Ministry of Agriculture and Food
Ontario

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Factsheet

FARM SILO SELECTION

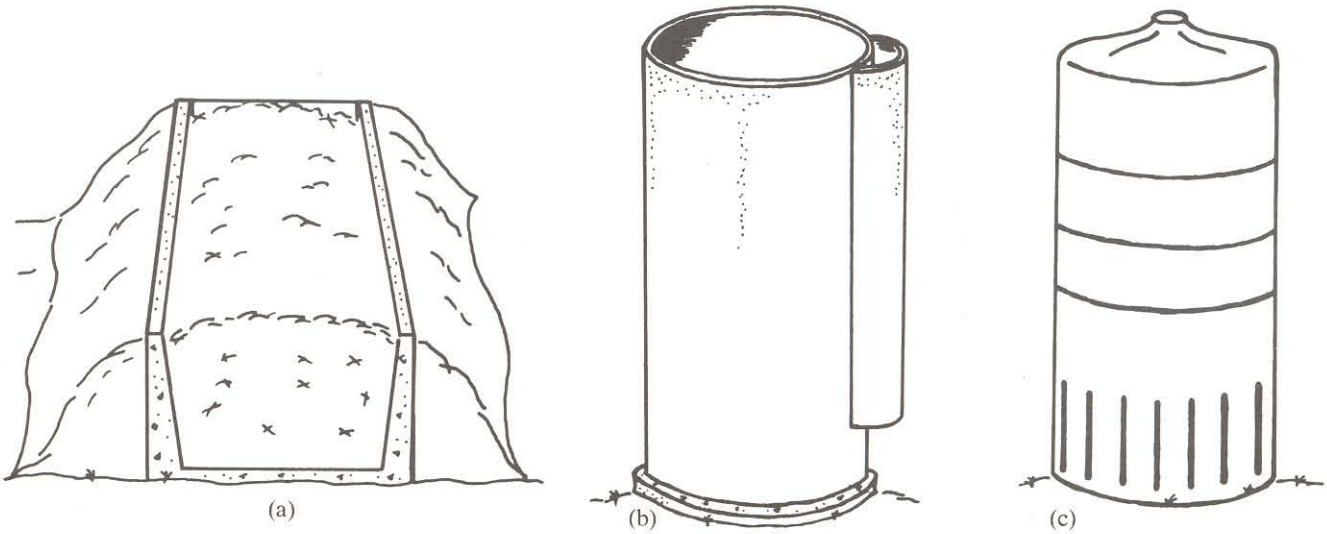

Figure 1. There are basically three types of silos: (a) horizontal; (b) conventional open-top tower; and (c) oxygen-limiting. It is important that the farmer select the right type for his particular farm situation.

The storage and handling of livestock feeds in the ensiled form, for instance, whole-plant corn silage, hay crop silage, high moisture corn, etc, has a number of advantages. These, however, can only be fully realized if the farmer selects the type of storage structure (silo) most suited to his particular farm situation.

Regardless of the farm situation, type of crop, type of storage structure, etc, it is important to think of each part of the feed handling picture, from field to feedbunk, as a total feed handling system. This means that each segment, each piece of equipment, storage structure, etc must be chosen with the whole operation in mind, so that it fits in well with every other segment to make the total the most effective, efficient combination possible. No one part should be allowed to create a bottle-neck in the system.

Figure 2. Tower silos may be either conventional open-top (usually concrete, cast-in-place or pre-cast stave), or oxygen-limiting (usually concrete or glass-lined steel).

This Factsheet will illustrate how to choose a silo with the whole farming operation in mind, for example, type and size of enterprise, type of livestock, type of feeding system, etc.

A silo is more than just a structure to hold a harvested crop in one place until it is needed for livestock feed. Its most important function is to provide the right environment for a proper ensiling process to take place, thereby minimizing feed loss and making a high percentage of the nutrients grown in the field available to the livestock. Essentially this means exclusion of air from the ensiling mass. In addition, the structure should be so designed and located that it provides labor saving storage that fits into a totally efficient handling system.

TYPES OF SILOS

1. Vertical Silos

In the past, vertical or tower silos have been constructed of many different materials. Today, nearly all are built of either concrete or steel. Tower silos may be further divided into two types: (a) open to the atmosphere on top i.e. - open-top; or (b) sealed to control the internal atmosphere - i.e. - oxygen-limiting.

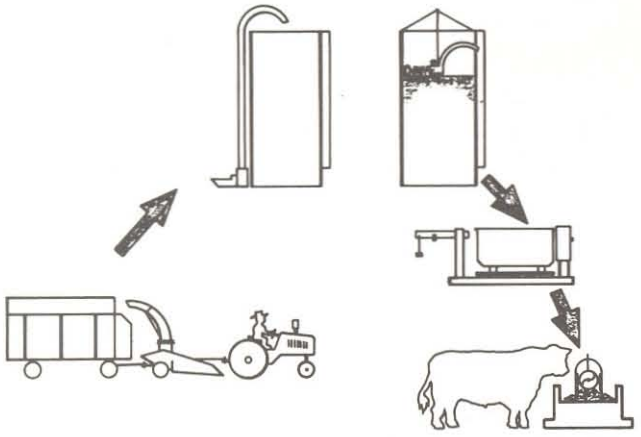

Figure 3. A silo is only part of a total feed storage and handling system. All the components shoud be selected to compliment one another.

(a) Open-Top Silos

Nearly all open-top silos today are made of concrete, either cast-in-place (poured) or pre-cast stave. There are several brands of steel open-top silos available but to date these have not gained widespread acceptance in Ontario. Basically all open-top silos use some type of top unloader.

(b) Oxygen-Limiting Silos

Most oxygen-limiting silos are constructed of steel or concrete. Of the steel units, the most popular is made of bolted panels of glass-fused-to-steel. As well, there are units available that consist of galvanized steel with some type of interior lining or coating to protect the steel from the corroding effects of silage acids. Oxygen-limiting silos are also constructed of concrete. Until recently these were all cast-in-place units; more recently several companies have started to market oxygen-limiting silos made with pre-cast concrete staves together with some type of interior lining. In addition, several attempts have been made to supply Ontario farmers with silos made from fiberglass, but to date this has not proven economically successful.

Nearly all oxygen-limiting silos are equipped with some type of bottom unloader; one company uses a top unloader with bottom delivery in its forage units.

2. Horizontal Silos

All silage storage structures which have the greatest dimension in the horizontal plain may logically be referred to as "horizontal" silos. Basically there are three main types of horizontal silos:

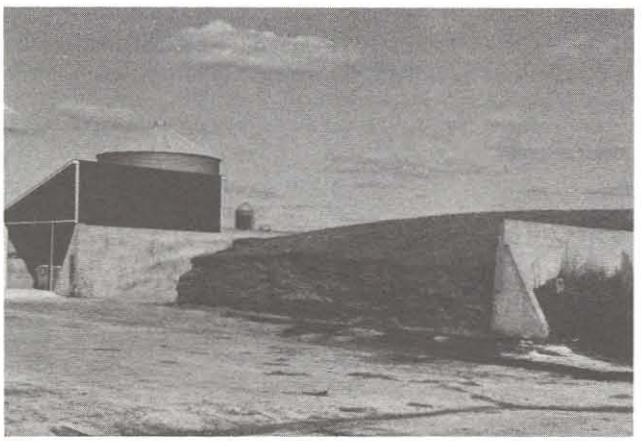

Figure 4. Horizontal silos, with concrete walls (as shown) or wood walls, are relatively inexpensive silage storage structures.

(a) Trench – a silo that is built into the ground by digging a hole or "trench" below the natural grade-line (sometimes referred to as a "pit" silo);

(b) Bunker – a silo that is built above the natural grade-line; and

(c) Stack – essentially a pile of silage where no structural walls are used to contain the material.

Both trench and bunker silos may have walls constructed of wood or concrete. The selection of types of walls and materials will depend on economic considerations of capital and annual cost, availability and durability of materials, types of silos, and personal preference.

COMPARISON OF SILOS

1. Cost

A comparison of the suitability of different types of silos should include not only the initial capital cost, but also the yearly operating costs for the entire feeding system.

(a) Initial Capital Costs

Any comparison of capital costs of silos must, first of all, be based on equivalent storage capacity. Unfortunately there is no uniformly accepted standard by which capacities are stated. One common measure is volume of useable storage space. However, a major disadvantage with this type of measure is that it does not take into consideration the compaction effect on silage due to height. This puts higher, larger diameter tower silos at a disadvantage. Another measure is the tons of silage the silo will hold. This, of course, is subject to wide variations due to moisture content, fineness of chop, species of plant, method of distribution and packing, number of times the silo is refilled, etc. Great variation can occur with horizontal silos due to the amount that can be piled above the actual height of the side-walls, or sloped beyond the ends of the walls.

Among oxygen-limiting silo manufacturers, there is no uniform basis for measurement. Differences occur in volume measurement, due to the inclusion of varying amounts of the dome portion of the silo above the walls. Tonnage capacities vary due to the foregoing, plus the fact that various silage densities are used in the calculations.

One method of stating silo capacity for whole-plant silages, which eliminates some of the variation (particularly due to moisture content) is in terms of dry matter (DM) capacity. Within certain limits it has been observed that a particular size of silo will hold a fairly constant amount of dry matter, regardless of the moisture content. Since the basis of ration formulation is dry matter, this method of stating silo capacities seems to be both practical and appropriate.

Silo capacities for high moisture grains can be stated in terms of both the actual weight for a particular moisture content, and an equivalent volume of dry grain at a standard moisture content of 15.5%. Again this ties in well with the normal formulation of grain ration based on dry grain (15.5% MC). These figures should take into account changes in density due to material depth and the effect of size reduction (i.e. – grinding, rolling, etc).

(b) Annual Ownership and Operating Costs

The fixed cost of owning a storage structure should include a value for such items as depreciation, interest, repairs, taxes and insurance. Variable or operating costs should include a value for the cost of labor and equipment operation.

In addition to the foregoing some dollar value should be given to the losses incurred in the use of each type of silo.

There are basically two types of losses which may occur to feed in storage: (a) loss of dry matter; and (b) loss or deterioration of feed quality.

(1) Dry matter loss

Storage losses vary with the type of silo; the species, stage of maturity and moisture content of the ensiled crop; and the efficiency of excluding air and water from the silage. Some loss of dry matter always takes place whenever a crop is ensiled, even with the best storage structures and the highest level of management. This feed loss is made up of the following:

Surface Spoilage – Unless sealed in some way from air and moisture, the exposed surface of silage will rot after being placed in a silo due to the growth of molds and bacteria. As well, if silage that is exposed to the air is not removed fast enough during the feedout period, spoilage may occur here also. This material has a greatly reduced feed value.

Ensiling Losses – During the ensiling process, dry matter is consumed to form various organic acids, gases (particularly carbon dioxide) and heat. The latter two escape unseen from the silage mass. The amount of air incorporated within the silage at the time of filling, as well as that which is subsequently allowed to enter, affect the nature and duration of the ensiling action and thus the extent of dry matter loss, particularly in gaseous form.

Seepage Losses – This type of loss is caused by the squeezing out of excess liquid (mostly cell sap) due to the pressure of the overlying silage mass. For each moisture level there is a maximum pressure beyond which seepage will occur. Thus seepage losses increase with higher moisture levels and greater depths of silage.

One of the major variables involved with storage losses is the level of management applied to any storage structure. Following the basic principles of good silage making, for example, good air exclusion from the silage, control of the moisture level at time of ensiling, etc, will in itself greatly reduce total storage losses.

Losses as influenced by the type of storage structure are difficult to assess due to the many other factors which also affect losses. However, a number of research projects have been carried out (principally in the U.S.A.) to determine these figures. A review of reports on these projects indicates that using sound structures with good management, average total dry matter losses are approximately 5% for oxygen-limiting silos, 10% for conventional open-top silos and 15% for horizontal silos. Unfortunately, these projects were carried out with small to medium-sized silos. Larger structures, particularly horizontal silos, should have somewhat less loss, especially if the depth is increased above the 8 ft commonly used in the experiments.

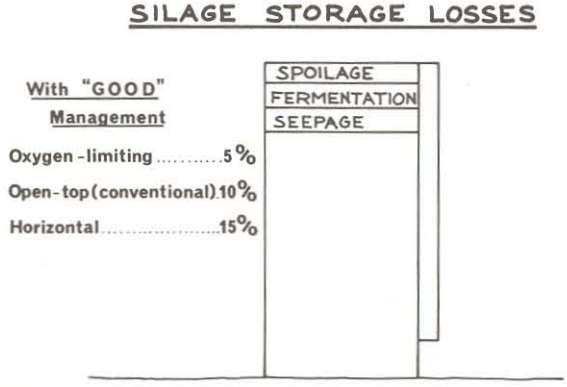

Figure 5. In general, research reports suggest approximately a 5% difference in dry matter storage loss between each of the three main silo types – provided good management practices are followed.

(2) Feeding value losses

Much has been said concerning the merits of different types of silos relative to their ability to preserve the feeding value of various feeds. There have been a number of research projects carried out (principally in the U.S.A.) to assess any differences that may exist. A review of these reports indicates that there was no consistent difference in feeding value that could be attributed to the type of storage structure. This applied to both whole-plant corn silage and hay crop silage. In feeding trials, comparisons were made on rate of gain and feeding efficiency for both dairy heifers and beef steers, and on milk production and feeding efficiency for milking cows. In some cases chemical and nutrient tests were conducted as well. Most comparisons were made between feeds stored in oxygen-limiting silos and conventional, open-top tower silos. In a few cases, feed from horizontal silos was compared as well.

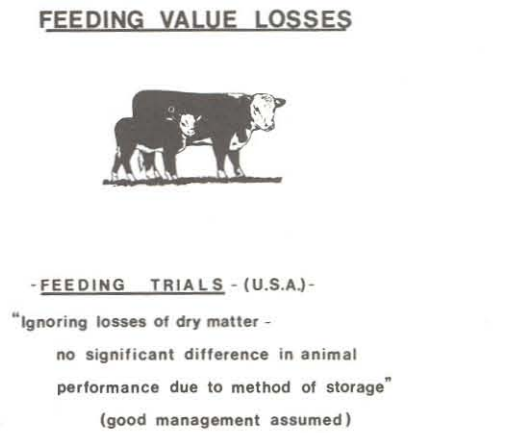

Figure 6. Feeding research reports, in general, suggest there is no significant difference in silages stored in the three main types of silos – provided good management practices are followed.

There were some variations reported, but these were neither significant nor consistent. In one area, however, an oxygen-limiting silo seemed to have a slight advantage. This was in the feeding value of low-moisture hay crop silage, at moisture levels below 45%. It would seem that by virtue of the close control over the storage atmosphere (oxygen control) an oxygen-limiting silo is better able to develop and maintain close to optimum ensiling conditions than other types of silos with this low moisture material. This level of moisture is below that recommended for silos that are open to the atmosphere.

2. Suitability

The choice of any storage structure should be based on how well it will fit into any farmstead operation as part of a well organized feed storage and handling system, considering the following general points:

(a) Labor and Mechanization

One large item too often overlooked in a comparison of types of storage structures is labor requirements – both type and amount. Since farm income is directly related to output per man, any production system should be so organized that labor is utilized as effectively and efficiently as possible, consistent with the highest possible net farm income. Capital in the form of equipment may profitably be substituted for labor up to the point where costs outweigh the added returns. In some cases, the possibility of reducing

labor and drudgery through mechanization is an important consideration (often allowing a farmer to remain in business). These facts should be evaluated considering the degree and cost of mechanization possible with each type of storage structure. Tower silos for example, are more adaptable to semi-automatic or automatic operation than horizontal silos and fit in more readily where a totally mechanized feeding system is desirable.

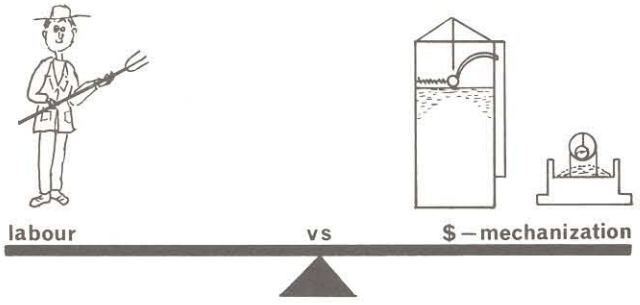

Figure 7. One of the choices a farmer must make is the balance between labor and investment in mechanization. The proper relationship may be different for each farm situation.

(b) Size and Type of Livestock Operation

The most suitable type of storage structure for a particular farm situation will vary with the type of livestock, the feeding program, the size of operation, and the types of feed.

For example, beef cattle that are finished in a feedlot can usually be full-fed corn silage. Thus, self-feeding from a horizontal silo might be used. However, if the cattle are to go back out to pasture after a winter season in the feedlot a full-feed program of corn silage may not be advisable. Thus, controlled or limited feeding may be required, thereby nullifying a possible advantage of the horizontal silo.

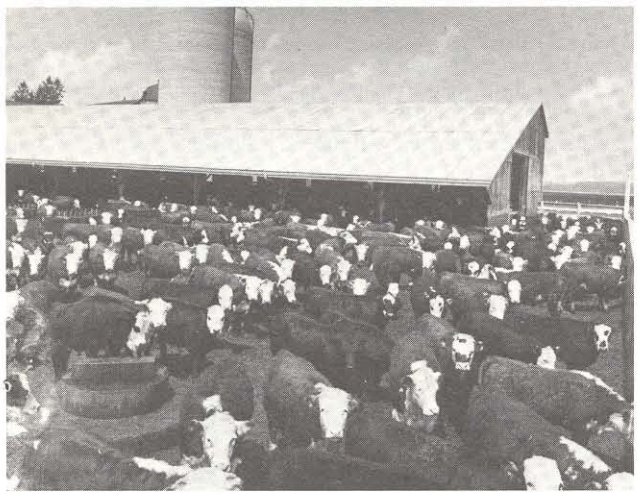

Figure 8. Size of livestock operation is one of the major factors affecting the choice of silo type.

Size of silo affects such items as initial cost, operating cost, labor, degree of mechanization, etc. It also affects the choice of the total storage and handling system, i.e. – what may be suitable for hundreds of tons may not be suitable for thousands of tons and vice versa.

(c) Type of Livestock Housing and Feeding Systems

The cattle housing system being used on a particular farm influences the suitability of the type of storage structure. For example, a horizontal silo may not be as suitable for a tie-stall dairy unit, as for an open loose-housing type beef feedlot. On the other hand, a horizontal silo is usually more compatable with a feeding system that uses a self-unloading mixer-feeder unit for cattle feeding than with a mechanical bunk feeder.

(d) Climatic Conditions

The amount of snow and ice, to be expected during a winter season, should be taken into consideration in selecing the type of silo. The more open the storage structure, the more adverse weather conditions affect the smooth, efficient operation of the silage handling system. In other words, one has to recognize the normal winter-time climatic conditions where one lives – and select a silo and feeding system accordingly.

Figure 9. Climactic conditions, particularly in winter, vary across the country, and affect the selection of silo type.

(e) Management

Although success with **any** storage structure is highly dependent on following proper management principles, still the degree of management skills and attention required varies somewhat with the different types of structure. Up to a point the more expensive the structure, the less particular the management level has to be.

(f) Length of Time in Business

The length of time a farmer intends to carry on farming may influence the type of silo most suitable for the situation. For example, a farmer with only a few more years until retirement should probably think in terms of a lower cost, less permanent type of structure than a younger farmer with many more years ahead of him.