

Appendix A: Dairy Farms in Southern California

This appendix section characterizes dairy farms in the six southernmost counties in California: Riverside, San Bernardino, Orange, Los Angeles, San Diego, and Imperial, in order to provide a wider context and perspective to the data presented in this report for the Chino Valley study area dairies.

As with the Chino Basin area, the exact number of dairy cattle for the rest of Southern California is difficult to determine from the data available, however data were collected to allow a general characterization of dairy cattle in the rest of Southern California versus the specific area of the Chino Basin. In some instances, data are not available due to reluctance on the part of individual farms to have data on herd size disclosed.

A.1 Data Collected for Southern California

Data collected on dairy cattle in the rest of Southern California were obtained from two sources:

- 1) The California Agricultural Statistics Services (CASS), which publishes a Census of Agriculture every five years, the latest publishing being 1997 data, and
- 2) The California Department of Food and Agriculture (CDFA), which publishes yearly statistics on dairy cows in California.

Both of these services publish statistics on cattle by county in California. Of the two, the CASS data is more comprehensive, while the CDFA data provides more current figures (data through 2001 are available at CDFA). The next CASS Census of Agriculture will be 2002 data, due out later in the 2003 calendar year.

Table A-1 shows data from the CASS 1997 Census of Agriculture for cattle in six Southern California counties:

TABLE A-1

1997 Cattle and Milk Cows - CASS Census of Agriculture Data

Source: California Agricultural Statistics Service, Census of Agriculture, 1997.

County	Total Cattle & Calves Inventory	No. of Farms	Avg. Total Herd Size	No. of Milk Cows	Milk Cows No. of Farms	Milk Cows Avg. Herd Size
San Bernardino	326,075	324	1,006	185,249	187	991
Riverside	204,968	353	581	113,719	119	956
Orange	2,092	22	95	N/A	N/A	N/A
Los Angeles	11,479	117	98	N/A	N/A	N/A
San Diego	26,493	288	92	4,942	27	183
Imperial	348,529	69	5,051	N/A	N/A	N/A

N/A: Data not available – not published to avoid disclosing individual farm data

The total cattle inventory includes all cattle in the county on December 31, 1997, including beef cattle, milk cows, heifers and calves. Milk cows, which are of primary importance to this study, are broken out in the table above where data were available. These numbers for milk cows include heifers that have calved, so that these numbers can be compared to the CDFA data table below. Beef cows are also broken out; for San Bernardino and Riverside counties the 1997 numbers are 8,460 and 7,629 head respectively, representing only 2.6% - 3.7% of the total. Thus, for San Bernardino and Riverside counties, the majority of cattle are dairy cows.

San Diego County shows 4,942 milk cows in the 1997 Census, and the farms there are smaller operations (averaging under 100 head herd sizes). Los Angeles and Orange Counties also have small operations, and fewer of them, so they do not represent significant concentrations of animals.

The data available to the 1997 CASS Census of Agriculture shows a total of 333 dairy farms in the six-county area, of which 306 are in Riverside and San Bernardino Counties.

Imperial County is notable in that it shows a total 1997 cattle inventory of almost 350,000 animals. Also notable are the number of farms and herd sizes; these are much larger operations, averaging 5,000 head on a single farm, in areas around the Imperial Valley. Additional information from CDFA suggests that Imperial County has one of the lower dairy production rates in California (ranking between 20th and 24th among all counties in California), so that most of the cattle in Imperial County are presumed to be beef cattle.

CDFA publishes statistics specifically on dairy cows annually in its California Dairy Statistics Annual. The number of cows is broken down by county. This publication is specifically focused on dairy animals, and the animals recorded are “Milk Cows and Heifers that have Calved”. Numbers of animals for Imperial, Los Angeles and Orange counties are not reported. Table A-2 shows CDFA data for San Bernardino, Riverside, and San Diego Counties for 1998 – 2001:

TABLE A-2:
California Department Of Food And Agriculture Dairy Cattle Statistics: 1998 - 2001

Source: *California Dairy Statistics Annual, 1998 – 2001 Publications*

County	Cows & Heifers that have Calved (Milk Cows)			
	2001	2000	1999	1998
Riverside	100,434	113,283	116,131	112,288
San Bernardino	152,466	161,251	163,304	160,206
San Diego	5,985	6,757	7,565	7,596

A.2 Data from the Inventory Report

The SARWQCB data in section 2.2 of the Inventory Report for Agricultural and Food Processing Facilities break down dairy cattle in the Chino Valley study area into:

- Milking cows (162,876 head)
- Dry Cows (27,196 head)
- Heifers (6-24 months old; 34,011 head)
- Calves (up to 6 months old; 16,905 head)

This data is from 2001. A data point that would be reasonably comparable to the 2001 CDFA data would be to omit the calves, and compute a total of Milking Cows, Dry Cows, and Heifers (162,876 + 27,196 + 34,011 = 224,083 total). This number would be slightly higher than comparable county numbers in the CDFA data, since not all heifers would have calved.

The Chino Valley study area actually lies in parts of two counties: Riverside and San Bernardino. According to the CDFA data for 2001, the number of dairy cows (including heifers that had calved) for these two counties combined was 100,434 + 152,466 = 252,900. Thus, the Chino Valley study area could represent as much as 224,083/252,900 = 89% of the total number of dairy cows in the two counties in which it is situated. Due to uncertainty in the assumptions used to obtain comparable data, it would be reasonable to state that the

Chino Valley study area probably contains around 80 – 85% of the total dairy cows in Riverside and San Bernardino counties combined.

The total numbers of cattle reported for 1997 by CASS in Orange and Los Angeles counties are much smaller and assumed not to have grown significantly since 1997. The number of dairy cattle reported for San Diego county is also much smaller, relative to San Bernardino and Riverside counties. The number of dairy cattle for Imperial county is not reported, but estimated to be small as well. Only two dairies are reported in Imperial County, and the rest of the cattle is said to be beef cattle.

A.3 Conclusions

The majority of the dairy cows in Southern California are found in San Bernardino and Riverside counties. San Diego, Orange, and Los Angeles counties, being mostly urbanized, have small, scattered dairy operations with no significant concentrations of animals. Imperial county does contain a significant amount of cattle around the Imperial Valley, however most of these are beef cattle on large feed lot operations, which pose different waste management challenges than does the concentrated dairy cluster in the Chino Basin.

Compared to other areas in Southern California, the Chino Basin contains by far the highest number and concentration of dairy cows, and therefore dairy waste. The approximately 115 square miles encompassed by the Chino Valley study area contains within it some 80 – 85% of the total dairy cattle in San Bernardino and Riverside counties combined, and most of the dairy cattle in all six counties considered in Southern California. The combined land area of San Bernardino and Riverside counties is 27,407 square miles, so that 80 – 85% of all of the dairy cows and manure production in these two counties is found on less than 1% of their combined land area. Thus, the Chino Valley study area can be characterized as unique in the six southernmost counties in California for its high concentration of dairy cows. This suggests that the Chino Basin is the likely place in Southern California to establish centralized manure collection and digester facilities.

In terms of manure production, using the numbers from section 2.2 of this study, there may be another 166,000 dry tons/year of dairy farm manure per year available in the combined areas of Riverside and San Bernardino counties that are outside the Chino Valley study area. This includes both wash-water and corral dry manure. It should be noted that, because this manure is on smaller farms that are much more widely scattered, the concept of large centralized digester facilities is much less relevant outside the Chino Basin; these operations would likely be small, on-farm facilities.

Appendix B: Comparative Data for Typical Dairy Power Usage

A 1994-95 electrical energy use and milk production survey of 42 out of 93 San Joaquin Valley dairies, performed by the University of California Cooperative Extension Dairy Advisor, Kings County, under the California Dairy Energy Project (www.energy.ca.gov/process/pubs_list.html), found that electrical energy use averaged about 42 kWh per cow per month.

The survey found that the dairy sizes ranged from 95 to 3,200 cows and averaged 984 cows per herd. Electrical energy use averaged 1,603 kWh per dairy per day, as stated in this study:

“The total connected hp for refrigeration and air compressors, milk and vacuum pumps averaged 67.3 ± 42.0 hp per dairy farm. The connected hp per cow averaged 0.08 ± 0.03 hp per cow.

Fifty-eight percent of the dairies used heat exchanges (mainly plate type coolers) to pre-cool milk with well water; 36 percent used heat exchangers with well water and chilled water for instant cooling and 5 percent of dairies had no pre-cooling. Water heating was fueled by propane on 68 percent of the dairies, 26 percent used natural gas; 5 percent used electricity and one dairy used a vacuum pump heat exchanger.”

The survey also found that total connected hp and electrical energy use increased with increasing herd size, and the efficiency of electrical energy used for milk production (milk/kWh) was unrelated to herd size. The survey finding of an average electrical use of 42 kWh per cow per month is consistent with the lower range of the Milk Producers Council data.

Another evaluation of dairy energy usage, based upon information from Dr. D. J. Reineman at the University of Wisconsin, results in slightly higher, but similar monthly energy usage per cow. This evaluation references telephone discussions with Dr. Reineman and documentation available at http://www.uwex.edu/uwmrnl/pdf/RuralEnergyIssues/Dairy/ASAE_Trans_94_Dairy_Model.pdf. Table 2-7 provides framework and reference for the following discussion on dairy loads.

Situation	units	Midwest	California
Herd Size	cows	400	800
Typical Mass of Cow	lb/cow	1,400	1,400
per Animal Unit of 1000 lbs	lb/AU	1.4	1.4
Milk Production	lb/day/cow	70	70
Milking Parlor Capacity	cows	1,000	1,000
Milking Machine	Hp	40	40

duty factor	hr/hr	40%	80%
	kW	14	27
Effectiveness of Well Pre-cooling	kW/kW	0%	36%
Milk Chilling	kWh/cwt	0.78	0.78
	kW	9.1	11.6
Lighting	kW	2	2
Fans (half time)	kW	-	7.5
Water Heating	kWh/cwt	0.26	-
	kW	3.0	-
Water Content of Manure	lb/day/AU	80	80
	lb/day/cow	89.6	89.6
Washdown Water	lb/day/cow	17.5	17.5
Water Pumping	lb/day/cow	177	177
Well Head	ft	300	300
Well Pumping	Hp	0.7	1.5
	kW	0.7	1.3
Miscellaneous at least	kW	5.0	5.0
Total Power Average Power	kW	33.3	54.4
	kWh/cow/yr	729.20	595.77
	kWh/cow/mo	61	50
Demand (Estimated)	kW	67	77
	kW/cow	0.17	0.10

Electrical energy is used by the vacuum pump of the milking machine, refrigeration from 95 to 40F, lighting, water supply and disposal, hot water heating and comfort fans. Electric hot water heating is generally not practiced in California but is common in the Midwest. Fan cooling of cattle in the milking parlor is common in California but not in the Midwest. Therefore, the figures used in the document referenced above have been modified for the above table.

Dr. Reineman estimates a figure of 40 Hp for the vacuum pump for a standard milking parlor capable of serving 1000 cows if operated continuously. Smaller herds would still use the standard milking parlor but would simply be turned off part of the day. Newer more efficient vacuum pumps can operate at 20 Hp. With a variable frequency drive (VFD), they can go to 20 Hp peak and lower horsepower average.

Milk chilling power is from the document referenced. It can be reduced by pre-cooling with well water.

Water heating is also from the document referenced, however propane is generally used rather than electricity in California. This load is nevertheless a good place to put waste heat from an engine.

Lighting and fan loads are anecdotal information from Dr. Reineman.

The water pumping was based on the water content of manure, milk production and wash-down scaled from heat usage. Typical pumping head was assumed to be 100 ft for the well,

100 ft for pressurization and 100 ft for disposal - a total of 300 ft. Note that there is no irrigation load given other than pumping out the manure lagoon.

The reference document gives a range of 700 to 850 kWh/year/cow (58 - 71 kWh/month/cow). In order to come up with 700 kWh/cow/year it was necessary to add 5 kW of miscellaneous power. This power might be for anything outside the milking parlor, such as running the farmhouse or outdoor lighting or barn lighting. There is no limit to how many other miscellaneous loads might be attached to the service, so these are low end amounts of power.

The major difference between the 58-71 kWh/month/cow usage number suggested in the Wisconsin study and the 42 kWh/month/cow from the University of California Cooperative Extension study is most likely due to the common use of electric hot water heating in the Midwest.