Theme 2: Forage conservation

FORAGE CONSERVATION AND STORAGE (Level 3)

Topic	Training & information Content
2.1	Fodder conservation and storage
2.2	Estimating ideal time of harvesting
2.3	Guideline for silage making
2.4	Fermentation process
2.5	Treatment of straw with Urea
2.6	Making of urea/molasses/mineral lick
2.7	Management of silage pit (feed out)
2.8	Estimating fodder supplies for dry season feeding & planning of feeding management

1. You will learn about (learning objectives):

- ❑ To conserve and store forages to preserve the nutritive value of the feed and avoid spoilage, appropriate practices, preparation of storage facilities and avoid storage losses
  - Hay
  - Haylage
  - Silage

Wrapping - haylage

2. Why conserve forages?

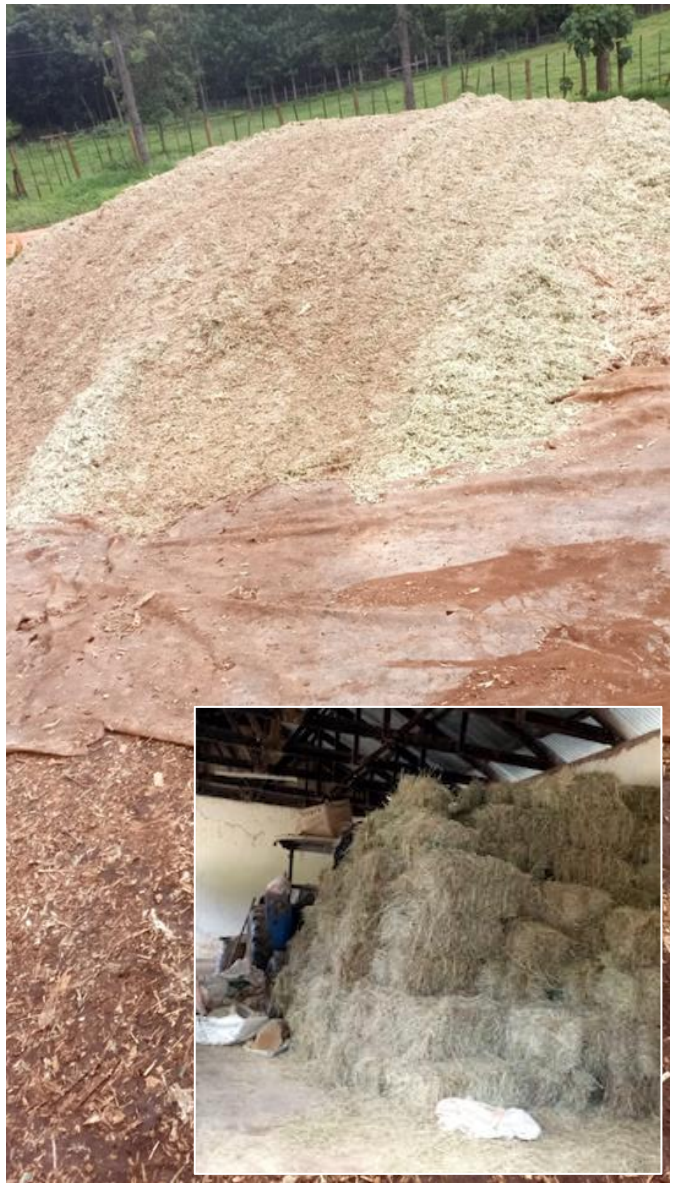
- Conserved forages offer extra feed supplement to the ration
- Is a means of storage of excess forage for future use
- Preserves nutritive value of forage for longer period
- Provides consistent balanced diet throughout the year especially during deficit periods
- Assists with feed planning that allows farmers plan for their feed year round

3. Factors affecting the quantity and quality of conserved forages

- Forage species - resistant and fast growing species allow for numerous harvests hence more forage is available for conservation
- Leafiness
- Maturity stage - early or late timing in harvesting
- Harvesting technique - poor harvesting methods lead to poor utilization and losses in the ration

3.1 Factors affecting the quantity and quality of conserved forages Cont'd…

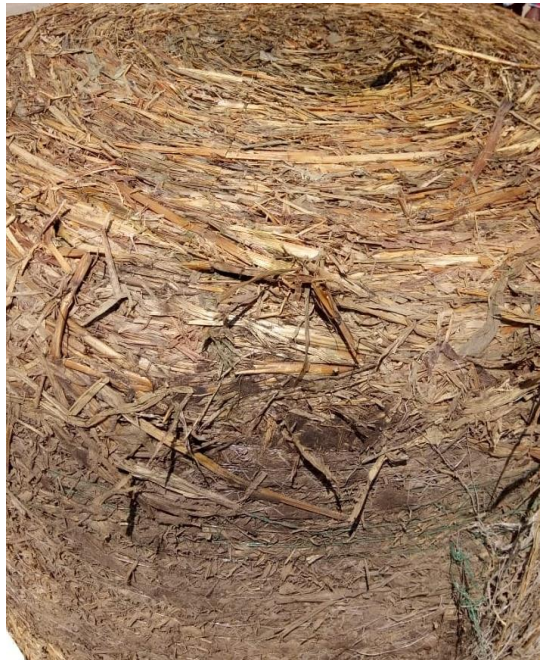
- Climate - right conditions (temperature) should be maintained to reduce losses at harvesting and post harvest handling
- Foreign matter – presence of unwanted materials like manure or soil in hay or silage. In silage, they affect fermentation
- Storage - poorly made facilities cause losses i.e. exposure to air (oxygen) for silage or mouldy hay due to water exposure



4. Methods of forage conservation

- Even as you consider various conservation methods, it is important to harvest forages at their optimum nutritional value. Methods include:
    1. Drying (hay)
    2. Fermentation (silage & haylage)
    3. Dehydration (artificial drying / pelleting)






5. Drying grass (wilting) to hay

- The goal of haymaking is to produce a stable, high-quality animal feed with minimum expenditure
- Grazing animals on pasture is more ideal than making hay. Hay is not as nutritious as fresh forage grazed by animals
- Hay is harvested and stored which requires manual labour and mechanization
- Hay utilizes the surplus forage pastures during peak growing times for use as feed during dry seasons
- Harvest and dry the forage (grass, legume or mixed hay) wisely and store them properly

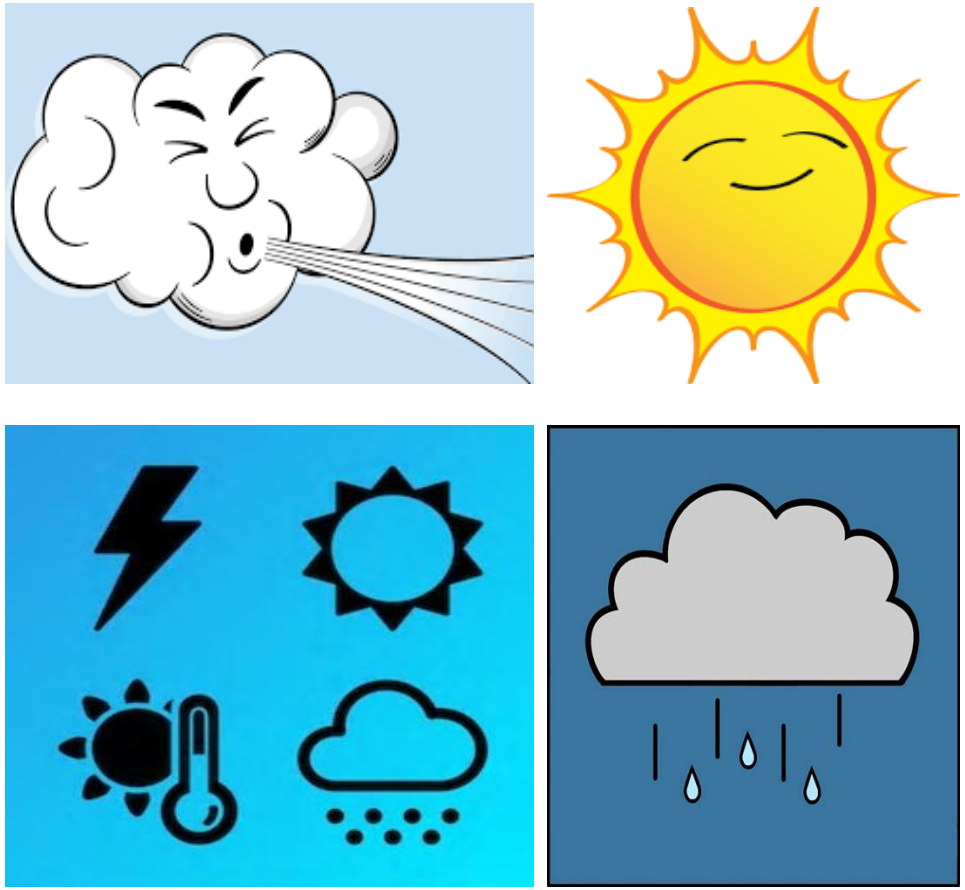
5.1 Drying grass (wilting) to hay Cont'd…

- Drying is commonly done with grasses, legumes or mixes of grass and legumes
- Common type of hay found in shops are non-legume hay i.e. made from Rhodes grass
- Hay making is one of the oldest techniques used for preserving forage and is done to prevent it from rotting and decomposing
- Moisture content in the forage is reduced to inhibit the action of plant and microbial enzymes.
- As long as hay is kept dry, it can be kept for longer periods
- Most hay however is of low quality due to poor management practices and timing of harvesting
- Good quality hay should be leafy and have a balanced stem to leaf ratio

6. When to make hay

- Weather forecasts will assist to identify the ideal time of harvest

- Deciding when to make hay is a critical decision:
  1. Should be based on an understanding of plant growth
  2. Harvesting should be done when there is a likelihood of several days of good haymaking weather



7. Considerations when making hay

- Select a forage varieties that can produce good quality hay
- Good hay retains as many leaves as possible since the leaves contain two/thirds of the protein
- Cut or mow the grass at first bloom or heading stage
- Nutritive value and palatability decrease after first bloom or heading
- During harvest:
    - Maintain leaves which contain the best nutrition
    - Dry rapidly to 15-20% moisture (equal to 80-85% dry matter)
    - Maintain green colour which indicates minimal deterioration

8. Guidelines for drying hay

- Turn the grass (tedding) to allow air and sun for even drying but avoid too much damage to leaves or leaves dropping (e.g., alfalfa)
- Allow the grass to dry for 5 – 7 days in the field
- Bring the grass (rake) together in straight lines to reduce grass exposure to dew in the evening
- Once grass are in straight lines start baling
- Bring the bales to a dry and secure storage area
- Well managed pasture, receiving enough rainfall, can be cut every 6-8 weeks

9. Methods of compacting hay

- Compacting dry grass (hay) into bales (square, round)
- Hay is compacted to reduce storage space

10. Storing dry grass (hay)

- Store the hay so that feed quality is maintained (protect from rain and moisture) and expenditures minimized

- Storage may be done
  - as long hay
  - chopped hay
  - baled hay (rectangular, big bales, round bales)

11. Considerations when storing hay

- Baling hay at lower dry matter content (below 80%) can cause moulding and heating
- Moisture content of hay is also affected by the size and density of the bale during storage
- Hay stored outside is affected by higher storage losses compared to hay kept in a store

12. Fermentation - haylage

- Haylage is an in between hay and silage making
- For farmers who find it hard to dry grass to make hay, one can wilt the hay for a shorter period and package the grass for future use
- Haylage unlike silage is made under lower moisture conditions (estimated at between 40-50% dry matter)
- Additive(s) such as (molasses) may be added to fasten fermentation process
- Haylage is only considered if one has machinery for heavy compaction

13. How to make haylage

- Mow at right harvesting stage just before flowering stage
- Spread the grass for even wilting or make wider swaths
- Leave the grass to wilt for 12-18 hours
- Make tight, compact bales to ensure that there is no space for oxygen (air) in the bales
- Wrap bales within the shortest possible time. Ensure you wrap the bales in dry weather

14. Fermentation - Silage

- Silage making has become popular among farmers because it:
  - is simple to make
  - is less weather dependent
  - can be done repeatedly (after regrowth 6-8 weeks)
- Silage can be made from maize crop, sorghum crop, legumes and grasses
- Main principle is to exclude air during the ensiling process, prevent air from entering the silage during storage and minimise losses and quality problems during feeding out

14.1 Fermentation - Silage Cont'd…

- Modern technologies, such as oxygen impermeable covers and additives, can greatly reduce surface losses - irrespective of storage method

Note: *How to make silage: See module 2.3 Guidelines on silage making & module 2.4 Fermentation process*

15. Methods of storing silage

- Silage can be stored above ground (horizontal or vertical), or in hillside pits (horizontal). Most common methods include:
  - hillside pits
  - above ground bunkers (clamp)
  - in ground pits or trenches
  - stack and bale silage

- The system to be used depends on;
  - capital available
  - area available
  - Topography
  - equipment available
  - Expertise
  - personal preference

16. Size and shape of silage storage

- Long, deep, narrow pits are preferred over short, wide, shallow storages because these are easier to fill and compact progressively and minimise exposure to air when feeding out

- The target removal rate should be to a depth of at least 15 cm/day, increasing to 30 cm/day for unstable silages such as maize. Removing 15–30 cm/day minimises aerobic spoilage, as silage is removed from the bunker or clamp, and the complete face of the silage bunker/clamp should be sliced at this depth every one or two days

17. Amount of silage required

- The table below shows amount of silage needed corresponding to herd size

Feeding category	Feeding for 180 days			Feeding for 300 days			Feeding for 365 days		
	Daily feed quantity			Daily feed quantity			Daily feed quantity		
Number of cows	20kg	30kg	40kg	20kg	30kg	40kg	20kg	30kg	40kg
1	3.6	5.4	7.2	6.0	9.0	12.0	7.3	11.0	14.6
2	7.2	10.8	14.4	12.0	18.0	24.0	14.6	21.9	29.2
3	10.8	16.2	21.6	18.0	27.0	36.0	21.9	32.9	43.8
4	14.4	21.6	28.8	24.0	36.0	48.0	29.2	43.8	58.4
5	18.0	27.0	36.0	30.0	45.0	60.0	36.5	54.8	73.0
6	21.6	32.4	43.2	36.0	54.0	72.0	43.8	66.0	87.6
7	25.2	37.8	50.4	42.0	63.0	84.0	51.1	77.0	102.2
8	28.8	43.2	57.6	48.0	72.0	96.0	58.4	88.0	116.8
9	32.4	48.6	64.8	54.0	81.0	108.0	65.7	99.0	131.4
10	36.0	54.0	72.0	60.0	90.0	120.0	73.0	110.0	146.0

Note: *Units expressed in tonnes*

18. Packing density of silage

- **Example:** From the table on the previous page we know that to feed 5 cows 20 kg of silage per day for a period of 300 days 30 tons of silage is needed.

    1. To calculate the size of the storage for maize silage you divide 30 tons (= 30000 kg) with the packing density of the silage. -> 30000 / 600 = 50 m^3 (or in case of a higher packing density 30000 / 700 = 42.8 m^3)
    2. If the width of the silage bunker is 1.5 meter and the height after compaction is a meter the length of silage bunker is 50 m^3 / (1.5 *1) = 33.3 meters.
    3. If the forage material when harvesting is enough to make a 5 meter long silage bunker then you would require 33.3 / 5 = 6.7 bunkers. Practically you would make 7 bunkers of 5 meter (1.5 meter wide and 1 meter high)

Forage material	Weight (kg/ m^3)
Fresh pasture	700-800
Wilted pasture	600-700
Maize	600-700
Sorghum	600-700

19. Silage silo size (table)

- The silo size is determined by;
  - Herd size
  - Amount of daily feed
  - Number of feeding days
  - Packed density of the forage material

Indicative	Approximate pit (silo) capacities (tons)	
Pit (Silo)dimensions	Well compacted silage	Low compacted silage
height x width x length (m)	35% dry matter	35% dry matter
2.5 x 15 x 30	979	795
2.5 x 15 x 45	1551	1260
2.5 x 15 x 60	2397	1947
3.75 x 23 x 30	1980	1609
3.75 x 23 x 45	3238	2631
3.75 x 23 x 60	4495	3653
3.75 x 30 x 60	6244	5073
3.75 x 30 x 75	7497	6498
3.75 x 30 x 90	9750	7922
5 x 45 x 90	18601	15113
5 x 45 x 120	25460	20686
5 x 45 x 150	32319	26259
6 x 45 x 90	21810	17121
6 x 45 x 120	30040	24408
6 x 45 x 150	38271	31095

20. Correct size of silage silo

- Determine the quantity of silage that will be fed from the pile each day (in kilograms)
- Determine the cross-sectional area of the feed-out face or pile by dividing the quantity of silage that will be fed from the pile each day by the density of the silage (kg/m^3), multiplied by the rate of removal (0.15m) and the number of days to slice the face form top to bottom
- The surface area can then be used to determine a suitable width and height for the bunker or stack. For example, divide the cross-sectional area by the average depth to obtain the average width
- Calculate the cross-sectional area of the feed-out face to be removed per day as shown:

$$\text{Area of feeding face (m2)} = \frac{\text{Quantity of silage fed per day (kg fresh weight)}}{\text{Silage density (kg/m3)} \times \text{Rate of removal (m/day)}}$$

21. Factors to consider to reduce spoilage during storage

- Pit design - create pits with narrow width to reduce chances of air entering during feed out
- Avoid contaminating silage with soil and manure when compacting
- Type of sealing material - polythene used should be strong to reduce chances of damage to the seal
- After heavy compaction of silage bunkers a (heavy) soil cover is still of great importance to remove remaining air (oxygen)
- Always leave the face of the silage silo clean during handling
- Slow feeding speed often causes a lot of spoilage in the silage face due to heating and secondary fermentation

22. Dehydration – pelleting/artificial drying

- Dehydration involves removal of moisture (water) from feeds to preserve it for a long period of time
- Drying can be done manually by small scale farmers but for large production a mechanical dryer is required
- For pelleting a feed pellet machine will be required.
- In Ugandan context, dehydration as a means of conservation has no priority
- The process of drying is very efficient, although expensive
- Lucerne (alfalfa) is mostly dried artificially

23. How to make pellets

- Dry the alfalfa (lucerne) plant with air
- Crush the dry alfalfa plant or young grass to powder form
- Make pellets out of the alfalfa powder using a feed pellet machine
- Add a little molasses to give a sticky effect to the powder

24. Reasons for storing forages

- To create reserve for the dry season
- To utilize excess forage during rainy season
- To protect against climatic factors
- To avoid deterioration and spoilage caused by:
  - Water and heat
  - Pests and insects
  - Fungal invasion
  - Chemical damages

25. Storing pellets

- Dehydrated feeds such as pellets and cubes are easier to store and maintain their quality compared to wet feed
- They are mostly stored in eithers bales or bags
- Ensure moisture is less then 10% (i.e., >90% dry matter content)

26. Aspects of a good storage facility for forage

- Proper construction - needs to be covered all round
- Adequate space - according to needs of the farm
- Easy accessibility - easy loading and offloading
- Location - close to the cows feeding area
- Security against - animals, intruders and fire

27. Take home messages: Storing hay

1. Dry feeds are easier to store and maintain quality compared to wet feed. Some of these dry feeds include pellets, cereals and hay
2. They are mostly stored in either (hay) bales or sacks
3. Ensure dry matter content during hay baling is above 80% to reduce further losses during storage. Baling hay at lower dry matter content (below 80%) can cause moulding and heating
4. Maximum moisture content of hay is also related to the size and density of the bale during storage
5. Hay stored outside suffer higher storage losses compared to hay kept in a store.

28. Take home messages: Storing silage

- Consider the following to reduce spoilage during storage and at feed out:
    1. Pit design - narrow pits makes it easier to maintain feeding speed and reduce chances of air entering the silage during feed out
    2. Contamination - with soil or manure during ensiling when compacting should be avoided
    3. Type of sealing - polythene used should be new and strong to reduce chances of damage
    4. Compaction - heavy compaction of silage (or haylage) is of great importance to remove air (oxygen)
    5. Covering - add weight on top of silage for extra compaction
    6. Feed face and silage handling - farmer handling the silage should remove all loose silage material
    7. Feeding speed - low feeding speed often causes a lot spoilage

- END -