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Design And Development of Irrigation System Using Solar Energy to Cow Shade

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ABSTRACT

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. Environmental control includes sanitation and effluent management. This chapter discusses housing for non-grazed dairy herds. Housing requirements fort milking herds with access to pasture for grazing are simpler because they only require sheds for milk harvesting and for milk rearing calves. The features of shed design specifically to minimise the adverse effects of heat stress were discussed in the previous chapter. This chapter concludes with a detailed checklist for planning dairy shed design. With feed troughs, the width should be related to the reach of the animals. which is up to 80 cm for mature dairy cows eating from the base of the trough 30 cm above ground level. The base of the trough should then be raised 10-30 cm, with the front 50 cm above this. Cows in tie stalls are likely to have restricted reach. Feeding strips should be positioned 7-15 cm above cow feet level, with a nib wall 40- 55 cm above the feeding strip, to protect the feed from the effluent. Feed barrier walls wider than 15 cm can restrict how far stock can reach into troughs or onto feed strips. Molasses blocks are a good supplement and can be used as carriers of non-protein N or minerals. The blocks are solid, and fairly easy to make, transport and store. Molasses intakes should not exceed 20% of the total intake, because at higher levels it will depress digestibility.

Keywords- Solar Energy Irrigation Dairy.

1) INTRODUCTION

Factors to be considered when choosing land for dairy farming are fertile soils, t evidence of flooding during the wet season, convenience for transportation, proximity to milk collection centres, access to supplies for farming and, of greatest importance, yeas-round supplies of sufficient clean water. Distance from factories (which may release bad odours or lead to pathogenic infections) and to urban areas (where pollution from fan effluent will not be tolerated) should also be key influences on location. This has been covered in some detail in Chapter 12. The essence of good shed design is making the best use of natural ventilation, with open sides, a high and well-pitched roof together with an open vent along the top. Concrete alleys of loose houses should slope in the direction of the movement of manure, with a 3% slope down the shed, but level from side to side. They must be easy to clean and concrete makes a smoother surface than bricks. It must allow for quick and free drainage. with all effluent directed towards a tank, either for biogas or recycling as fertiliser. In countries where dried manure is a value-added product for kitchen fuel, floor designs may differ slightly to those in other countries, where all effluent is directed to open drains. There are several options for constructing the roof, such as iron, bricks or even bamboo/mud in a low rainfall area. It is important to construct wide laneways to include the feeding area. By raising the walkway, building costs would be reduced and farmers will get a better view of their stock, which would be below walkway level.

1.1 Considerations when developing housing systems for tropical dairy farms.

1. Sufficient feeding trough space for each cow.
2. Shade over the feeding, as well as over the loafing, area.
3. Wire fences instead of solid walls to avoid restricting air flow.
4. Planting trees on the western side to lower air temperatures.
5. Sowing grass or other forages in the area surrounding the shed for stock feed.
6. Painting buildings white to maximize reflection.
7. Ensuring sufficient space between buildings. (four times their height)
8. Shading over drinking troughs to keep drinking water as cool as possible.
9. Orientating buildings to maximize winds and shade.
10. Orientating buildings north-south to allow the sun to dry the shed being very wary of steep slopes.

The checklist at the end of this chapter can be used when assessing the specific requirements for shed design of particular farms

1.2 Building for the animals.

1. It is essential that when designing housing systems, farmers keep the following key principles in mind:
2. To achieve cow productivity, farmers must consider the twin issues of cow comfort and health, where health is the freedom from infections, injuries and metabolic problems
3. To achieve cow wellbeing, farmers must look at the twin issues of housing and. management, where management covers all the normal farm practices associated with dairy farming.
4. Addressing cow comfort and housing means that the farm's physical facilities must be optimized before putting cows in sheds.

Cows grazing in a paddock have access to forages virtually all the time and the concentrates at least twice per day, at milking. This should also be the case when cows are maintained in sheds. They should be encouraged to make at least 12 trips each day from their lace of rest to the feed and water troughs. This will only occur if the cow feels good', has healthy feet and the route is safe and comfortable.

There are six key housing aspects of cow health and wellbeing, namely.

- **Water**, with access to clean, palatable water at least 21 hr/day.
- **Light**, with at least 6 hr/day of darkness.
- **Air**, that is fresh and clean.
- **Rest**, with a dry and comfortable place to lie down for at least 13 hr/day.
- **Space**, so cows can walk to feed and water troughs from their free stalls without fear.
- **Feed**, in that cows can eat a palatable and well-formulated feed for at least 21 hr/day.

2) Objectives

1. Sheds should be located to maximize natural ventilation.
2. Cement floors should be sloped for manure management and be non slip for cows" comfort.
3. There should be sufficient watering points or troughs for all stock.
4. Cows can be maintained in tie stalls or be loose housed. They can be provided with free stalls or have an open lounging area.
5. Additional health facilities should include treatment areas for sick stock and a calving area to permit close attention.

6. Young stock should be housed according to age
7. Access to an outdoor area provides for more effective night-time cooling.
8. A separate milking parlour will aid in milking hygiene
9. Good sanitation is very important for both cow cleanliness and effluent disposal. Recycling effluent will reduce necessary fertilizer inputs to forage production areas.

3) LITERATURE SURVEY

- Throughout Asia, dairy cows have been traditionally housed in tie stall sheds. bot is gradually changing as SHID farmers realise the benefits of providing stock with space move around. loose housing can be of two types, either with a common lying area with open lounging or with cubicles , known as free stalls.
- In open lounging systems, cows can lie down anywhere. The floor can be earthen or cement, generally with bedding material, with the base being well drained. In dry climates, earthen floors without bedding can be used as long as the dry manure is frequently removed. The loafing area behind the feed troughs should be cement and at least 3 m wide
- With free stalls, each cow is provided with a cubicle, which she may enter and leave at will. Cubicles can be arranged in a single row or in more than one row with a central feeding alley or with feeding alleys along the sidewalls. The cubicles can be arranged with cows facing one another (head-to-head) or the other way around (tail-to-tail).
- With the tail-to-tail arrangement, a central loafing alley with a width of 2.2 m between the cubicles is needed. If the cubicles are head-to-head, two loading arecas behind each row are necessary. Usually one of the loafing alleys is combined with the feeding alley behind the feed troughs. The total housing area needed in this case is no larger than the tail-to-tail arrangement

3.1 Free stall layouts

The size of the cubicles depends on cow size. For cows

- weighing 400-500 kg. they should be 104-109 cm wide and 198- 208 cm long.
- weighing 500-590 kg, they should be 109--114 cm wide and 208-218 cm long.
- weighing 590-680 kg, they should be 114- 122 cm wide and 229-244 cm long.

3.2 The surface of the free stall should have a consistent fall of 2%. It should:

- Be comfortable to the cows to encourage high occupancy.
- prevent hock damage and other injuries.

- Be easy to clean and be durable.
- Be cost effective to install.

The ideal lying surface is soft, absorbs moisture and does not promote the growth of bacteria. When cows are forced to lie down on hard surfaces, they do not lie down for long. are more easily unsettled and may develop knew and hock lesions and swelling. The floor of the cubicles can be car then with a thick layer of bedding, or can be solid, with a soft top layer. The simplest bedding is packed earth or sand, this being inexpensive but requires care to maintain a it surface. Sand is quickly pushed around by cows, so it should not be used with mechanical or liquid manure handling systems because it fills up storage tanks and is very abrasive, damaging equipment such as manure pumps. A concrete foundation with a disposable bedding of chopped straw, sawdust. wood shavings or crushed corn cobs is more common in Europe. because rice hulls are no readily available. Rice hulls would make ideal bedding for free stalls but their high silica content could damage liquid manure handling equipment. Hard surfaces should have a slope of at least 1% so that urine will drain into the alleys. Rubber mats and cow mattresses are new innovations for free stalls but the thin ones (10 mm or less) have short life spans. Thicker ones (25-30 mm), although more expensive. are likely to be more cost effective in the long term. The front of the cubicles with thick bedding should be 1.2 m high and the back 0.85 m. In cubicles with solid floors, these measurements are 1.1 and 0.75 m, respectively. To prevent the cow from soiling the cubicle, shoulder and head rails are needed. This provision will force cows backwards when they stand up. The distance of the adjustable shoulder rail to the back of the cubicle, measured diagonally, should be about 1.8 m; the height to the cubicle floor may vary between 0.9 and 1.05 m.

4) DESIGN, CONSTRUCTION & WORKING

4.1 MATERIALS

Sr. No.	PART NAME	QUANTITY
1	Solar Panel	1
2	DC Motor	1
3	Irrigation System	1

	Model	
4	Plastic Base	1
5	Base Of Cow Shed	1
6	Top roof Of Cow Shed	1
7	Wooden sticks for roof support	4
8	Bowl for storage representation	2
9	Buckets for well representation	1
10	Pipes for water supply	1
11	Toy for animals representation	8

Table-1 Material Used in Design

4.2 DESIGN & CONSTRUCTION

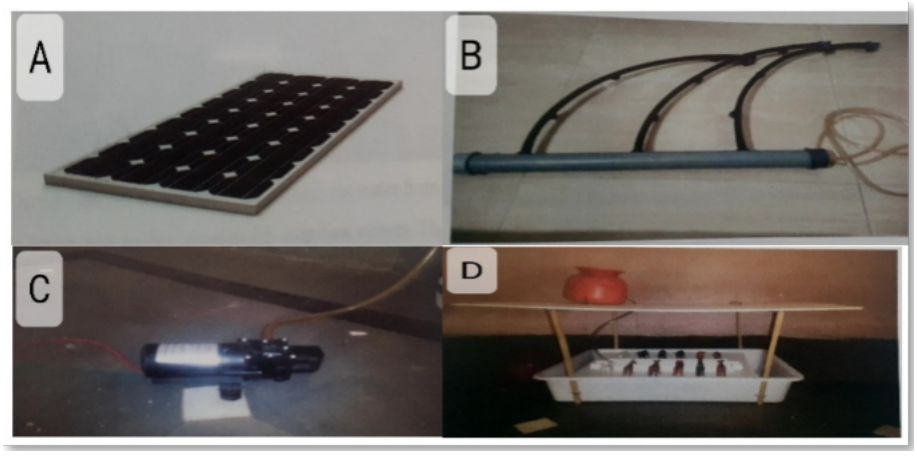

Fig.- 1. A- Solar Panel, B- Irrigation System,

C- D.C Motor, D- Cow Shade.

4.2.1) Solar Panel:

It is basic energy convertor of our system which convert solar energy into electricity. As our purpose is to use of natural energy source, we choose the solar energy. The electricity generated from solar panel will

be forwarded to DC motor which will suck the water from the well. Panel is of 12 V & 40 w output.

4.2.2) Irrigation System:

The First application of system. Water will first circulated through the irrigation system then forward to further application. The size and space of irrigation layout will be depend upon the application in the farm.

4.2.3) D.C. Motor:

Direct Current motor will used for suck the water from representation of well. This water will further circulated in irrigation system. The motor capacity is 12 v. 2.2 A. ith this capacity it can discharge min 3L to max 6L.

4.2.4) Cow Shade:

The Shed is made up of a tray which will act as a flour for shed. This shed is made up of 18*18". A foam sheet is used as top roof of shed which has dimensions as 2424. This foam is attached with flour by means of four wooden sticks.

4.2.5) Biogas Power plant:

One of the application of the system. When water from the cow shed will be used for cooling of animals and cleaning of shed, then same water will used to clean the shed and all waste products will get swiped through the shed. This waste will get collected in biogas power plant. As water get mixed with the mixture then there is no need of addition of water. This reduces need of manpower also

4.2.6) Piping arrangement:

This arrangement takes almost all place in the given system. It starts from when attached to motor to suck out the water from the well. Then in irrigation system wider piping system included. Then same water will be circulated to cooling system storage tank through pipes

4.3 WORKING :

Solar Cow Shed is an multi application project based on single energy source. The project is prototype which runs on solar energy. Also it has an agricultural application. A motor which will run on solar energy will be placed near well and motor will suck the water until solar energy is available (average 12 hours per day). This water will be circulated firstly to irrigation system which is sprayed throughout the farm. Then same water will pass to storage tank which placed on roof of cow

shed. The tank has two outlet. First outlet is given to drinking water purpose of animals and second outlet given to shower system provided above the animals exactly. Thus water will supply through both outlet simultaneously. The water provided to shower system will further used to clean waste of animals and same waste will pass to biogas power plant located beside the shed. Following are several applications of projects.

1. Irrigation system.
2. Drinking water for animals.
3. Cooling purpose of animals.
4. Cleaning of cow shade.
5. Bio gas power plant.

5) General considerations

Considerations when planning free stall sheds

5.1A) System design –

1. Allow for easy cow movements around the shade.
2. Stalls should be comfortable and clean.
3. Should allow for regular manure removal.
4. Provide easy access for machinery to feed out
5. Allow for multiple routes from stalls to feeding area, to overcome dominance within herd.
6. Feeding space and free stalls should be proportional.
7. Stalls, feeding and watering spaces should be arranged in modules.

5.2B) Modular design –

1. No more than 60 stalls per module
2. Modules can be manipulated to match site constraints

5.3C) Stall Sizing

1. Depends on cow size (weight and body dimensions).
2. Size based on largest 25% of cows in group.
3. Provide adequate room for lying down, as well as necessary forward and

sideways lunging to stand.

5.4D) Stall slope

1. 4% slope from front to rear.
2. 3% lateral slope, so cows lie in same direction facing down slope, to minimise teat injuries.

5.5E) Stall curb

1. Minimum of 200 mm above alley way

5.6F) Alley width

1. 3-3.6 m wide avoiding sharp turns

5.7G) Crossovers

1. Locate every 20-25 stalls, that is every 24-30 m
2. 4.5-4.8 m wide, so one cow can drink and two cows pass behind
3. Elevate floor slightly above stall curb, allow crossover to drain into alley

5.8H) Bedding material

1. Inorganic (sand or rubber).
2. Organic (sawdust, straw, hay, composted manure or rice hulls) At least 100 mm thickness of rice hulls, sawdust shavings or sand.
3. Consider hygiene, degree of compression when cow lies down, performance over time, how it will interact with effluent disposal system.

Open lounges create their own problems of regularly removing and cleaning the bedding and ensuring all cows will use it in preference to lying on dirty cement walkways, and hence increasing potential mastitis-producing areas.

5.1) Considerations in flooring

The required floor slope depends on the cleaning method adopted and the natural slope of the site. A minimum slope of 0.5% (1 in 200) is required to prevent pooling of water. Steep cow alleys (greater than 1 in 15) will result in cows not standing perpendicular to the feed trough, but standing uphill. Flood washing of the cow alley ideally requires a slope on between 2.5%6 (1 in 40) and 3.0%% (1 in 30), to achieve acceptable wash with minimum amounts of water. If the slope is less than 2.5%%, the volume of flood wash water required increases to get extra water depth to compensate for the lack of slope. There should not be any sideways slope on cow alleys with flood washing, If flood washing is not used, the cow alley should have a 2.5%% slope away from the feed trough. Hose washing and dry scraping are not

slope sensitive. so the site slope will influence the alley slopes. The feed alley needs a concave floor (with 50 mm fall) sloping away from the feed to the centre of the alley to prevent run-off water mixing with the feed. The long-ways slope should be the same as the cow alleys. Cows can be standing or walking on shed floors for up to 10 hr/day. In tie stalls. cows should be provided with rubber mats to cushion the hard concrete floors. With loose housing, concrete floors should be roughened to reduce slippage, but not too rough to wear out hooves, leading to lameness problems. Another alterative is to install grooves or patters in new concrete floors. These can even be cut into old concrete floors.

Grooves should be positioned so that at least one of the four feet lands in a groove whenever cows put their feet down to stop slippage. Parallel grooves should be spaces about 15 cm apart. 12 mm wide and 12 mm deep. Although placing grooves perpendicular to the length of the alley will maximise their effectiveness, they may compromise removal of shed effluent, so they should be located parallel to normal alley-way cow flow. Anti-slip aggregates mixed in with the top laver of concrete or epoxy floor coatings can be applied to existing floors. Another alterative in areas of high cow usage, such as in feeding alleys, is construction of synthetic rubber floors such as those used on athletic tracks.

5.2) Water troughs-

Stock must be provided with sufficient drinking water at all times and the system should be able to supply at least 20 L/cow/hr to meet likely peak demand. The optimum temperature for drinking water is 15-17"C. Water troughs should be well separated (but within 15 m) from feed troughs, with the same water trough servicing adjacent pens. Trough design should allow for regular, easy cleanings with a removable bung for complete drainage. Each cow should be provided with 75 mm of linear watering space in free stall sheds, while for circular water tanks, one watering space (60 cm of tank perimeter) should be available for every 15 to 20 cows. A water depth of 15-20 cm helps keep water cooler. fresh and easier to clean because less debris accumulates. The optimal trough height is 60-90 cm from the ground to the top of the trough. Round If cows are tethered, it is possible to install individual cattle drinkers, with two animals sharing one drinker. To ensure water is freely provided, troughs need to have float valves, rather than depend on a hose whenever the farmer decides to refill it. A single watering trough system can control water levels in un to 10 small troughs just by one float valve in a central reservoir with syphon pipes leading to all the troughs.

5.3) Feed troughs and feeding strips

It is important that all stock can eat comfortably with minimal competition. Whether feeding into troughs or onto cement feeding strips, 70 cm of feeding space should be allocated per mature cow. For a feeding string or trough when cows eat from both sides of the strip, hence face each other to eat, this equates to a total feeding strip allocation of 35 cm/cow. Trough space can be reduced to 45 cm/head

for 6-month-old cattle, or to 55-60 cm/head for stock 18 months old With feed troughs, the width should be related to the reach of the animals, which is up to 80 cm for mature dairy cows eating from the base of the trough 30 cm above ground level. The base of the trough should then be raised 10-30 cm, with the front 50 cm above this. Cows in tie stalls are likely to have restricted reach.

Feeding strips should be positioned 7-15 cm above cow feet level, with a in wall 40- 55 cm above the feeding strip, to protect the feed from the effluent. Feed barrier wall wider than 15 cm can restrict how far stock can reach into troughs or onto feed strips

5.4) Feed storage

Feeds should be stored in secure and vermin-proof locations with easy access for the stock. They should be located well away from waterways. Most feeds are sourced in bass although larger farms may handle feeds, such as by-products, in bulk. In these cases, good road access for trucks in essential, with the feed bunkers under cover. Such bunkers should have concrete floors and brick, concrete block or refabricated or reinforced cement walls. For storing by-products with very low dry matter contents, soil ramps adjacent to these bunkers will aid discharge from trucks.

Forages can be conserved dry as hay or straw. or moist as silage. Hay or straw must be stored in weatherproof buildings and should not be stored in confined places if it is likely to be most, where it can catch on fire. Silage must be continually covered with plastic cheats to exclude any sir prior to feeding out Silages can be stored above ground in bunkers or below ground in pits. In-ground pits are best for long-term storage but above-ground storage is referred in areas with high rainfall. Buns or stacks are silage units without structural support, but with their high surface area-to-volume ratios, plastic costs per tonne silage and wastage rates can be high. Bunkers or clamp silos are the most common storage systems, while individually covered bales or stretchable bags are often used in regions well serviced by silage making contractors. The dimensions, particularly their width, should be determined prior to their construction, based on the predicted daily rate of removal from the silage stack.

Silages can produce a lot of liquid. called leachates, during storage, which is very corrosive and lethal to aquatic life if it escapes into rivers or streams. The production of leachates can be reduced by incorporating dry material, such as rice straw or rice bran, at the base of the silage bunker.

5.5) Preparing concentrate mixtures.

It is rare for milking cows to be offered only one type of concentrate. because of their high nutritive demands and the poor nutritive value of tropical forages. Concentrate mixtures usually contain a variety of energy and protein supplements together with minerals. usually macro minerals and. for hich-vielding cows, maybe even micro minerals. One very simple method of hand mixing a complex concentrate

mix for storage op immediate feeding is to spread each ingredient on top of each other in lavers (even the mineral pre-mixes) then collect the mixture into bags or buckets by shovelling it perpendicular to the floor. This method is ideally suited for dry concentrate ingredients, although it could be used each day for offering mixtures containing wet by-products, such as cassava or soybean waste.

Molasses blocks are a good supplement and can be used as carriers of non-protein N or minerals. The blocks are solid, and fairly easy to make, transport and store. Molasses intakes should not exceed 20% of the total intake, because at higher levels it will depress digestibility. If the basic ingredients of concentrate mixtures are stored, a space must be allocated to blend them into a formulation. Hand mixing may be practical with small herds of stock, but a mechanical mixer is preferred to ensure complete blending of mixes for larger groups of animals. These formulations are either placed on top of forages or fed out following removal of residual forages from the feeding troughs. With very large herds, however, a mixer wagon is a good investment to ensure consistency of ration formulations. Such mixtures are called total mixed rations, or partial mixed rations if stock also have access to grazed pasture.

The tradition of mixing water with the concentrate portion of the ration is widespread throughout Asia. Farmers wrongly believe that cows will better use concentrate slurries compared with dry mixes. This may be one way of providing additional water, in housing systems where there is limited free access and stock are only provided with restricted times to drink. However, given free access to water, there is no need to feed slurries of concentrates. Cows can be fed their roughage portion on a flat area of concrete with no sides. It is also easier to clean such a flat feeding area. Therefore feed troughs could become superfluous.

6) Additional Features:

6.1) Additional health facilities

To ensure good health care, sufficient health facilities are needed. Sheds should include additional stalls for such purposes. These are as follows:

- A treatment area for confining animals in heat, artificial insemination, routine health checks, pregnancy diagnosis and examining sick cows. Because animals are usually separated when they leave the milking parlour, the treatment area should be located close by. The width should be at least 0.7 m per cow and the length 3 m. It is convenient to have a separate movable veterinary drug and equipment box for treating hoof problems. or trimming hoofs, taking blood samples, and so on. There should be one treatment stall per 20 stalls with a minimum of two.
- A separation area to treat sick cows properly and prevent the spread of disease. It should be located close to the milking parlour. The cows can be housed in this area in 1.2 m stalls, which could be changed into pens. Drinking

water should be available. with concrete floor and gutters to allow for frequent cleaning and sanitising. There should be one treatment stall per 30 stalls with a minimum of two. With tie stalls, there is little need for a special separation area.

- A calving area, to permit proper attention at this critical time. With loose housing, cows may need to be tied up in stalls and should calve down away from the milking herd and close by the calf pens. As with the separation area, ease and thoroughness of cleaning and sanitation are key features. There should be one calving stall per 30 stalls with a minimum of two.
- Foot baths should be available; they should be at least 2 m long and 0.15 m deep. The width should be the same as the passage to prevent cows from bypassing the bath without using it.

6.2) Calf cages

Containing each calf in a raised metal cage provides the best housing because they are isolated from each other, live in a well-ventilated and clean pen, are easier to feed and water (because the reared does not have to bend down to feed them) and, of most importance, allows for much easier individual surveillance. Calves should live in cages up to 3 weeks of age, after which they can be moved to individual pens. Each cage should be 110 cm long, 75 cm wide and 105 cm high (including the legs). The rear of the cage is a removable gate to put the calf into or remove it from the cage. The floor can be made from wood or plastic, with the floor lattice perpendicular to the length of the cage. The space between floor boards should be 1.5-2 cm. The cage should stand on legs and be 30 cm above floor level. To avoid injuries, there should be no sharp edges inside the cage. The metal bars should be about 15 cm apart: any narrower can lead to injuries if calves get their legs stuck between the metal bars.

6.3) Outdoor area for night-time:

Once the sun sets, outdoor areas are cooler than inside any shed. Saudi Arabian dairy feedlots have them, as do many Australian dairy feedlots. They are much less common in Asia because of the high rainfall and problems with mud. Where cows are commonly housed out of doors, they should be an integral part of any shed design. Whether the floor needs to be concrete or brick or just plain dirt is another issue. Cow will eat more during the cooler part of the day, so provision must be made for adequate feeding space. It is better to provide the bulk of the forage in the evening, particularly during summer, so feeding space is important. Free access to adequate watering space is essential. Also, because it is easier to observe oestrus when cows are loose in a yard at night, permanent lighting is important. A lounging area for the milking herd should:

- Be located in a well-ventilated area.
- Be well drained.

- Have a dirt or gravel surface.
- Provide at least 5-10 m/cow.
- Incorporate water troughs.
- Incorporate troughs for feeding forages.

Storage of veterinary drugs and other dairy equipment Veterinary drugs should be stored in a dark cupboard or, if required, inside a refrigerator. For security purposes, the cupboard should be lockable. Other dairy equipment, such as detergents and sanitizers for cleaning milking machines and equipment for trimming feet or dehorning calves, should also be stored in a specific location. Milk-harvesting equipment, such as buckets. sieves and milk cans should be stored off the ground and hanging upside down to aid drying.

6.4) Farm office

Maintaining good farm records is much easier in a farm office. An area at home or in the dairy shed should be dedicated to keeping records. It must have a desk and good lighting. It must be a quiet place to set up the office files (preferably in a filing cabinet), computer and office supplies. The how and when of keeping farm records depends on the person recording them. Computers are very convenient, but require money to purchase and skills to operate efficiently. Record keeping should be given as high a priority as other farming activities. Suitable chairs and tables should be included for business meetings with service providers and other farm-related visitors.

6.5) Staff quarters

Farm staff should be provided with space to eat and relax when off duty. This could include a shower and toilet, food preparation area and storage for their work clothes.

6.6) Milk harvesting

Once a decision is made that cows are allowed outside to cool down at night, it seems logical to plan their movements around milking times. A separate milking area has many advantages. It can be centrally located, requiring only one supply of hot water (for cleaning animals and equipment). Daily hosing down and weekly disinfecting will minimise environmental constraints to good milk quality. Furthermore, if farmers eventually decide to invest in machines for milking, one milking area minimises problems with low vacuum pressures in long air lines Milking hygiene is very poorly managed in many countries, particularly those where farmers are not rewarded for their milk quality.

6.7) Designs of milking parlours.

All parlours should have a high-quality concrete floor and metal rails for durability and ease of cleaning. Walls are not required, but, if included they should be at least plastered masonry walls. The pit where the miler stands should have a floor level 90 cm below that of the cows for the most comfortable working position. The number of stands is determined by the allowable milking time of the herd or time taken by the cows to eat the concentrate rations usually fed. Parlours can be of the following types:

- Abreast parlour - The milkier and the cows share the same floor space. Cows can enter and leave individually. The stands should be 1-1.1 m wide when a bucket milkier is used or when the cows are hand milked, while 0.7-0.8 m is adequate when a pipeline-milking system is used. The width for the milkier should be 0.6-0.8 m. The main drawback is the relatively long distance to walk between milking points, and the cows obstructing the milkier.
- Tandem parlour - This allows for individual care of the cows, but has larger space requirements.
- Walk through parlour - Cows enter and leave in batches. The narrower width can be an advantage if fitted into an existing building
- Herringbone parlour - This provides a compact working area and allows feeders to be fixed to the side walls. Three or four stands on each side should suffice for up to 80 milking cows. Its popularity is due to its simplicity and high capacity (measured as cows milked per man hour). However, the risk of cows kicking the milkier is greater than in arbours where the milkier stands beside the cow
- Rotary parlour - Because these are expensive to install, they are better suited to much larger herds

It is best to equip milking parlours with grain feeders that allow each cow to be fed in proportion to her milk production. Because cows expect to be fed while being milked, they will enter the parlour more readily, thus saving some labour. Each cow can be manually fed her ration using a measuring scoop. An entrance to a milking parlour that is straight, with no turns, will ensure a smooth and convenient operation. Once trained, stock will walk readily into the parlour. A single 1 cm step will help keep manure from being carried into the parlour. An exit leading to an uncrowded area will facilitate the flow of cows. It should be narrow (70-80 cm depending on the size of the cows) to keep the cows from turning around.

6.8) Milk room and cooler.

Sanitation is the primary consideration in handling milk, whether from a hand-ot machine-milked cow. Adequate supplies of potable water are essential for cleaning the milking equipment immediately after use. Hot water (85°C) mixed with a chemical detergent are required for effective cleaning and cold water used for rinsing. Milk should be handled in a separate area that can easily be cleaned and is free of insects, birds, rodents and dust.

The milk room should be well ventilated, with a concrete floor sloped 20 mm/m to a drain and with masonry walls having a smooth, water-resistant surface that can be easily and thoroughly cleaned. On dairy farms of sufficient size, the milk is cooled by cold water circulated between an evaporative water cooler and a milk cooler (plate heat exchange), through which the milk is passed until it is adequately cooled. Where milk is transported in cans, cooling can be accomplished through a coil, which is immersed in the can. The larger scale farmer, having a pipeline milking system, and milk collection by a tanker, will require a refrigerated cooler and holding tank With machine milking, the vacuum pump and engine that powers it, should be put in a separate engine room.

6.9) Sanitation and effluent management.

Dairy farm effluent is both a liability and an asset to the small bolder farmer. It is a liability so far as contaminating feeds, encouraging flies and animal health issues are concerned, whereas its role in fertilising forages is an asset. Unfortunately, its full potential is not realised unless all the nutrients contained in the urine are returned to the pastures. The nitrogen in urine is easily lost through volatilisation, unless it is stored and recycled to the pastures in liquid form. Each day each cow produces 30-35 kg faeces and 12-16 kg urine plus shed effluent from washing down floors. Each day a 50 cow shed then produces 1.6-1.8 t faeces plus 700-1000 L urine, which is equivalent to 1.5-2 m volume, excluding rainfall run-off. Therefore it is important to:

- Design floors for efficient effluent run-of
- Ensure that there are suitable gutters and sufficient wash down water to keep floors. Clean.
- Ensure that the effluent pit and pond has sufficient capacity
- Ensure that the base of the pond is I m above the water table
- Provide equipment to handle solid effluent for recycling onto the forage area.
- Provide equipment to remove liquid effluent, such as a pump and pipes that

lead directly to the forage area.

- Be aware that 'social standards' are always changing.
- Consider an area to dry manure for bricks or cooking fuel.

6.10) Effluent as a liability:

The management of animal manure represents a major health hazard on small holder farms with the problem increasing with herd size, unless specific facilities are constructed. The problem is associated with a number of issues, such as:

- The quantity and quality of faeces and urine produced.
- The adequacy and frequency of removal.
- Storage in proximity to the shed.
- Labour availability.
- The methods of storage and disposal.
- The value and use of manure.
- Community concern about pollution (smell, as well as contamination of groundwater and water courses).

The human health hazards are becoming more serious than previously realised, due to inadequate supervisory and sanitary measures. For example, in Thailand, a survey noted waste water from SHID farms constituted a considerable risk to public health. A checklist for planning dairy sheds

6.11) Physical aspects:

- Aspect of shed with respect of wind and sun.
- Flooring (material, slope.
- Rubber mats for floors.
- Wooden or metal uprights.
- Roof height.
- Roofing material ('colourbond' or tiles).
- Maximum natural ventilation.
- Feed troughs (cement, wood or other material.
- Water drinkers (automatic, trough plus float valve, trough plus hose).
- location near feed-growing areas (for effluent recycling).

- Design shed to allow easy stock observation.
- Wide aisles for ease of carrying heavy loads.

6.12) Services

- Electricity (single or three phase).
- Water (drinking, cooling, washing, sanitising).
- Water heating (liquid petroleum gas or fire).
- Water for washing down, taps and hose for floor flushing.

6.13) Environment:

- Insulation for under roof.
- Sprinklers for cooling.
- Hose for washing down hot cows.
- Cooling fans (large overhead or small moveable).
- Fans for all milk cow areas or just for high-yielding cows.
- Computerised system to initiate specific cooling cycles.
- Plant trees, grass around sheds.

6.14) Effluent disposal:

- Suitable gutters to keep floors clean.
- Effluent pit (suitable capacity).
- One large pit for several sheds.
- Liquid effluent removal (pump and pipes).
- Solid effluent removal.
- Location of fodder growing areas for recycling area to dry manure and make bricks/cooking fuel.

1. ### 6.15) Feeding facilities:

- Separate feed-storage areas.
- Bird, vermin and insect proof.
- Silage pits.

7) CONCLUSION

Future research should be conducted on the effect of climate change on heat stress in pastured dairy cows as well as heat abatement techniques, especially within pasture-based systems and in different locations. Furthermore, research should investigate whether shade use during the hottest hours of the day is more or less beneficial to the cow than grazing. Complete pasture coverage by PV systems may allow for simultaneous grazing and cooling of cows. Agitolalias may provide an acceptable method of heat abatement to pastured dairy cows, although more long-term studies should be conducted to gain a clearer picture of the effects of solar shade on dairy cows. Future research on solar systems in a pasture dairy system should explore the economic effects of the solar system as well as long-term effects on milk production, reproductive performance, BW, and fat plus protein.

Fig.-2 Modern Cow Shade model

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