Bio Vet Innovator Magazine
Volume 1 (Issue 4) OCTOBER 2024
OPEN ACCESS
Popular Article

Housing of Dairy Animals

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DOI - https://doi.org/10.5281/zenodo.14060287

Received: October 20, 2024
Published: October 22, 2024

Abstract:

The housing of dairy animals is a critical aspect of dairy farming that directly impacts animal welfare, productivity, and overall farm efficiency. Factors such as climatic conditions, herd size, and management practices influence the choice of housing, ranging from traditional tie-stall barns to modern loose housing systems. Key considerations in housing design include providing adequate shelter, ventilation, access to feed and water, and opportunities for natural behaviors. The adoption of appropriate housing solutions can significantly improve animal well-being, reduce stress, and enhance production outcomes. Additionally, effective housing design contributes to the overall sustainability and profitability of dairy operations.

Introduction:

In India, a vast majority of regions endure significant stress during April, May, and June due to the high Thermal Humidity Index (THI), reaching between 75 and 85. In a quarter of these areas, THI levels exceed 85%, particularly during May and June. While indigenous cattle breeds show more resilience to heat, crossbred cows and buffaloes suffer notable reductions in milk yield. Exposure to prolonged heat leads to heat stress in dairy animals. Moreover, the tropical climate exacerbates this with its hot and humid conditions. To mitigate the negative impacts of heat stress, effective management strategies, particularly in housing, are essential.

Importance of Thermal Humidity Index on Discomfort of Animals:

The Thermal Humidity Index (THI) serves as a gauge of discomfort, blending assessments of both ambient temperature and atmospheric moisture levels within a specific area and timeframe. When ambient temperatures surpass 25 degrees Celsius and relative humidity exceeds 50%, animals may begin experiencing discomfort or negative health effects. Across various livestock species, generally, THI levels between 65 and 72 denote no distress, while THI ranging from 72 to 78 indicates mild stress. Once THI surpasses 80, animals typically experience severe stress.

During the initial phases of intensification, animals were often confined in tied stalls, but this approach quickly diminished in larger-scale systems, giving way to loose housing systems. In a loose housing setup, animals

have the freedom to lie down either in cubicles or on deep straw bedding. Deep straw bedding is particularly favored for the welfare of cows, as it offers superior comfort, health, and hygiene, as indicated by lower mortality rates compared to cubicles and tied stalls. Tie stalls are commonly associated with various welfare issues such as stiffness when rising, leg injuries, trampled teats, and stereotypical behaviors like tongue rolling.

Functions of Livestock Housing:

The fundamental goal of livestock housing is to enhance animal productivity. An effective design should aim to adjust or regulate the microclimate within the animal housing, minimizing exposure to extreme weather conditions. Additionally, it should offer improved control and protection against diseases and parasites, favorable working conditions for staff, seamless integration of various farm activities, enhanced labor efficiency, and opportunities for animals to engage in their natural behaviors.

1. **Protection from Inclement Weather Conditions:**
   Environmental factors such as temperature, rainfall, humidity, wind direction, and velocity exhibit significant variation across seasons and months, particularly in tropical regions. Optimal conditions for livestock generally entail temperatures between 25 to 35 degrees Celsius and humidity levels ranging from 55% to 65%.
2. **Provide Adequate Feed and Water:**
   Ensuring a sufficient supply of feed and water is essential, and the design of animal housing should facilitate proper access to both. Reduced feed intake can lead to significant declines in body weight, growth rates among young animals, and the productivity and reproductive capabilities of mature livestock.
3. **Minimizing Energy Losses:**
   When livestock are subjected to notably low or high temperatures, they expend energy to regulate their body temperature, impacting their growth, productivity, and reproductive abilities. Therefore, housing should be designed to manage their microenvironment across different seasons, minimizing energy losses for the animals.
4. **Opportunity to Express Natural Behavior:**
   Proper housing design provides an opportunity to express their natural behavior hence they are less stressed and more productive indicating that their welfare standards are taken care properly.
5. **Grouping:**
   Proper housing provides an opportunity for housing the animals according to their category and size for proper management.

Key Elements of Optimum Housing Conditions at Tropical Climate:

In tropical climates, essential aspects of housing encompass adequate shelter provision, appropriate roofing materials and angles, suitable bedding, ventilation systems, structures for feeding and watering, management of microorganism levels, temperature control, and choice of construction materials.

Livestock in tropical climates typically benefit from a loose housing system over conventional setup. In this system, animals have freedom of movement for most of the day, being tethered only during milking in designated parlours and for administering medication.

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Adequate Air Space For Dairy Cattle (RSPCA, 2011)

Weight Class (kg)	Minimum Unit Building Volume (m^3)
Up to 60	7
61-100	10
101-200	15
More than 201	20

Floor Space Requirement Per Animal Under Loose Housing System (BIS: 1223-1987)

Type of Animal	Floor Space per Animal (sq. ft.)		Manger Length / Animal inch
	Covered area	Open area	
Cow	20-30	80-100	20-24
Buffalo	25-35	80-100	24-30
Young stock	15-20	50-60	15-20
Pregnant cow	100-120	180-200	24-30
Bull pen	120-140	200-250	24-30

Orientation of Animal House: East to west orientation of house at tropical climate has been found beneficial for dairy animals. It offers proper shade thereby providing protection against direct and exhausting sun rays to the animals.

Proper Provision of Shelter: Apart from offering a protective place to live animal shelter must consider of animal comfort, animal health and sanitation, convenience and comfort to the operator; it should help in automation, labor saving, feeding, milking and proper waste removal.

Proper Roofing Material: Proper roofing material becomes an inevitable aspect of housing. It should be light, strong, durable, weather proof, bad conductor of heat and free from tendency to condense moisture inside (Rural structure in tropics, FAO, 2004). There are several roofing materials available like thatch, clay tiles, wood, reinforced concrete cement, PVC sheets, galvanized sheets, asbestos, etc. The most suitable material is thatch followed by clay tiles, woods, reinforced concrete cement, galvanized sheets, PVC sheets and asbestos sheets. Height of the roof preferably should be 12 feet for flat type and 20 feet at center for gable type with 12 feet at eaves.

Roof Angle: It is the angle at which two sides separately make angle with the central axis of the roof. Proper care should be taken while making roof angle so to avoid more than 45 degrees in any case. For thatch material roof angle limits to 30-35 degrees, clay tiles 25 degrees and for galvanized sheets it is 15 degrees.

Ventilation: Basic concept of ventilation process is where the fresh air comes in mixes with moisture, dust and microbes if present, along with heat and gases and finally stale air is pushed out through outlets like windows, furrows, or holes. Natural ventilation types include large continuous sidewall openings, continuous eave openings and continuous ridge openings. For Indian condition best, suited natural ventilation type is large continuous sidewall opening as it allows ample amount of fresh air to come in and completes ventilation process efficiently.

Bedding and Floor Material: The bedding should be soft, rest promoting, cost effective, less microorganism loads, positively promote health and performance of dairy animals. More lying time signifies rest in dairy animals whereas more standing time denotes uneasiness of living conditions under housing management. Most lying

time was found in sand followed by straw, mattress and rubber mat wherein the standing time was just in opposite trend.

Dairy cows have been found to have a partial likeness for an optional outdoor area but liked pasture than outdoor sand pack in night, as a reason of more space facility in pasture or may be due to the ability to graze. Furthermore, allowance to an outdoor pack facilitates estrus behaviors.

Particle size of sand is 0.1-2.0 mm, for wood shavings 2-4 cm. Bedding material should not absorb water and should be kept as dry as possible. Wet bedding material may serve as a breeding place for microorganisms or other parasites which may be harmful for animals.

Manger and Watering Facility: Animal's performance mainly depends on how and what it eats, so it is important to build manger of optimum size, shape and height. Size of water trough is approximately 10 per cent of the dimension's manger. Adequate water intake is required for optimal milk production by animals. 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. 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.

Dimensions of manger and water troughs (BIS: 1223-1987)

Type of Animal	Dimensions of Manger (cm)		
	Width	Depth	Height of wall
Adult cattle and buffalo	60	40	50
Calves	40	15	20

Microorganism and Gaseous Load: Recommended maximum limits of dust particles and different gases are Dust ≤10 mg/m3; Carbon dioxide ≤3000ppm; Ammonia ≤10ppm; Hydrogen sulfide ≤0.5ppm. Average microbial load in a farm should be nearly 4.3 log CFU/m^3. Care should be taken in order to prevent excessive dust, gaseous and microbial load inside animal houses.

System of Housing:

For cattle and buffaloes there are two types of housing system that are basically followed-

a. Conventional/ tie/ stanchion barns, or closed housing

b. Loose housing

These housing systems are adapted based on environmental factors, the size of the farm, and material availability. They can be adjusted to suit varying climatic conditions. Conventional barns are favored for colder regions and smaller herds, while loose housing systems are preferred for hot, dry, or humid climates with larger herd sizes.

A. Loose Housing System:

In this setup, animals roam freely in an open paddock except during milking, insemination, vaccination, or treatment. Shaded areas within the paddock offer shelter during adverse weather. Common water tanks and feeders are provided, and concentrates are usually given separately during milking in dedicated barns. This housing style is suitable for many regions across the country, except for temperate and heavily rainy areas. The open paddock is enclosed with either half walls or wire fences.

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Advantages of Loose Housing System	*Disadvantages of Loose Housing System*
Low cost of construction	More land is required
Flexible in nature. At least 10-15 per cent of additional stock can be accommodated for shorter periods without affecting their performance	Different types of sheds are needed for different purposes
Feeding, watering, milking and cleaning is easier	Risk of disease spread increases
Sick animals and animals in heat can be easily detected	Not suitable for small holdings
Social structure is built among animals and they are more comfortable as they can roam freely	

B. Conventional / Tie Barn:

In this system animals are tied from the neck with chains inside the house on a platform. The cows are fed, watered as well as milked inside these barns. These barns are completely roofed with complete walls with proper windows and adequate ventilation.

Advantages of Tie Barn	*Disadvantages of Tie Barn*
Less land is needed	Costly housing structures
Useful for small holdings	Not suitable for large herds
Individual animal care is easy	Difficult to identify animals in heat or diseased animals
Spread of diseases is slow	Not suitable for hot humid places
Feeding and watering level of each animal can be observed easily	Additional animals can't be accommodated as number of animals in a shed is fixed
	Leg disorders and other injuries can occur due to restricted movement

❖ Number of animals if not more than 16 can be kept under single row system. But, number of animals if greater than 16 are kept under double row system. In single shed under double row, up to 50 animals can be accommodated. Distance between two sheds should not be less than 30 feet.

a. Head to Head Type:

In this, head of animal is towards the middle of the building and hind quarter toward outer wall.

Advantages:

- Feeding and observation of animal is easy.
- If less space is available then it is better in comparison to tail to tail.

Disadvantages:

- Milking operation cannot be observed and managed conveniently.
- Risk of disease is more as head of both the rows are nearer.
- Cleaning is not convenient.

b. Tail to Tail Type:

The head of the animal is towards the wall where feeding manger and feeding space is provided but hind quarter of animal of both the rows is towards the middle where gutter and central passage is provided.

Advantages:

- Milking can be supervised and organized easily.
- Disease spread is slow.
- Cleaning is easy.
- Animals in heat can be detected easily.

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Disadvantages:

- Feeding of individual animal is difficult.

Other Types of Housing System:

Free Range System: In this arrangement, the animals are kept in a sizable area that may encompass thousands of square meters. The estate's center is home to the farm's headquarters. Generally, the region is cultivated pastureland or natural, with watering holes and shelters placed in handy locations.

Loose Housing with Cubicles: Cubicles are utilized as places to rest and as socially secure spaces. Compared to open or shaded yards, this kind of dwelling offers greater protection. Additionally, less bedding is needed, and less dung needs to be cleared out.

This ought to be the appropriate size to prevent accidents and to keep animals clean. If the stalls are too tiny, there will be more teat injuries and the cows may also sleep in unclean locations; if the stalls are too large, excrement spilled within the stall will dirty the cows and more work will need to be done to clean the shed area.

Dimensions of Cubicle

Type of animal	Age (months)	Weight (Kg)	Cubicle	
			Length(m)	Width(m)
Young stock	1.5-3	70-100	1.2	0.6
Young stock	3-6	100-175	1.5	0.7
Young stock	6-12	175-250	1.8	0.8
Young stock	12-18	250-350	1.9	0.9
Bred heifers & small milking cows	-	400-500	2.1	1.1
Milking cows	-	500-600	2.2	1.2
Large milking cows	-	>600	2.3	1.2

The cow will be discouraged from moving too far forward in the stall for comfortable lying down movements and will be encouraged to take a step backwards while standing so that dung is deposited outside the stall by a bar placed across the top of the free stalls.

Essential Buildings at Dairy Farm:

1. **Milking barn-** It is a fully covered barn used for milking milch cattle. It should be positioned in the middle, surrounded by all other structures. Depending on the size of the animal, the standing area's length and width can vary from 1.5 to 1.7 meters and 1.05 to 1.2 meters respectively. The middle passage's width should be between 1.5 and 1.8 meters.
2. **A feeding lane** that is 0.75 meters wide extends beyond each of the two continuous feed mangers on either side of the shed. On either side of the central tunnel is a 20-centimeter-wide, shallow U-shaped drain. The shed's roof has to be gabled. The distance between the roof's eaves and side walls should be at least 50 cm. On the side walls, there may be left-over large gaps.
3. **Milch/ dry animal shed-** Th Separate lodging for milch and dry cows is provided by these sheds. These are basic shelters with an open paddock next to a closed space. Cement concrete is the best material for the covered space. For an open pasture, kankar or moorum flooring, brick on edge, stone shed flooring, or all three can be used.
4. **Maternity pens-** The cows are moved into maternity enclosures two or three weeks before to calving. Calving

boxes needed are about 5% of the total breed able female stock on the farm. Each calving enclosure is 3 * 4 in size for the covered space and an additional 3* 4 in the open area. 25-meter-tall wall around the open space and a 1.25-meter-wide gate that opens into the paddock can be built.

5. **Calf shed-** On small farms, the calf shed is usually built next to the milking barn; on larger farms, it is located at the end. The quantity of calves to be housed determines the calf shed's dimensions. For better care and feeding, calves belonging to various age groups should be housed apart if there are a lot of them.
6. **Young stock shed-** Calves should be kept apart from nursing calves until they are six months old or until they are ready to breed. All male calves older than six months are usually disposed of.
7. **Bull shed-** The bull shed ought to be situated on one side of the form. One bull should be housed per shed. A 120 square meter open paddock can be combined with a covered area of 3* 4 meters for the bull shed. For every 50 breed able cows, one bull is needed in the event of natural service. Bulls do not need to be kept on farms if services for artificial insemination are provided.
8. **Sick animal shed-** These sheds should be used to keep sick animals apart from healthy ones. To stop the spread of disease, the sick animal shed should be placed far apart from the other sheds.
9. **Ancillary buildings include-** Feed store, silos, milk house, hay/ straw sheds, etc.

Conclusion:

Dairy animals' general health, productivity, and well-being are greatly dependent on their housing. Climate, size of herd, and management techniques are only a few of the variables that should be taken into account while designing housing systems. The type of housing chosen for an animal depends on its demands as well as the environment, ranging from conventional barns to loose housing systems. When building efficient housing for dairy cows, it is crucial to take into account factors like sufficient ventilation, access to feed and water, natural behaviour possibilities, and adequate shelter. In the end, a thoughtfully designed housing arrangement benefits dairy operations' sustainability and efficiency in addition to the welfare of the animals.

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