Farm Structures in a zero-grazing dairy unit

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Introduction

With the ever-increasing human population in Uganda, land holding per household is on the decline and, therefore, conventional dairy production is becoming more difficult. This is particularly so in peri-urban settings, where families need milk not only for domestic consumption, but also income generation. This scarcity of farmland calls for highly intensive dairy farming system to increase efficiency of land utilization, thus the zero-grazing system or stall-feeding.

Proper farm structures contribute to the performance of a dairy system as well as comfort of the animals and the attendants. A well designed farm structure should be able to:

- Reduce the cost of the materials or utilize locally available materials.
- Provide safety and comfort to the animals.
- Provide a safe and pleasant environment to the attendant.
- Lead to higher productivity and profitability.

Lay-out and design of a zero grazing dairy unit

(1) Site location

The site where the zero-grazing unit is built determines the efficiency of operations throughout the dairy cattle enterprise. Zero-grazing dairy system requires an increased level of labour input, due to the need to cut fodder daily. The following should be considered when selecting a site for construction of a dairy unit:

- The unit should be as near as possible to the source of forage to reduce labour costs of carrying the cut fodder to the cows and carrying manure back to the farm.
- Proximity to the homestead in relation to the biogas plant is also an important consideration.
- Easy access to the farm.
- Vehicles delivering feeds or collecting milk must be able to turn around the dairy facility.
- Make the most of natural light and shade.
The facility should be as close to the centre of the grazing area as possible to minimize cow walking time and exposure to causes of lameness.

Enable access to power, proper drainage, location to relative watercourses and local byelaws should be all considered.

Align the building according to how much protection is needed from weather. The east-west alignment is best suited for the weather in Uganda.

(2) Safety
A good dairy animal is a costly investment that must be accorded security. This can be ensured by the kind of design you adopt for the unit and its location. Many cases of malicious poisoning of high producing dairy cows and vandalism by jealous neighbours or even farm workers are common. Locating the unit close to farm houses will add to security, but this should be such that the wind should blow away the dung smell.

(3) Good manure handling design
Manure is a daily by-product from dairy production and measures must be incorporated in the unit design to ensure that it is properly disposed of without being an odour nuisance to the farm and neighbourhood.

(4) Ventilation
Good ventilation is good for a healthy respiratory system and adds to the comfort, which we have noted is crucial for maximal milk production. The level of ventilation depends on the climatic conditions of a given area. Where the climate is hot, a zero-grazing unit should be scantily enclosed to maximise air circulation and reduce heat stress. The direction of the wind is important in ensuring good ventilation while at the same time protecting the animal from adverse climatic conditions.

(5) Protection
Protection from adverse weather conditions like rain, strong wind and hot sunshine. Where winds are strong consider utilising wind breakers like trees and buildings.

(6) Isolation
Isolation is a key function of a zero-grazing unit. Different animals need to be isolated from each other to avoid injuries resulting from fights and mounting to control breeding and avoid spread of diseases.

(7) Bio-security
Bio-security management practices prevent the spread of disease by minimizing the movement of biological organisms and their vectors (viruses, bacteria, rodents, flies, etc.) onto and within your operation through animals, vehicles, visitors, personnel, pests, and other means. A footbath is a very simple bio-security measure that helps prevent the potential spread of disease. Depending on the amount of traffic on your farm, it may be necessary to have more than one footbath. There are several recommended disinfectants for use in footbaths. Make sure to maintain a "clean" footbath. On average, footbaths require weekly cleaning. Post guidelines near footbaths instructing users how to correctly wash footwear.

(8) Comfort
Cow comfort is a term used to describe the overall comfort level of a dairy cow in its environment on the farm. It is an important part of maintaining a healthy herd. The first aspect of cow comfort are the facilities in which they live. Cows are housed in well ventilated and clean cubicles. For exercise, the cows are provided plenty of space to walk around whenever they choose. To rest, the cows should have large free stalls, bedded with clean materials such as: sand, sawdust or rubber mats. The bedding materials help the cows’ udders to keep them clean and comfortable when lying down. Cow comfort is very important to milk quality, and a priority for dairy farmers and veterinarians.

Components of a zero-grazing unit
A zero-grazing unit has various components: (1) cubicles, (2) walking area, (3) resting area, (4) feed and water troughs, (5) milking place, calf pens, (6) fodder chopping area, store, (7) manure pit, (8) roof water catchment and water tank and, (9) a holding crush.

(1) **Cubicles**
Cubicles in a dairy unit form the resting area for the cow, thus it should not restrain the animal from moving around. The recommended measurements are: 6 ft by 3 ft to 7 ft by 4 ft depending on the animal size.

Cubicles are normally covered with soft materials like saw dust to avoid wounds from bruises as the animal sleeps. Rubber mats, also known as cattle mats, are commonly used in cubicles. Mats need litter to absorb moisture and reduce abrasions. Rubber mats have several advantages:
- Increase milk yield by encouraging cows to lie and ruminate for longer period.
- Reduce veterinary bills by reducing leg injuries and abrasions as cows get up and down.
- Reduce incidence of mastitis by keeping cows clean and dry for longer, hence improving udder and milk hygiene.
(2) Walking area
It is recommended that the floor should be made of concrete for ease of cleaning and should have a gradual slope towards the dung pit and be about 3ft wide. Feed and water troughs should be raised above the ground to avoid contamination from the walking area and to ensure easy feeding by the cow.

(3) Resting area
The resting area should also be roofed to provide shelter against rain and sunshine. A neck-pole is fixed across the cubicle. This prevents the cow from entering too far into the cubicle and ensures that the urine and dung will drop on the walking area. This will ensure that the cubicle and the cow remain clean. A mineral box can be fixed at the head of each cubicle for individual mineral supply to each cow. This can limit fighting among cows and between cows and young stock for access to mineral blocks. Water should always be available and must have an outlet to drain before refilling.

(4) Feed and water troughs
The feed troughs should run along the length of the walking area with a water trough in the middle. The total length of the feed trough should be such that each cow or heifer has 75-90 cm to itself.

(a) Old water baths, (b) old tractor tyres and (c) wooden feed trough

The water trough should be placed such that both the young stock and the mature cows have access to it instead of constructing separate trough for each side (the unit divided to separate young and mature stock). Below are different types of feed troughs made from locally available local materials.

(5) The milking parlour
Particular consideration must be given to the milking area to ensure clean milk production. The milking parlour should be constructed next to the cubicles. The floor should be flat and made of firm concrete and slope towards the walking area. The direction of slope of the floor should ensure that manure
collected from the floor can flow through the walking area into the manure pit. There should be a feed trough in the milking place for feeding concentrates to the cows during milking. The milking place should be kept clean.

Noise during milking may disturb the cow making it to hold back some of her milk. However, a report from a study by the University of Leicester found that slow music can mitigate stress in cows and increase the amount of milk they produce by 3 percent. Music can have a positive effect on milk let down, but it must be consistent and calming. Stress can inhibit the release of oxytocin, a hormone key to the milk-releasing process.

(6) The calf pen
Successful dairy production is based on proper rearing and management of dairy calves for herd expansion and as replacement stock. In Uganda, inadequate and/or inappropriate calf housing facilities remain a major problem undermining calf performance and survival. Calves are often housed in makeshift structures close to the main cattle shade, which predisposed them to a lot of bacterial infections and diseases like pneumonia. Such infections result into reduced growth rates and calf mortalities. Majority of the calves on dairy farms are housed in groups making it difficult to meet individual feed requirements. To address the challenges identified with calf housing, the National Livestock Resources Research Institute (NaLIRRI) designed and fabricated a calf pen to optimize calf performance.

(7) The fodder chopping area
Chopping fodder reduces the sizes of forage parts which enables farmers to uniformly mix forage resources of varying nutritive quality and palatability, which improves forage acceptability by animals,
feed intake and lowers feed wastage. Forage chopping may be achieved by use of a hand held panga, fixed knife chopper and motorized forage choppers. Innovative attributes of NaLIRRI calf pen prototype include:

- A slated floor to provide for good drainage of urine and to maintain warm beddings for the calf.
- The pen has an exercise area to enable the calf to bask in the sun.
- The pen is fitted with a 10-gauge welded wire mesh on the upper sides and at the back to improve ventilation.
- The pen is fitted with a plastic nipple bucket which mimics the cow’s udder and facilitates milk acceptance by calves.
- A back door to enable easy removal and replacement of the calf beddings with minimal disturbance to the calf.
- The pen provides for individual feeding of calves based on their specific nutritional requirements.
- Portability. Pen can easily be dismantled, reassembled and even moved from one place to another.

Recommended calf beddings can be untreated wood chips, shavings, sawdust, straw, or shredded paper.

Different types of forage choppers: (a) panga, (b) motorized chopper by BrazAfric and, (c) fixed knife chopper
However, chopping forages using pangas has resulted into injuries and many farmers have lost their fingers during the chopping operations. In addition, use of rudimentary chopping equipment such as pangas is associated with drudgery and is not appropriate for a herd size of more than three dairy cows.

(8) The store
A store where inputs such as concentrates, minerals, milk utensils and other small equipment are kept should be attached to the zero-grazing unit next to the milking place and opposite the fodder chopping area. The store should be well-ventilated and free from rodents.

(9) Manure disposal pit
Accumulated manure can cause health, odour, pest, and water quality problems if not properly managed. One option is to collect the waste daily and spread it on food crops or pastures. This is time consuming and also has to be done regardless of the soil moisture, weather, or time of year. The alternative to daily spreading is to stockpile or store the manure for a period of time, at which point it may be spread and utilized beneficially elsewhere. Even though the number of animals on your farm may not be large, enough manure will be generated to pose a problem if planning is not done. Manure pits make clean-up easier for farm employees, however, these pits may contain gases such a methane, carbon dioxide and ammonia in dangerous concentrations. Within the confined space of a manure pit, these gases can create an oxygen deficient, toxic, and/or explosive atmosphere. Treat manure pits like any other type of confined space.

One cow can produce up to 20 tons of compost per year depending on feeds and feed management. Twenty (20) tons of compost contains approximately 80 kg of nitrogen, 40 kg of phosphate and 10 kg of potash. Manure can also be stored as compost made from urine, cow dung and plants. In this case, the compost must be heaped next to the grazing unit. Compost may be covered with plastic or soil. The manure produced from 3 cows is sufficient to produce the amount of gas needed for cooking and lighting in the farm.

(7) Roof rain water catchment and water tank
Water is vital to the animal’s health, growth and milk production and to all key body functions. Lack of sufficient quality water reduces the quantity of feed consumed and digested by the animals which in turn reduce the amount of milk produced and overall animal performance. A dairy cow requires about 5 litres of water for every litre of milk it produces.

Water harvesting is the collection and concentration of rainwater for the production of crops, pasture or trees, for livestock or domestic water supply or for other productive purposes. Roof top rainwater harvesting involves collecting rainwater from roofs to storage tanks using gutters located at the edges of the roofs. A simple water harvesting and storage system It involves the following activities:

(a) Digging a pit—the size of a pit will depend on the capacity of your tank
(b) Laying a dam liner inside the pit. In Uganda, good and genuine dam liners can be obtained from Balton (U) in industrial area.
(c) Roofing
(d) Constructing a small wall around the tank to prevent soil erosion entering the tank.
Construction of an underground rainwater harvesting tank

Excavated reservoirs can be lined with either a tarpauline of a dam liner. Tank measurements with a capacity of 35,000 litres of water have the following:

- Tank dimensions (6 x 3 x 1.5 meters)
- Tank capacity: 24-27 cubic meters
- Roof catchment (5 x 10 = 50 square meters)

Plastic tanks can be used to store water. The major challenge is the high cost of plastic tanks.

Open surface rain water tanks

In areas where good water quality is needed for domestic and animal consumption but the roof catchment is too small to collect sufficient water, open surface water tanks can be constructed. These can however be constructed in areas that receive good rainfall to ensure collection of enough water. The design is based on the principle that for every 1mm of rainfall, 1 cubic meter of water is collected in every square meter of surface. Therefore, a water tank constructed with surface area of 24 square meter will collect 24 square meter of water from a storm of 1mm rainfall. These tanks provide clean quality water for a variety of purposes including domestic use.
(8) **Holding crush**

A crush is a more convenient and practical place to carry out activities such as: Artificial Insemination (AI), pregnancy diagnosis and several treatment activities e.g. drenching.

![Diagram of crush](image)

Purpose-built crushes are commercially available. A typical specification is: Length: 1830 mm (6ft), Width: 790 mm (2 ft 7 inches), and Height: 1625 mm (5 ft 4 inches)

**Space requirements for each age group and status**

It should be noted that separating animals based on age groups prevents unnecessary bullying by the dominant animals of subordinate ones. This brings about improvement in feeding and milk production; than when housed in mixed groups. Where stalls are too small, the animals are not comfortable, increased animal injuries, reduced lying time which results in decreased milk production and if the stalls are too large, it results into dirty stalls, poor hygiene for animals, increased stall maintenance and small cows would prefer to lay backward in stall.
### Open area (square meter) space requirements

<table>
<thead>
<tr>
<th>Type of animal</th>
<th>Floor area/animal (square meter) covered</th>
<th>Open area (square meter)</th>
<th>Feeding trough space/animal (cm)</th>
<th>Water trough space/animal (cm)</th>
<th>Mode of housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young calves (&lt;8 weeks)</td>
<td>1.0</td>
<td>2.0</td>
<td>40-50</td>
<td>10-15</td>
<td>Individuals or in groups below 5</td>
</tr>
<tr>
<td>Older calves (&gt;8 weeks)</td>
<td>2.0</td>
<td>4.0</td>
<td>40-50</td>
<td>10-15</td>
<td>Groups of below 15</td>
</tr>
<tr>
<td>Heifers</td>
<td>2.0</td>
<td>4.0-5.0</td>
<td>45-60</td>
<td>30-45</td>
<td>Groups of below 25</td>
</tr>
<tr>
<td>Adult cows</td>
<td>3.5</td>
<td>7.0</td>
<td>60-75</td>
<td>45-60</td>
<td>Groups of below 25</td>
</tr>
<tr>
<td>Downer calves</td>
<td>12.0</td>
<td>20-25</td>
<td>60-75</td>
<td>60-75</td>
<td>Individual</td>
</tr>
<tr>
<td>Bulls</td>
<td>12.0</td>
<td>120.0</td>
<td>60-75</td>
<td>60-75</td>
<td>Individual</td>
</tr>
<tr>
<td>Bullocks</td>
<td>3.5</td>
<td>7.0</td>
<td>60-75</td>
<td>60-75</td>
<td>Pairs</td>
</tr>
</tbody>
</table>

### Materials required for construction of a zero-grazing unit

Quality construction materials which are locally available can greatly reduce costs. The cow shed must be functional, cheap and long lasting. The choice of an artisan is important because a lot of expensive material can be wasted by hiring a bad artisan. It should always be noted that the most expensively built structure is not always the best and most durable one.

(1) **Strong Posts:**
The first 2 columns below represent number of posts required for a unit of 5 and 3 cubicles respectively.

<table>
<thead>
<tr>
<th>Number of posts</th>
<th>Length (cm)</th>
<th>Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>15</td>
</tr>
</tbody>
</table>

(2) **Timber:**

<table>
<thead>
<tr>
<th>Number</th>
<th>Length</th>
<th>Diameter (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3”x1”</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3”x2”</td>
<td>99.5 metres</td>
<td>55</td>
</tr>
<tr>
<td>2”x2”</td>
<td>33.5 metres</td>
<td>50</td>
</tr>
<tr>
<td>6”x 1.25”</td>
<td>45 pieces</td>
<td>170</td>
</tr>
</tbody>
</table>

(3) **Iron Sheets:**

Twelve (12) corrugated iron sheets of 3 meter for a 3-cubicle unit and 17 similar iron sheets for a 5-cubicle unit (28 or 30 gauge).

(4) **Other requirements:**
- 4 cubic meters hardcore (1/2 lorry-load)
- 3 cubic meters ballast (1/2 lorry-load)
- 3.5 cubic meters sand (1/2 lorry-load)
- 10 bags cement
The concrete should be mixed in the following ratio: 1 bag cement + 2 wheelbarrows sand + 3 wheelbarrows ballast.

(5) Nails:
- 3.5 kg of 4”
- 3.5 kg of 3”
- 2 kg of 2”
- 2 kg of roofing type

To prevent high investment costs, it is advisable to make use, as much as possible, of local materials and where possible from the farm. The cows will not notice the difference and will be equally productive.