



TECHNICAL BULLETIN No.12
BAG SILAGE-APPROPRIATE METHOD OF
FEED CONSERVATION FOR THE
SMALLHOLDER FARMER



ESGPIP

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FOREWORD

“Bag Silage - Appropriate method of fodder conservation for the smallholder farmer” is the twelfth technical bulletin in a series produced by the Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP).

One of the problems of sheep and goat feeding by the smallholder farmer is the huge gap in the availability of green nutritious fodder between the wet and dry seasons. A practical way to bridge the gap is to conserve the excess high quality fodder during the wet season for use during the dry season. Excess forages can be conserved as hay or silage. However, ensiling generally produces better quality fodder than hay because less time is required to wilt the feed, causing little reduction in feed quality.

There are many ways to store silage. Silage pits or heaps for smallholders should be small due to the small quantity of fodder available and the need to use the resource with minimum spoilage. Making bag silage is a viable option to make small quantities of silage that can be fed out in a short time (1 or 2 days) without spoilage. Recycled plastic bags or reject fertilizer bags make very good silos under the situation prevailing in Ethiopian smallholder farms. This technical bulletin focuses on this issue of bag silage making and utilization.

Kebele Development Agents (KDA's) can use this technical bulletin as an extension aid to improve the productivity of sheep and goats through increasing producers' knowledge regarding the making and utilization of bag silage. The information contained in this Technical Bulletin is also relevant to other users engaged in business ventures based on sheep and goat rearing and also production of other types of ruminants.

At this juncture, I would like to thank all those involved in the preparation and review of this technical Bulletin.

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Bag Silage - Appropriate method of fodder conservation for the smallholder farmer

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1. What is silage?

Silage is cut green plant material that is sealed in a silo without air and water. Silage can be stored for many months and still have up to 85% of the energy and protein value of the original fodder crop.

2. Why make silage?

The major fodders during the dry season are crop residues and poor quality roughages. Green fodder is needed to enhance rumen function. Excess high quality fodder can be preserved for use during the dry season. Excess forages can be conserved as hay or silage. However, ensiling generally produces better quality roughage than hay because less time is required to wilt the feed, causing little reduction in feed quality. Hay making requires a longer period of rain-free days, which are often rare in many areas during the wet season when feed excesses generally occur (refer to Technical Bulletin No. 6 "*How to Make and Conserve Hay*"). During the wet season, tropical forage species grow very fast, with forage yields often exceeding animal requirements. If not cut and fed to animals, it will continue to grow, producing very long fibrous material, low in feeding value. Silage making is a viable option under such circumstances. If cut plant material is stored with air and water it becomes rotten and can be used as fertilizer but not animal feed. There are three main roles played by silage making. These are:

- to build up feed reserves for utilization during periods of feed deficiency, e.g. dry season.
- as a routine feed supplement to increase productivity of animals.
- to utilize excess growth of pasture for better management and extended utilization.
- Silage quality is maintained for longer than is hay quality, because hay oxidizes during storage. Thus silage is better as a fodder bank than is hay.

3. Types and sizes of silage storage systems

The principles of silage making are the same regardless of size of operation, the major difference being in the type of storage used. There are many ways to store silage. Silage pits or heaps for smallholders should be small. Making bag silage is another option to make small quantities of silage that can be fed out in a short time (1 or 2 days) without spoilage. Recycled plastic bags or reject fertilizer bags make very good silos under the situation prevailing in Ethiopian smallholder farms. This technical bulletin focuses on the making and use of bag silage.

4. How much silage should be made?

The quantity of silage to store depends on several factors such as how many animals are to be fed, how much they are to be fed, for how long they are to be fed, the storage space available, the amount of excess feed to conserve, forage DM content, available labor, etc. The following example shows the calculations for total silage requirements for a smallholder sheep farm.

Assume that a farmer has 10 sheep that need to be supplemented for 90 days on 1 kg fresh material at 20% dry matter (200 g silage DM/d) for each sheep. To calculate total silage requirements:

- 10 sheep x 1 kg/ sheep/day x 90 days = 900 kg fresh silage required.
- In most storage systems, there will be a loss of about 15% due to fermentation. Consequently, the fresh weight that needs to be stored for the total of 900 kg required is:
 - 900 kg divided by 0.85 = 1059 kg fresh silage for 90 days.
 - This is equal to 1059/90 = 11.8 kg fresh silage/day.
 - If the farmer is using plastic bags to make silage, he will need silage stored in 2 plastic bags of size 30 x 30 cm (see Table 1 for capacity of plastic bags) each with a capacity of 4-6 kg to feed his sheep daily. He will need 180 bags for the 90-day feeding period.

The typical weights of silage in various types of storage are listed in Table 1. Weights will vary widely according to content of material, chop length, type of material ensiled and how well it is compacted.

Table 1. Weights of chopped silage in various types of storage

Storage type	Silage weight (kg fresh weight) or per unit volume
Small plastic bags, 30 x 30 cm	4-6
Medium sized plastic bags, 10 x 85 cm	35-45
Small plastic drum 20 L	15-20
Large plastic drum 120 L	60-120
Steel drums (200L)	140-190
Pits in the ground	300-500 kg/m ³

5. Why use silage bags?

Bag Silage has been developed and shown to be a workable system for smallholder farmers. Strong plastic shopping bags and plastic lined fertilizer bags are available in most rural areas. These can make very good silos. The fertilizer bag is the best type to use as it will last for at least three seasons. Alternatively, other containers may be used instead of plastic bags. Conserving green forage as silage in bags allows smallholder farmers to conserve green fodder and preserve it for use during the dry season. This can be fed in small amounts as a green fodder supplement to dry fodders over long periods, with minimal disturbance to the remaining

silage stock. It is generally much easier to feed silage from individual bags instead of having to untie and re-tie the large bag of thick plastic or use silage from larger permanent silos. There are many advantages of bag silage to the smallholder:

- The silage is completely sealed in the bag. This means that all the acid is retained in the silage, unlike that in pit silage where it seeps out through the bottom of the pit as effluent. This compensates for the longer pieces of forage and poorer compaction than that found with silage machinery, so that the quality of the silage is just as good.
- Ensiling in a bag avoids the hard work of having to remove silage, as from a pit where silage must be dug out every day.
- Because the whole bag is fed out to the animal, it means the rest of the silage which is in the other bags is not exposed to air at removal and is therefore unspoiled. Much of the silage in pits has been found to be spoiled due to poor sealing and exposure to air every day when the silage is removed for feeding.
- The bag is easily stored and easily portable so that most members of the family can carry it to the feed trough.
- Low initial investment cost and equipment requirement.



Figure 1. Various alternative bag types and sizes filled with silage. Courtesy: Christoph Reiber, DICTA (Honduras) and the International Center for Tropical Agriculture (Colombia)

6. Requirements to make good silage

Silage making is useful only if the ensiled product is of good quality, i.e., well-preserved and of high digestibility and protein content. The main requirements are:

- The fodder should be harvested at a young stage of growth.
- Fodder should contain enough sugars for fermentation. Tropical grasses are inherently low in soluble carbohydrates, with the exception of maize and sorghum species. If the material is of adequate quality, but lacking in sugars, molasses or another source of sugar may be added.
- The material to be ensiled should be easily compactable and covered to exclude air. Chopping before ensiling will help to compact the material.

7. Fodder for silage making

The quality of silage depends on the fodder being conserved, and applies equally to silage made in bags. Fodder with high sugar content conserves well. Fodder with low sugar content rots, leading to a bad reputation for silage in the tropics. Problem fodders include mature grasses harvested in the rains and legumes in general. Wet grasses and legumes must be wilted before ensiling. Additives, which may be used to enhance fermentation or sterilize the crop, may be added. Any compound for smallholder use must be cheap, not toxic or corrosive, and easy to apply. Molasses is such an excellent additive where available.

Under Ethiopian smallholder conditions where landholdings are small, the fodder might include edible leafy weeds harvested from crop fields, terraces and bunds. In Hararghe, leaf stripping and thinning of maize and sorghum are wide spread practices. These would make excellent silage in bags. Some farmers may have cultivated or natural pastures that can be used for the purpose.

8. Basic Method of Silage Making

8.1. Harvesting fodder to be ensiled

Harvest at the optimum stage of maturity: One of the main advantages of harvesting silage is that timely harvest is usually possible. The quality of silage depends upon the stage of harvesting. The stage of plant growth at harvest mainly affects the amounts of digestible protein and energy. Recommended stages of harvest are:

- Legumes and grass legume mixtures, when legumes reach the 10% bloom stage.
- In general, grasses should be harvested just before flowering.

Moisture content: The crops should contain about 30-35% dry matter at the time of ensiling. If moisture content is high, first wilt the crop to 30-35 % dry matter content by spreading the fodder under shade and frequently checking the drop in the moisture content so that the material will not be too dry. Wilted silage should produce little or no effluent. Unwilted silage will produce some effluent, which may leak out and cause spoilage especially in case of bag silage. At higher moisture levels, seepage or a sour fermentation can occur and at lower levels, the silage will heat or mold, or both.

A useful field method to check that the moisture level is right is called the squeeze test. Start by chopping some forage as you would to fill the silo. Then grab a couple handfuls of chopped forage and squeeze them tightly in your fists for about 30 seconds.

Does free juice run or drip from your fingers? This forage is too wet for proper ensiling. Wait a few days to chop and try again or wilt. What if it doesn't drip? Then, slowly open your hand. Is your hand barely damp and does the ball of forage start to fall apart quickly? This forage is too dry and is likely to heat and spoil in the silo. Add some water or find wetter forage to mix with it. When you release your squeeze, if your fingers and palm are moist and the forage ball holds together, the forage is just right for chopping.

8.2. Chopping

Chop the fodder into small pieces (1-3cm) before ensiling. Chopping makes it easy to compact the silage and to remove the air. The fodder can be chopped by hand, with a large knife / guillotine, or using a chaff-cutter with a rotating blade if available. By making bag silage throughout the growing season, harvesting and chopping fodder by hand is feasible.



Figure 2. Chopping fodder with guillotine and an ordinary knife (background)



Figure 3. Chopping forage on logs using a machete



Figure 4. Feeding a hand driven chopper



Figure 5. Diesel driven forage chopper

8.3. Filling

Fill the chopped fodder into one of the plastic bags layer by layer without making any holes in it. When using small shopping bags for ensiling, gently but firmly squeeze the bag by hand to expel air; while compressed twist the neck of the bag then turn it over and tie it tightly with twine as close to the material as possible and as tightly as possible. This will compact the silage. Then seal it from air. Invert the bag of silage into a second empty bag, close and tie again. Once again invert the bag of silage into a third empty bag and seal. Each bag of silage is now triple wrapped, and seams which might be expected to leak air are doubly protected.

8.4. Packing / Compaction:

Packing is necessary not only to get the air out, but more important, to keep it out by excluding air pockets. Figure 6 shows the steps of sealing silage using shopping bags. The use of a removable mould (e.g. plastic barrel – Figure 7) makes compaction easy and protects plastic from stretching and tearing.



Step 1. Squeezing and sealing first bag layer



Step 2. Tying second bag layer



Step 3. Tying third bag layer

Figure 6. Use of small shopping bags for ensilage



Forage compaction in a mold



Removing the mold

Figure 7. The use of a plastic barrel as a removable mold Courtesy: Christoph Reiber, DICTA (Honduras) and the International Center for Tropical Agriculture (Colombia)

8.5. Storage and transportation

Finally, stack the bags carefully in an area protected against rats, mice and other pests. Alternatively, the bags can be stored in a pit and covered. Transportation to the site of storage can be done by humans, using pack animals or animal drawn carts depending on the size and number of the bags and the distance to the storage site.



Filling and compressing chopped forage in fertilizer bags



A filled and packed bag tied tightly at the top with twine to seal the silage



Fertilizer bag filled with 10 kg silage- easy to carry

Figure 8. Use of fertilizer bags for ensilage



Figure 9. Filled silage bags ready for storage



Figure 10. Silage bags being transported for storage

9. Feeding Bag Silage

The silage will be ready to feed after three weeks. Silage can be fed as a source of roughage either on its own or with other feed sources. The silage made should be inspected for presence of mold. Poorly made silage can result in health problems in animals and man caused by molds that grow particularly fast at high temperatures. Moldy silage should not be fed.



Figure 11. Inspection of bag silage before opening.



Figure 12. Well-conserved green as silage.



Figure 13. Sampling the bag; note fungal growth at top of bag - This should be avoided

Silage removed from a pit or emptied out from a bag should be fed as soon as possible, preferably within a few hours. It can be moldy and become unpalatable after a short period because of toxins formed in the silage when it is exposed to air. After feeding, the feeders must be cleaned out to prevent any remaining silage from spoiling and contaminating the next feed. After emptying, the bags must be carefully washed, dried and stored in a safe place for reuse if not damaged.

Silage has a characteristic odor unfamiliar to livestock unaccustomed to it. Sheep and goats may not eat the silage initially. They should start eating once the silage has been left in feed troughs for an hour or so, thus allowing some of the smell to escape. If they do not consume it after this period, some incentive, such as molasses or fresh forage mixed with the silage will help. Generally, it is very unusual for sheep and goats to refuse silage after a slow introductory period.

What the Kebele Development Agent can and ought to do?

- Select progressive farmers that own sheep and goats (preferably those that depend on sheep and goats for their livelihoods)
 - Train them on:
 - the problems of seasonal fluctuations in feed quality and quantity;
 - the value of feed conservation to reduce wastages during periods of oversupply and serious shortages during dry periods;
 - the advantages of silage making as a conservation method;
 - the specific advantages of bag silage over other forms of silage making.
 - Convince some of the selected farmers to do demonstrations of bag silage making on their farms. The demonstrations can be done twice at the following times:
 - around the end of the wet period when ample green fodder is available for silage making. The procedures of silage making can be demonstrated at this period;
 - during the dry season when there is no green fodder. The bag silage made earlier can be opened and farmers in the surrounding can be shown what characteristics good silage has; the use of bag silage as a dry season supplement can be explained and demonstrated.

10. SUMMARY

Silage making is the best method of fodder conservation. Making silage involves cutting fodder at the optimum stage of development, chopping to the right size and proper compaction to create an air-tight condition. Various storage structures can be used and different volumes can be made. Making silage in plastic bags of different sizes is based on the use of resources available at smallholder farms and is an efficient method of utilizing available fodder. Kebele development agents can promote the use of bag silage as a means to improve feed resource utilization and sheep/goat performance in smallholder farms.