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Dairy Update

HOUSING THE GOAT HERD

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Before one buys a goat some considerations should be given to housing the animal. Because of the long and sometimes "hard" winters in Minnesota, the question of "what is adequate housing?" is more important than it is in some other parts of the U.S.

Dairy goats do not need fancy housing. To minimize costs, many older buildings can be adapted. Those intending to either remodel a building for housing goats or build a new one should first visit several goat dairies, inquire about the strengths and weaknesses of their housing systems, contact the local county agent regarding insulation and ventilation needs, then see the contractor about the job.

TWO TYPES OF GOAT HOUSING

There are two main methods of housing dairy goats: 1) shed type or loose housing, and 2) tie stalls or individual confinement. Some use a combination system; stalls for milking does, and loose housing for the yearlings and kids.

Loose housing has many advantages and some disadvantages. These may be summarized as follows:

Advantages	Disadvantages
1. Exercise resulting from the freedom is desirable.	1. Boss goats, especially when horned, may cause injury.
2. Daily handling of manure is minimal or possibly eliminated.	2. There will be much riding when a doe is in heat.
3. Manure pack, when kept dry, provides heat and comfort.	3. More bedding is required.
4. Building construction and maintenance costs are minimized.	4. A separate milking parlor is an absolute requirement.

Dirt pen floors are preferred over cement. At least 15 square feet of bedded area should be provided for each goat. The floor should be bedded regularly with dry straw, wood shavings or ground corn cobs to absorb moisture. Some dairymen construct feeding stanchions at the feed bunk. Stanchions permit one to control intake of feed grains. At least 10 feet of vertical space from floor to ceiling rafters is desirable to facilitate cleaning with a tractor and front-end loader.

Goats prefer to be outside some on nice days, even when it is cold. The outside exercise lot should provide a minimum of 25 square feet of space per animal, be well drained and properly fenced. Goats like to lean on the fence to greet visitors. A 6-inch woven wire fence (4 to 5 feet high) is adequate. Some goats will get out of nearly any fence. In this case, place an overhanging wire from 10 to 12 inches from the inside and top of the fence, supported by offset pieces nailed to the posts. This wire may be electric, although barbed wire is usually adequate. Put snap hooks on all gates. Goats are able to unlatch other types of hardware.

Confinement housing also has several advantages and disadvantages, namely:

Advantages	Disadvantages
1. Less bedding is used.	1. Building costs are increased because of concrete floors and individual pens.
2. Individual pens permit more attention to the needs of each animal.	2. Individual pens are more labor intensive.
3. It is easier to show animals to prospective buyers.	3. Poorly ventilated housing is conducive to more health problems.
4. An outside exercise lot is not an absolute requirement.	

Individual pens should be about 6 feet square, and equipped with a hay feeder, grain box and water pail, all attached to the pen wall. The pen floor may be constructed to slope 3 or 4 inches toward a gutter cleaner.

VENTILATION AND INSULATION

Ventilation is a continuous process to remove moisture and other contaminants given off from the breath of animals from inside the building, provide fresh air for the animals, remove odors and gases from animal waste, provide a satisfactory minimal temperature in winter, and maintain a summer temperature inside the barn that is approximately the same as outside.

A "system" is required to bring fresh air into the building, distribute it evenly, and remove it. This system is completely different for the 2 types of housing environments, "cold" and "warm".

In "cold" housing, natural convection forces move the air, and properly located adjustable inlets provide distribution and volume control. In "warm" housing, a mechanical ventilation system, either exhaust or pressure, is used. Exhaust systems are the more popular in Minnesota. Air distribution is

provided by properly located inlets. Air is exhausted via 2 or more mechanical fans, at least 1 running continuously.

Cold housing is becoming more popular in Minnesota where manure pack "bedded" systems are used because of increasing energy costs and simplicity in providing a healthy environment. The "cold" unit is mainly a shell to keep rain and snow off the animals and to protect them from wind.

Sufficient air movement must be provided to prevent fogging and excessive condensation beneath the roof. Satisfactory ventilation can be provided through a continuous open ridge (minimum 4-inch width with no screen over the opening) together with suitable wall openings. A 1-inch thickness of rigid insulation is recommended under the roof to reduce condensation in winter and heat gain in summer.

Inlets in the wall of the building need to be at least 2 sizes, large openings for summer and much smaller ones to provide air movement in winter. Summer air inlets are often 3 x 6 or 4 x 8 foot doors, which may be adjusted during changing weather. Winter air inlets are commonly under overhangs and may be equipped with hinged doors that can be closed during snowstorms.

Since "cold" barns may get below 32° F in winter, depending on the number of animals housed, it is recommended their use be limited to loose housing systems whereby heated, insulated waterers may be provided for each group of goats.

Warm housing involves a mechanical ventilation system in which winter temperatures are maintained at 40° F or above. To control temperature and moisture, the following items must be provided:

1) insulation in the walls and ceiling (insulation R values in the walls of at least 14 in Minnesota; ceilings should have an R value of 23 or more);

2) at least 2 exhaust fans (1 running continuously and 1 thermostatically controlled);

3) adjustable air inlets;

4) limited door and window openings; and

5) supplemental heat if needed.

In Minnesota, adequate insulation can usually be obtained by placing 3-1/2 inches of blanket insulation in the walls and 8 inches of fill insulation in the ceiling. All insulation must be protected with a tight vapor barrier installed on the warm side. The thermal resistance (R values) of the more common insulation materials available are shown in Table 1. These may help you select the insulation that best meets your needs.

The ventilation system consists of: 1) a fresh air inlet system, and 2) the exhaust system. Each is equally important. A fundamental requirement of any successful ventilation system is that at least 1 exhaust fan run continuously. A minimum of 4 air exchanges per hour is recommended.

Total winter ventilation capacity, including the thermostatically controlled exhaust fans, should approach 15 air exchanges per hour. A practical summer ventilation rate is 1 air exchange every 2 minutes, or 30 air exchanges per hour.

Example: Consider a barn 20 feet wide, 38 feet long, with an 8 foot ceiling.

1. Total cubic foot capacity = length x width x height
   = 38' x 20' x 8'
   = 6080 cubic feet

2. To obtain 4 air exchanges per hour, divide total cubic foot capacity by 15 minutes:

   $$\frac{6080}{15} = 405.3 \text{ cfm (cubic feet per minute)}$$

   Thus, a 400 cfm fan running continuously would be appropriate.

3. To obtain 30 air exchanges per hour, divide total cubic foot capacity by 2 minutes, then subtract 400 cfm (supplied by the continuous fan):

   $$\frac{6080}{2} = 3040 - 400 = 2640 \text{ cfm}$$

   Thus, two 1300 cfm fans, thermostatically controlled, would be appropriate. These could be set at different settings, so only one would operate intermittently in winter.

A fresh air inlet system must be provided for satisfactory ventilation. This is frequently overlooked or ignored, especially when attempting to use older buildings, and is the most common cause of unsatisfactory ventilation performance.

A slot inlet system permits adequate distribution of small amounts of air in many places. It can easily be built into the barn during construction by making an adjustable slot at the junction of the walls and ceiling, except for a distance of 4 feet on either side of each exhaust fan. Air is drawn into the barn through these inlets by the exhaust fans.

This slot should be 1 inch wide for winter use. Note: If all fans are placed along one side of our 36-foot long "example" barn, then a 1-inch slot along the other side will provide 3 square feet of air inlet. Air velocity entering the building will be 133 feet per minute (400 cfm divided by 3 square feet) or 1.5 miles per hour, enough to prevent a back draft (excess of 100 feet per minute is recommended), but not enough to be considered an excessive draft.

During the fall and spring months, when one of the thermostatically controlled fans will be operating much of the time, the slot inlets should be opened to a width of 1-1/2 to 2 inches to allow more air to enter. This will prevent a vacuum from forming within the building, thus limiting exhaust fan performance.

In older, existing buildings it is often more practical to construct ceiling intakes rather than remodeling to make a slot. In our example where 3 square feet of slot intake was recommended, one could locate 6 ceiling intakes (each 0.5 square foot capacity) to draw air from the attic or hay loft. These should be equally spaced (about 5 feet apart) along the ceiling and about 5 feet from the wall opposite the exhaust fans. Additional ceiling intakes for summer use may be placed in the ceiling closer to the exhaust fans, but remember to close these during the winter months.

Remember that satisfactory ventilation in poorly insulated, older buildings of wood construction or those having stone or concrete block walls, single windows, and loose fitting doors is often an impossible task. Often one or more fans are installed in an attempt to improve conditions with mediocre results. As a consequence, air enters through available openings around loose fitting doors and windows, hay chutes, cracks, etc. The results often times are excessive drafts and/or decreased fan performance. In either event, the result is one of damp and wet facilities, diseased animals, and dissatisfaction.

RULES FOR LOCATING EXHAUST FANS

1. In barns where animals are maintained all year on a manure pack, space the fans uniformly in the south or west wall to provide for best air flow across the barn in summer.

2. Locate all fans at least 10 feet away from doors or other openings.

3. Locate the thermostats controlling the high capacity fans near the center of the building and at a height of 5 to 6 feet. Do not place thermostats on an outside wall.

4. In winter, attempt to maintain the temperature at 40 to 45° F. Remember, the higher the inside temperature, the more difficult it is to control moisture during cold weather.

5. Do not locate fans near pens of kids or yearlings in an attempt to draw heat to this area from areas where older animals are kept. Aerosol contaminants from the older animals may cause younger ones to have more disease problems.

6. Wet corners often can be dried up by admitting fresh air. In parts of the stable where fewer or smaller animals are housed, added insulation, and possibly heat, may be required.

7. Install all fans near the ceiling. In barns with limited insulation, build a duct 12 inches deep and as wide as the fan frame around the continuously running fan to draw cooler air from near the floor in winter. Locate a door in the duct directly in front of the fan. Keep the door closed in winter, open in summer.

8. If the continuous fan has too much capacity and creates too much air flow, place a damper near the bottom of the duct to reduce air movement in extremely cold weather.

Table 1. Insulation values of commonly used materials. Values do not include surface conditions unless noted otherwise. All values are approximate.

Material	Thermal resistance (R-value) Per inch (approximate)	For thickness listed
Batt or blanket insulation		
Glass wool, mineral wool, or fiberglass	3.00 to 3.80[a]	
Fill-type insulation		
Cellulose	3.13 to 3.70	
Glass or mineral wool	2.50 to 3.00	
Vermiculite	2.20	
Shavings or sawdust	2.22	
Hay or straw, 20"		30+
Rigid insulation		
Expanded polystyrene, extruded, plain	5.00	
Expanded polystyrene, molded beads, 1 pcf	5.00	
Expanded polystyrene, molded beads, over 1 pcf	4.20	
Expanded rubber	4.55	
Expanded polyurethane (aged)	6.25	
Glass fiber	4.00	
Wood or cane fiberboard	2.50	
Polyisocyanurate	7.04[b]	
Foamed-in-place insulation		
Polyurethane	6.00	
Urea formaldehyde	4.00	
Building materials		
Concrete, solid	.08	
Concrete block, 3-hole, 8"		1.11
Concrete block, lightweight aggregate, 8"		2.00
Concrete block, lightweight, cores insulated		5.03
Metal siding, hollow-backed		.61
Metal siding, insulated-backed, 3/8"		1.82
Lumber, fir and pine	1.25	
Plywood, 3/8 in.	1.25	.47
Plywood, 1/2 in.	1.25	.62
Particleboard, medium density	1.06	
Hardboard, tempered, 1/4"	1.00	.25
Insulating sheathing, 25/32"		2.06
Gypsum or plasterboard, 1/2"		.45
Wood siding, lapped, 1/2" x 8"		.81

[a]The R-value of fiberglass varies with batt thickness. Check package label.
[b]Time aged value for board with gas barrier quality aluminum foil facers on two major surfaces.

*From Dairy Housing and Equipment Handbook. MWPS-7. Midwest Plan Service, Ames, Iowa. 1985.