

Ventilation and Lighting for Goat Barns –  
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At this time of year in our climate, we need to be aware of the environment we subject goats to when they are kept in a barn. For those that confine their goats year-round, this concern of adjustments for the winter months will match those that are bringing in their goats from grazing. In France, most goat dairies are confinement systems with the exception of farms in Southern and Eastern France where it is more mountainous and where grazing/browsing is preferred or required. (To make Crottin de Chavignol cheese, goats must be outside grazing.) So, French dairy goat farmers are keenly aware of what conditions in the barn are optimal for goat health. Here are some of their and US recommendations for ventilation and lighting.

In general, natural lighting should give light to 1/20<sup>th</sup> of the floor area and come in laterally, i.e. from side windows. Artificial lighting with fluorescent lights is preferred and those lights should be in a protective casing and placed about every 18-20 feet (6 meters) against the wall at a height of about 6-8 feet (3-3.5 meters). For out of season breeding, provide enough light to give the goats 2,000 foot-candles (200 lux) down at their level. Make sure bucks get this treatment, too.

Air in the barn, without any ventilation, will accumulate gases (ammonia, carbon dioxide/monoxide, hydrogen sulfide and methane), moisture, heat and contaminants like dust and airborne pathogens. If you can detect the smell of ammonia with your nose, the air quality is poor and ventilation is insufficient. Gases come from the animals' respiration and aerobic and anaerobic fermentation of urine and feces in the bedding. Moisture accumulates because each goat secretes out up to 2-3 quarts (2-3 liters or ~7 lbs) of water each day in the form of breathe and body vapor along with urine and feces. Heat sources are the goats themselves, radiant heat on roof and through open side walls, lights, fans and the manure pack fermenting/composting at around 130 °F.

A litter base of 8-24 inches (20-60 cm) of straw, hay or sawdust provides good thermal insulation from the ground and acts as a sponge to soak up moisture. This is provided the bedding is changed regularly and is not wet when you kneel down on it. Humidity in the barn should not exceed 70% and the ideal temperature range for goats is between 50-60°F (10-16°C) for adults, 54-65°F (12-18°C) for kids. Temperatures above 80 °F start to cause heat stress. Between 0°F to 55°F there is no loss of feed intake or production (however, feed intake may increase at lower temperatures). In France, wooden buildings are favored because they are considered the best in insulating the inside of the barn from fluctuating outdoor temperatures and they 'breathe' some moisture out.

When considering how much open air space from the floor to the ceiling is best for your number of goats, the table below has these recommendations:

Volume of static airspace (ft<sup>3</sup> = cubic feet) per animal:

Animal	Minimum	Optimum
Bucks	26-33 ft <sup>3</sup> (8-10 m <sup>3</sup> )	40-50 ft <sup>3</sup> (12-15m <sup>3</sup> )
Does	13-16 ft <sup>3</sup> (4-5 m <sup>3</sup> )	26-33 ft <sup>3</sup> (8-10 m <sup>3</sup> )
Kids	10-13 ft <sup>3</sup> (3-4 m <sup>3</sup> )	16-20 ft <sup>3</sup> (5-6 m <sup>3</sup> )
Meat goats	8-10 ft <sup>3</sup> (2.5-3 m <sup>3</sup> )	13-16 ft <sup>3</sup> (4-5 m <sup>3</sup> )

To maintain optimum environmental conditions, either natural air flow or mechanically forced air flow is needed to exchange the barn air with outside air. In the summer, heat removal governs ventilation and moisture removal governs minimum winter ventilation. In the summer, 150-200 cubic feet of air per minute per animal or one room volume air exchange every 2 minutes (30 per hour) is recommended. In the winter, recommendations of 20 cubic feet per minute per animal or 4-15 room volume air exchanges per hour are given.

Dynamic ventilation or air exchange by forced air extraction is recommended at the minimum output of 2.2 cubic feet per pound of live weight of animals (1.5 m<sup>3</sup> per kilogram). Fans used to accomplish this should be placed about 6.5 feet (2 meters) above the goats. Air exchange assumes that air has a place to enter and to exit. Air can exit through the open ridgeline along a gable roof and air can enter along the eaves of the roof, for example. Recommendations for the surface areas where air enters and leaves the barn are as follows (ft<sup>2</sup> = square feet):

Surface area recommendations of air entering/exiting per animal:

Animals	Surface area for air exiting	Surface area for air entering
Does	.1 ft <sup>2</sup> (.03 m <sup>2</sup> )	.2 ft <sup>2</sup> (.06 m <sup>2</sup> )
Replacement doelings	.06 ft <sup>2</sup> (.02 m <sup>2</sup> )	.13 ft <sup>2</sup> (.04 m <sup>2</sup> )
Meat goats	.06 ft <sup>2</sup> (.02 m <sup>2</sup> )	.13 ft <sup>2</sup> (.04 m <sup>2</sup> )
Bucks	.13 ft <sup>2</sup> (.04 m <sup>2</sup> )	.26 ft <sup>2</sup> (.08 m <sup>2</sup> )

The speed at which the air flows at the level of the goat should not surpass 1.6 feet/second (.5 meters/second) for an adult goat. To test this, the flame of a candle must remain upright when held in that area. For kids, airflow should not surpass .65 feet/second (.2 meter/second). To help keep an area for kids draft free, you can construct a mini-ceiling like an A-frame open at both ends or a box with a top so the kids can get under it. This can prevent the kids from stacking on each other for warmth with the potential for smothering.

*Information summarized from the book La Chèvre by Jean-Christophe Corcy, notes from Dr. Paul LeMen, France and a presentation by Scott Inigus/Curt Gooch from Cornell University at the September 2002 Caprine Outing, Solon, NY.*