Dairy Housing and Manure Management
Part I Training manual
Part II Training Guideline
Preface

SNV Ethiopia, through EDGET project (Enhancing Dairy Sector Growth in Ethiopia, 2013-2018), engages in the capacity building, extension services and innovative support to the Ethiopian dairy sector particularly working with smallholder dairy farmers. The aim of the project is to increase milk production and productivity in order to double the income of the smallholder dairy farmers. EDGET is operational in the regions Oromia, Amhara and SNNP, and working with 65,000 dairy farming households.

The project works closely together with livestock regional bureaus and their respective zonal, woreda and kebele staff in delivering extension and other supports. One area of collaboration is the development of practical training and coaching tools and materials for extension workers based on a need assessment.

SNV has engaged the Netherlands based Dairy Training Centre (DTC) for the development of the Training package for extension workers. The documents were more elaborated and validated with the utmost contribution of high level experts from regional Livestock and Fisheries resources Development Bureaus/Agencies and Research Centers from the three operational regions of EDGET.

Overall nine training packages were developed on Breed Improvement and Fertility Management; Dairy Cattle Feeding and Nutrition Management; Dairy Cattle Health Management; Dairy Farm Management; Dairy Housing and Manure Management; Farm Economics; Forage Production and Management; Hygienic and Quality Milk Production; Young Stock Management.

This training package is on Dairy Housing and Manure Management.

SNV, also on behalf of the experts that contributed and DTC, would hope to see the materials widely used outside the project areas by all interested dairy development practitioners. The materials will be available in hard copies and soft copies including on SNV website www.snvworld.org and other relevant websites.
# Table of Contents

**Preface** ........................................................................................................ I

**List of Tables** ................................................................................................ III

**List of Figures** ................................................................................................ IV

**I. Dairy Housing and Manure Management Training Manual** ......................... 1

1. Introduction ................................................................................................... 1

2. Stock Management and Basic Housing Requirements .................................. 2

2.1. Dairy cattle housing as a tool for improvement ........................................... 2

2.2. Types of dairy housing ............................................................................... 3

2.2.1. Loose housing ...................................................................................... 3

2.2.2. Conventional dairy barns ...................................................................... 5

3. Dairy Housing for Smallholder Dairy Systems ............................................. 5

3.1. Dairy cattle house design ........................................................................ 8

3.1.1. The cubicles (resting area) ................................................................... 8

3.1.2. The walking area .................................................................................. 9

3.1.3. The feed and water troughs .................................................................. 9

3.1.4. The milking place ................................................................................ 9

3.1.5. The calf pen ......................................................................................... 9

3.1.6. The fodder chopping area ..................................................................... 10

3.1.7. The store ............................................................................................ 10

3.1.8. The manure storage ............................................................................ 10

3.2. Dairy housing construction ....................................................................... 10

3.3. Handling of dairy cow/animals ................................................................. 11

3.4. The dairy farmer and farm workers ...........................................................) 12

4. Dairy Housing Sanitation and Manure Management ..................................... 12

4.1. Manure Management ............................................................................... 13

4.2. The benefits of manure .......................................................................... 13

4.3. Side effects of manure ........................................................................... 14

4.4. Housing and manure collection ................................................................ 15

4.5. Manure storage ....................................................................................... 15

4.6. Manure treatment and handling ............................................................... 15

**Reference** ..................................................................................................... 17

**II. Dairy Housing and Manure Management Training Guideline** ..................... 18

A. Module Book ............................................................................................. 19

B. Lesson Matrices for Extension Workers ....................................................... 22

C. Exercise ..................................................................................................... 29

D. Assignment Housing and Manure Management ........................................... 30

E. Assessment form written report (Group score) ............................................. 33
List of Tables

Table 1 The floor and trough space requirement of dairy cattle .......................... 4
Table 2 Essential and optional parts of zero-grazing housing system .................... 7
List of Figures

Figure 1 A typical loose house ................................................................. 4
Figure 2 A zero grazing unit complete with a sun shade structure .............. 6
Figure 3 Plan view of zero-grazing unit with five cubicles ......................... 8
Figure 4 Properly designed barn is a grant for proper sanitation ................. 12
Figure 5 Unhygienic barn is source of pathogenic organisms .................... 14
Figure 6 Pile of dung cake used for fuel .................................................. 16
Figure 7 Methods of composting .............................................................. 16
I. Dairy Housing and Manure Management Training Manual

1. Introduction

As elsewhere in developing countries, in Ethiopia, dairy production plays an important role in the economy of the country and livelihoods of the people. However, this sector has not been fully exploited and properly promoted in the country. As a result, compared to other least developed African countries, milk production and the overall milk consumption in Ethiopia is very low. A lot of technical and non-technical constraints could be cited for such substandard dairy production. These includes inefficiencies in the input (feed, genetics and veterinary services) and output (livestock and livestock products) marketing, including poor market infrastructure, lack of marketing support services and limited market information. Although it is not usually mentioned as a constraint for dairy development, poor housing management and its related challenges are among others.

Although cattle, camel and goats are the main livestock species to supply milk, cattle is the main source of milk in Ethiopia. Thus, cattle housing related topics in this document focuses on housing requirements for cattle kept primarily for milk production. The basic justification of shelter or accommodation for cattle is that it should alter or modify the environment for the benefit of animals housed under it and the operators managing them. Care should be taken to provide comfortable accommodation for dairy cattle in order for them to efficiently produce and reproduce. Besides, dairy housing needs to provide a desirable working condition for the operator, be integrated with feeding, milking and other farm operations for handling the input and output required. Furthermore, proper sanitation, durability and arrangements for the production of clean milk under convenient and economic conditions are very important preconditions for a good dairy housing systems. Sanitation is necessary in the dairy housing in order to eliminate all microorganism that are capable of causing disease in the animals. The presence of organisms in the animal shed contaminates the milk produced thus reducing its shelf-life, milk produced in an unclean environment is likely to transmit diseases which affect human health. Similarly the presence of flies and other insects in the dairy housing are not only, disturbs the animals but also spreads deadly diseases to the animals.

Most important to know is that the housing system determines the major manure characteristics. Dung and urine of confined animals can be easily collected. Flooring facilitates collection of both dung and urine. Similarly, manure stored in roofed houses is less exposed to nitrogen losses through volatilization. Roofing also prevents run-off and seepage losses of nutrients due to rain. Therefore, this training material focuses on dairy cattle housing managements and within it manure management in smallholder dairy production systems. Proper knowledge in dairy housing and its relative importance and significance as an instrument for increased production, and the types of dairy housing affordable and suitable for smallholders would be crucial to the advisor and producer. Dairy housing should also be combined with proper sanitation in order to minimize dairy cattle disease hazards and to facilitate clean milk production. Thus, the aim of the training material is to provide extension workers and through them smallholder dairy producers a basic dairy housing and manure management skills. At the end of the training extension worker will be able to design dairy housing for smallholder farmers, train and advice farmers how to construct cost effective dairy housing from locally available materials. They will also be able to convey knowledge of manure management to smallholders, its relationship with sanitation and cattle health risks, and what farmers would benefit out of manure if they properly managed it.
2. Stock management and basic housing requirements

Dairy cattle will be more efficient in terms of production and reproduction if they are protected from extreme heat, and particularly from direct sunshine. Thus, it is essential to provide good housing and farm layouts for rearing and milking dairy stock in the tropics to reduce the extreme effects of air temperature and humidity. Such control improves milk production by reducing stress and disease hazards and also making herd management easier. In tropical and subtropical climates shade becomes an important factor.

If cattle are kept in a confined area, it should be free of mud and manure in order to reduce hoof infection to a minimum. Concrete floors or pavements are ideal where the area per cow is limited. However, where ample space is available, an earth yard, properly sloped for good drainage is adequate.

Housing always need not be expensive structures but it should be built in ways that allow for easy cleaning and maintenance of hygienic conditions. A good dairy housing is one that meets the demands of both animals and dairy farmers at reasonable cost. It is quite easy to understand that unless cattle are provided with good housing facilities, the animals will move too far in or out of the standing space, defecating all round and even causing trampling and wasting of, feed by stepping into the farmers. The animals will be exposed to extreme weather conditions all leading to bad health and lower production. Thus dairy housing should be so designed that they are less expensive and afford protection from extreme weather conditions. By using suitable materials for construction of buildings and by landscaping around them, effect of solar radiation and high ambient temperature on animal can be minimized. Cattle will be more efficient in the production of milk and in reproduction if they are protected from extreme heat, i.e. temperatures of 25 to 30°C, and particularly from direct sunshine. Thus in tropical and subtropical climates shade becomes an important factor.

The housing should have proper facilities for milking barns, calf pens, arrangement for store rooms and other important facilities. In each shed, there should be arrangement for feeding, manger, drinking area and loafing area. The housing may be cemented or brick paved, but in any case it should be easy to clean. The floor should be rough, so that animals will not slip.

2.1. Dairy cattle housing as a tool for improvement

Dairy farming is an activity in which we use our animals to turn animal feed into precious milk for human consumption. Cows therefore need to be milked twice a day. Milking usually takes place in a specially constructed milking place. Besides this milking activity, farmers often start feeding supplemental feed to cattle just around milking time. To protect animals against theft, predators, climatically threats and so on, farmers usually make use of a kind of ‘housing’ for the animals in a restricted area at the farm.

A more specialized housing system combines different management related aspects at a dairy farm such as milking, feeding, health care and manure management.

Housing of dairy cattle needs quiet a high investment, but will also open possibilities to get high returns. Key issues for high returns are; reduction of losses, efficient feeding, efficient utilisation of manure etc. There are also advantages of individual cow management like heat detection, health control, treatments, A.I. etc.

The best solution in terms of design of the building depends on several farm specific objectives. You can think of herd size, milking method, available feeds and labour input. Good planning is very important to be able to find the most suitable solution.
Housing cows in a zero-grazing unit allows the farmer to use high yielding fodder crops like Napier grass or Alfalfa. These crops are not suitable for grazing. By making use of good housing cows can be managed better, by making use of ‘cut and carry’ the farmer can feed the crop in the right nutritive stage of growth and in the right amount to each cow / group of cows. If well managed ‘cut and carry’ will lead to lower losses, and higher yields per acre. The total acreage of fodder crops must cover the total requirement of feed of the whole year. Surplus in rainy season must be conserved, in the right stage of growth, to feed the cows in the dry season. In this way, the available farm area is used more efficient and will give more feed for animals or there will be extra space available for arable crops.

Advantages of zero-grazing do not come from the presence of infrastructure like housing and high yielding animals and crops only. Management is the key to better farm results, differently said better management makes it possible that your investment in infrastructure will give returns.

Education / knowledge is an important aspect of management. A labourer needs to know how a job should be done and, why his/her job is important. In a farm where the manager is also the labourer management is easier than in a farm where different labours have different tasks.

In management, all tasks come together, and done well it will lead to:

- Clean milk production
- Better calf rearing => better next generation of cows
- Effective collection of manure and urine (slurry)
- Effective reproduction => heat detection, insemination moment, bull selection.
- Efficient use of land
- Better feeding
- Monitoring herd size => selection and culling

Farmers making buildings for their animals have decided how many animals to keep. For every new-born animal, a decision must be made! In a well-managed dairy herd on a farm 40 – 50% of the total number of animals must be producing milk at any time.

2.2 Types of dairy housing

In any types of dairy production systems, ranging from smallholder to large-scale commercial, dairy cattle may be successfully housed under a wide variety of conditions, ranging from close confinement to little restrictions except at milking time. However, broadly two types of dairy barns namely; conventional barns and loose houses are generally use in the present time based on the suitability of the local conditions and availability of resources.

2.2.1 Loose housing

Loose housing can be defined as a system where animals are kept loose except during milking and at the time of treatment. Figure 1 indicates a good example of loose housing. Loose houses comprises keeping cows loose in an open paddock partially covered house throughout the day and night except at milking time. This type of dairy housing system is most economical. The loose houses are cheaper to construct, easier to expand and flexible in utility. Feeding and management of stock is easier in these because of common feeding and watering arrangement, and animals are more comfortable as they can move about freely. At least 10 to 15 percent more stock than the standard can be accommodated in each loose house for shorter periods without unduly affecting their performance.
The loose house having three walls with one open side allows extensions to be easily made if necessary. The paddock is provided with shelter along one side under which the animals can retire when it is very hot or cold or during rains. A common watering tank is provided and fodder is fed in common mangers. Cows may also be milked in the stalls provided in the loose house. It is important, therefore, to keep the stalls clean at all times. Concentrates are fed at the time of milking, which could be done in a separate milking barn. All types of livestock can be housed and managed under loose housing system. This type of housing is suitable to smallholder dairy farmers in most parts of the country with floor and trough requirements indicated in table 1.

The following are some features of loose housing systems.

- Cost of construction is significantly lower than conventional type.
- It is possible to make further expansion without much change.
- Facilitate easy detection of animals in heat.
- Animals feel free and therefore, prove more profitable with even minimum grazing.
- Animals get optimum exercise which is extremely important for better health and production.
- Overall better management can be rendered.

Table 1 The floor and trough space requirement of dairy cattle

<table>
<thead>
<tr>
<th>Type of animal</th>
<th>Floor space per animal (m²)</th>
<th>Trough length per animal (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Covered area</td>
<td>Open area</td>
</tr>
<tr>
<td>Cows</td>
<td>6 – 9</td>
<td>24 – 30</td>
</tr>
<tr>
<td>Young stock</td>
<td>4.5 – 6</td>
<td>15 – 18</td>
</tr>
<tr>
<td>Pregnant cows</td>
<td>30 – 36.5</td>
<td>55 – 61</td>
</tr>
<tr>
<td>Bulls</td>
<td>36.5 – 42.5</td>
<td>61 – 76</td>
</tr>
</tbody>
</table>
Although simple yard and a shade or yard and bedded shed systems are entirely satisfactory in warm climates, particularly in semi-arid areas, some farmers may prefer a system with somewhat more protection. A loose housing yard and shed with free stalls will satisfy this need. Less bedding will be required and less manure will have to be removed. Free stalls must be of the right size in order to keep the animals clean and to reduce injuries to a minimum. When stalls are too small, injuries to teats will increase and the cows may also tend to lie in other areas that are less clean than the stalls. If the stalls are too large, cows will get dirty from manure dropped in the stall and more labor will be expended in cleaning the shed area. The floor of the stall must be of a non-slippery material, such as soil. A good foothold is essential during rising and tying down movements to avoid injury.

### 2.2.2 Conventional dairy barns

Conventional dairy barns refer to housing in which the cows are confined together on a platform and secured at neck by rope or neck chains. The cows are fed as well as milked in this barn. The barns are completely roofed and the walls are also complete with windows and/or ventilators located at suitable places. It is comparatively costly and is now becoming less popular day by day. However, by this system cattle are more protected from adverse climatic conditions.

The three basic conventional barns for large scale dairy farming are tie-stall, free-stall and loose. The tie-stall housing of dairy cattle is used extensively in developed countries for large scale commercial farms. Although it restricts voluntary movement of the cow, each cow has a separate stall that permits individual attention during feeding, grooming and milking. Additional pens are provided for calves, young stock and for freshening cows. Free-stall housing system can provide a comfortable place for dairy cows to lie down and rest. Cows are not restrained in the stalls and are able to enter and leave as they like. Feed and water are not provided at the stall, so a cow desiring to eat or drink leaves the free-stall and walks to another area of the free-stall shelter. Free-stalls are the most popular for 50 or more head. Loose housing uses a deep-bedded resting area plus separate feeding, holding and milking areas. Bedding requirements are very high, so it is seldom used now except where bedding is inexpensive and abundant. In loose housing system animals are kept loose except milking and at the time of treatment.

### 3. Dairy Housing for Smallholder Dairy Systems

Different dairy cattle rearing systems have different requirement for housing although they share some common needs. For instance, on smallholder farms in Ethiopia cattle are often confined in an open or roofed kraal and sometimes in the family house. The most widely used practice is to tie the cattle with rope on the tree or wood pole. For the smallholder who wants to make the very best use of his/her crop land and to provide his cattle with good housing that will encourage high production, a zero grazing system is recommended. Majority of dairy animals are kept by smallholder farmers under zero grazing or semi zero grazing systems. Under the zero-grazing housing 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. For instance, in Kenya zero-grazing is particularly a good system for keeping dairy cattle in densely populated, high potential areas, where land per farm family is small. Therefore, this housing system can be used in urban and peri-urban dairy production systems in Ethiopia due to land shortage.

On more intensive farms, improved zero-grazing units have been established, with cubicles, a roof and a concrete floor. For the farmer with up to about 30 cows a yard with paved shade and feed area would be suitable. The yard and feeding area may alternatively be combined with an open sided barn designed for deep bedding or equipped with free stalls and where the herd consists of high yielding cows the milking shed may
be equipped with a bucket milking machine. Some farmers with up to 30 cows may even consider using an open sided tie-stall shed. Generally speaking, the zero-grazing unit should be designed in such a way that it is well ventilated and protected from wind, rain and constant direct sunshine to avoid livestock developing coughs, colds and stress. The zero grazing housing system has various areas some of which are essential and therefore must be included in the structure while others are optional and need not necessarily be part of the unit (Table 2).

![Zero Grazing Unit](image)

**Figure 2 A zero grazing unit complete with a sun shade structure (source: Kenya Ministry of Livestock Development, 2012)**

Generally, the main advantages of the zero-grazing system are:

- Cows are confined and therefore use most of the energy from feeds for growth and milk production.
- Saves land for other enterprises by allowing the use of high yielding fodder crops like Napier.
- Enables on farm clean milk production.
- Good calf rearing is possible.
- Manure can be easily collected for the benefit of fodder crops.
- The animals are better protected against diseases, especially tick-borne diseases.
- Close observation of the animals is possible, making heat detection and attendance to animals easier and faster.
- The animals are kept inside which is more secured and protected them from attack by predators
- Little or no time is spent on herding the animals. Therefore labor for other farm tasks is saved.

The disadvantages of the zero-grazing system are:

- Much labor is required to take feed and water to the animals.
- Much capital is required for construction of a ‘zero-grazing unit.
- The possibility that animals are stressed because of too much confinement inside the zero grazing unit.
Table 2 Essential and optional parts of zero-grazing housing system

<table>
<thead>
<tr>
<th>Basic (Essential) parts</th>
<th>Basic (Optional) parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>(The cubicles (resting area)</td>
<td>The store</td>
</tr>
<tr>
<td>The walking area</td>
<td>The manure storage</td>
</tr>
<tr>
<td>The feed and water troughs</td>
<td>Fodder cutter</td>
</tr>
<tr>
<td>The milking place</td>
<td>Roof water catchment</td>
</tr>
<tr>
<td>The calf pen</td>
<td>Water tank</td>
</tr>
<tr>
<td>The fodder chopping area</td>
<td>A holding crush</td>
</tr>
</tbody>
</table>

The following are strongly-recommended as considerations during construction of a unit:

1. Ensure that the correct site, considering the direction of wind, is chosen for the unit. The choice of site influences the security and protection of animals from rain, sunshine and other weather effects.

2. The unit should be closer to the house and on the opposite side of the wind. The location of the unit in relation to the house should ensure minimal smell from manure pit. It should be noted that it is more important to protect an animal from the rain than from wind or sunshine.

3. Ensure that the constructor is supervised by a Livestock Extension Officer during the construction of the unit. This is necessary because some parts (i.e. walking area, troughs) once constructed are permanent. Mistakes made during construction can be very costly.

4. Use of local materials for construction of the unit will reduce cost.

5. Finally, one should as much as possible, carry out regular maintenance of the zero-grazing unit while in use. This is usually very important for the walking area.

There is an established fact that cattle housing received only little attention by smallholder dairy farmers in the tropics. Knowledge of their exact number and distribution in various age groups during different months is therefore not as important to a building designer as to the manager of the herd. However, dairy cattle requires different care on the bases of their age group. Each of the parts of the dairy unit can be constructed using different alternative materials based on resource availability and affordability by smallholder dairy farmers. Under smallholder dairy production system houses of different shapes and dimensions are typically constructed using local building materials consisting of timber or mud bricks and bamboo. For instance, grass thatch or plastic sheet can be used instead of corrugated iron sheet for roofing purpose. Similarly, in smallholder system dairy cattle could be housed on earth floors with some rice or wheat straw bedding instead of constructed the housing with expensive concrete floor. It is also possible to slightly modify the structure of the housing and the building materials used based on the differences in agro-ecology and available resources in different parts of the country. The dairy housing can be built with the open wall from all sides in lowland areas with hot climatic conditions. However, the sides of dairy housing need to be covered with wooden materials with or without mud plastering with a kind of ventilation in highland regions characterized by cold weather and prevailing winds. This fact in mind, a zero-grazing unit shown in Figure 3 can be constructed using available resources that are not much expensive but all the essential parts needs to be included in the structure.
3.1 Dairy cattle house design

3.1.1 The cubicles (resting area)

Each cow needs to have her own place in the resting area, called cubicle. The cubicles must be covered with a roof made of iron sheets, grass thatch or plastic sheet. The roof must be high enough so that it cannot be eaten by a cow if it is made of grass or if hay is stored under it. The measurements of the cubicle are very important. It should not be too small for the cow or too big to allow the cow to turn around inside the cubicle. The cubicle should be constructed such that the cow remains clean all the time. One should construct the number of cubicles enough to be occupied by animals most of the time. Unoccupied cubicles are a waste of space and money. For a given number of cows to a unit, extra cubicles are required to house young-stock (heifers). If young bulls are to be kept inside the unit (although this is not recommended), then they must be provided with separate cubicles. However, when the bull matures, it is better to house it away from the unit.

The recommended measurements for a cubicle are based on pure breed cows (Friesians and Ayrshires) because pure breeds give the highest economic returns in a zero-grazing system. They are therefore used as the standard. A cubicle has a length of 210 cm and a width of 120 cm. Cubicles are separated from each other by two poles. If the cows are small in size (e.g. Jerseys), the measurements can also be smaller (200 x 110 cm). However, it is much better to use the above standard measurements for a cubicle because the size fits most animals. The standard cubicle can also be adjusted to fit smaller breeds whenever necessary. They can therefore be used for both larger and smaller breeds as need arise. The floors of the cubicles are raised and filled with plain soil. A soft bedding provides comfort to a cow and prevents wounds on its skin. In this way, the animal has a comfortable place which is cheap and easy to maintain. The resting area is 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. The cubicle and the cow then remains clean. Young animals should be separated from the milking cows. This will ensure no fighting occurs between young animals and cows. Cubicles for young animals should be adjusted according to their size by moving the neck-poles backwards to make the cubicles shorter.

3.1.2 The walking area

The walking area is about 3 meters wide i.e. between the resting area and there the feed and water troughs are located. No roofing is required for this area except under very hot conditions. The floor of the working area is made of concrete if it is affordable. This makes it possible to collect urine and manure. The floor and the cows are also kept clean. The surface of the floor should be rough so that animals cannot slip on it. But it should be easy to clean. The floor should slope from the milking place towards urine and dung collecting pit located at one end of the walking area. The slope should allow for easy cleaning of the milking and walking area.

3.1.3 The 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 through 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). Fighting between young stock and cows will not occur due to the boundary created between them. Fighting can also be prevented in constructing vertical poles along the inside of the feed trough at intervals of 75 to 90 cm. A horizontal line of pole is nailed along the vertical ones at 90 cm above the feed trough. Each cow then has its own feeding space.

The trough can be made of wood or stones. For water, a half barrel can be used, each for two cows, instead of constructing a trough. For more than two cows more barrels are used as necessary so that water and enough space for each animal is available. If sufficient financial resources are available both feed and water troughs can be made of bricks and cement (assuming that concrete is more costly in relation to costs of barrels and wood). The choice of the materials used for making troughs depends on the costs and availability of materials. The inside measurements of the feed trough should be 60 cm wide at the bottom and should be raised at least 15 cm above the ground level of the walking area. The feed trough should not be too deep or cows will have difficulty reaching feed at the bottom. If it is too shallow, spillage and wastage of feed will occur. The trough is constructed such that its outside is raised to prevent spillage of feed.

3.1.4 The milking place

The milking place should be constructed next to the cubicles. It should also be of the same dimensions as cubicles i.e. 120 cm by 210 cm. The floor should be flat and made of firm concrete and slope towards the walking area. The direction of slope of the floor would ensure that dirt collected from the floor can flow through the walking area onto the manure pit. There should be a feed trough at head of milking place for feeding the cows during milking. The milking place should be kept clean. Noise during milking may disturb the cow making it hold back some of her milk. For a zebu cow, a calf pen should be constructed next to the milking place. This is because most zebu cows let milk down only-when they see their calves.

3.1.5 The calf pen

Calf housing is recommended where free suckling is not permitted like in the case of zero-grazing system. The calf pen is situated opposite the milking place. It has a floor surface of
120 cm by 150 cm. A calf pen can also be situated on the side of a cubicle or milking place. This depends on the type of unit and whether zebus, cross breeds or pure dairy cattle are kept. The floor of the calf pen should be slatted and raised by 15 to 30 cm above the concrete floor. The raised and slatted floor makes it easier to clean the calf pen floor and the concrete under it. The floor under the slats can be concrete or not. The sides should be open to allow for free air flow around the calf pen. They should also be high enough to contain the calf inside. The calf pen can be movable or fixed. The advantage of a movable calf pen is that it can be taken to the family house, for example when the weather is too cold. Beddings are recommended for a calf pen. Due attention should be given not to encourage parasites resulting to disease condition and/or infection of the calf.

3.1.6 The fodder chopping area

This place is for a fodder chopping equipment (chaff cutter) and the chopped fodder. It is situated opposite the store next to the calf pen. It is also placed under the roof. The fodder chopping area floor can be made of concrete to avoid the feed getting mixed with soil. A fodder chopper is recommended if there are more than three cows in the unit and where labor on the farm, is generally inadequate. One can chop Napier grass or any other fodder in an open space next to the unit, therefore, a fodder-chopping area is optional.

3.1.7 The store

If required, a store can 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 animals. A store is optional where finances are inadequate. It can however be built later-on when funds are available. Inputs like dairy meal and drugs are kept in the living house before a store is built.

3.1.8 The manure storage

Manure can be stored in a small pit dug out of the soil. The pit may or may not be cemented. Manure can also be stored as compost made from dung, urine and plant materials. In this case the compost is heaped next to the unit. Compost may be covered with soil or plastic.

3.2 Dairy housing construction

It is important to put the buildings at the farm at a high place. All over-roofed parts of the farm buildings will drain a lot of water to a small area during showers and long rainfall. Think in advance where to drain it, or even better, how to utilize the rainwater for farm purposes by caching and storing it (capacity!)

Besides the place to situate the building(s) it is important to think of the needed function of the building and the capacity. A model dairy farmer needs building capacity for all different groups of animals. Meaning: lactating cows, dry cows, pregnant heifers, heifer >1 year, calves. (And may be as an exception one bull).

Other important functions to take in to account are; maternity, feed storage, milking, storage of farm materials and tools.

Milk producing cows and growing (female) young stock are two most important groups. Improvement of housing, or better said improvement of management, of these two groups will give the fastest returns. Small holders going into commercial dairy farming can consider starting to build for these two groups first. A farm plan of good housing will take time and great investment, so start there were the fastest returns are expected.

First it is important to decide upon the place to situate the unit on the farm plot. Choose a place high enough to protect animals from flooding during heavy rains. Excess of water must be able to drain at any time.
**Cow and farmers comfort:** Plan on how to realize important aspects for animal and worker like:

- Climatically conditions, sun protection (roofing), ventilation etc.
- Lightening (also in the night)
- Drainage of rain water from the roofs / rain water collection
- Feeding and drinking
- Working environment (easy to clean)
- Collection of manure
- Storage of feeds and farm tools

Make a complete list of all needed constructions for all dairy farming activities. The more complete the list the easier to make the fitting farm design. Basically Zero-grazing units need more labour input, still the amount of extra input depends on the design. *A smart design allows smart labour input and will save a lot in running costs of the enterprise.* Remember that the unit is going to be built for a long-term period. Smart spending of a little extra investment can bring a lot of extra profit in saving costs.

**Materials:** Often units are built with locally available materials. Make sure the materials are of an acceptable quality (long duration) and make sure that floors have a long durability. Once a construction is build it might need regular maintenance, take the costs involved also into account.

Make sure in your planning that all factors effecting your farm activities or animal comfort are considered. You can think of:

- Number of animals to keep (is restricted by the available feeds)
- Milking method / system
- Available space => total space needed including feed storage
- Transport distances of feed, milk etc. (investment in transport?)
- Walking lines within the farm place
- Prevailing direction of wind, sun rise and sun set
- Effect on environment

### 3.3 Handling of dairy cow/animals

Animals kept in a zero-grazing housing system can only produce milk when all basic needs are available. Animals need to be able to express natural behaviour as much as possible.

Make sure your animals are held according to the five freedoms.

- Freedom of thirst, hunger and malnutrition
- Freedom from discomfort.
- Freedom from pain, injury and disease.
- Freedom to express normal behaviour.
- Freedom from fear and distress.
3.4 The dairy farmer and farm workers

The consequence of keeping cows in zero grazing units is that all freedoms of the cow must be arranged by the farm labourers. This is a challenging job that need to be planned well. It also needs a 24/7 routine for a lot of activities. In return the farmer has everything in control activities like;

- Feeding
- Milking
- Cleaning and care taking
- Manure management
- Health, fertility etc.

Are under responsibility of the farm manager. If something goes wrong the losses will be substantial.

Good management means that all farm workers are aware of the important of their individual job. It also means that the manager needs to have enough education on the total process. This process includes sustainability in the mineral circle from feed to milk/manure and specifically the manure going back to the field equally distributed!

4. Dairy Housing Sanitation and Manure Management

Although it is not given due attention in smallholder dairy system, dairy housing sanitation is significantly important in terms of dairy cattle health management. The amount of dung and urine produced by animals is very variable due to differences in feed and water intake, which in turn are strongly related to body weight and production intensity. Large amount of dung and urine are excreted by dairy cattle due to the types and amount of feed they fed on and their unique digestive system. If it is not timely and properly cleaned, manure becomes a source of disease causing agents to both human and livestock and a threat for clean milk production. On the other hand, a clean barn is critical to the health of the cattle, for clean milk production and profitability of the farm. Therefore, the objective of this section is to provide the trainee a basic skill of hygienic measures of dairy barn and disposal of wastes, and the benefit, management and utilization of manure.

Figure 4 Properly designed barn is a grant for proper sanitation
4.1 Manure Management

Keeping cow at the farm place during the whole day or only at night means that (part of) the manure must be stored at the farm for some time. It is important to realize that manure is a precious ‘waste’ product. Manure needs to be managed well!

Too often it happened that lots of manure is found at the farm plot while the surrounding fields are exhausted. This makes manure management one of the most important (labour) consequences of zero grazing. Manure is a precious product giving fertility to the soil. It reduces the need of chemical fertilizer, and most important it is free of charge except that it will need to be equally distributed to the (fodder) crop fields.

Manure is a natural fertilizer. Cows grazing in the field fertilize the soil with their own droppings. It is part of the sustainable natural circle of minerals. To maintain this sustainable circle, it is essential that manure produced by the cows goes back to the same fields where the feed is coming from.

In modern dairy farming in a zero-grazing system the mineral circle can be maintained when the farmer is growing its own feeds (roughage) on its own land. Using this method consequently, a farm can produce for several generations with very little input of external fertilizers.

Even if manure is used for production of biogas, the slurry (digestate) released after the biogas production process is finished is still very rich in minerals and can be used as a fertilizer the same way as normal manure. The biogas is available for cooking and lightening in the household. This is much more convenient and safe than using dried manure as a fuel.

Using dried manure as a fuel gives a lot of losses of precious minerals even when the ashes return to the field.

4.2 The benefits of manure

On average about 40 kg of dung can be obtained per day from a dairy cow weighing 500 kg. This resource may play an important part in maintaining high levels of crop production. It represents a valuable resource that, if used appropriately, can replace significant amounts of chemical fertilizers and energy source. Thus, applying manure to soils saves purchase of synthetic fertilizer, increases crop yield and saves water. Overall manure is a source of energy, organic fertilizer and soil improver.

Manure is an important low-cost source of crop nutrients in mixed crop-livestock systems. Adding manure proving nutrients and organic matter to soils enhances soil fertility and soil health that leads to increased agricultural productivity, improved soil structure and biodiversity. Also, improved soil structure will increase water-holding capacity and erosion control along with increasing drainage and permeability and reducing soil acidity. Improving soil health, drought resilience and nutrient levels through the use of livestock manure from a sound manure management system will immediately enhance crop production. Subsequently, this improves both the quality and quantity of food and feed leading to a better nutrient status of the family. Eventually the situation may arise where food security is not an issue anymore and in which even a product surplus may occur to be sold on local markets.
Production of biogas through anaerobic digestion of organic material e.g. manure, is a relatively simple technology that can be implemented at industrial, village and farm household scales. Biogas substitutes for fossil fuels and biomass fuels. The gas can either be used directly as a heat source for cooking or lighting, or indirectly by powering a generator to produce electricity. One cubic meter of biogas is equal to approximately 1 liter kerosene, net 2 kWh electricity, 4 kg firewood and 6 kg paddy straw.

4.3 Side effects of manure

Unless it is managed carefully to minimize odor, nutrient losses and emissions, manure becomes a source of pollution and a threat to aquifers and surface waters. It can also be a direct threat to human and livestock health. Livestock dung can be significantly contaminated with pathogens and cause outbreaks of gastroenteritis related diseases to livestock. This goes for fresh manure as well as stored and or treated manure products. In all cases, direct contact of manure products with especially ready-to-eat crops should be prevented. Storage and treatment may reduce the number of pathogenic organisms, but will never kill them all. Besides, if manure is not properly cleaned from the barn it could serve as a host of pathogens and causes disease that leads to drop in milk production and death of cattle. Some of major diseases are mastitis, leg and foot diseases, and internal parasites. The incidence of these diseases affects the farmer through raising cost of treatment and reducing income that could be obtained from milk production.

Figure 5 Unhygienic barn is source of pathogenic organisms

Nutrient losses from livestock manure can have detrimental effects on the environment at local, national and global scale. Losses can be emissions to the air, like CH₄, N₂O and NH₃; or to water sources by leaching of e.g. NO₃⁻ and P₂O₅ through the soil and by run-off (including intended discharge).

- **CH₄ (methane)**: combustible greenhouse gas, 281 times more powerful than CO₂; produced from the decaying organic matter in manure stored under oxygen-free conditions.

- **N₂O (nitrous oxide)**: greenhouse gas, 2651 times more powerful than CO₂; intermediate product during the nitrification of NH₄⁺ into NO₃⁻; and during the denitrification of NO₃⁻ in manure applied to soils low in oxygen (e.g. waterlogged).

- **NH₃ (ammonia)**: aggressive and acidifying gas; product from urea degradation in manure (urine); causing respiratory problems in humans and animals and acidification of soils when deposited.
- **NO\textsubscript{3}^- (nitrate):** formed in the soil by nitrification of NH\textsubscript{4}+/NH\textsubscript{3} after manure application, water-soluble ion prone to leaching; high concentrations in potable water may lead to nitrite poisoning (NO\textsubscript{2}^-) causing an oxygen deficit in the blood of humans and animals.

- **P\textsubscript{2}O\textsubscript{5} (phosphate):** from superficial run-off of manure and/or from leaching of the water-soluble form, causing eutrophication of open waters (dense growth of algae and death of fish from subsequent lack of oxygen).

### 4.4 Housing and manure collection

Housing of cattle constitutes an important aspect of manure management. Therefore, an important aspect of sustainable manure management is to develop housing and manure storage systems that help to conserve the plant nutrients and maintain a high concentration of plant nutrients in the manure. For confined animals (simultaneous) optimization of both housing and manure management is important to facilitate feeding, for hygiene and animal health/welfare, to facilitate manure collection and nutrient conservation and to save labor.

A well-managed zero-grazing unit, with cubicles, a concrete floor and a slurry pit, allows rather efficient collection of excreta as slurry. Liquid manures however, are difficult to store and to handle and to use on annual crops, and are therefore best used soon after excretion to limit Nitrogen (N) losses. Alternatively, dung and urine can be collected separately, with frequent dung removal and instantaneous drainage of urine into a closed and watertight pit, where it may be diluted with water. N-losses in such systems are probably relatively low. Also in a tie stall urine and dung can be collected and stored separately, with relatively low N losses, provided that urine is properly stored. The mixture of dung and bedding material is transferred twice daily to a (covered) compact storage facility for farm yard manure, from where leached liquids can be drained into the urine pit.

### 4.5 Manure storage

Manure storage is necessary to bridge the gap between the moment of excretion and the optimal moment of application on crop land. This is also the period in which nutrients are very susceptible for losses to the environment. Proper manure storage plays a key role in preventing environmental pollution and other nuisances like bad odor and flies.

Manure stored in roofed houses is less exposed to nitrogen losses through volatilization. Roofing also prevents run-off and leaching losses of minerals due to rain. Major emissions from prolonged storage can be reduced by limiting the contact surface between manure and air by stacking and compressing the heap and by protecting the manure against the influence from wind, water and sunlight. Volatilization losses are dependent on the level of ventilation, depth of storage and storage time, but often range between 5 and 35 percent of the total N excreted. The major emission from prolonged storage of slurry in deep pits or silos will be CH\textsubscript{4} (Methane). This emission can be reduced by anaerobic digestion of the fresh slurry in a closed silo.

### 4.6 Manure treatment and handling

Careful recycling of animal manure to land will contribute plant nutrients to crops and reduce the need for mineral fertilizers. In animal manures, nitrogen (N) is in both an inorganic (ammonium) and organic form, whereas phosphorus (P) and potassium (K) have a fertilizer value equivalent to that of mineral fertilizers. However, information on nutrient losses between excretion and application of manure is still limited under smallholder conditions in the tropics, also due to the wide variation in farming conditions and variation in livestock and manure management.
Manure may be treated for several reasons, e.g. to reduce the volume, to improve the applicability, to prevent losses during storage, and perhaps to increase the value. Air drying is an easy method to reduce the volume of liquid manures like slurry and bio slurry. A major disadvantage of air drying is, however, that practically all mineral N is lost through NH₃ volatilization. Physical separation is a mechanical treatment mostly applied to slurries to separate the slurry into a relatively N-rich liquid fraction and a relatively P₂O₅-rich solid fraction.

Figure 6 Pile of dung cake used for fuel

Composting is an attractive proposition for turning on-farm organic waste materials into a farm resource and is suitable in all farm situations, large or small and with solid and liquid manure types. However, compost production is labor intensive and demands regular attention. The two most common methods are the heap or pile method, suitable for large-scale processing and for small-scale operations in areas with higher rainfall, and the pit method, suitable for small-scale processing in areas with low rainfall and a long dry season and for composting of liquid manures.

Figure 7 Methods of composting

In summary, although Ethiopia’s dairy sector plays an important role in supporting the livelihoods of a large proportion of smallholder farmers, its productivity is considerably low. Farmers’ lack of knowledge about dairy cattle management, particularly housing, is among many factors that leads to poor productivity of the sector. Knowledge and skill to help smallholder farmers improve dairy housing and manure management is thus quite important, thereby to improve their dairy production and productivity. Therefore, this manual is developed with the aim of providing training to extension workers and through them to smallholder farmers a basic dairy housing and manure management skill so that they can produce clean milk from their cattle. Besides, farmers can benefit out of cattle’s manure protect the environment in which they are living from pollution through proper manure management.
Reference


Moran John Dairy Adviser, DPIV, Senior Kyabram, 120 Cooma Rd, Kyabram, Department of Primary Industries, 2005: Feeding Management for Small Holder Dairy Farmers in the Humid Tropics Victoria, 3620 Australia


Dairy Housing and Manure management
Training Guidelines for Dairy Extension workers
I. Dairy Housing and Manure Management training Guideline

A. Module Book

Introduction

The module Housing and Manure management is part of the EDGET Project. After extensive discussions with EDGET Regional Managers as well as with Government and SNV extension workers during the Training of Trainers Program implemented in November 2016.

One of the EDGET project objectives is to make small holders dairy farms more aware about “commercial farming”. The Module Farm Economics will help the EDGET Project extension workers to acquire the awareness knowledge and implementation skills to make decisions which will enable them to improve the readability of their enterprises by implementation of better Housing and Manure management, like a Zero-grazing unit makes possible.

Professional situation

As an extension worker in the EDGET Project you usually have to advise small holder farms on how to manage their crops and livestock in the most optimal way.

A small holder farmer in Ethiopia has to manage his/her dairy enterprise more and more as a business, using improved techniques. This also means that the farmer has to determine the objectives of the dairy which traditionally focusses on having enough food for the family but it also must generate income.

Small holder farmers usually have traditional knowledge and skills to run the livestock part and try to avoid risk as much as possible. Although some farmers have a vague idea about profitability of their enterprises, none actually is able to estimate the effect of implementation of new techniques to the possible improvement of it.

As an extension worker you have the knowledge, skills and innovations to advise farmers on implementation of a housing system and the implementation of manure management in the most optimal way. You have the motivation and “drive” to convince small holder farmers to do so. You will be able to explain small holder farmers what it means to become a commercial farmer.

But you (and the owner) have other responsibilities as well; how to deal with environmental and social issues. In the end any business is only really sustainable if it is taking into account the three P’s; People, Planet & Profit.

Required entry qualification

To take part in this module on Housing and Manure management you should comply with the following entry requirements:

- Competent in the English language.
- Competent in basic calculation skills
- Have basic insight/experience in managing small holder farms and the enterprises present on those farms
- You have completed the module economics successfully
Specific objectives and related topics

a. At the end of the course participants are able to give an integrated advice on implementation of housing (zero-grazing) in a commercial dairy enterprise.

Related topics are:
- Herd composition
- Fodder crop selection
- Animal comfort
- Milking method/system
- Fodder conservation

b. At the end of the course participants can point the economic value of manure management as part of a zero-grazing housing farm system.

Related topics are:
- Biogas
- Mineral circle
- Crop selection

c. At the end of the course participants can work with different farm models for different farm size situations.

Related topics are:
- Design of buildings
- Implementation of dairy related herd composition
- Milking systems

Assessment

During the course one assessment will be conducted to measure the competence level of the participants to advise a small holder farm on a zero-grazing housing system. The assessment will be a group assignment. The group (maximum 4 persons) will have to design a housing for a zero-grazing farm. Based on a real farm situation on herd composition, labour and available capital.

- Translate the given situation into a farm plan considering; herd size, available labour and available capital
- Advise on the method of milking and motivate it
- Make a draft sketch and drawing of the total plan
- Find out the needed investment capital, yearly costs and translate it into cost price per liter of milk.
- Prepare an advice for the farmer and his/ her family on building a zero-grazing unit to increase the farm income.
- Presentation of assessment results and advice.
**Activities**

Below an overview of all activities related to this module are presented:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Introduction Module/ participants/ trainer and introduction into farm housing, zero-grazing, and manure utilization</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Theoretical explanation of zero-grazing concept and utilization of manure</td>
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<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Construction and lay out of zero grazing unit in relation with farm size</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Exercise judgement of existing housing at a zero-grazing farm</td>
</tr>
<tr>
<td>Tue</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Discussion on needed improvement of visited farm of previous day</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Continued discussion. Estimation of costs and benefits of the improvements. What is the economic effect</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Exercise from manual. Make a plan for a new farm, and estimate investment and cost price</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Presentation of plan for a new farm, and estimation of investment and cost price. Last 20 minutes Introduction of assignment for assessment</td>
</tr>
<tr>
<td>Wed</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Assessment</td>
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<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Assessment</td>
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<tr>
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<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Assessment</td>
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<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Assessment</td>
</tr>
<tr>
<td>Thur</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>Prepare for presentation</td>
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<tr>
<td></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Presentation in presence of farmers</td>
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<tr>
<td></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Brainstorm on farmer training</td>
</tr>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Course Evaluation and closing</td>
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</tbody>
</table>

**Notes:**

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B. Lesson Matrices For Extension Workers

<table>
<thead>
<tr>
<th>Lesson Matrix</th>
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</thead>
<tbody>
<tr>
<td># Topic / Serial</td>
</tr>
<tr>
<td>Practical Lesson</td>
</tr>
<tr>
<td>Date</td>
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<tr>
<td>Venue</td>
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<tr>
<td>Duration</td>
</tr>
<tr>
<td>Type of students</td>
</tr>
<tr>
<td>Suggested number of students</td>
</tr>
<tr>
<td>Starting situation</td>
</tr>
<tr>
<td>Outcomes</td>
</tr>
</tbody>
</table>

### Practical Lesson
Lesson 1 Housing and Manure management

### Date
Day/ Day 1 of the Course

### Venue

### Duration
day/ Day 1 of the Course

### Type of students
Extension Workers

### Suggested number of students
16

### Starting situation
Students have very little or no experience with Housing and Manure management
Students have already finished the module Farm economics and have knowledge of planning of feed supply

### Outcomes
The student is able to

<table>
<thead>
<tr>
<th>Skills</th>
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</thead>
<tbody>
<tr>
<td>Fill out a farm checklist-</td>
</tr>
<tr>
<td>Give their comments on housing based on observations-</td>
</tr>
<tr>
<td>Turn information into an advice to improve-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention important aspect related to cow comfort and freedoms-</td>
</tr>
<tr>
<td>Explain value of an efficient utilisation of manure-</td>
</tr>
<tr>
<td>Explain how to plan feed supply in zero-grazing-</td>
</tr>
<tr>
<td>Explain how housing can benefit farm productivity-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attitude</th>
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<tbody>
<tr>
<td>Convince farmers that for commercialization and optimization of their small holder farms Housing and Manure management is an essential part of farm management</td>
</tr>
<tr>
<td>Time in minutes</td>
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<td>120</td>
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<td>60</td>
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<tr>
<td>60</td>
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<tr>
<td>150</td>
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<tr>
<td>30</td>
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</tbody>
</table>
LESSON 1: Housing and manure management

Required materials:
- Manual Farm economics
- Exercise 1
- Farm to do exercise on existing housing
- Measuring tape for answering worksheet
1. Sharing experiences with farm economics
2. Introduction
   - Distribute and discuss course plan
   - Distribute book “Housing and Manure management”
3. Lecturing the manual:
   - Interactive open class session
   - Farm visit for deeper explanation
   - Worksheet as source of information for advice
4. Evaluation:
   - Summary of the lessons, any questions?
   - Home work; preparation of list of improvements based on worksheet information and observations
   - If time allows, students start working on homework
5. End of day 1

<table>
<thead>
<tr>
<th>Lesson Matrix</th>
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</thead>
<tbody>
<tr>
<td>Topic / Serial #</td>
</tr>
<tr>
<td>Practical Lesson</td>
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<tr>
<td>Date</td>
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<tr>
<td>Venue</td>
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<tr>
<td>Duration</td>
</tr>
<tr>
<td>Type of students</td>
</tr>
<tr>
<td>Suggested number of students</td>
</tr>
</tbody>
</table>
| Starting situation | Students have very little or no experience with Housing and Manure management
Students have already finished the module Farm economics and have knowledge of planning of feed supply. |
| Outcomes | The student is able to: |
| Skills | -Advice a farmer to set up a zero-grazing unit
-Work out a farm plan and estimate the effect of investment to cost price.
-Work with information received from observations, questionnaires and measurements. |
| Knowledge | -Mention important aspects on housing, milking, manure management and labour input.
-Explain value of total farm planning to improve profit
-Explain how to sustain a dairy herd in a zero-grazing farm situation
-Explain how housing can reduce the cost price |
<p>| Attitude | Convince farmers that for commercialization and optimization of their small holder farms Housing and Manure management is an essential part of farm management |</p>
<table>
<thead>
<tr>
<th>Time in minutes</th>
<th>Brief Content</th>
<th>Role trainer /didactical methods</th>
<th>Teaching aids</th>
<th>Role/activities</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>Discussion home work: Improvements to be obtained at the visited farm</td>
<td>-Asking/ giving questions List all mentioned improvements</td>
<td>-White board -Flip over</td>
<td>-Study theory and examples -Asking questions/ giving answers</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Continued discussion Improvements to be obtained at the visited farm + what will be the effect of implementation.</td>
<td>-Explaining -Instruction on examples given -Discussion on answers</td>
<td>-White board -Flip over</td>
<td>-Asking questions/ giving answers -Making exercises</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Break</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Work out with student the different options of improvements. Investment/yearly costs/economic effect on farm (including higher yield expectation)</td>
<td>-Explaining -Instruction on exercises -Discussion on answers</td>
<td>-random exercises given by trainer -Whiteboard -Flip over -Internet examples</td>
<td>-Study theory and examples -Asking questions/ giving answers -Making exercises -put summary on wallpaper</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Share outcomes and discuss briefly</td>
<td>Guide</td>
<td>Wallpaper</td>
<td>Exchange findings and motivate them</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>-explanation exercise from manual</td>
<td>-Explaining -Instruction on example and exercise -Discussion on answers</td>
<td>-PPT -Example -Exercise</td>
<td>-Study theory and example -Asking questions/ giving answers</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Work out exercise manual.</td>
<td>Coaching guiding</td>
<td>-Exercise</td>
<td>-Study case -Making farm plan -Estimate needed investments based on found information -Calculate cost price</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Share outcomes and discuss differences in outcome. Different solutions are not wrong! Sharing ideas makes inventive.</td>
<td>Guide</td>
<td>Wallpaper</td>
<td>Exchange plans and defend them as if it is to the farmer you made it for.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Introduction to assignment for assessment</td>
<td>-Explaining</td>
<td>-Assignment</td>
<td>-Asking questions -Prepare for farm visit</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 2: Housing and Manure management

Handouts: Exercises and assignment

Internet connection available to do some resurgence on pricing information

1. Homework
   - Discussion and summary of what was done on day 1, through asking and answering a brief repetition.
   - Student is requested to work out improvements to be implemented in the visited farm of day 1. All options of different groups will be noted discussed and worked out later

2. Working out a selection of improvements suggested

To select students will select most effective improvements based on

- Expected impact on milk sales
- Expected investment needed
- Effect on animal welfare

The trainer will guide the selection and will make sure every group works out a different aspect.

3. Work out assignment from manual

Student work out in groups of 4 the assignment from the manual.

They do this independent from each other.

Different solutions of the same case show that 1+1 can be 3

4. Assignment/ assessment

- Distribute assignment/ assessment, ask students to read/ study. Then go through the assignment/ assessment and allow students to ask questions.
- Make groups of maximum 4 students
- Students to sit in groups and prepare questionnaire for farm visit.

<table>
<thead>
<tr>
<th>Lesson Matrix</th>
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</thead>
<tbody>
<tr>
<td><strong>Topic / Serial #</strong></td>
</tr>
<tr>
<td><em>Practical Lesson</em></td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>Venue</td>
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<tr>
<td>Duration</td>
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<tr>
<td>Type of students</td>
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<tr>
<td>Suggested number of students</td>
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</tbody>
</table>
| Starting situation | Students have very little or no experience with Housing and Manure management
                      Students have already finished the module Farm economics and have knowledge of planning of feed supply |
| Outcomes | The student is able to: |
**Lesson Matrix**

**Skills**
- Collect required information to work out a housing plan, considering manure management for zero-grazing on a small holder farm
- Present and explain small holder farmers how their airy enterprises can economically perform better making use of a zero-grazing unit.

**Knowledge**
- Explain farmers how housing and utilization of manure can be improved.
- Explain farmers benefits of controlled conditions for cows
- Explain how the extra input of labour is paid by lower losses

**Attitude**
Convince farmers that for commercialization of their small holder farms housing and manure management is an essential part of farm management

<table>
<thead>
<tr>
<th>Time in minutes</th>
<th>Brief Content</th>
<th>Role trainer /didactical methods</th>
<th>Teaching aids</th>
<th>Role/activities Participants</th>
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</table>
| 240             | -Travel to target farmers  
-Groups to observe the farm and its used housing structures  
-Groups to meet with their assigned farmer and collect info herd composition, land size manure utilization a.s.o. and verify with their observations  
-Return to workshop premises | -Guidance and coaching | -Target farms | -Observing  
-Interviewing  
-Collection of information |
| 60              | Lunch         |                                  |                |                             |
| 240             | -Groups work out their observations and information into an adjusted farm plan on housing and manure management  
-Groups estimate and calculate investments and costs involved  
-Groups work out an advice for their target farm | -Guidance and coaching | Target farms | -Collected observations and information  
-Benchmarks per identified enterprise |
Lesson Matrix

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<tr>
<td>120</td>
<td>Students prepare for presentation</td>
<td>- Guidance and coaching</td>
<td>- target farms</td>
<td>- Preparing presentation</td>
</tr>
<tr>
<td>60</td>
<td>Break and arrival of farmers</td>
<td></td>
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<tr>
<td>120</td>
<td>Presentation of farm plans by the different groups</td>
<td>- Assessing performance</td>
<td>- Projector/ white board/ flipovers</td>
<td>- Group presentations</td>
</tr>
<tr>
<td>60</td>
<td>Lunch (students and farmers)</td>
<td></td>
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</tr>
<tr>
<td>60</td>
<td>- Assessment result per group</td>
<td>- Reflection on assignment results and assessment score</td>
<td>- Discussion per group</td>
<td>- Reflection and discussing assessment result</td>
</tr>
<tr>
<td>60</td>
<td>Evaluation of course</td>
<td>- Explaining evaluation form</td>
<td>- Evaluation form</td>
<td>- Filling evaluation form</td>
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</table>
C. Exercise

Make an advice for a small holder farmer for housing all animals based on the description below. In groups of 4 participants.

Farm:
Available hectare of land for fodder crops = 15

Based on external advice on the possibilities to grow feed the farmer expects to have the following herd composition in the future:

- Cows in milk = 11
- Dry cows = 2
- Pregnant heifers = 1
- Heifer >1 year = 2
- Heifer calves < 1 y = 3

All land is situated at the farm plot in a square and fenced all around. The farmer has some capital to invest. The farmer wants to be able to manage the whole farm without external labour, except for peak moments in feed conservation during growing season. Total available labour for dairy activities is 1.8 labour unit. The farmer is planning to get a power connection and is planning to buy a trolley-milking machine, but he wants your advice on it.

Include in the plan your personal ideas upon:
- Storage of feed, manure and farm inputs
- Security
- Labor input needed for fodder conservation
- Sustainability
- Energy input sources

Tips

The following aspects can be considered:
- Make use of locally available materials
- Animal welfare and environmental consequences
- Social acceptance / culture
- Contribution of this plan to regional economy

What to submit? – On paper:
1. Drawing/sketch of the buildings and milking system.
   - Make sure all animals have the right type of housing
2. Motivation of your plan containing: (describe on paper)
   - Motivation of your personal ideas and decisions
   - Estimation of budget needed for this plan.
   - Motivate the choice you made, regarding the design and the materials used
   - Time planning of construction
3. With the knowledge gained in “Farm economics” also describe:

- Estimation on the effect of the planned investment to the cost price of milk.

**Presentation:**
- Present as a group the plan on a wall paper and prepare to defend it in front of a group.

For extension workers, it is important to be able to convince local farmers to adopt the new farming systems.

**Ideal situation:**
The best way to convince potential users of new methods is a real-time example like a model farm for zero-grazing.

Look for farmers within your area that have created a good example themselves first. In case they are not available motivate farmers to become one. These farmers usually are open to try-out and adopt these new developments. By giving them the opportunity to become a model farm for some time these farmers will be eager to learn.

The best way to create good example model farms is to let the farmers make their own choices, they might need help in offering possibilities they do not know. By doing so you create a self-developing farm model, which will be easily adopted by their colleagues.

**Real Life situation:**
Often in real life stations it is necessary to convince farmers to adopt new methods in a more forced way. Tradition and cultural believe is strong, and basically, they are not wrong in the original setting of survival.

In commercial dairy farming, however the objective is also to make profit (for living) from milk sales. Investment made for this purpose can only give readability from this objective.

Making use of *special model farms* in were new innovations are implemented is another method to convince farmer to adopt. These kind of model farms are often set up by organisations as part of a project, and are subsidised by the project. The benefit of this kind of approach is that real new up to date techniques can be used. On the other side the shown model might not be realistic for a large group of farmers due to limited capital available. Because although the model might be profitable the budget involved cannot be found.

In this case extension service has to take in consideration to show a route for development staring from a common present farm situation. Something like: “Develop your farm in .... steps in .... years.”

Model farms will only work if the common local farmer is shown how to come to that level. And even more important what are the risks and what are the returns to expect.

**To finish:**
It is important to consider that a model farm of 15 cows is not just a triple 5 cow model farm!

Every scale of farming needs to have its own approach! Think of differences in mechanisation and labour demand.

**D. Assignment Housing and Manure management**

During the course one assessment will be conducted to measure the competence level of the participants to advise a small holder farm on his/her economic performance. The assessment will be a group assignment. The group (maximum 4 persons) will have to visit an assigned small holder farm and implement the following tasks:
Visit a dairy farmer having plans to improve the dairy enterprise by implementation of zero-grazing.

Make an overview of the present situation
- Available acres of land for fodder crops and types to grow
- Herd composition and total number
- Present buildings and feed storage
- Present utilization of manure
- Present way of milking and condition of milking place
- Present (yearly) milk sales of the farm in kg.

Interview the farmer about his/her plans on
- Fodder crops and conservation
- Wanted herd composition / check in relation to carrying capacity
- Milking method to practice
- Available labour in family and casual labour
- Capital to invest (if farmer wants to mention it)

Write an advice based on the above collected information.

Include in the plan your personal ideas upon:
- Storage of feed, manure and farm inputs
- Security
- Labour input needed
- Sustainability
- Energy input sources

**Tips**

The following aspects can be considered:
- Make use of locally available materials
- Animal welfare and environmental consequences
- Social acceptance / culture
- Contribution of this plan to regional economy

Try to make use of the existing farm situation to fit in your plans, but also keep up the standard of cow comfort, efficiency and manure management.

What to submit?

**A. On Paper:**

4. Drawing / sketch of the buildings and milking system.
   - Make a legend
   - Make sure all animals have the right type of housing
   - Describe details like cubicle sizes, storages, water supply, feeding places etc.

5. Motivation of your plan containing: (describe on paper) Motivation of your personal ideas and decisions
   - Estimation of budget needed for this plan.
   - Motivate the choice you made, regarding the design and the materials used
   - Time planning of construction

6. With the knowledge gained in “Farm economics” also describe;
   - Influence of the planned investment to the cost price of milk.
• Calculate the yearly costs of this investment (depreciation/interest/maintenance).
• The total budget needed, break even point of cash flow.

B. Presentation:

Present as a group the whole plan and prepare to defend it in front of a group of local farmers.

Consider that this plan probably is also an example to farmers without budget to invest.

• How to realize plans step by step from savings in family budget
• Low budget alternatives
• Are there credit facilities available and is it realistic to use it for this type of plan

A. Tuesday afternoon, after working groups have been formed, prepare yourself for the visit to your assigned small holder farm:

- Discuss with your group members the assignment and divide tasks among the members
- Given the enterprises normally present on a small holder farm decide what observations you want to make to have an impression on housing and manure management at the farm
- Make your own questionnaire / and observation list (including measurements if applicable) to be filed out during farm the visit

B Wednesday morning, after arrival on the assigned small holder farm;

- Organize brief meeting with the farmer and his/ her family during which the group introduces themselves and explains the exercise and purpose of the visit.
- Requests the farmer and family to show the dairy farm buildings and fodder crops.
- Organize to fill out your questionnaire and observation list, make sure you will get all needed information!
- At the end of the interview thanks the farmer and his family for their time and information and invite the farmer to attend the presentation of the results and advice for the next day.

C Wednesday afternoon, after returning to the workshop premises and after lunch:

- Decide which investment are needed for an efficient implementation of zero-grazing at the farm.
- Make sure effective manure management is part of the investment plans
- Go for the optimal situation even when little capital is available.
- Through internet and other information sources try to find out additional information on investment prices involved in your plan
- The group works out the ‘On Paper’ part of the assignment and handed over to the Course Trainer/ Coordinator for assessment purposes and to the concerned small holder farm. This reports will be submitted Thursday evening at the latest before 10 PM, preferably earlier.

D Thursday morning:

- Each group member prepares for the presentation of his/ her enterprise to all the colleagues and invited farmers. Don’t forget to include your sources of information used in your presentation.
- The group as a whole prepares for their presentation of their advice for optimization.
- After the break, during which the farmers are received, Each group makes their presentation with a duration of maximum half an hour. The sequence of the groups will be determined by the trainer/ assessor.
E Assessment:
- Each group receives a group score for their report.
- Each group member receives an individual score for their individual presentation.
- Assessment results will be discussed with the groups after lunch.

E. Assessment form written report (Group score)

Group members: .................................................................

Subject / Title: .................................................................

Group Score ......................................................... (out of 60, each item can score from 1 to 10 points, 1 = very poor/ 10 = excellent)

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Very poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>- Objective of the report was indicated</td>
<td>- Method of work is explained</td>
<td>- Content of the report is introduced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Description of the actual situation</td>
<td>- Description of the farming system</td>
<td>- Description of enterprises</td>
<td></td>
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<tr>
<td>3. Data collection and analysis of the actual situation</td>
<td>- Data collection</td>
<td>- Analysis of data</td>
<td>- Identification &amp; Relative importance of constraints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Proposal for improvement</td>
<td>- Technical description of the proposal</td>
<td>- Housing plan/technical lay out</td>
<td>- Implementation of manure utilization as part of the plan</td>
<td>- Organisational aspects of the proposal</td>
<td></td>
</tr>
<tr>
<td>5. Conclusion</td>
<td>- Based on the contents of the report</td>
<td>- Clear and well formulated</td>
<td></td>
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<tr>
<td>6. Quality of the Report</td>
<td>- Language</td>
<td>- Level (for farmer)</td>
<td>- Lay out</td>
<td>- General impression</td>
<td></td>
</tr>
</tbody>
</table>

Assessment is passed with a score of minimum 35 points
Assessment form for observation of student during presentation (Individual score)

<table>
<thead>
<tr>
<th>Name trainer:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Enterprise presented:</td>
<td></td>
</tr>
<tr>
<td>Observer:</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td></td>
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</tbody>
</table>

**Behaviour criteria; The participant:**

<table>
<thead>
<tr>
<th>Remarks and score by observer (range from 0 (insufficient) to 5 (very good))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has prepared the correct and required teaching aids</td>
</tr>
<tr>
<td>2. Presentation can be followed by all including farmers</td>
</tr>
<tr>
<td>3. Presentation follows a logical path and is divided in clear steps if required</td>
</tr>
<tr>
<td>4. Links the level of knowledge and skills instructed to the level of the farmers</td>
</tr>
<tr>
<td>5. Can execute the basic skills required for the lesson</td>
</tr>
<tr>
<td>6. Speaks clearly and is pleasant to listen to</td>
</tr>
<tr>
<td>7. Makes contact with the group and keeps this momentum during the lesson</td>
</tr>
<tr>
<td>8. Stimulates interaction with the participants</td>
</tr>
<tr>
<td>9. Provides feedback during the presentation to check if message comes through</td>
</tr>
<tr>
<td>10. Can describe to which extent outcome was realised</td>
</tr>
</tbody>
</table>

**Further Remarks and final score:**

Minimum score for passing the assessment will be 30.