



Food and Agriculture
Organization of the
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Hay-making for **smallholders**



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1. INTRODUCTION

To be prepared for long cold or dry periods, livestock farmers can prepare a sufficient amount of quality animal feed in advance to last these periods. Hay-making is possible for smallholder livestock farmers, with or without some form of mechanization. You could either use the hay for your animals or sell it for profit. Hay in the barn is like having money in the bank.

Hay-making is one of several methods used to conserve animal feed. Hay-making is the process of drying fodder so that it can be stored for a long time. The aim is to harvest the crop at the time of its maximum nutrient content, early in the flowering stage. If the harvesting is done too late, the forage is classified as straw.

Hay can either be made manually, with simple mechanization like draught animal power or small tractors, or with fully mechanized systems.

Hay that is made correctly will have sufficient nutrients. Good-quality hay will improve the health of your animals and increase your productivity when combining with other quality animal feed ingredients. The critical steps in hay-making are the following:

1. Cut
2. Dry
3. Rake
4. Collect
5. Bale
6. Store

Grass – both natural and planted – can be used for hay-making. Legumes can also be used for hay-making, and these can be mixed with grass.

Hay can be stored in heaps or bales. Loose hay can be heaped into a dome-shaped stack and covered with a plastic sheet. Hay can also be baled to reduce storage space. Baling can be done by hand or by mechanized balers.



2. CROPS FOR HAY-MAKING

In general, grass and legumes are used for hay-making. However, not all grasses and fodder are suitable for hay-making. You can mix legumes with grasses to make better-quality hay. It is essential to avoid forage to which herbicides or pesticides have been recently applied. Some commonly used crops for hay-making are listed below:

- **Natural pasture**
- **Planted grasses**
- **Alfalfa (Lucerne)**
- **Sweet clovers**
- **Clovers**
- **Vetches**
- **Cereals**
- **Mixed crops**

Tip:

When you make hay from natural pastureland, watch out for toxic plants.

Natural pasture

Natural pasture in general means vegetation that has not been sown, and can be very diversified depending on the climate, landscape, type of vegetation, etc.

Sown grasses

Some more commonly used grasses for hay are:

- **Rescue grass** is a perennial, mainly used for hay and with a production of two years.
- **Buffelgrass** is a perennial, is very persistent, drought-resistant and withstands grazing and mowing well. It makes reasonable hay and should be cut at the early flowering stage.

- **Rhodes grass** is a perennial that is drought-resistant and easy to establish. It is easy to make into hay.

- **Bermuda/star grass** is a perennial, makes reasonable hay and is easy to dry. Bermuda grass is highly tolerant to drought and heavy grazing.

- **Cocksfoot** is a perennial, it can withstand heavy grazing and is used for pasture, hay and silage. Cocksfoot has a greater forage production during summer compared to other forage grasses.

- **Weeping lovegrass** is a perennial, has fine leaves, is easy to dry, and makes excellent hay.

- **Tall fescue**, a perennial, combines well with legumes and can produce high-quality hay.

- **Italian ryegrass**, an annual or biennial, is very widely used for hay, but also for silage and pasture.

- **Perennial ryegrass**, a perennial, is a significant pasture and hay grass and frequently mixed with clover species.

- **Reed canarygrass** is a perennial up to 2 m tall, which spreads vigorously. It is a coarse grass that needs to be cut early for hay and is not easy to dry.

- **Timothy grass** is a perennial and a major hay grass but should be cut early.

- **Other local grasses**

Tip:

If you want to find out more about certain grasses or crops for animal feed, check www.feedipedia.org

Lucerne (Alfalfa)

Lucerne is a perennial legume, meaning it has a higher protein content than grass. It is the world's most important crop for forage and makes one of the best-quality feed ingredients. Lucerne grows well on sandy to loamy soils and needs good drainage. For the best-quality hay, cut the crop early at 25 to 50 percent flowering/bloom. You should handle and bale carefully, as the shattering of leaves will cause significant nutrient losses. To avoid this, you can roll Lucerne into small bundles.



Clovers

Clovers are legumes (higher protein content than grass). Many types of clovers can be used for hay-making, including Egyptian (Berseem), Crimson, Red, White and Persian Clover. Clovers are lower-growing than Lucerne and therefore produce less volume. If the conditions allow, you can make several cuts of clover per year, just before blooming. Clovers, in general, are not easy to dry; drying can be completed at the farm once the first part of the drying has been completed in the field. Clover hay is also prone to becoming mouldy.



Sweet clovers

Sweet clovers are annual or biennial legumes (legumes have a higher protein content than grass). In the first year, you should harvest sweet clovers in late summer, just before blooming, and give adequate time for re-growth before winter. In the second year, you can make two cuts.

Vetches

Vetches are legumes (higher protein content than grass). Several species of vetch are grown as fodders, often mixed with oats or other cereals. Harvesting should take place when the lower vetch pods begin to fill.

Cereals

Several cereal crops can be used for hay, although most species are used for straw and some for silage. If cereals are cut while they are still leafy, excellent hay can be made. Oats and barley are commonly grown for hay, with oats the better crop for hay-making. Wheat and rye are not that suitable for hay-making. Maize can be used for hay (or stover) but is generally used

more for silage-making. Some sorghum species can be used for hay-making as well, e.g. Sudan, Columbus grass.

Mixed crops

Legumes and grasses in mixed pasture can form very palatable and nutritious hay that dries fairly quickly.

3. HARVESTING

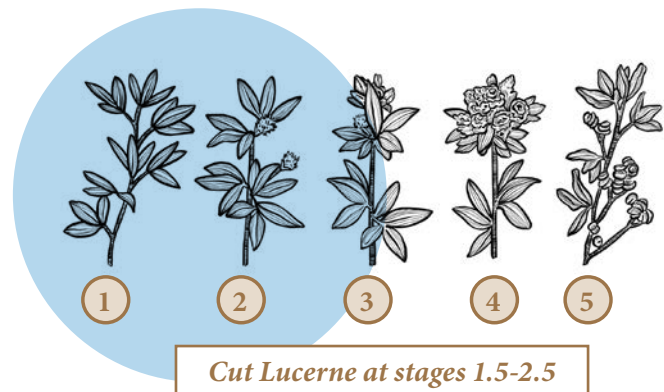
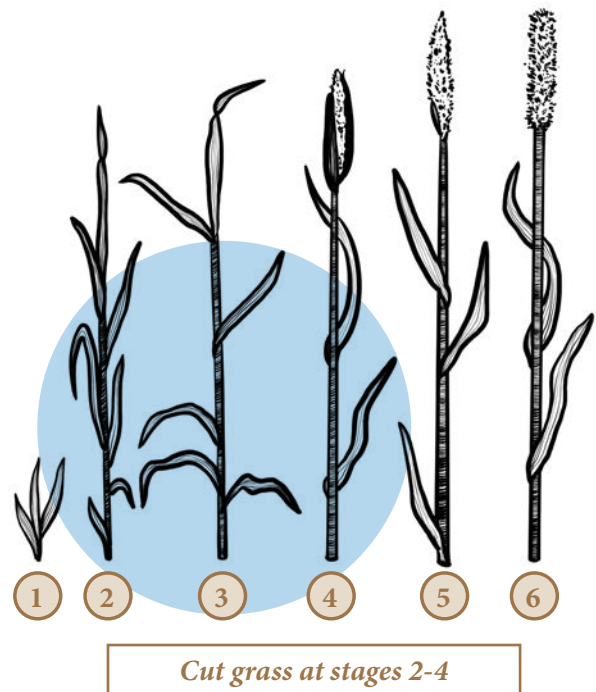
Cut the forage at the right time

Harvesting at the right time is crucial to make the best quality hay, and it is important to get this right. Choosing the right time to harvest is a balancing act between making sure there is sufficient forage growth, that you are not harvesting too late for best quality, and that the weather conditions are dry.

Forage has the highest nutritional value when all leaves are fully developed, and seed or flower heads are just a bit short of full maturity (the flowering stage between 25 and 50%); this is when the forage needs to be cut. This period is usually a two-week window, so it's a challenge to get this right.

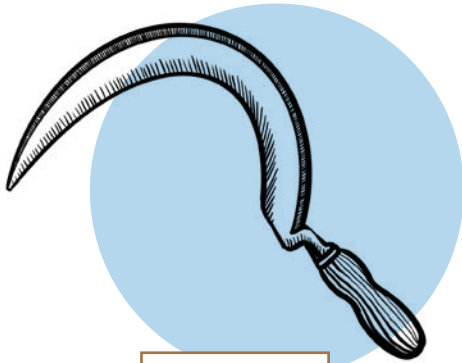
- **Cut too early**, when the forage is not very tall, and there will not be a lot of material for hay-making. Hay cut too soon has high moisture content and will not dry quickly.

- **Cut too late**, and the quality of the hay will be much lower, and the taste will be reduced. The protein levels will be low, and as the leaves become brittle, there will be more losses.



Weather

As you need to dry the hay for several days (see below), the correct weather conditions are essential. Make sure you follow the weather forecast carefully before you decide on the day you want to harvest your hay crop. If it's raining during hay-making, the hay might develop rot and mould later, creating the potential for toxins, which could make the animals sick.



A sickle

Cutting the forage

The forage can be cut either by hand or by machine. Make sure you can rake, collect and bale the amount of hay that you harvest.



Cutting with a scythe

Sickle or scythe?

There are two basic hand tools: the sickle and the scythe. Sickles are designed for cutting cereals but are poorly adapted to mowing hay. They are very slow and require a lot of work compared to the scythe.

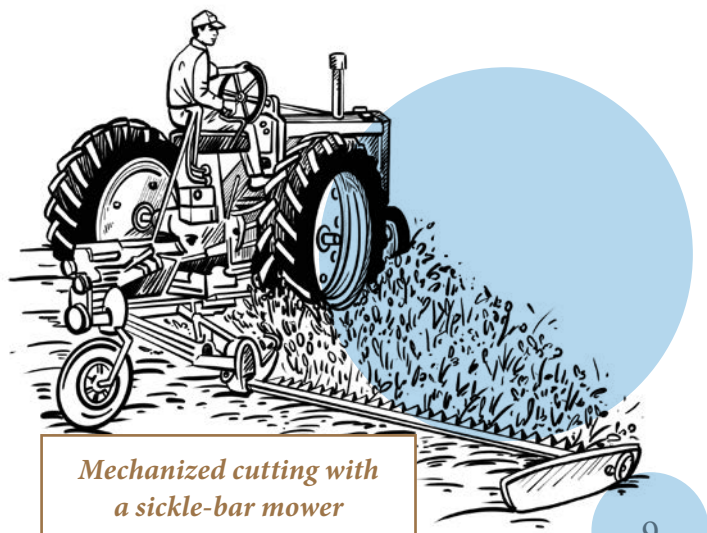
The scythe is a traditional grass-cutting tool and can mow at about five times the speed of the sickle. The scythe must be sharpened regularly.

Tip:

If you use a scythe for mowing, it is best to start early in the day when there is dew on the forage, as it makes it easier to mow. For hay-making by sickle, however, it is recommended that you wait until the dew has dried.

The minimum cutting height is 10 cm, but if you want to make sure that the hay dries, you can leave a higher stubble during cutting (e.g. 15 cm). This will ensure that air can blow under the hay and the drying process will be quicker.

Several types of mowing equipment exist that can be pulled behind a tractor. This includes the sickle-bar mower, the sickle-bar mower-conditioner (also called haybine), which has conditioning rollers that help in the drying of the hay, the disc mower and several other mowers.



Mechanized cutting with a sickle-bar mower

4. DRYING, RAKING AND COLLECTING

Fresh grass, in general, contains around 80 percent water. If you want to make hay, this has to be reduced to 15-20 percent. To achieve this reduction, about two to three days of good weather are needed. Sunshine, wind and low humidity all help with the drying process.

After cutting, place the material into small heaps or rows about 20-30 cm high and turn the heap once or twice a day in the sun to encourage quick drying. Rows will assist with the hay-baling process later on if the hay is baled by a mechanized hay baler.

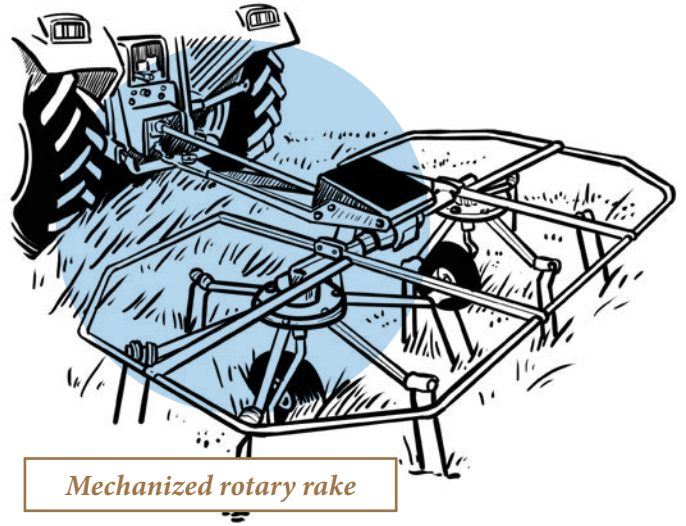
Tip:

Consider additional drying of the hay in the barn, stack or bale if the hay is not yet dry enough in the field.

The raking can be done by hand or by machine. You should complete the raking before the forage is completely dry to



Hay drying in rows



Mechanized rotary rake

avoid excessive shattering of leaves and overexposure to the sun. Mechanical raking is better suited to grass than to legumes like Lucerne, as there is a danger of losing leaves through shattering, especially in the drier stages.

Tips:

Where possible, do the drying under shade so that the dried fodder retains its green colour.

If the rain has started unexpectedly, gather the hay in bigger rows or so that less hay will get wet.

When is the hay dry enough?

Let the hay dry so that the moisture content is between 15 and 20 percent. The hay should dry as quickly as possible, and ideally it should keep its green colour. If the hay is not dry enough, the hay can

heat up during storage, and this will lower the feeding value of the hay (or cause fires). The table that follows is a guide to the moisture content of the hay crop as it is drying.

Guide to the moisture content of the hay crop

| Moisture % | Characteristics | Conclusion |
|------------|--|-------------------------------------|
| 30–40 | Leaves begin to rustle (a soft crackling sound), but do not appear moist unless rubbed hard. If a stem is scratched with a fingernail, moisture shows easily. Twist the leaves and moisture will show, but not easily. | Too wet |
| 25–30 | The hay rustles; twist a bundle, and it will snap with difficulty but doesn't show surplus moisture. The thicker stems may show some moisture when scraped with a fingernail. | Too wet Ready to rake |
| 20–25 | The hay rustles readily; twist a bundle, and it will snap easily, leaves shatter, and there are few moist stems. Bark on the stems cannot be lifted with a fingernail. | Slightly too wet |
| 15–20 | The hay fractures easily. Twist a bundle, and it will snap easily. There is almost no moisture anywhere, and the leaves shatter easily. | Stop raking Ready for collection |

Tips:

If you think the forage is too dry, e.g. 12 to 15 percent moisture content, you may have to wait for the evening dew to bring the crop back up to 18 to 20 percent moisture content.

If it has started to rain and you think the quality of the hay is compromised, consider making silage, as you might still be able to make silage from some crops.

Speeding up drying

To increase the speed of drying, you can consider:

- Raking the hay more often, e.g. when it is rained on
- Spreading the hay more by widening the rows
- Leaving a stubble of around 15 cm to lift the hay from the ground, so that the wind underneath can dry the hay more quickly.

Once the hay is dry, it should be collected and not excessively exposed to the sun or rain.



Loading hay onto a trailer

5. BALING

To bale or not to bale?

Storing loose hay takes up quite a lot of space. To assist with this, you can bale the hay, which allows for more hay to be stored in a given area. Baling can be done

manually or mechanically. The table below lists some advantages and disadvantages of loose hay versus bales.

Loose hay versus bales

| Loose hay | Smaller square bales | Large square or round bales |
|--------------------------------|--------------------------------------|--------------------------------------|
| + not heavy | + can be mechanized | + minimum losses |
| + easy process | + easy to ration for feeding | + can be stored outside (round) |
| - labour-intensive to collect | + smaller storage space required | + ideal for large herds |
| - larger storage area required | + fewer losses compared to loose hay | + fewer losses compared to loose hay |
| - must be stored under cover | + smaller bales easy to handle | - heavy, must be moved by machines |
| | - manual baling is labour-intensive | - large equipment required |
| | - must be under cover | |

Baling by hand

Bales can be made by hand using a simple wooden frame. The frame should measure 100 cm long, 50 cm wide, and 40 cm high and be open at the top and bottom. To start the baling process, place two lengths of rope across the frame, and

let them hang over each side. Put the hay in the box and compress the hay tightly. Use weights or stand on the hay to compact it as much as possible. Once the box is full, tie the bale as tightly as possible and push it out the frame.



Box frame



Compacting the hay



Tying the ropes

Hand-powered bale press

Several contraptions can be built to assist with the bale-pressing. The photos below show examples of some of these bale pressers.

Mechanical baling

Balers are usually pulled by a tractor, with larger balers requiring more powerful tractors. Typically, these balers can make small or large bales and round or square bales. Round bales shed rain and resist water better than square bales.

6. STORING HAY

Proper hay storage is crucial to avoid losses. Hay should be stored in a sheltered place, away from direct sunlight and rain. Wet hay can easily develop rot, and adequate ventilation is essential. Rats and other rodents should be controlled during storage as they can damage the hay. Storing loose hay takes up more space than storing hay bales.

Hay should never be exposed to heat or flames, as dry hay is highly flammable.

Storing loose hay

You can store loose hay on a wooden floor or pallets, by heaping it into a stack. You should store it under a roof or covered

with a plastic sheet. If you are worried that the hay is a little too wet, make sure you store the hay loosely, so that it can still dry.

Storing hay bales

Before storing hay bales, you will need to make sure the hay is adequately dried. Slightly wet bales can produce enough heat to start a fire. This combustion generally takes place within five to seven days of baling, so make sure you keep checking your hay during the first week of storage.

Very large and round bales are often left outside until they are fed to the animals; sometimes they are covered with a light plastic wrap.



Mechanized baling with a small square baler

7. FEEDING HAY

Quality check

Before you feed hay to your animals, it is essential to do a quality check. Never judge the quality by looking just at the outside of a bale or a stack. You will need to break the pile or stack open and look inside. If the hay seems to be stuck together, this means that the hay heated because it was too wet. This hay might have lost quite a few nutrients and is therefore lower-quality hay. Also check for mouldy spots caused by moisture.

High-quality hay should:

- **be leafy and greenish**
- **have no foreign material**
- **smell good**

Poorer quality hay can contain:

- **few leaves**
- **many coarse stems**
- **seed heads**
- **dust**
- **brownness**
- **mould**

Tip:

Poor hay is better than no hay. You may still be able to feed the hay, and you can make up for quality by feeding concentrates.

If you have different qualities of hay in your barn, note that:

Dairy animals produce best when they are fed on the very highest-quality hay.

Beef cows, in general, don't need high-quality hay and will probably sustain the winter better on hay that's cut later.

Meat animals that you would want to put weight on feed best on good-quality hay.

Most horses need only moderate- to high-quality hay, but it must be free of mould to prevent sickness.

Tip:

If the quality of the hay is too poor for feeding, you can sell it as fuel or use it for straw.

Feeding

In the ideal situation, cows eat 7 to 12 meals per day indoors; each meal takes around 30 minutes, with a total eating time of around 5 hours per day. This means you need to provide new feed at least two or three times per day. Start feeding when there's about 5 percent feed left. Try to provide feed at the same times each day.

A dairy cow weighing 400 kg will consume an equivalent of about 3 percent of its body weight in dry matter (= 12 kg dry matter) per day. Since hay contains 85 percent dry matter, if the cow consumes nothing else, it will require 14 kg of hay per day.

It was mentioned before that grass hay usually has a lower quality and nutritional value than legume hay. However, pure legume hay may be too rich for many types of livestock. Therefore, feeding a combination of both grass and legume hay can make an excellent ration.

**Food and Agriculture Organization
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