requirements of each system should be compared to determine which most nearly meets the resource requirements of the farm and personal preferences of the individual producer.

When determining the most practical forage handling system for an individual farm, several factors in addition to the cost must be considered. Availability of capital is important. If capital is limited or a more profitable alternative use exists, then capital intensive systems (concrete stave and sealed storage) may have to be ruled out (17). Yet, in other instances, limited labor or high labor costs may necessitate that only low labor requirement systems be considered.

The skill and experience of the operator with various systems and methods of harvest should be considered. The differences in costs among many systems are small. This indicates that for many given situations there may be several alternative systems of similar desirability from a cost standpoint. In such cases the efficiency with which the chosen system is managed will be as important or more important than the choice of system. Good management is necessary for satisfactory performance with any system. If the operator is likely to be considerably less efficient than average with a particular system, his costs for that system will be greater.

Some systems may have an advantage over others on a given farm because of the availability of certain fixed assets. For instance, an existing silo might reduce the relevant costs of a haylage system since the fixed costs for the silo are "past costs" and will be incurred whether it is used or not. Therefore, these costs should be ignored when calculating the cost of a haylage system.

The system's capacity to harvest a sufficient volume of forage during the harvesting season is an important consideration at larger volumes. Other things being equal, the system with the greater potential capacity has the advantage since a short or unfavorable harvest season will be less likely to prevent the harvesting of a sufficient amount of forage for livestock.

## Factors influencing choice of crops

Crop selection is also modified by individual farm resources. The crops planted are influenced by soil type, topography, climatic environment, relative yields and personal preferences. Rotation management and climate have a smaller influence than previously on crop selection because of new hybrids and varieties.

Advances in harvesting and handling equipment for all forage systems have minimized the technology influence on crop selection. One of the major factors affecting forage quality is stage of maturity at harvest. As forage matures its nutritive quality declines. For this reason the cost of over capacity in equipment is much smaller than the penalty for undersized machinery.

Corn silage has benefited from the development of new technology and improved cultural practices. United States corn grain yields have doubled in the last 15 years and silage yields have shown similar increases. The increased forage has come from the use of production practices and inputs such as minimal tillage, higher plant populations, higher fertilization levels, chemical control of weeds and insects and improved harvesting equipment (6). Research data on the loss of quantity and quality has placed more farm emphasis on timeliness in planting and harvesting. Improvements in storage facilities and know-how of silage preservation has increased the advantage of silage. Any management practice that increases the nutrients available for feeding lowers the cost per ton of silage.

The alfalfa crop has also benefited from new technology. Improved seeding practices, proper fertilization and seedings with chemical weed control have produced economical yields the year of seeding. More emphasis on fertilization and more frequent harvests have resulted in higher alfalfa yields and more TDN and protein per acre. Development of the techniques of storing forages as low moisture silage and labor saving equipment to fill and unload silos have made alfalfa more competitive. Research in many states report 6 or more tons per acre from three cuttings of alfalfa. Harvested yields under excellent management are reported by Hoglund for Indiana and Ohio which approached 8 tons per acre on highly productive soils (7). These yields lower the per ton cost of production as many of the costs remain constant regardless of yield.

Estimation of the value of forages

Selection of forages based on a cost of production analysis has several weaknesses such as the variation in quality and relative proportion of nutrients. Variation in quality was reported in a Purdue University study where corn silage contained a consistent 8% crude protein on a dry matter (DM) basis. On the other hand, there was a tremendous variation in protein content between harvests of legume-grass mixtures (12).

Dollar estimation of returns over feed costs are widely used as a measure of feed value. In a long-term study reported by Donker and Marten (3) the returns above feed costs were higher by about $60 per cow per year from those cows fed early vs. late cut forage. This was due to both the decreased in-take of late cut alfalfa and the decreased availability of energy per pound consumed. In some cases they reported animal production was more affected by intake than by changes in the energy level of the forage fed (3).

An appropriate estimation of feed values is possible by chemical composition along with relative feed stuff costs. If livestock nutrition needs are specified in terms of requirements and restrictions, then a linear programming least cost forage and grain ration can be formulated.

Scientists at Purdue used such a linear program to determine the factors that affected the value of forages given a set of requirements and restrictions(12). They reported how the values of forage in the ration is determined not only by the composition and cost of the forage but also by the alternative feeds available. For example, where urea was available and used, it increased the competitiveness of corn silage. Feeding unrestricted amounts of urea lowered the value of alfalfa. As shown on Table 1, low protein alfalfa was worth only 58% as much as corn silage valued at $6.36 per ton but 90% as much when corn silage was valued at $8.48 per ton. With the coefficients used, good quality alfalfa was able to compete with corn silage.

## Total Farm Budgeting

Hoglund, et al. (9) reported a study on growing, harvesting and feeding three combinations of corn silage and alfalfa. They compared total cost of feeding a 120-cow Holstein dairy herd for a year under these three situations. Inputs and costs were calculated for three qualities of cropland and for two assumed levels of forage management.

They used partial budgeting to explain the "whys" behind recent cropping and feeding trends and to determine least-cost rations under varying soil and crop management alternatives.[4/] The feed requirements were budgeted for a 120-cow herd and necessary replacements. This herd size was chosen as it is large enough to be economical to utilize modern forage equipment which tends to improve forage quality and reduces labor needs.

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4/ Partial budgeting considers only those cost items which change when different forage alternatives enter into the analysis. Similar results would have been obtained by linear programming.

Three important soil productivity groups were included in this analysis of the major dairy areas in southern Michigan. The area would be representative of several other sections of the Lake States as well as Northern Iowa and Minnesota. Since I cannot describe all possible soil types and conditions, I will use the Hoglund study (9) as representative of a possible method for further research. The three groups were designated as I (highly productive), II (moderately productive) and III (less productive). In terms of corn grain productivity they would represent 142, 120,86 bushels per acre for groups I, II and III, respectively, under excellent management. Group I soils are suitable for intensive corn production while Group III would be limited to no more than 50 percent of the cropland in corn.

Three different proportions of alfalfa and corn silage were analyzed in the study. These included the following percentages of the forage dry matter supplied from corn silage (a) 70 percent, (b) 50 percent and (c) 30 percent. Alfalfa supplied the balance of the forage dry matter or 30, 50 and 70 percent, respectively. An all corn silage forage ration would have been an alternative for Group I soils, but it was not considered in that study. One reason for not budgeting smaller percentages of either alfalfa or corn silage was that quantities grown and harvested would be too small to economically utilize specialized equipment.

Research results (1, 4, 16) show equally high milk production when cows were fed varying proportions ranging from all corn silage to all alfalfa hay when properly supplemented with grain and protein. From an economic standpoint, Hoglund reports it will be necessary to increase yields substantially if alfalfa is to compete favorably with corn silage for cropland on farms with the more productive land (8). Current technology and production practices are available for much higher yields of alfalfa than are normally attained.

<u>Relationship of land to cows in a Northeastern study (2)</u>

In the Northeastern States most of the grain fed to milk cows is purchased rather than grown. The relationship between milk cow numbers and cropland productivity is very important in determining what to grow. On highly productive land suitable for continuous row crops often these farms will have a comparative advantage in the production of corn silage up to the fixed labor limit, when less than one acre per cow is available. On farms with ratios of less than one acre per cow, most producers could pay dearly to secure additional land for forage production, unless an inexpensive forage substitute was available. When land is limited to ratios of less than 1 to 1, the marginal value of labor becomes very high during planting and harvesting time. When labor was completely utilized at corn planting or harvesting periods hay crop silage came into the optimum solution. When land is more plentiful at land to cow ratios more than 1 to 1, hay crop silage with less TDN per acre but high protein came into the optimum solution. Only after the forage needs are fulfilled does corn for grain come into solution on Northeastern dairy farms (2).

Assumptions in the Hoglund et al. study (9)

An economic analysis of alternative forage crops requires certain assumptions relative to levels of management, acres of cropland available, yields, quality, inputs and prices. For each soil group in the study, a specific acreage of cropland was assumed. This was 280, 310 and 370 cropland acres for the three soil Groups I, II and III , respectively. It was also assumed that alfalfa would be seeded in an oat crop which was harvested for grain. Further budgeting would include direct seeding established with chemicals and purchased straw compared to the companion crop situation. Clear alfalfa was budgeted even though many dairymen will continue the practice of seeding alfalfa with brome or other grasses.

Levels of management

Two levels of management termed "good" and "excellent" were budgeted for the three soil groups and the three forage crops combinations. The management skills were assumed to represent dairymen's actual levels of application of yield-increasing forage production and harvesting practices. They were based on the degree of adoption of improved production practices including use of recommended quantities of lime and fertilizer, use of improved seed varieties, timing of harvesting and storage operations which affect harvest and storage losses, quality of forage and feeding skills.

Good management practices would approximate what the top one-third of dairymen now accomplish. Excellent management was associated with a small percent of dairymen who excel in all phases of forage production and feeding. The yields under excellent management were assumed to be 25 percent above those produced with good management practices. This level should represent the goals of dairymen concerned with minimizing costs of forage which will be reflected in the total farm return.

Yields and land requirements

Yields of alfalfa, corn silage and corn grain were estimated for the three soil groups and the two production management levels and are shown in Table 2. The yields of alfalfa are based on harvesting the forage at moisture levels ranging from 50 to 70 percent but averaging 65 percent, as low moisture silage. Corn silage was estimated to contain approximately 68 percent moisture and corn grain was reported on a number two corn basis. These yields were based on crop yield research information supplied by the Department of Crop and Soil Science at Michigan State University and are what top dairy farmers are achieving on comparable soils in the Lake States area. It is important to distinguish between the harvested yield and the amount preserved for feeding basis. The latter is used to arrive at the quantities available for feeding. This amount is determined by subtracting storage and handling losses from harvested yields.

Once the corn grain yields were established, the following factors were used in estimating corn silage yields (5).

| Yields of corn grain | Bushels of corn per ton of corn silage |
|---|---|
| Less than 90 bushels | 5.0 |
| 90-110 bushels | 5.5 |
| 110-130 bushels | 6.0 |
| 130 and more bushels | 6.5 |

The total acres of forage and grain needed to supply feed for 120-cow Holstein herd were calculated for the three soil groups and for the three combinations of alfalfa and corn silage. For Group II cropland the acres needed are reported on Table 3. The application of excellent management resulted in somewhat more than a 20 percent reduction in the total acreage of feed crops required. Likewise, as the percent of corn silage in the ration was increased from 30 to 50 percent and 50 to 70 percent the total acres of both forage and grain crops were reduced markedly.

Feed requirements

Total annual feed requirements for a Holstein cow and her replacement were calculated for the three combinations of forage and two levels of management (Table 4). The feeding requirements were based partly on data from Morrison's Feeds and Feeding adjusted for more recent research results in feeding a 1,300 pound cow with annual milk sales of 13,000 pounds. Forage quality was assumed to be higher under excellent management compared to forage produced under good management.

In the Hoglund study (9), forage requirements for the six alternatives were based on an equal DM tonnage fed per cow. In general, research results show a lower forage DM consumption for rations high in corn silage compared to those high in hay. It is assumed that wastage in feeding is less for alfalfa silage than hay and that forage quality is higher for alfalfa silage, thus the justification of equal dry matter fed for the six feeding alternatives.

Investments and Annual Costs for Harvesting, Storing and Feeding

The total quantities of corn silage and alfalfa silage harvested for the three combinations of forage crops are as follows:

| Percent Corn Silage | Tons Harvested 30 | 50 | 70 |
|---|---|---|---|
| Corn silage (32% DM) | 864 | 1,440 | 2,016 |
| Alfalfa silage (40% DM) | 1,600 | 1,150 | 700 |

The total tons of forage dry matter harvested was nearly the same or about 920 tons for each of the three combinations of corn silage and alfalfa.

In the Hoglund study (9), the harvesting and handling equipment for the forage crops and the silage storage and feeding equipment needed to feed the material to a 120-cow dairy operation was calculated for the three combinations of forage crops grown. It was assumed that corn grain and oat harvesting was custom hired while all forage crops were harvested by the operator. There was little difference in the total investments for the three alternatives (Table 6). The highest investment was for the 30 percent corn silage - 70 percent alfalfa silage alternative which was $1,900 higher than the investment for the 70 percent corn silage - 30 percent alfalfa silage program. This difference is only about $2.00 additional investment per ton of dry matter. The investments for the complete forage harvesting, storing and feeding system ranged from $500 to $516 per cow.

Costs of depreciation, repairs, insurance, taxes [5/] and interest were calculated for the various harvesting and handling equipment and the silos. Equipment was depreciated over an 8 to 10 year period and silos over a 20 year period. The total annual costs for machinery, equipment and storage ranged from $8,516 to $8,742 per farm. This was an average of about $70 per cow. Annual costs were $226 higher for the 30 percent vs. the 70 percent corn silage alternative.

## Cost to Grow, Harvest and Store the Feed Crops for 120-Cow Operation

The 1972-73 projected costs of all inputs including lime, fertilizer, herbicide and insecticides, seed, fuel, protein supplement, and labor are shown in Table 5. Investments and costs for machinery and equipment were based on present prices adjusted upward for expected cost increases.

All costs of growing, harvesting, storing and feeding of the forage and grain crops were calculated for a 120-cow dairy operation for the three soil groups, the two levels of management and for the three combinations of alfalfa and corn silage. The charge for land was based on land values per acre of

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5/ If applicable.

$600, $475, $300 for Groups I, II and III soils, respectively. The annual use cost per acre was 8.5 percent of the total land value. The 8.5 percent annual rate was based on a 7 percent charge for interest on investment and 1.5 percent to cover taxes and other direct land costs. Costs for seed, fertilizer, lime, insecticides and herbicides were based on the input costs in Table 5 multiplied by rate and acres. The cost of the tractor operation including depreciation, repairs, insurance and interest and fuel and oil used to grow and harvest the crops were based on time requirements for the various activities multiplied by appropriate cost figures per acre. Both hired and operator's labor was charged at $3.00 per hour. Cost of purchased bedding was added as the quantity available varied with proportion of alfalfa seeded.

Feed costs with highly productive cropland (Group I, Table 7)

Group I soils are in areas with highly productive loams that are nearly level. Tile drainage was assumed necessary to obtain the projected high yields. For comparison of the three forage combinations, a limit on the acreage available for cropland was set for each productivity of land. For Group I, 280 acres of land was assumed. With this acreage limitation and the 120-cow herd assumption corn grain was purchased with "good management" and increasing quantities of corn grain were sold (as silage proportion increased) with the "excellent level of management". All land not needed in the production of forages was assumed planted to and harvested as corn for grain. This grain was sold as a cash crop.

With good management practices a reduction of nearly $2,300 or $19 per cow in net cost of feed attained in going from 30 percent to 50 percent corn silage. An additional $1,645 or $14 per cow was attained in going from 50 percent to 70 percent of the forage DM feed from corn silage (Table 7). With excellent management the reduction in feed costs as corn silage fed increased were not as high as with good management. These differences were significant and in the same direction as the amount of corn silage fed increased. The excellent management practices resulted in sharp reductions in the total cost of feeding the 120-cow dairy operation compared to costs with good levels of management.[6] These reductions ranged from nearly $8,200 for the 30 percent level of corn silage to $6,958 for the 70 percent corn silage alternative (Table 7). For highly productive cropland, it appears essential that a maximum acreage of corn silage be utilized under the yield and cost relationships assumed in this study. Many dairymen find it profitable to grow corn silage and grain on a high percent of their cropland up to the limit of their machine timeliness capacity.

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6/ Similar conclusions were obtained from an unpublished L.P. study by F. G. Mentzer, Jr., "The Economics of Some Alternative Methods of Feed Crop Production, Harvesting and Utilization for an Eastern Massachusetts Dairy Farm". M.S. Thesis, University of Massachusetts, 1965.

Dairy farming is not an important enterprise in many areas of highly productive cropland. In the Saginaw-Thumb area in Michigan and the northern corn belt areas, first priority is usually given to the production of high value cash crops. Dairy farming is often a secondary enterprise on these basically cash crop farms. Cattle feeding is an important livestock enterprise in many highly productive cropland areas. Dairy farming must be efficient and economical to compete with these alternative enterprises.

Feed costs with moderately productive cropland (Group II, Table 8)

Dairying is an important enterprise in areas in which moderately productive soils predominate. Representative soils would be predominately silt loam with some sandy loams and level to gently rolling topography.

The net cost of producing feed for the 120-cow Holstein herd was similar for Group II compared with Group I soils. The costs on Group II soils were slightly lower under the good management practices but about the same or slightly higher for the excellent management practices in comparison to the Group I soils.

When good management practices were used, feed costs were reduced by $1,469 ($12 per cow) in switching from 30 percent to 50 percent corn silage and by an additional $1,105 ($8 per cow) in going from 50 to 70 percent. The gains in feed costs from going from the 30 to 50 or 50 to 70 percent corn silage were less for this productivity of land than for the highly productive corn land designated as Group I. This was due to the competitive advantage held by the more productive soils.

When high level management practices are applied in producing both alfalfa and corn silage, the gains in favor of corn silage are reduced. On Group II soils, a dairyman's decision to grow and feed 50 or 70 percent corn silage of the total forage ration would probably be determined by the total amount of cropland available, distribution of harvest labor and storage facilities. June labor peaks were 20 percent lower when at least 50 percent of the forage dry matter came from corn silage. September labor peaks were nearly identical for all three combinations of corn silage and alfalfa. Personal choice and risk are also factors to be considered by the feeder.

Feed costs with less productive cropland (Group III, Table 8)

Dairy farming is an important enterprise in areas in which less productive and often rolling cropland occurs. Production limitations on these soils are acidity, relatively low fertility, erosion hazards on the more sloping areas, low content of organic matter and low moisture holding capacity. These soils are best suited for a combination of alfalfa and corn silage. The budgets include 30 or 50 percent of the forage dry matter fed from corn silage.

With the yield and cost relationships assumed previously, the net cost of feed was reduced by only $543 with good management and by only $175 with excellent management in going from 30 to 50 percent corn silage. Cost would probably be minimized by staying somewhere in a range between 30 and 50 percent of the land in corn silage depending to topography.

Forage systems for beef cows compared

The costs and resource requirements for six different systems for harvesting, storing and feeding hay suitable for beef cow enterprises are compared in a Minnesota study (11). Two handling systems in each of three forms: baled, loose, and haylage, are compared.

It was concluded that in large herds of 200 or more cows haylage systems were feasible alternatives with comparable costs and probably greater harvest capacity for the season than the loose hay systems. However, they require possibly more critical managerial skill and more capital than the other systems. Baled hay apparently is practical only in situations where the volume of hay handled is low, labor is cheap and plentiful and expected losses from loose stacks are excessively large. Low moisture silage in Wisconsin had 6 to 8% less total loss at the excellent stage compared to baled hay and 10 to 14% less loss even under poor hay management (13).

In many cases the differences in costs between several of the alternatives budgeted were small, which indicates that for any given situation there may be several alternative systems of hay harvesting and handling which would be of about equal cost. Therefore, the efficiency with which the chosen system is managed may be nearly as important as the choice of system.

Studies in Wisconsin (10) and Pennsylvania (15) evaluated forage harvesting, storing and feeding systems on dairy farms. The Pennsylvania study compared the profitability of various forage handling systems on a representative dairy farm. Profits were based on returns from the sale of milk and the sale of forage not needed by the dairy herd. At both the 30 and 70 cow sizes there were many systems about equal in profitability. At the 70 cow size all of the most profitable systems were silage of combination silage and baled or chopped dry hay systems. The all baled hay or all chopped dry hay systems were less profitable than the systems containing silage for 70 cow herds. They further concluded that the greatest returns were realized with the use of mechanized systems as acres and wage rates increased and/or family labor available decreased. Current census data shows each of these variables are trending in the direction indicated.

The Wisconsin study found no significant differences in net farm income between dairy farms using baled hay, chopped hay, or haylage as the major forage. However, the total cost of handling a ton of baled hay from the field to feeding for the most efficient baled system was about $1.80 to $2.60 less than for haylage. This finding differed from the results of the Minnesota study. Several differences in assumptions between the two studies seem to account for this difference. The Wisconsin study did not make a direct comparison of harvest losses between the two systems which would have added about $1.90 per ton to baled hay costs. They reported that dairy farmers spent the same amount of time for feeding baled hay as for haylage, while the Minnesota study estimated that haylage feeding would require less time than baled hay per ton for feeding to beef cow herds. This difference in estimated feeding time gave a $1.00 per ton advantage to haylage in the Minnesota study.

The above discussion indicates the importance of carefully reviewing the assumptions and methods of analysis of a study before applying the results to a given situation.

Storing corn grain in silos

A practice that has gained popularity in the Midwest is that of storing high moisture shelled corn or ground ear corn in silos. There is considerable interest in this method as it eliminates drying, permits earlier harvest and has potential feeding efficiency gains for some classes of livestock (14). Present handling and feeding equipment exists so that this feed can be easily mechanized, Additional work is needed in getting feeders to balance their rations using the correct moisture levels and DM feed values of all high moisture feeds.

Remote computer analysis

Many Midwest colleges and universities are now using the computer to calculate least cost rations by use of linear programming. Michigan State University has developed a small linear program that is capable of solving least cost rations by remote access. This program can be accessed by a remote teletype terminal or touch-tone phone. There is currently a lot of interest in livestock areas for on the farm ration balancing and least cost determination. By using the remote access technology several farms in Minnesota are currently inputting their feed alternatives, composition and costs to obtain by telephone the least cost ration given their resource restrictions.

## Summary

Forage crops account for a large portion of the costs of livestock production. The management or mis-management of forage affects the total profits of the business. Costs of forage production can be reduced by increasing yields and/or quality, reducing losses or changing to different crops.

The selection of a forage system must consider the existing resources of the business. Systems should be selected based upon labor requirements, capital investments and annual costs. Limited labor necessitates low labor systems. Limited capital necessitates low capital systems. Good to excellent management ability is needed for any system to operate profitably.

Crop selection is modified by the cropland available and productivity. More emphasis is needed on relative yields between forages as a criterian for selection. On highly productive cropland, to maximize profits requires a maximum of corn silage grown. When land was limited corn silage as the forage source came into the optimum plan up to the limit of available labor.

Forage quality data are needed with production costs and feed alternatives before one can objectively evaluate forage systems. The quality of the forage fed in turn affects the amount of concentrate fed or purchased.

When excellent management practices were assumed in the Michigan (9) study, the total costs of feeding were sharply reduced. With both good and excellent management practices there were gains in going from 30 to 70 percent corn silage as the DM forage source. In many cases the differences between systems were small but the efficiency with which a system was managed was as important as the choice of the system.

Table 1. Comparative Value of Corn Silage and Alfalfa in a Dairy Ration. 1/

| Corn Silage 2/ | Value of Alfalfa as a % of Corn Silage 3/ | | | |
|---|---|---|---|---|
| | C.P. % 4/ | 13.0 | 15.8 | 17.8 |
| | TDN % 4/ | 46 | 53 | 56 |
| $ 6.36 per ton | | 58 | 130 | 169 |
| 8.48 per ton | | 90 | 136 | 160 |
| 10.61 per ton | | 120 | 145 | 160 |

1/ Source (12).

2/ Cost per ton of 35% DM.

3/ Values rounded to whole numbers and expressed on same DM basis as corn silage.

4/ Composition based on 90% DM.

Table 2. Estimated Yields of Alfalfa and Corn Silage and Grain, Three Soil Management Groups and Two Production Management Levels. 1/

| Soil Management Group and Crop | D. M. % | Relative yields with management level of: 2/ | | | |
|---|---|---|---|---|---|
| | | Good 3/ | | Excellent 4/ | |
| | | Harvested | Preserved for feeding | Harvested | Preserved for feeding |
| I | | | | | |
| Alfalfa | 90 | 5.0 | 4.5 | 6.3 | 5.7 |
| Corn Silage | 32 | 18.2 | 17.1 | 22.8 | 21.4 |
| Corn Grain | 84.5 | 114 | 107 | 142 | 135 |
| II | | | | | |
| Alfalfa | 90 | 4.6 | 4.2 | 5.8 | 5.2 |
| Corn Silage | 32 | 16.2 | 15.2 | 20.2 | 19.0 |
| Corn Grain | 84.5 | 96 | 92 | 120 | 114 |
| III | | | | | |
| Alfalfa | 90 | 4.0 | 3.6 | 5.0 | 4.5 |
| Corn Silage | 32 | 11.8 | 11.0 | 14.8 | 13.8 |
| Corn Grain | 84.5 | 69 | 66 | 86 | 82 |

1/ Source (9).

2/ The yields of alfalfa are based on harvesting the forage at an average moisture of 65%, (low moisture silage). Quantities preserved for feeding are based on a 10% loss in storage and feeding for alfalfa, 6% for corn silage and 5% for corn grain.

3/ These yields are better than average farmers are achieving today.

4/ These yields are attainable with the application of recommended cultural and production practices. They are achieved only by the top alfalfa and corn growers.

Table 3. Acres Needed to Grow all Feed for a 120-Cow Holstein Herd. Group II Soils and Three Percentages of Alfalfa and Corn Silage with Good and Excellent Management Practices. 1/

| | 30 Percent Corn Silage 70 Percent Alfalfa | | 50 Percent Corn Silage 50 Percent Alfalfa | | 70 Percent Corn Silage 30 Percent Alfalfa | |
|---|---|---|---|---|---|---|
| | Good Management | Excellent Management | Good Management | Excellent Management | Good Management | Excellent Management |
| Corn Silage | 57 | 46 | 95 | 76 | 133 | 106 |
| Alfalfa | 174 | 136 | 123 | 95 | 74 | 57 |
| Total Forage Crops | 231 | 182 | 218 | 171 | 207 | 163 |
| Corn Grain | 112 | 87 | 107 | 84 | 102 | 81 |
| Oats for Seeding Alfalfa | 58 | 45 | 41 | 32 | 25 | 19 |
| Total Acres Needed | 401 | 314 | 366 | 287 | 334 | 263 |
| Reduction in Acres 2/ | | 87 | | 79 | | 71 |

1/ Source (9).

2/ Due to use of better management practices.

Table 4. Calculated Annual Feed Requirements per Holstein Cow and Replacement. Three Combinations of Corn Silage and Alfalfa and Two Crop Production Management Levels, 1,300 Pound Cow and 13,000 Pounds Milk Sold per Cow. 1/

| Percent of Forage DM from Corn Silage | Quantities of Feed Fed: Corn Silage 2/ | Alfalfa 3/ | Corn grain (corn and cob meal) | Soybean oil meal | Urea |
|---|---|---|---|---|---|
| | tons | tons | bushels | lbs. | lbs. |
| 30 percent | | | | | |
| Good Management | 7.2 | 6.1 | 86 | 100 | 75 |
| Excellent Management | 7.2 | 5.9 | 84 | --- | 75 |
| 50 percent | | | | | |
| Good Management | 12.0 | 4.3 | 82 | 250 | 120 |
| Excellent Management | 12.0 | 4.1 | 80 | 100 | 120 |
| 70 percent | | | | | |
| Good Management | 16.8 | 2.6 | 78 | 400 | 170 |
| Excellent Management | 16.8 | 2.5 | 78 | 200 | 170 |

1/ Source (9).

2/ 32% DM corn silage.

3/ 65% moisture alfalfa silage adjusted to 90% DM hay equivalent.

Table 5. Projected Costs of Inputs and Prices Received. [1]

| Item | Unit | Cost per Unit |
|---|---|---|
| | | Dollars |
| Lime (custom spread on field) | ton | 8.00 |
| Fertilizer | | |
| N | lb. | 0.10 |
| $P_2O_5$ | lb. | 0.12 |
| $K_2O$ | lb. | 0.06 |
| Herbicide - corn | acre | 6.00 |
| Weevil control - alfalfa | acre | 8.00 |
| Seed | | |
| Corn | bu. | 24.00 |
| Oats | bu. | 2.00 |
| Alfalfa | cwt. | 80.00 |
| Brome-grass | cwt. | 30.00 |
| Corn grain - purchased | bu. | 1.30 |
| Corn grain - sold | bu. | 1.15 |
| Gasoline - tank truck | gal. | 0.32 |
| Diesel fuel - tank truck | gal. | 0.22 |
| Soybean oil meal | cwt. | 6.00 |
| Urea | cwt. | 6.00 |
| Labor | hour | 3.00 |

[1] Source (9).

Table 6. Investments and Annual Ownership and Maintenance Costs for Harvesting, Storing and Feeding Forage Crops for a 120-Cow Holstein Herd. Three Forage Rations. 1/

| Item | Investments | | | Percent 2/ | Annual Costs | | |
|---|---|---|---|---|---|---|---|
| | Percent Corn Silage | | | | Percent Corn Silage | | |
| | 30 | 50 | 70 | | 30 | 50 | 70 |
| | ----- Dollars ----- | | | | ----- Dollars ----- | | |
| Harvesting equipment | | | | | | | |
| Mower-Conditioner | -- | -- | 1,600 | 20 | -- | -- | 320 |
| Side delivery rake | -- | -- | 700 | 20 | -- | -- | 140 |
| S.P. windrower | 4,200 | 3,600 | -- | 17 | 714 | 612 | -- |
| S.P. field chopper | 10,000 | 10,000 | 10,000 | 17 | 1,700 | 1,700 | 1,700 |
| Corn head | 1,000 | 1,200 | 1,200 | 16 | 160 | 216 | 240 |
| Forage head | 1,000 | 800 | 800 | 18 | 180 | 136 | 128 |
| Blower | 1,000 | 1,000 | 1,000 | 20 | 200 | 200 | 200 |
| Mechanical wagons | 4,800 | 4,800 | 4,800 | 16 | 768 | 768 | 768 |
| Sub-Totals | 22,000 | 21,400 | 20,100 | | 3,722 | 3,632 | 3,496 |
| Storage and unloading | | | | | | | |
| Silos | 32,200 | 32,200 | 32,200 | 10 | 3,220 | 3,220 | 3,220 |
| Unloaders | 4,500 | 4,500 | 4,500 | 20 | 900 | 900 | 900 |
| Plastic covers | | | | | 420 | 420 | 420 |
| Sub-Totals | 36,700 | 36,700 | 36,700 | | 4,540 | 4,540 | 4,540 |
| Feeding equipment | | | | | | | |
| Feed bunk | | | | | | | |
| Mechanical feeder | 3,200 | 3,200 | 3,200 | 15 | 480 | 480 | 480 |
| Total Investments | 61,900 | 61,300 | 60,000 | | 8,742 | 8,652 | 8,516 |

1/ Source (9)

2/ Annual use cost as a percent of investment. Includes depreciation, interest, repairs, taxes and insurance.

Table 7. Total Cost of all Feed and Purchased Bedding for 120-Cow Holstein Herd, Including Replacements. Highly Productive Cropland (Soil Group I) 280 Acres. 1/

| | Good Management | | | Excellent Management | | |
|---|---|---|---|---|---|---|
| | Percent Corn Silage | | | Percent Corn Silage | | |
| Expense Item | 30 | 50 | 70 | 30 | 50 | 70 |
| | - - - - - Dollars - - - - - | | | - - - - - Dollars - - - - - | | |
| Land charge | 14,280 | 14,280 | 14,280 | 14,280 | 14,280 | 14,280 |
| Seed, fertilizer and lime | 5,975 | 6,681 | 7,341 | 8,532 | 9,635 | 10,566 |
| Insecticide and herbicide | 1,682 | 1,682 | 1,673 | 1,676 | 1,674 | 1,678 |
| Power, fuel and oil | 3,104 | 2,748 | 2,437 | 2,615 | 2,348 | 2,136 |
| Harvesting machinery | 3,722 | 3,632 | 3,496 | 3,722 | 3,632 | 3,496 |
| Storage, handling and feeding | 5,020 | 5,020 | 5,020 | 5,020 | 5,020 | 5,020 |
| Labor | 4,439 | 4,110 | 3,825 | 4,715 | 4,453 | 4,134 |
| Custom hire 2/ | 781 | 1,012 | 1,187 | 1,573 | 1,761 | 1,903 |
| Bedding 3/ | 660 | 820 | 970 | 780 | 900 | 1,020 |
| Purchased feed | 9,848 | 7,240 | 5,349 | 540 | 1,584 | 2,684 |
| Total Expenses | 49,511 | 47,225 | 45,578 | 43,453 | 45,287 | 46,917 |
| Less crop sales | -- | -- | -- | 2,127 | 5,416 | 8,297 |
| Net Cost of feed | 49,511 | 47,225 | 45,578 | 41,326 | 39,871 | 38,620 |
| Change in cost due to: | | | | | | |
| Improved practices | | | | -8,185 | -7,354 | -6,958 |
| Increased corn silage 4/ | | -2,286 | -1,647 | | -1,455 | -1,251 |

1/ Source (9).

2/ Harvest of corn grain and oats crops.

3/ Since it was assumed that alfalfa seedings would be made in oats, the cost of bedding purchased varied with the proportion of land seeded to alfalfa each year, thus the cost of purchased bedding was included in total costs.

4/ Change resulting from increasing corn silage from 30 to 50 and from 50 to 70 percent of forage dry matter fed.

Table 8. Total Cost of all Feed and Purchased Bedding on Moderately Productive Cropland (Soil Group II) 310 Acres and Less Productive Cropland (Soil Group III) 370 Acres. 1/

| | Good Management | | | Excellent Management | | |
|---|---|---|---|---|---|---|
| | Percent Corn Silage | | | Percent Corn Silage | | |
| Items | 30 | 50 | 70 | 30 | 50 | 70 |
| | ----- Dollars ----- | | | ----- Dollars ----- | | |
| Moderately Productive Cropland 310 Acres | | | | | | |
| Total Budgeted Expenses | 48,212 | 46,743 | 45,638 | 43,058 | 44,890 | 46,848 |
| Less Crop Sales | -- | -- | -- | 1,489 | 4,551 | 7,222 |
| Net Cost of Feed | | | | 41,569 | 40,339 | 39,626 |
| Change in cost due to: | | | | | | |
| Improved practices | | | | -6,643 | -6,404 | -6,012 |
| Increased corn silage 2/ | | -1,469 | -1,105 | | -1,230 | - 713 |
| Less Productive Cropland 370 Acres | | | | | | |
| Total Budgeted Expenses | 48,168 | 47,625 | | 42,907 | 44,631 | |
| Less Crop Sales | -- | -- | | 769 | 2,668 | |
| Net Cost of Feed | 48,168 | 47,625 | | 42,138 | 41,963 | |
| Change in cost due to: | | | | | | |
| Improved practices | | | | -6,030 | -5,662 | |
| Increased corn silage 3/ | | - 543 | | | - 175 | |

1/ Source (9). Other resources same as Table 7.
2/ Change resulting from increasing corn silage from 30 to 50 and from 50 to 70 percent of forage dry matter fed.
3/ Change resulting from increasing corn silage from 30 to 50 percent of forage dry matter fed.

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