Zero-grazing dairy cattle production system

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Small-scale dairy cattle production systems are among the many forms of dairy production systems in Uganda. The systems involve the production, processing and marketing of milk and milk products that are channelled to consumers in urban and peri-urban centres. These systems evolved to satisfy the increasing demand for milk as a consequence of increasing urbanisation, rising per capita income and increasing cost of imported milk and milk products. The systems contribute to overall development through income and employment generation, food security, asset accumulation, poverty alleviation and improving human nutrition and health**.**

More than 90 percent of the small-scale dairy cattle farmers live in the medium and low-density areas and use their residential units as places where dairying is carried out. These farmers have little or no access to grazing land and they rely mainly on purchased feeds and forages harvested from public land. This results into dairy cattle receiving sub-optimal level of nutrition especially during the dry periods. Due to small land holdings, **zero grazing (stall-feeding) dairy cattle production system** is common in peri-urban and rural areas.

A zero-grazing dairy cattle unit in Apac district, Uganda

Under the zero-grazing system, cattle are confined in one place where feed and water are brought to the animals. Other animal husbandry activities such as animal health, are also carried out under zero grazing. Zero grazing is very important as it produces over 60% of the milk needed for the life of animals and humans in Uganda.

Advantages of zero grazing production systems

- Diversification of household income sources.
- On-farm production of milk, which improves household nutrition.
- The animals are kept inside which is more secure and protect them from attack by predators.
- Increased opportunities for small-scale farmers to keep improved dairy animals.
- The feeds are utilised well---- reduced pasture damage.
- Many animals can be fed from a very small area.

- Easy collection of manure for soil fertility improvement, crop and biogas production.
- Increased use of crop residues, fodder grasses, legumes and multipurpose fodder trees and shrubs in producing high value products,
- Disease and pest control made easier.
- Easier animal health management.
- Close observation of the animals is possible, making heat detection and attendance to animals easier and faster.
- In addition to milk production, a farmer also gets calves, which in turn grow up into heifers, which will produce more milk, or a bull, which can be sold to generate more income.

Disadvantages of zero grazing dairy cattle production systems

- Requires animals of higher genetic potential to make economic sense, which is more expensive.
- More resources (capital and labour) are devoted to construction of a zero-grazing unit, chopping the fodder, feeding in the stalls, cleaning the stalls and transporting manure to the fields.
- Large amounts of pasture and supplements required for high milk producers.
- Increased expenses on disease control and treatment, because high milk producing cows are more susceptible to diseases such as milk fever.
- Diseases can easily spread to animals in the same enclosure because stalls might be too close.
- There is a possibility that animals are stressed because of too much confinement inside the zero-grazing units.
- It might not be easy to detect cows with silent heat if you are keeping one cow.

Requirements for a good zero grazing unit

A good zero grazing unit design should take into consideration the following:

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 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.

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 for dairy facilities*

Bio-security management practices prevent the spread of disease by minimizing the movement of biologic organisms and their vectors (viruses, bacteria, rodents, flies, etc.) onto and within your operation through animals, vehicles, visitors, personnel, pests, and other means. A vehicle wheel bath or 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 the 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 have large free stalls, bedded with clean materials such as: sand, sawdust or rubber mats. The bedding materials form to the cows' udders to keep them 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: cubicles, walking area, feed and water troughs, milking place, calf pens, fodder chopping area, store, manure pit, roof water catchment, water tank and a holding crush.

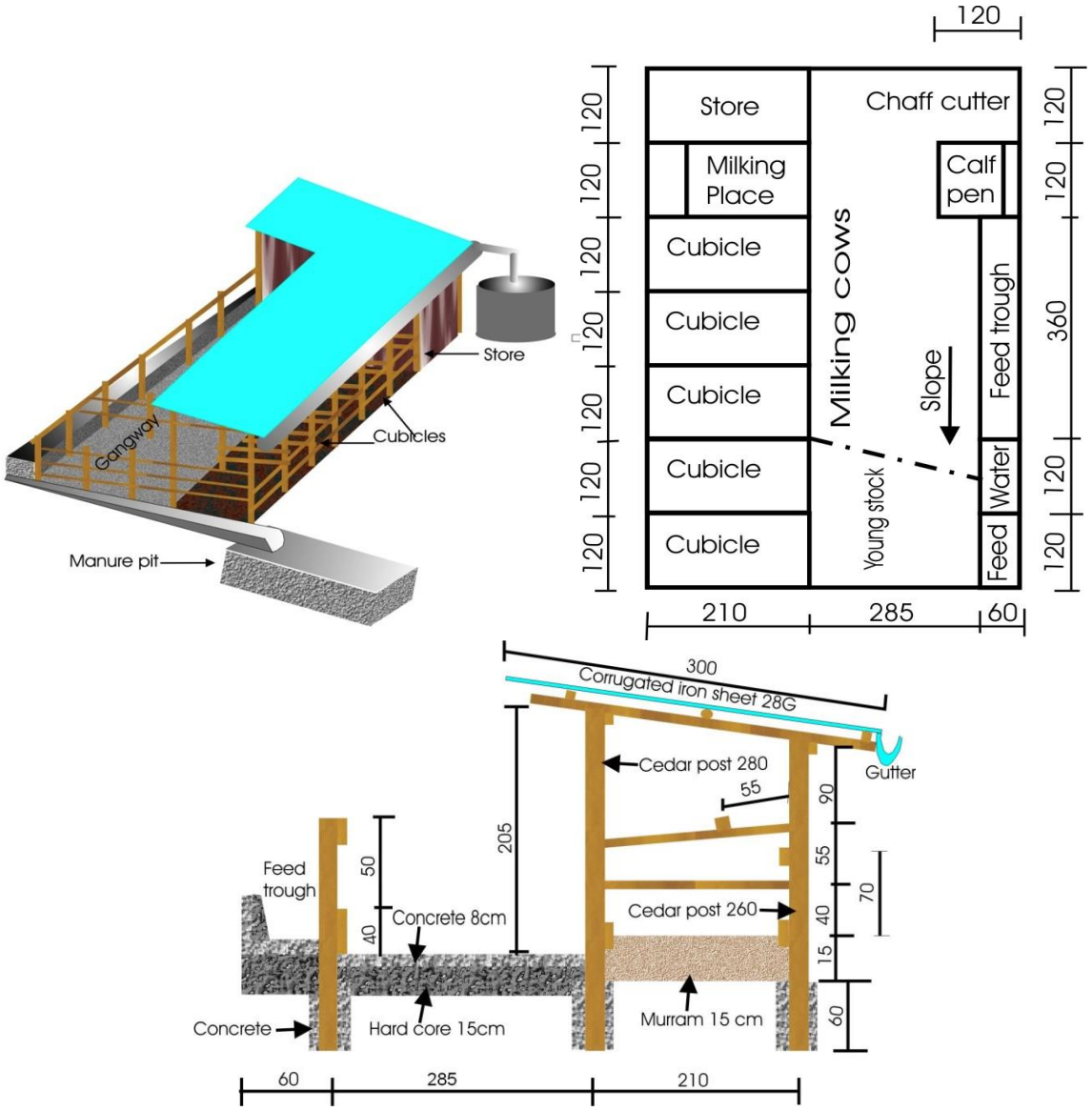
1. *Cubicles*

Cubicles in a zero- grazing 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 3ft to 7ft by 4 ft depending on the animal size. Cubicles are normally covered with soft materials like such as sawdust and sand 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.

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. The resting area should 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.



A lay out of a simple zero grazing unit

2. *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 dirt 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.

3. *The fodder chopping area*

Chopping fodder (forage grass and legumes and crop ressidues) 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. Chopping forages using pangas is very common but it 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. Forage chopping may be achieved by use of a hand held panga, manual and motorized forage choppers

Different types of forage choppers; Panga (a), fixed knife chopper (b) and motorized chopper by BrazAfric (c).

4. *The store*

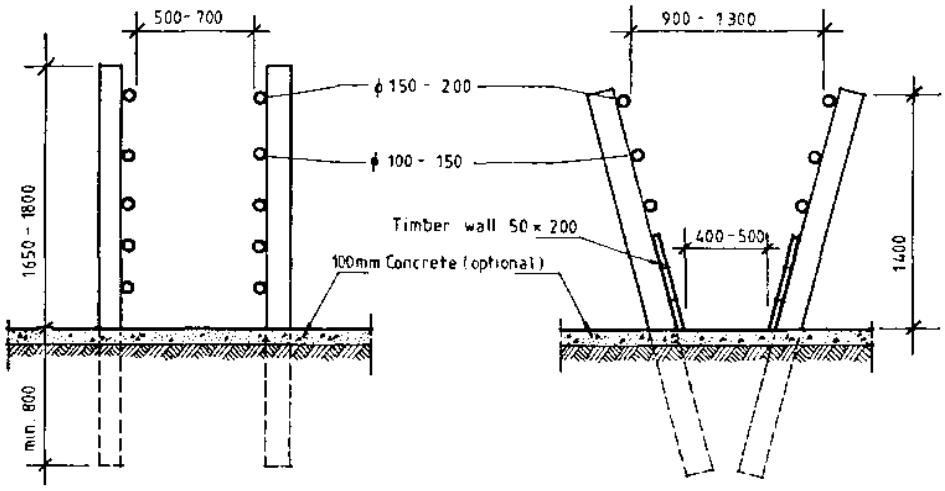
A store where inputs are kept should be attached to the zero-grazing unit next to the milking place and opposite the fodder chopping area. In this way, concentrates, minerals, milk utensils and other small equipment can be stored near to the. A store is optional where finances are inadequate. It can however be built later. The grazing unit should have facilities for harvesting water.

5. *Manure disposal storage*

Manure can be stored in a pit dug out of soil. The pit may or may not be cemented but it must be covered. 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.

6. *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.



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)

7. 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. Innovative attributes of the NARO-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.

(a)

(b)

(c)

Side view (a), Back view (b) and prototype of the NARO-NaLIRRI calf pen (c)

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

8. *Roof rain water catchment*

Water is vital to the animal's health, growth and milk production and to all key body functions such as digestion, transporting oxygen and nutrients throughout the body. 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. Therefore, a cow producing 10 litres of milk a day must drink about 50 litres/day. The amount required also depends of breed, body size, and season.

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.

9. *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. 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.

(a)

(b)

(c)

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

Water should always be available and must have an outlet to drain before refilling.

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.

Open area (m^2) space requirements

Type of animal	**Floor space/area animal (m^2) covered area**	**Open area (m^2)**	**Feeding trough space/animal (cm)**	**Water trough space/animal (cm)**	**Mode of housing**
Young calves (<8 weeks)	1.0	2.0	40-50	10-15	Individuals or in groups below 5
Older calves (>8 weeks)	2.0	4.0	40-50	10-15	Groups of below 15
Heifers	2.0	4.0-5.0	45-60	30-45	Groups of below 25
Adult cows	3.5	7.0	60-75	45-60	Groups of below 25
Downer calves	12.0	20-25	60-75	60-75	Individual
Bulls	12.0	120.0	60-75	60-75	Individual
Bullocks	3.5	7.0	60-75	60-75	Pairs

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.

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.

Strong Posts

The first 2 columns below represent number of posts required for a unit of 5 and 3 cubicles respectively.

Number	**Length (cm)**	**Diameter (cm)**
0	310	15
10	120	15
7	260	15
5	180	15
12	120	15

Timber

Number	**Length**	**Diameter (metres)**
3”x1”	0	0
3”x2”	99.5 metres	55
2”x2”	33.5 metres	50
6”x 1.25”	45 pieces	170

Iron Sheets

12 corrugated iron sheets of 3.00m for a 3 cubicle unit and 17 similar iron sheets for a 5 cubicle unit (28 or 30 gauge).

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.

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.