

Theme 1: Forage production and pasture management

OPERATING FARM EQUIPMENT AND SELF-PROPELLED TRACTORS (Level 3)

Topic	Training & information Content
1.1	Planning of fodder/feed requirements for the dry season
1.2.1	Integrated soil fertility management I
1.2.2	Integrated soil fertility management II
1.3	Use of natural resources, compost making, farmyard manure, manure storage and use
1.4	Growing maize and sorghum for fodder and estimating time of harvest and yield
1.5	Brachiaria, Panicum, & Napier (cut and carry) grass management
1.6	Growing fodder trees and use of feed
1.7	Estimating of dry matter content, feeding value and yield of various fodder crops
1.8	Guidelines for Tropical pasture management and grazing management
1.9	Scaled mechanization of forage production and pasture management (harvesting practices)
1.10	Operating farm equipment and self-propelled tractors
1.11	Mechanization of feeding management
1.12	Economics of forage and pasture production



1. You will learn about (learning objectives):

- How to operate various farm equipment & tractors.
- Various functions of farm equipment and machinery.
- Standard operating procedures for operating various farm equipment and tractors.



2. Background

- Selecting the right machinery and equipment for your dairy farm is important to ensure reduction of unnecessary running cost.
- Proper maintenance of equipment ensures extended use and effectiveness.
- Preventive maintenance is therefore key in reducing damage of machinery. This refers to routine check up of machinery to reduce unplanned breakdowns.



3. Benefits of using mechanized equipment in a farm

- Operations are conducted timely.
- Encourages precision operations i.e. precision planting by tractors.
- Increases productivity in activities.
- Increases output increases profits for farmers.
- Minimizes losses during operations.



4. Types of tools and equipment in a dairy farm

- i. Tractor and its implements
- ii. Harvesting equipment & machinery
 - Chopper
 - Harvester
- iii. Milking machine
- iv. Milk processing equipment
 - Milking can
 - Milk cooler
 - Pasteurizer
 - Processed milk packaging machine



Photo: Felix Opinya



Tractor

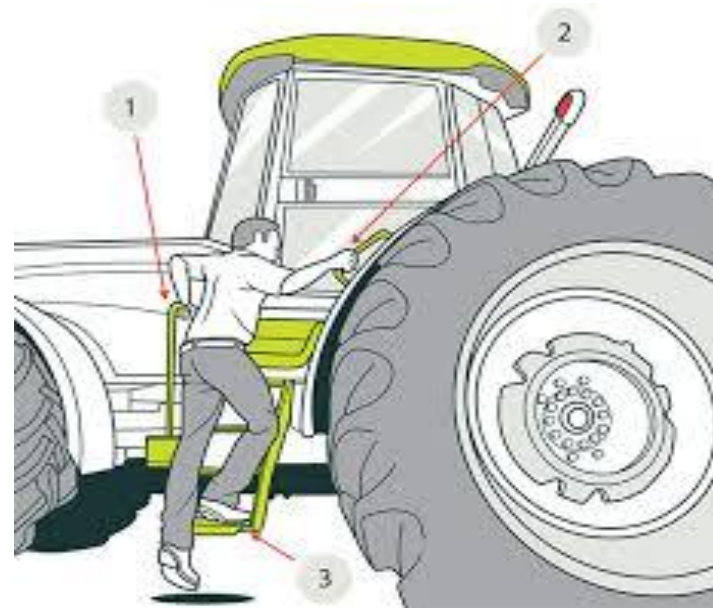


Milk pasteurizer

5. Tractor and tractor implements

Starting engine and moving/driving a tractor

1. To begin, climb up the tractor after inspecting and ensuring it is safe.
2. Make sure the tractor gear is in neutral.
3. Using the left foot depress the clutch pedal down to the floor.
4. Using the right foot engage the break while turning the keys to start the engine, slightly drop the throttle to warm up the engine.
5. Release parking breaks and depress the clutch to the floor while putting the transmission into first gear.
6. Slowly lift your foot off the clutch smoothly.



Key parts when climbing a tractor



Foot throttle

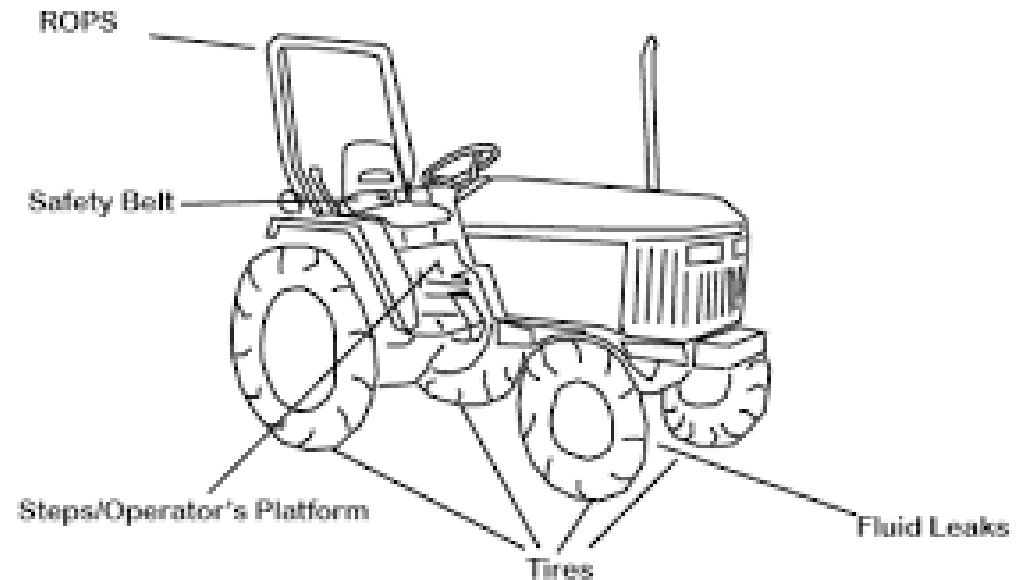
Stopping/switching off the engine

1. To halt/stop the tractor, depress the clutch to the floor completely and switch the gears to neutral.
2. Apply the parking brakes with your right foot.
3. Slow the throttle and turn keys to the off position.

6. Safety tips when handling/operating a tractor

Pre-operational safety tips

1. Only authorized driver should be given access to drive machinery.
2. Operators should be properly dressed before operating equipment.
3. Tractor should be well equipped i.e. seatbelts, roll over protection and tools in case of breakdown.
4. Ensure the three point-linkage securing pinions and safety chains are in good condition.
5. Check other important things with tractors before operating i.e. puncture, oil.



6.1 Safety tips when handling/operating a tractor Cont'd...

General tractor safety tips

- Only experienced operator should handle a tractor.
- Carrying passengers should be avoided.
- Avoid jumping off a moving tractor.
- Power take off (PTO) shafts and connections should be guarded and kept clear when engaged.
- Avoid standing between tractor and implements when making a connection.
- Slow down the tractor on rough terrain.



7. Implements to attach to a tractor

- Implements can be attached to a tractors in various places.
- Attachments on a tractors can be classified according to;
 - i. Type of tractor implement
 - ii. Method/place of attachment
- Some of these farm implements include;
 - Ploughs (disc plough, mouldboard plough, chisel plough)
 - Disc harrow
 - Planter/seed drill
 - Manure spreader
 - Trailer
 - Pallet fork
 - Tractor driven harvester/chopper



8. Implements to attach to a tractor Cont'd...

i. Trailing implements

- Are implements that are dragged by tractor, attached at the drawbar.
- These implements cannot be lifted or lowered.
- Examples; trailed mouldboard plough, disc harrow.



ii. Mounting implements

- Are implements that can be lifted with the help of a hydraulic system.
- These implements are attached with tractor through the 3-point hitch.
- Weight is transferred to the tractor.



iii. Semi-mounting implements

- Are implements that are lifted or lowered.
- These implements are attached to a 2-point hitch or 3-point hitch.
- Implements are supported by its wheels.
- No weight is transfer to the tractor.
- Example; Seed drill.



9. Mounting according to place of attachment onto a tractor

i. Rear mounting

- Are implements attached behind the rear axle.
- Implements are attached to drawbar or 3-point hitch.
- Examples; disc harrow, plough, seed drill machine, cultivator.

ii. Side/Mid mounting

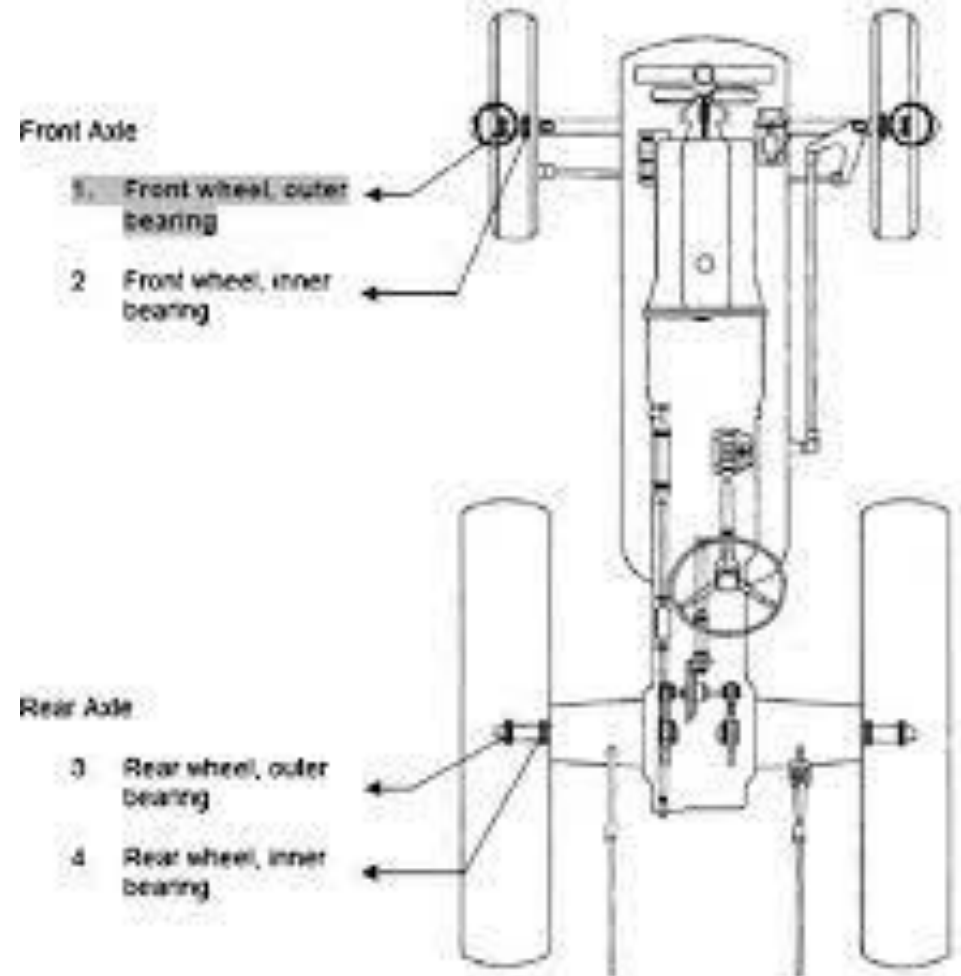
- Are implements attached between front and rear axle with the help of special attachments.
- Implement can be attached on the side or below tractor frame.
- Examples; levellers, graders and lawn mowers.



9.1 Mounting according to place of attachment onto a tractor Cont'd...

iii. Front mounting

- Are implements mounted before/on the front axle with help of front hitch or special attachments.
- The operator sees movement and how the implement works.
- Tractor wheels run on cultivated land causing soil compaction.
- Examples; loaders, harvesters and lawn mowers.



10. Common tractor implements: Disc plough

- Is an implement attached at the back of a tractor.
- Disc plough has circular plates used for cutting and turning soil and supported by a furrow wheel at the far end.
- It is used for initial land preparation and adapted to tillage.



11. Mouldboard plough

- Mouldboard plough works similar to disc plough.
- This implement has wedge shaped tips that aid in cutting vertically through the soil surfaces.
- Mouldboard ploughs turn furrow slices onto one side.
- It is mounted at the back of a tractor.



12. Chisel plough

- This implement has chisel like attachment.
- Chisel plough is also used for land preparation.
- The chisels plough land with minimum disruption to soil compared to the other types of ploughs and is more sustainable.
- Chisel plough is used to break hard pans and deep tillage.
- It is a great tool for aerating soils as it loosens it.



13. Harrows

i. Disc harrow

- This implement is used after a plough.
- They are used to make soil surfaces more levelled.
- Implement is attached with disc like plates that have been punctures/notched on the edges .
- Disc harrow is used to crumble soil clumps.
- Edges of the disc harrow plate uproots leftover crops as it loosens soil.



ii. Spring tooth harrow

- Equipment largely used in the past to loosen and level soil surfaces.
- Has many flexible curved teeth facing the ground.
- Attached using a 3-point hitch.
- Its is manually raised.

14. Planter

- The planter is an implement attached to the back/rear of the tractor and is closely similar to a seed drill. However, seed drills handle smaller seeds while planters handle larger seeds.
- It gets connected to a tractor through a drawbar or 3-point hitch.
- Planters can be driven mechanically or using hydraulic system.
- Planters are used for planting seeds like wheat and maize.
- Grains are placed in a box-like space of the planter and calibration is done before planting to ensure it releases seeds at a certain interval.
- Planters operate by dropping seeds to the bottom of the box into a seed plate and as the plate rotates, seeds fall to the soil.



15. Front-end loaders

- Front-end loaders are attachments made at the front end of the tractors just in front of the operator.
- Not all tractors are equipped to handle this implement.
- Loaders are attached to tractors using special attachments like arms placed at the sides of the tractor to support the loader.
- They are most suitable for moving soil, manure or forage. Example; Pallet fork.

Pallet fork

- Used to move objects like hay bales and boxed farm equipment.
- Can be attached to a front loader.



Pallet fork

16. Tractor trailers

- Tractor trailers are attached at the rear/back of the tractor.
- Used in different stages of production e.g., for carrying produce or farm inputs.
- Some trailer can tip over allowing easy offloading of produce. Example; Manure spreader.

Manure spreader

- This implement ensures even spread of manure in fields.
- A spreader has a rotating mechanism driven by a power take-off (PTO) shaft.
- Can be attached to the tractor using a PTO or it is ground-driven. The ground-driven spreader takes power from wheel movement.



16.1 Steps in making a PTO connection

- **Step 1:** Attach implements at the 3-point hitch or drawbar to the tractor.
- **Step 2:** Push the steel bolt through the PTO shaft and fasten the connection (Older models).

Or

Place the pin on the PTO driveline through the PTO stub shaft to secure it (Latest models).

- **Step 3:** Push the pin inwards all the way and ensure the detent pin snaps into position for safe connection.



17. Harvesting equipment

- Harvesting equipment should be well maintained prior to start of harvesting season.
- Farmers should keep equipment washed and free from harvests of last season to avoid any contamination.
- Common harvesting equipment's are:
 - Manual choppers
 - Self-propelled harvester



18. Manual chopper/chaff cutter

- Manual choppers are quite handy and assist in chopping variety of forages.
- Properly maintained choppers help make good silage.
- Care should be taken when handling this equipment to avoid injuries e.g., hands are not allowed into the feeding port.
- Machine should be used by adults familiar with its operations. Children should avoid coming close during operation.



18.1 Operating a manual chopper/chaff cutter

- First read the manufacturer's instructions manual carefully.
- Confirm that lubrication area has oil before starting the machine (motor).
- The operator should stand at the side of the feeding port.
- Do not switch power on if chopper is not loaded.
- Ensure the motor is disconnected from electric supply if not in use.
- In case of a fuel(diesel/petrol) engine ensure the engine is switched off when the chopper is not used.
- Forage material to be cut is evenly fed into the chopper and not forced. Excess loading is also prohibited to avoid choking.



Photo: Felix Opinya

19. Forage harvester and chopper

- Forage harvesters are used to harvest and chop forage, especially for making silage. They can be used in the field or at production site.
- Forage harvesters used in the field are attached to the front or side of the tractor.
- As the tractor moves along forage rows, the chopper cuts the maize and crushes the maize corn using a kernel crusher (has sharp knives).
- Chopped forage is expelled using a hose at the top into a trailer following the tractor closely.
- Choppers/harvesters used at the production site chop already harvested forage the same way a field harvester would.
- Forage harvesters can either be attached to a tractor or used as a self-propelled unit.



19.1 Safety precautions when handling/operating a harvester

- Only trained operators should be allowed to operate the harvester.
- Machines should be maintained during off-peak season of harvesting.
- Machines should be off when clearing a clogged harvester.
- Follow manufacturer's instruction manual when handling the machines, particularly the harvester knives.
- When servicing the machine, the head should be lowered to the ground after turning it off.
- Any complex maintenance should be by a professional to avoid injuries and further damages of machine.



Harvester
knives

20. Milk handling equipment: Milking machines

The following are two major categories/types milking machines:

i. Portable milk bucket machine

- This type of milking machine is portable, taken from one cow to the other.
- Can contain one or two buckets.
- mainly used by small-scale farmers with few milking cows.

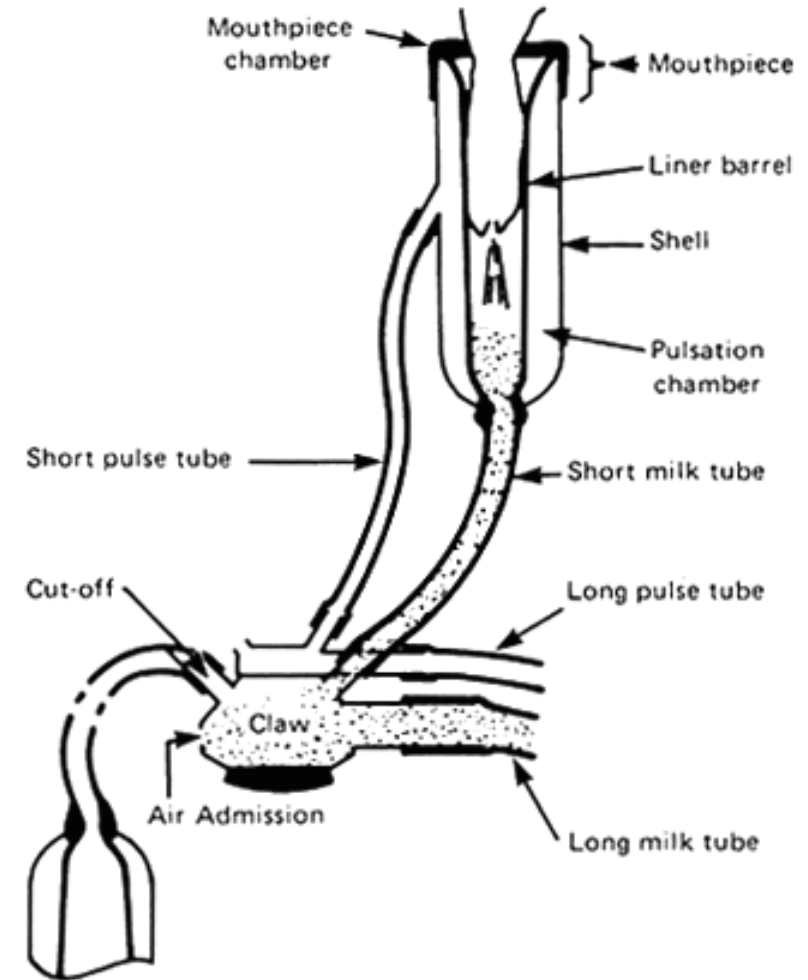


ii. Fixed milk bucket machine

- Similar to portable milk bucket but machine in design but equipment is fixed in milking parlour.
- After milking a different cow is brought to where machine is for milking.

21. Checks for using a milking machine

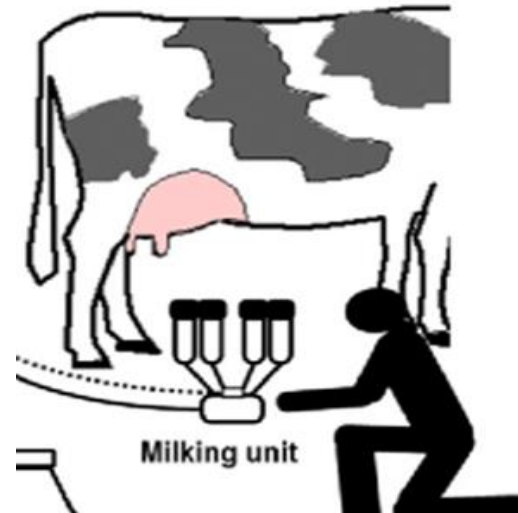
- Check;
 - i. Pipelines are free from milk or water, drain and flush with chlorinated water if found.
 - ii. Oil level in pump and refill with recommended oil by manufacturer.
 - iii. Water behind teat cup if found drain.
 - iv. Milk claw for vacuum stability, check that air admission hole in claw is clear and that the regulator is letting air into vacuum system.
 - v. Vacuum level and rate of recovery, this confirms any leaks into machine and vacuum regulator.



Cross-section of a teatcup cluster

22. Operating a milking machine

1. Clean hands with soap and water.
2. Clean udder of the cow and dry it with clean cloth.
3. Fore-strip the teats for milk using your hands, this is to check for presence of mastitis.
4. Turn on machine and attach milking unit to the cow's teats.



22.1 Operating a milking machine Cont'd...

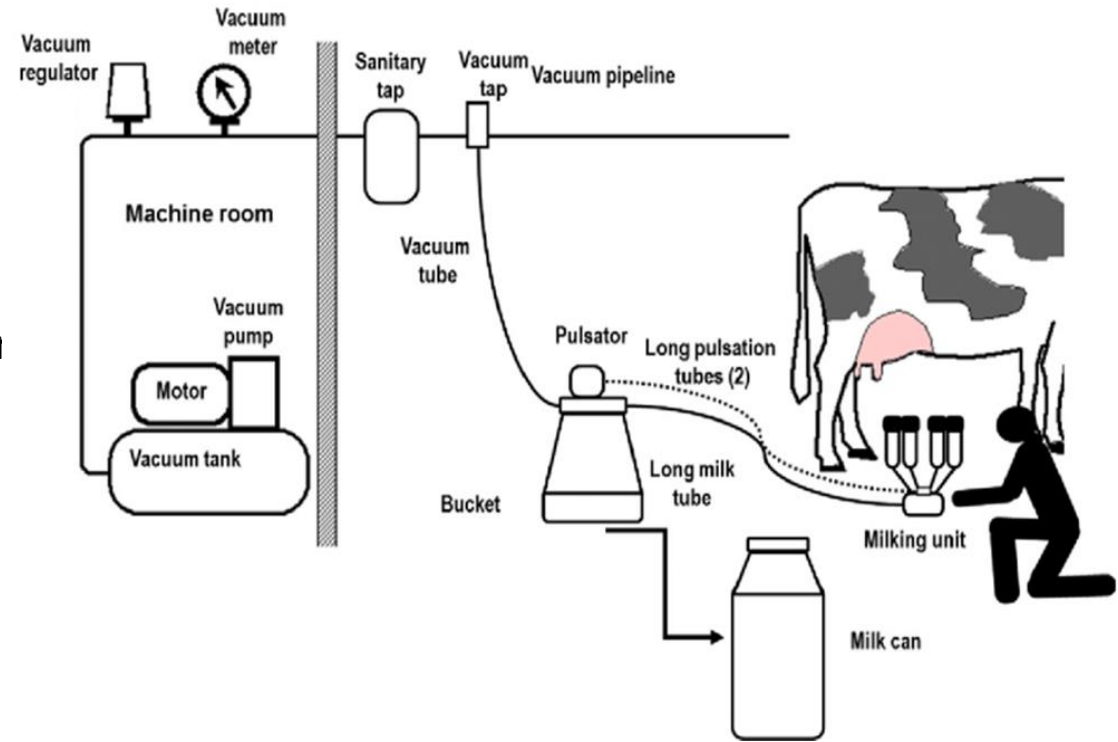
5. Adjust milking unit for proper placement to obtain square shape.
6. Observe milk flow to identify right time to detach milking unit and avoid “blind” milking.
7. Turn off vacuum before detaching the milking unit, pulling teat cups while vacuum is still on can damage teat ends.
8. Disinfect teats by dipping them in a disinfectant solution.
9. Before milking another cow wash machine before attaching milking machine for next milking.



23. How a milking machine works

Pulsation system

- Milking machine imitates a calf suckling the mother's teats.
- Vacuum supply and pulsation facilitates working of a milking machine.
- Pulsator is a valve that allows entry and exit of air within the shell.
- The milking machine controls the vacuum that creates pressure difference between inside and outside the teat.



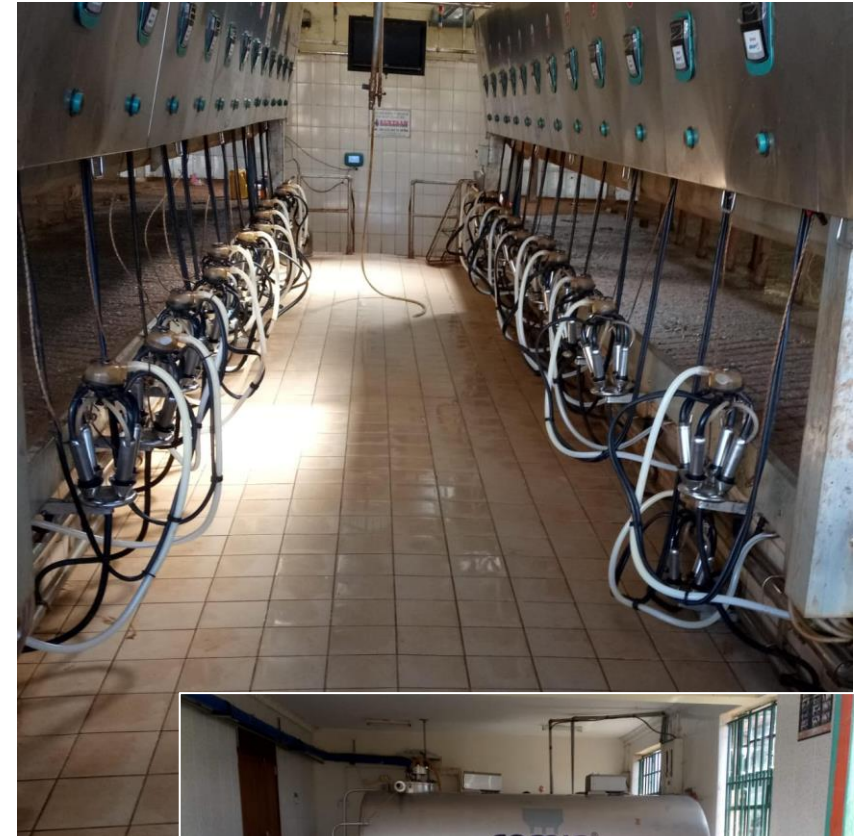
23.1 How a milking machine works Cont'd...

- Negative pressure opens the teat as pulsation assists in massaging the teats to facilitate milk flow.
- Vacuum supply (negative pressure) in the machine removes and moves the milk within the system.
- Duration and liner opening and closing is controlled by the pulsation system rate in combination with vacuum levels and liner design.



24. Pipeline milking machines

- This system is fixed within the milking parlour and is commonly used with fully zero-grazed cows.
- System is fully auto-mated to meet with needs of a large farm to milk many milking cows at same time.
- After milking, milk volume is recorded using a recorder jar or milk meter.
- Diameter of pipes is in relation to volumes of milk produced.
- The system then transfers milk to a cooling and storage tank.



25. Handling milking machine after milking

- Drain all the milk that is still in the pipeline (between the receiver and milk tank).
- Disconnect milk pipeline from tank, avoid mixing of water and milk.
- Remove and replace filters; they should be used once.
- Clean milking equipment including its outer surfaces.



26. Cleaning a milking machine

1. Use hot water and detergent to clean washing machine as instructed by equipment supplier.
2. Procedure for hand washing or automatic cleaning (pipeline milking machine) should follow equipment supplier guidelines.
3. All equipment's linked to milk handling/storage chain should follow equipment supplier procedure i.e. the whole pipeline milking machine chain.

Note: Pipeline milking machine chain includes bulk tank for milk storage



27. Milk processing equipment

- Milking processing equipment should be kept clean at all times. The deposits stuck on the surface in most cases are milk components.
- Milking area should be clean and milk should be strained immediately to prevent entry of foreign materials e.g. hair.
- Milk should also be covered after milking to avoid contamination by factors in the environment.
- Cooling should be done immediately after milking.
- Milk equipment easily keep bacteria especially pipes if cleaning procedure is not maintained.



28. Milk cooling systems

- After milking, milk should be well stored to maintain milk quality by avoiding contamination.
- Scale of production influences cooling methods. Common method of cooling by farmers is placement of milk in cold water at intervals while changing water.
- Modern methods of cooling involves use of milk coolers and refrigerators.
- Systems using water should constantly ensure adequate supply of chilled water.
- Some facilities precool milk before cooling milk, this reduces the load of refrigerating.
- Precooling can be done using main or ground water supply systems at specified temperature ranges.



Milk cooler

29. Milk pasteurizer

- Milk pasteurization involves heating milk to a particular temperature within the shortest time possible to kill pathogens that make milk go bad.

Common thermal processing methods

1. Batch pasteurization - Low temperature long time (LTLT), involves heating milk to 63°C for 30 minutes.
2. Flash pasteurization - High temperature short time (HTST) is the most common method of pasteurization used in large scale dairy factories. Involves heating milk to 72-74°C for 15-20 seconds.
3. Ultra-high temperature (UHT) pasteurization - Involves heating milk between 135-140°C for 2-4 seconds. Used by dairy processing factories.



Photo: Felix Opiya

30. Milk packaging machine

Safety operating procedures when packaging

- Labelling should be done early and should not be misleading.
- Milk and its other product should be sampled & tested on regular basic to ensure it meets the safety standards.
- Packaging of milk product should be done at site of pasteurization.
- Equipment used should be approved.
- Packaging should be done in a sanitary manner.
- Packaging material should be approved.



Photo: Felix Opinya