

DAIRY DESIGN FOR A SEMI-ARID CLIMATE

INTRODUCTION

A semi-arid climate has certain definite advantages for dairy husbandry. In the southwestern United States the climate is very favorable for about eight months of the year. Although temperatures during the remaining four months may be as high as 115°F, with good management practices, production can be kept at comparatively high levels throughout the summer.

Good design takes time and skill, and must follow an orderly development process. A professional designer works in concert with the owner and the builder throughout the planning and construction of a complete facility.

SITE ANALYSIS

Water Supply. An adequate quantity of quality water and a backup water source must be available. Supplies less than 130 gallons per cow-day and greater than 1500 ppm total salts are considered unacceptable.

Climatic Data. A designer needs to know wind characteristics, rainfall, temperature and humidity conditions.

Land Area. Each state may have different requirements. To prevent groundwater contamination, the following land areas for different waste disposal systems of semi-arid dairy farms have been recommended.

Open corral with dry waste	6 acres/100 cows
Open corral with flush feedline	32 acres/100 cows
Free stalls with total flush	50 acres/100 cows

Off-site Considerations. The site must be within the acceptable travel pattern of the milk processing plant and other dairy services. All-weather roads, utility services, access to feed resources and marketing services, rural

housing developments, water management district, air and water pollution districts, zoning and building code and right-of-way restrictions must be evaluated. Legal restraints may close the project and prevent investment recovery, so suitability of site and plans must be checked with appropriate authorities.

DEVELOPING PRELIMINARY PLANS

A preliminary dairy layout involves space requirements, functional flow, and orientation of all facilities and activities on the site. The major components of a dairy system are housing, milking, feeding, cow treatment and waste handling facilities.

Corral Design. The design criteria set livestock number and space requirements to meet long range goals. It is important to design for the ultimate goal, not for the first building phase. In warm semi-arid regions housing is simply a fenced pen or a "corral" with protection from the sun provided by an overhead shade. A feeding slab (manger) with self-locking stanchions is located on one fenceline and a tank for drinking water is located at an easily accessible site within the corral. The number of lactating cows in a corral should approximate the number of cows that can be milked in the parlor in one hour. Their corrals are located to provide the closest possible access to the milking parlor.

Corral space requirements have evolved from dairy practice as the best compromise for manure management, sanitation and heat stress relief. Table 1 represents a range of space recommendations for most semi-arid conditions. Table 1. summarizes the animal grouping arrangement, corral and shade area, and feeder space required for each animal category.

Table 1. Dairy corral, feeder and shade space recommendation for semi-arid conditions. (maximum of 2.5 inches of rainfall in any 24-hour period)

Animal Class	Per 100	Corral Space	Feeder Space	Shade
	Lactating/Cows	ft ² /cow	inches/cow	ft ² /cow
Milking Cows	100	500	27 or 30	40
Dry Cows and Springers	15	500	27 or 30	40
Bred Heifers (17-26 mos.)	33	350	24	40
Growing Heifers (6-16 mos.)	37	300	20	25
Growing Female Calves (6 wks to 5 mos.)	13	250	17	15
Baby Female Calves (1 day to 6 wks.)	6	Provide nine individual calf pens		
Maternity or Fresh Cows	1	500	30	40
Sick Cows	2	500	30	40

Dry cows are usually provided with a corral of identical size and description as for lactating cows or may be split into two corrals. Cows recently dried up are usually located in the more remote pen. The springer pen should conveniently access a maternity pen and treatment facilities. Fresh cows and sick cows should be located in two small pens near the parlor area unless a separate milking facility is used.

Replacement animals are grouped according to feeding and management programs. Heifers 6 weeks to 6 months of age are grouped in lots up to 25 with no more than 2 months age or 50 lb. body weight difference. Heifers 5 to 15 months and likewise breeding age heifers 14 to 18 months are grouped in lots up

to 100. Self locking stanchions are convenient for artificial insemination and pregnancy diagnosis. Bred heifers 17 to 28 months are also grouped in lots up to 100 or can be confined with dry cows and moved to the springer pen about one month before calving.

All corral surfaces should slope 2-1/2 to 3 percent from the feedline to the cow lane on the opposite side of the corral for good drainage of rainfall. The cow lane then serves as a collector so should slope 1/2 to 1 percent to carry away the collected runoff.

Cattle Shades. Shades should be at least 12 feet high and provide a solid shade pattern. A shade should be located near the center of the corral and oriented with the long dimension in the north-south direction. Corral drainage is enhanced if the shade is perpendicular to the fence line feed manger.

Placing shades over a feed area will increase feed consumption during the hot summer months and increase milk production. Additional protection from the heat during the hot summer months can be accomplished by placing a spray-line over the feeding area.

Cow Lanes. Since cows must be moved to the barn at least twice daily for milking, the lane and gates should be carefully located. Concrete surfaced lanes 12-16 feet wide are used for cow traffic lanes.

Water Tanks. A float-controlled water tank must be available to provide drinking water at all times. A minimum of one linear foot of tank space should be provided for each five cows. If the water tanks are located adjacent to the cow lane fence, overflow and cleanout drainage from the tank will drain to the surface of the concrete cow lane. Concrete tanks with a roof inhibits heat intake in hot weather and are preferred over steel or fiberglass tanks.

Fenceline Feeding. A flat feed apron lends itself to tractor sweep maintenance. The concrete feed apron and road are sloped about 1/8 inch per foot to drain away from the feedline. In areas where high winds are frequent, the traditional feed manger may be more satisfactory, especially in the presence of drifting sand.

The cow stand also is sloped to drain away. Lock stanchions are provided along the feed line for all lactating cows and heifers of breeding age. Cattle can be locked in at feeding time and held briefly for breeding, pregnancy diagnosis or minor treatment.

Treatment Facilities. Treatment facilities are needed for breeding, pregnancy checking, maternity, calf care, vaccination, dehorning, foot care, mastitis treatment, milk fever and culling. Most routine functions such as breeding, pregnancy checking and post-calving examinations can be done in lock stanchions at the feedline.

Cows requiring more vigorous examination and/or treatment by a veterinarian are moved to a special treatment area. A diversion gate at the milking parlor exit lane into a treatment lane is used to separate cows needing treatment. This can be done automatically with computer controlled gates responding to sensors in the milking claw. A smaller version of this treatment system is also needed in the replacement heifer area. The head gate and chute system should provide easy access to the cow's mouth, neck, horn area, udder, tail end, side body cavity and rear muscle area. Side gates may swing in either direction and provision should be made so that the head gate can be removed and replaced with a hoof-trimming chute.

The treatment lane should have access to an isolated sand floor pen equipped with belt lift, floor rings, overhead supports and with access for

front-end loader for downed animal handling. Several small hospital pens and a permanent loading chute should also be available to the main treatment lane.

Calf Housing. Calves can be housed in shaded individual pens with buckets for milk, water and dry feed or in a permanent calf barn. Portable outdoor calf pens require only a small investment, although labor requirements are high. Sanitary practice includes careful cleaning and relocation to an alternate site after each occupancy.

Because of the higher labor requirements of the portable calf pen, some producers favor a more permanent calf barn. The most successful model has two rows of individual pens separated by a convenient work alley all under shade. The pens are made of steel fence material set on the well-bedded concrete floor so that the barn is essentially open on four sides. Canvas and/or other windbreak systems provide winter protection for the calves.

Feed Storage. Feed storage space requirements for roughage are extensive and important to consider in the initial layout design. Feed constitutes about 50% of the cost of milk production. It is important to consider potential variations in both short- and long-term requirements. Many dairies in the southwest purchase nearly all roughage feed at harvest time, so peak roughage storage will approach 65-75% of the annual dairy requirement. The fire insurance carrier usually dictates the maximum hay stack size and the distance between stacks. A common stack specification is a 250-ton maximum with 100 feet minimum spacing between stacks. Hay stacks should not be located in front of the corral feedline because the solar heat reflected from the stacks will discourage cattle from feeding during the summer.

When trench silos are used, it is desirable to locate them near the feed mixing center. Two silos or more are preferred to eliminate conflict between filling and feeding functions.

A truck scale and office may be part of the feed service center but both are usually located near the main entrance to improve security and control. Non-roughage feed supplies are stored in open front bins set on a concrete slab, referred to as a "feed commodity barn."

Water System Design. Peak water use estimated for all animals and functions per lactating cow per day on twice-a-day milking schedule are as follows:

Drinking - 65 gallons (this includes 25 gallons per lactating cow for the replacement herd.

Parlor and milk room - 20 gallons.

Holding area jet cow wash - 25 to 60 gallons.

Evaporative cooled shades - 35 gallons.

Well water pump capacity is selected to deliver peak daily requirements in 12 hours. Since a backup water supply is imperative, an intermediate storage tank supply equal to one day's needs should be installed above ground so that water can flow throughout the system by gravity if necessary.

WASTE WATER AND SEWAGE DISPOSAL

Waste Disposal Waste management is relatively simple in a semi-arid climate because of high evaporation rate and the absence of prolonged freezing. The feedline cow platform and area under shade are scraped every few days as needed, and wet manure is dragged to dry areas of the corral. The entire corral area is drag harrowed lightly to keep manure spread and uniformly exposed to sun and air. This also serves to maintain a uniform surface for good draining of

storm runoff. Corrals are cleaned completely once or twice yearly and the manure stockpiled locally or spread directly onto farmland.

Required pond storage capacity depends on number of animals served, wash-down waste (hose wash-down or parlor flush), design storm runoff reserve volume, non-biodegradable solids accumulation, evaporation rate and irrigation interval. Of these, the greatest variable is the wash-down waste. Only 8-10% of the total cow manure is deposited in the milk barn and conveyed in the wash water. However, a few dairies have reused their barn water to flush the feedline platform in the corrals. This flush concept involves 50-60% of total manure produced. Since sludge build-up is proportional to the manure fraction, pond storage must be enlarged proportionally, or the frequency of sludge removal increased.

Any dairy layout design should strive for simplicity and efficiency. Most design requirements are available in published material but the best source of innovative ideas are existing dairies recently built but with a year or more of operating experience. An engineer can prepare the plans for construction but the variations involving personal management preferences must come from the dairyman. Working together, the result should be an effective dairy layout design.

Key Words: Efficiency, simplicity, dairy layout, semi-arid climate

TYPICAL DAIRY LAYOUT FOR A WARM, DRY CLIMATE.

