MINNESOTA AGRICULTURAL ECONOMIST

No. 644 NOVEMBER 1983

Profitability of Minnesota Dairy Farms Compared to Large Drylot Dairies in the Southwest

by Boyd M. Buxton*

Dairy producers in the upper Midwest might wonder about the large-scale 500- to 2,000-cow drylot dairies appearing in various parts of the country. These large scale dairies are becoming more common from Florida to California but are essentially non-existent in the traditional Midwest and Northeast regions. Are these large dairies here to stay or are they a short-run aberration that will disappear when the economy worsens?

The straight arithmetic is easy to calculate. It would take about 3,800 herds with 2,000 cows each to produce all the milk sold commercially in the United States in 1982. Nationally there were 311,800 operations with one or more milk cows in 1982.[1] If figures for the Dairy Herd Improvement Association (DHIA) average milk production per cow in 1981 are used, one 2000-cow dairy can produce as much milk as 43 50-cow dairies in Minnesota.

There are some interesting problems in comparing the large-scale drylot dairies in the Southwest with the typical 50- to 125-cow dairies in the upper Midwest. In addition to differences in herd size, dairies in the two regions have different housing, land and feed storage requirements.

This article summarizes the results of a study that examined the relative profitability of dairy farming in four states.[2] Three of the states—Arizona, New Mexico and Washington—are in areas where milk production during the last decade increased faster than in the United States as a whole while the fourth, Minnesota, is in part of the traditional dairy area where milk production has remained relatively stable.

PROCEDURES

Budgets were prepared for seven typical dairy operations in four states. The principal characteristics of the seven operations are summarized in Table 1.

This study estimated the return that could be expected from setting up a dairy operation in each of the four states similar to the existing viable ones in that area. Particular attention was given to making the profitability estimates comparable.

In Arizona and New Mexico cows are housed in open corrals with sun shades while free stall housing is assumed on the 125-cow Minnesota dairy

[1]U.S. Department of Agriculture, Statistical Reporting Service, Milk Production, Da 1-1 (2-830) Feb. 15, 1983, p. 20.

*Agricultural Economist, Economic Research Service U.S.D.A. Stationed at the University of Minnesota.

[2]Buxton, Boyd M., Tom McGuckin, Roger Selley and Gayle Willett, Profitability of milk production—a comparison between Minnesota, Arizona, New Mexico and Washington. Proposed Ag. Econ. Report, Economic Research Service, U.S. Department of Agriculture.

Table 1. **Principal characteristics of seven dairy operations budgeted.**

Characteristic	Minnesota		Arizona			New Mexico	Washington
	52-cow dairy	125-cow dairy	359-cow dairy	834-cow dairy	1,436-cow dairy	900-cow dairy	140-cow dairy
Herd size (Adult milk cows)[1]	52	125	359	834	1,436	900	140
Land (Acres)	191	456	20	46	78	50	60
for building and corrals	6	11	20	46	78	50	9
for crops	185	445	0	0	0	0	51
Housing type	Stanchion	Free Stall	Open Shades	Open Shades	Open Shades	Open Shades	Free Stall
Milking facilities	Pipeline	dbl-6 Herringbone	dbl-4 Herringbone	dbl-10 Herringbone	32 Polygon	dbl-12 Herringbone	dbl-4 Herringbone
Feeding facilities	Bunk	Bunk	Fenceline	Fenceline	Fenceline	Fenceline	Bunk
Silage storage	Up silos	Up silos	Trench	Trench	Trench	None	Trench
Commodity shed	No	No	Yes	Yes	Yes	Yes	Yes
Field equipment	Yes	Yes	No	No	No	No	Yes
Waste handling	Solid	Solid	Lagoon	Lagoon	Lagoon	Lagoon	Liquid
Source of Feed							
Concentrates	Raised	Raised	Purchased	Purchased	Purchased	Purchased	Purchased
Alfalfa	Raised	Raised	Purchased	Purchased	Purchased	Purchased	Purchased
Other forage	Raised	Raised	Purchased	Purchased	Purchased	Purchased	Raised
Labor							
Total man equivalent	2.03	3.3	7.0	12.0	16.0	13.0	2.96
Cows/man equivalent	26	38	51	70	90	70	47

[1]Lactating and dry cows including replacements 26 months of age and older.

and the 140-cow Washington dairy. A stanchion barn with an around-the-barn pipeline milking system is assumed for the 52-cow Minnesota dairy. Milking parlors are assumed for all other dairies.

Both Minnesota dairies are budgeted for sufficient land to produce all hay, haylage, corn silage and corn grain fed to the dairy animals. It is assumed that the Washington dairy produces silage only and purchases all-grain, alfalfa and other feeds. All feeds are purchased on the Arizona and New Mexico dairies. Field equipment for tilling and harvesting feed from cropland in Minnesota and Washington is not required by Arizona and New Mexico dairies.

Buildings, equipment and machinery costs are based on 1981 prices for Minnesota and Washington and 1982 prices for New Mexico and Arizona. Nationally the index of prices paid for buildings and fencing materials increased less than 1 percent from 1981 to 1982. Because a large part of the investment in New Mexico and Arizona was for dairy buildings and equipment, the 1982 investment costs used should closely reflect 1981 conditions and not seriously bias the measures of relative profitability. Although the cost of tractors and machinery increased about 8 percent from 1981 to 1982, these items were a relatively small part of total investment in New Mexico and Arizona. Milk prices, feed prices, production per cow and most other costs were based on 1981 conditions in all states.

Measure of Profitability

A simple average annual rate-of-return to total investment is used to measure profitability and compare returns. The measure can be expressed as:

$$r = \frac{R - OC - OS}{I}$$

Where:
- R = Total annual revenue from all sales including milk, dairy replacements, cull cows, bull calves, etc.
- OC = Total annual operating costs for the entire dairy including wages for hired labor and an allowance for the owner-operator's labor.
- OS = Total annual ownership costs including depreciation but excluding interest costs.
- I = Total investment in the entire dairy operation.
- r = The average annual rate-of-return.

The debt/asset ratios, liquidity and solvency measures would vary for each person setting up one of the dairy operations considered in this report. Although these aspects of financial management affect an individual's success and long-term viability in milk production, they are not considered here. Over time, individuals with adequate financial backing and favorable net worths would be attracted if the rate-of-return on total investment (profitability) were high enough. Dairy profit opportunities are expected to be a more important financial determinant of regional expansion or contraction of milk production than the net worth, liquidity or solvency positions of specific individuals.

Revenue

The specialized dairy operations considered in this report receive all revenue from the dairy enterprise. Milk sales are the single largest source of revenue but the sale of cull cows, bull calves and replacement heifers in excess of those needed for herd replacement is also important. Price changes for any of these items would have a great impact on a dairy operation's total revenue and, therefore, on the rate-of-return to total investment.

Revenue from milk sales depends on the amount of milk produced and the price received for it. It is assumed that herds with good management could achieve the same level of milk production per cow as the average achieved by herds on DHIA tests in the respective states: 14,840 pounds in Minnesota; 16,284 pounds in Arizona; 16,135 pounds in New Mexico; and 16,233 pounds in Washington.[3]

In 1981, dairy producers received $13.11 per hundred weight of milk in Minnesota, $14.18 in Arizona, $14.32 in New Mexico and $13.58 in Washington. These differences reflect the pricing policy of federal milk orders and the proportion of milk used as fluid in the various states.

Annual Cost

The average annual cost of dairy farms is divided into operating and ownership categories. Operating costs include purchased feed and a wide range of expenses such as farm repairs, hired and operator labor, utilities and fuel for dairy herd, veterinary services, breeding fees and other costs. Operating costs also include all seed, fertilizer, fuel and other annual expenses associated with feed production on Minnesota and Washington dairies.

Annual ownership costs include depreciation, property taxes and insurance premiums. Straight line depreciation was calculated on durable assets including buildings, dairy equipment, tractors and vehicles, and field equipment. Property taxes and insurance premiums were based on annual dollars paid per hundred dollars of average annual value.

All interest charges, except interest on operating costs, were excluded to calculate the average annual rate-of-return to total investment. The model assumes a money withdrawal for the operator's labor is already reflected in the calculation of the rate-of-return to total investment (r).

Feed Costs. Feed, whether purchased outright or raised within the management of the dairy itself, is the single most important cost in milk production.

Differences in feed assumptions can make a significant difference in the relative rate-of-return to investment in the various states. The ration composition differs from one state to another. However, the basic assumption for feeding dairy cows regardless of location was that a milk cow of a given weight and breed producing the same amount of milk would require the same amount of dry matter.[4] Regional variations in forage quality would be made up through changing the composition of the concentrates by adding supplements so as to yield a balanced ration.

The average annual pounds of dry

[3]From 1981 DHIA annual summaries for each state.

[4]Discussions with Robert Appleman and Jim Linn, University of Minnesota, were helpful in deciding to use this assumption. However, the author assumes responsiblity for its use.

[5]Estimated from Minnesota DHIA data.

matter intake per day per hundred pounds of body weight was estimated to be 2.326 plus .004824 times the hundredweights of milk the cow produces per year.[5] Using this assumption in all states, the dry matter intake for a 1,300-pound cow varied from 3.042 pounds in Minnesota to 3.112 pounds in Arizona (Table 2). Assuming 1,300-pound cows producing the amount of milk previously mentioned, total dry matter intake per year per milk cow ranged from 14,434 pounds in Minnesota to 14,766 pounds in Arizona.

Table 2. Annual feed requirements (not including wasted feed) for adult milk cow, four states.

State	*Dry matter fed per milk cow*[a] per day per 100 lbs. body weight	annual	*Source of dry matter fed*[b] concentrates	forages
	Pounds			
Minnesota	3.042	14,434	5,209	9,225
Arizona	3.112	14,766	6,742	8,024
New Mexico	3.104	14,728	6,825	7,903
Washington	3.109	14,752	5,552	9,200

[a]Estimated from Minnesota Dairy Herd Improvement Association average herd data.
[b]The proportion of dry matter from concentrates and forages was determined from Statistical Reporting Service series of concentrates fed. Source: U.S. Department of Agriculture, Statistical Reporting Service, *Milk Production*, July 16, 1982, p6.

Feed required to raise a dairy heifer replacement to 1,250 pounds in 26 months was assumed to be 11,877 pounds of hay, 627 pounds of grain, 52 pounds of calf starter and 40 pounds of milk replacer. A dairy bull weighing 2,000 pounds is assumed to require 4,056 pounds of grain and 7,300 pounds of hay per year. These requirements were the same in Arizona as in New Mexico, the only operations that were assumed to use bulls to catch undetected cows in heat.

Labor Cost. An annual charge for the operator's (manager's) labor was assumed for each dairy operation. This amount ranged from $20,000 in Minnesota, and $24,000 in Washington to $40,000 for the 1,436-cow Arizona dairy. The values represent the number of supervisory and management responsibilities associated with each dairy operation.

The labor for each dairy is the total required for the entire operation including raising crops for feed in Minnesota and Washington. The total hired labor ranges from 1.03 of a man equivalent (2,575 hours) of part-time hourly labor on the 52-cow Minnesota dairy to 15 full-time employees on the 1,436-cow Arizona dairy. Some of the part-time labor hired in Minnesota and Washington is seasonal and associated with crop production. The wages of hired labor include fringe benefits of 25 percent in New Mexico and 22 percent in the other states. In addition to the wages shown in Table 3, part of the housing costs are provided for workers in New Mexico and 22 percent in the other states. In addition to the wages shown in Table 3, part of the housing costs are provided for workers in New Mexico budget. Those labor-related costs are incorporated with other investment requirements.

RESULTS

The average annual rates-of-return based on budgeted 1981 revenues and costs provide a comparison of profitability between states. Adjustments were made where the 1981 conditions were believed to deviate from the longer-term interregional prices and costs. Estimates were also made to reflect possible policy changes that might affect relative returns to investment in various states.

Estimates Based on 1981 Conditions

Investment. Total investment in the seven dairy operations ranged from $726,000 for a 52-cow Minnesota dairy to $6,711,000 for the 1,436 Arizona dairy (Table 4). When the land cost is included, approximately $14,000 per cow is required for the 52-cow Minnesota dairy. Excluding land, investment per cow is still $8,350 for the 52-cow Minnesota dairy compared to $3,212 for the 900-cow New Mexico dairy.

Investment in field machinery, tractors and vehicles is approximately

Table 3. Labor and labor costs on assumed dairy operations.

	Minnesota		Arizona			New Mexico	Washington
	52-cow dairy	125-cow dairy	359-cow dairy	834-cow dairy	1,436-cow dairy	900-cow dairy	140-cow dairy
	Number of Workers						
Operator	1	1	1	1	1	1	1
Herdsman	0	0	1	1	1	1	0
Asst. herdsman	0	0	0	1	2	1	0
Milkers	0	0	2	5	5	6	0
Calf feeder	0	0	1	1	2	2	0
Herd feeder	0	0	1	1	2	1	0
Maintenance	0	0	0	1	1	0	0
Relief man	0	0	1	1	2	1	0
All purpose	0	1	0	0	0	0	1
Part-time hourly	1.03	1.23	0	0	0	0	.96
Total	2.03	3.23	7.0	12.0	16.0	13.0	2.96
	Dollars						
Total hired	12,906	29,312	92,964	179,340	253,272	182,500	26,000
Hired labor/cow	248	234	259	215	176	203	186

$2,500 per cow on the 52-cow Minnesota diary compared to $190 in New Mexico. When only dairy buildings and equipment are considered, investment per cow is still almost four times as high for the 52-cow Minnesota dairy ($3,874) as for the New Mexico dairy ($988).

Investment per cow in Arizona is very similar to the investment in New Mexico. The major difference is the $1,218 investment in milk base in Arizona. There is no quota or production base program in New Mexico.

Within Minnesota the investment per cow is $2,591 less for the 125-cow dairy using free stall housing and milking parlors than for the 52-cow stanchion barn dairy. This difference is partly due to more efficient use of field machinery and tractors in dairy feed production. In Arizona investment per cow is also less for larger herds than for smaller herds (Table 4). However, investment per cow declines only from about $4,924 for the 359-cow Arizona dairy to $4,673 for the 1,436-cow Arizona dairy.

These results show the marked advantage in terms of investment per cow that large scale dairies in New Mexico and Arizona have compared to smaller Minnesota dairies.

Table 4. Investment requirements for assumed dairy operations, 1981.

	Herd Size						
	Minnesota		Arizona			New Mexico	Washington
	52-cow dairy	125-cow dairy	359-cow dairy	834-cow dairy	1,436-cow dairy	900-cow dairy	140-cow dairy
				$1000 per operation			
Dairy building and equip.	201	309	486	1,024	1,629	889	237
Tractors and vehicles	54	87	79	108	288	171	62
Field machinery	75	79	0	0	0	0	38
Cattle	104	250	726	1,684	2,892	1,830	280
Land	292	696	39	90	154	235	239
Milk base	0	0	437	1,016	1,748	0	12
Total	726	1,421	1,767	3,922	6,711	3,125	868
				$ per cow			
Dairy building and equip.	3,874	2,471	1,354	1,227	1,134	988	1,689
Tractors and vehicles	1,043	693	220	130	200	190	443
Field machinery	1,433	633	0	0	0	0	269
Cattle	2,000	2,000	2,022	2,019	2,014	2,033	2,000
Land	5,605	5,567	110	109	107	261	1,714
Milk base	0	0	1,218	1,218	1,218	0	88
Total	13,955	11,364	4,924	4,703	4,673	3,472	6,203

Although investment per cow is not the sole criterion for deciding where to establish dairy farms, more cows could be milked in New Mexico or Arizona for the same total investment than in either Minnesota or Washington. For example, an investment of $1.42 million would be needed for a 125-cow dairy in Minnesota while an investment of $1.76 million would be needed for a 359-cow Arizona dairy.

Rate-of-Return on Investment. The rate-of-return was an estimated 1.53 percent for the 52-cow Minnesota diary and 6.04 percent for the 125-cow Minnesota dairy compared to 19.86 percent for the 900-cow New Mexico dairy (Table 5). The estimated rate-of-return was higher in both Arizona and New Mexico than in either Minnesota or Washington. In Arizona the rate-of-return ranged from 10.96 percent on the 359-cow dairy to 14.64 percent on the 1,436-cow dairy.

Longer-term Outlook

Several changes in the 1981 conditions used in this study may affect the relative returns between the states.

Alfalfa Cost. The longer-term breakeven cost per ton for hay was estimated to be about $10 lower in Arizona, $2 lower in New Mexico but $6 higher in Washington than the 1981 prices used in the previous section. Using the expected long-run relative prices increased the calculated annual rate-of-return from 19.86 to 20.29 percent for the 900-cow New Mexico dairy and 13.65 to 14.86 percent for the 834-cow Arizona dairy. The expected rate-of-return would decrease from 7.29 to 6.55 percent for the 140-cow Washington dairy. These results increase the profitability of dairies in the Southwest relative to Minnesota.

Milk Prices. The expected rate-of-return to investment is very sensitive to changes in milk prices. Several factors can affect milk prices, including (1) the support price set under the price support program and (2) the proportion of milk used as fluid.

A reduction in the support price under the national price support program would result in equivalent milk price declines in all four states. A $1.00 per hundredweight lower (higher) milk price would reduce (increase) the calculated rate-of-return 1.3 percentage points for the 125-cow Minnesota dairy but 4.6 percentage points for the 900-cow New Mexico dairy (Table 5).

The proportion of milk utilized as fluid may not change milk prices received by farmers uniformly in all states. If milk production continues to expand at half the rate during the 1980's as it did in the 1970's and fluid use remains about the same, the relative prices received by dairy producers would be about the same in Minnesota, 67 cents per hundred-weight less in Arizona, 83 cents less in New Mexico and 20 cents less in Washington. Recalculating the rate-of-return based on these lower prices indicates the narrowing differences between the states. The rate-of-return would decline from 13.65 to 11.33 percent on the 836-cow Arizona dairy and 19.86 to 16.00 percent in New Mexico (Table 5). The price in Minnesota would show minimal change.

Table 5. Estimated cost per hundredweight of milk and rate-of-return to investment under alternative assumptions.

	Herd Sizes						
	Minnesota		Arizona			New Mexico	Washington
Assumption	52-cow dairy	125-cow dairy	359-cow dairy	834-cow dairy	1,436-cow dairy	900-cow dairy	140-cow dairy
				Percent Rate-of-Return			
Base 1981 conditions	1.53	6.04	10.96	13.65	14.64	19.86	7.29
Triple water cost for alfalfa	1.53	6.04	8.84	11.44	12.41	15.08	7.29
One dollar lower milk price	.46	4.74	7.65	10.19	11.15	15.26	4.67
Continued expansion of milk production	1.52	6.03	8.74	11.33	12.30	16.00	6.76
Fifty percent higher land values	1.17	4.74	10.83	13.49	14.46	19.11	6.10

Land Cost. the value of land is affected by many factors, some of which are not directly related to dairy. Population and urban growth can create wide variations in land values, especially for dairies located close to metropolitan areas. An acre of land well beyond the urban development area in Arizona could be acquired for about $2,000 including cost of excavation and grading the land for trench silos and waste ponds. An acre of land near Las Cruces, New Mexico, could be acquired for about $4,000 including excavation cost. Land in the Puget Sound marketing order area of western Washington would cost about $4,000 per acre. These assumed values were based on the same studies on which investment costs were obtained. In rural Minnesota, the land base for a typical dairy could be acquired for $1,526 per acre.[8]

Possible capital gains that might be expected on dairies built close to urban area were not considered? The total acreage of the Arizona and New Mexico dairies is less than for Minnesota but the opportunity for capital gains through appreciation in land values may be greater in Arizona and New Mexico. Individuals would be expected to be willing to accept a lower rate-of-return to investment in milk production where there is potential for appreciation of land values.

The impact of 50 percent higher land values on the rate-of-return to total investment in the dairy operation and on the cost per hundredweight of milk is shown in Table 5.

[8]Estimated average land values per acre in Southeast Minnesota 1980. Source: Mattew G. Smith and Philip M. Raup, *The Rural Real Estate Market in 1981*. Department of Agricultural and Applied Economics, University of Minnesota. Economic Report 82-4, March, 1982.

CONCLUSIONS

The decisions that determine the regional location of milk production are complex and go beyond the estimated rate-of-return calculated in this report. However, the relative rates-of-return between areas probably are a major consideration. Results based on 1981 prices and conditions suggest that large scale dairies in the Southwest, which have relatively low housing requirements, are more profitable than investments in their smaller counteraparts in the North.

Results suggest that the regional shifts in milk production probably will continue through the 1980's as returns are quite favorable in those areas showing the greatest expansion during the 1970's. However, rates-of-return on alternative investment opportunities have not been examined in this report. A decision to invest in milk production, in part, depends on the possible rate-of-return to money invested in non-dairy alternatives within each region.

The lower rate-of-return in Minnesota compared to New Mexico and Arizona reflects lower milk prices, less milk produced per cow, and higher investment requirements per cow. Milk prices received by dairy producers in Minnesota are lower than in New Mexico and Arizona because the price of milk used as fluid (Class I price under federal milk orders) is lower and because a smaller proportion of milk is used as fluid. A change in market order pricing policies would change the relative profitability between the two areas.

Differences in milk production per cow account for much of the differences in rate-of-return to investment between regions. There are no regional differences that explain why milk production per cow is lower in Minnesota than in New Mexico, Arizona or Washington. However, the dairy producers in Minnesota tend to be spread much thinner in their management responsibilities. Rather than focusing attention exclusively on the dairy herd, Minnesota producers are involved in planting, raising and harvesting feed crops. Also, labor in the large-scale dairies in New Mexico and Arizona is more specialized, allowing a closer management of individual dairy tasks.

The rate-of-return to investment in New Mexico and Arizona is quite sensitive to changes in the cost of irrigation water for alfalfa. Non-farm competition for water could alter the expected returns by increasing forage costs. Part of this question involves whether agriculture carries the full cost of irrigation water or receives water subsidies. The uncertainty of how water costs might change increases the risk associated with milk production in areas dependent on irrigation.

Climate differences probably account for the differences in herd size and technologies employed in North Central states compared to the southwest states. The fact that large-scale drylot dairying, so typical in the Southwest and South, is practically nonexistent in the North Central dairy area suggest limits to inter-regional transfer of technologies and practices. Housing requirements during cold winter months are different in Minnesota than in the warmer regions. Higher rainfall in Minnesota than in New Mexico and Arizona greatly changes the waste handling problems.

Forage quality is more of a problem and the forage market is less developed in the high rainfall areas than in the southwest. The trends to high moisture feeds such as haylage, corn silage and high moisture corn in the high rainfall climates make it more difficult for feed markets, especially for forages, to develop than in areas where dry feeds are fed. Dry feeds can be stored and transported over longer distances. These are among the reasons that will tend to maintain the existing differences in herd size, practices and technologies between regions.

During the late 1970's and early 1980's national milk production increased faster than consumption. Government purchases under the price support program increased to more than 10 percent of total production in 1982 and is still increasing in 1983. Dairy operations are likely to be less profitable until this surplus is reduced. Nationally milk production in the next six years cannot increase as much as it did from 1977 to 1983. Despite this lower profit outlook for dairy nationally, the relative profitability will still show an advantage to those areas that have increased milk production most rapidly. The large-scale dairy in the Southwest will likely continue to increase in relative importance as a supplier of dairy products.

Dale C. Dahl . . . . Editor

Prepared by the Agricultural Extension Service and the Department of Agricultural and Applied Economics. Views expressed are those of the authors, not necessarily those of the sponsoring institutions. Address comments or suggestions to Professor Dale C. Dahl, Department of Agricultural and Applied Economics, 1994 Buford Avenue, University of Minnesota, St. Paul, MN 55108.

Please send all address changes for Minnesota Agricultural Economist to Nancy Rush, 231 Classroom Office Building, 1994 Buford Ave., University of Minnesota, St. Paul, MN 55108.

AGRICULTURAL EXTENSION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
UNIVERSITY OF MINNESOTA
ST. PAUL, MINNESOTA 55108

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE—$300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF AGRICULTURE
AGR 101

U.S.MAIL

No. 644 NOVEMBER 1983