Chapter 5

Economic Impacts of Emerging Technologies and Selected Farm Policies for **Various Size Dairy Farms**

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One of the most controversial policy areas in the 1985 farm bill debate is expected to be in dairy policy—in 1983 a large amount of surplus milk production cost taxpayers approximately $2.6 billion. For that reason, there will be many alternatives proposed to the current dairy program. This chapter examines the current state of the dairy industry, identifies the technologies most likely to affect the industry from 1983 to 1992, identifies policy options most likely to be considered in the 1985 farm bill, and analyzes the effects of these options on moderate, large, and very large dairy farms in major U.S. dairy production regions.1

1 The representative farms were developed and analyzed in the paper "Economic, Policy, and Technology Factors Affecting Herd Size and Regional Location of U.S. Milk Production," prepared for the Office of Technology Assessment by Boyd M. Buxton.

BACKGROUND

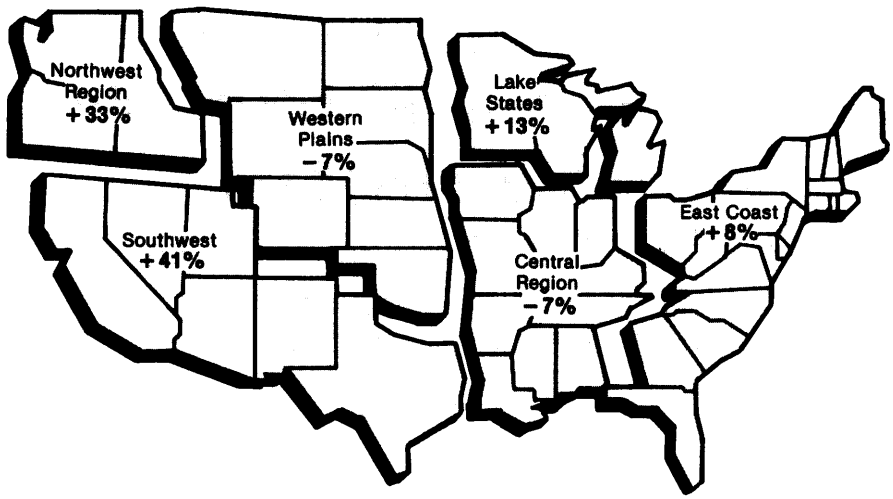
During the 1970s, milk production increased 41 percent in the Southwest region of the United States and 33 percent in the Northwest, while total milk production increased only 11 percent (fig. 1). Much of the increased production came from dairies with more than 500 cows, with herds of 1,500 to 2,000 cows being common. Although 303, 710 farms in the United States reported having milk cows in 1983, less than 5,000 well-managed dairies with 1,500 cows each could have produced all the milk sold commercially that year.

Herd size, technologies employed, and practices used in milk production vary considerably throughout the United States. In May 1983 the average herd size for 120,655 producers selling milk to plants regulated by Federal milk marketing orders was 63 cows per farm (table 5-1). However, the average herd size in each State varied from 49 cows in Pennsylvania to 532 cows in Florida,

The variation in herd size within each State was even more dramatic. Although the average herd size in Florida was 532 cows, the average herd size for the largest 10 percent of the herds in that State was 1,861 cows (table 5-1). Similarly, the average herd size for the largest 10 percent of herds regionally was about 1,700 cows in the Southwest, but only 125 cows in the Lake States region. Generally, dairy herds are much larger in the Southwest, Southeast, and Northwest regions than in the Lake States and Northeast regions.

From the herd size information in table 5-1, 22 dairies were selected to represent existing herd sizes in five major dairy areas (table 5-2), The 200-cow Pennsylvania and 600-cow New York dairies exceed the average size of the largest 10 percent of dairies in those States. However, such larger sized dairies exist in these States and will become more prevalent in the near future.

Figure 5-l.— How the Dairying Picture Has Changed
(percent change in milk production in various regions from 1970-71 to 1980-81)



SOURCE: U.S. Department of Agriculture

Table 5-1 .–Total Producers and Size Distribution of Herds Selling Milk to Plants Regulated by Federal Milk Marketing Orders, May 1983[a]

Region (State)	Total producers (number)	Average herd size (milk cows) for:				
			Largest			Smallest
		All farms	10 percent	70-89 percent	40-69 percent	40 percent
Lake States:						
Minnesota	9,968	53	116	74	49	30
Wisconsin	24,400	54	133	68	52	28
Northeast:						
Pennsylvania	12,928	49	127	66	44	25
New York	13,374	59	162	81	53	27
Southeast:						
Georgia	962	127	343	181	117	54
Florida	352	532	1,861	931	355	133
Southwest:						
New Mexico	176	333	1,832	433	169	32
Arizona	160	510	1,733	714	433	160
California	13	400	1,640	580	253	110
Northwest:						
Idaho	574	135	607	169	90	34
Washington	1,647	127	418	171	108	46
United States	120,655	63	202	82	54	26

a The 120 655 farms accounted for about 69 percent of all milk produced in May 1963, but excluded most farms in California and other States where there is no Federal milk order,

SOURCE: Boyd M Buxton and John P. Rourke, "Size Distribution of Dairy Farms Marketing Milk Under Federal Milk Orders, " unpublished report, Economic Research Service, U.S. Department of Agriculture, April 1964.

Table 5.2.— Representative Dairies by Region and Herd Size

Region/State	Herd size (cows)	Cropland (acres)	Housing facilities (type)	Sun shades	Feed produced	Silage storage (type)	Total labor (W/e)[b]
Lake States:							
Minnesota .	52	188	Stanchion	No	Most	Upright	2,03
Minnesota .	125	449	Free stall	No	Most	Upright	3.30
Northeast:							
Pennsylvania	52	156	Stanchion	No	Forage	Trench	2.2
Pennsylvania .	125	375	Free stall	No	Forage	Trench	3.8
Pennsylvania .,	200	600	Free stall	No	Forage	Trench	5.54
New York	52	156	Stanchion	No	Forage	Trench	2.21
New York	200	600	Free stall	No	Forage	Trench	5.54
New York .	600	1,800	Free stall	No	Forage	Trench	14.36
Southeast:							
Georgia	200	400	Free stall	Yes	Forage	Trench	4.5
Georgia . .	350	700	Free stall	Yes	Forage	Trench	7.84
Florida ., ...	350	0	Open field	Yes	None	NA	7
Florida	600	0	Open field	Yes	None	NA	11
Florida ., ...	1,436	0	Open field	Yes	None	NA	18
Southwest:							
New Mexico . . .	900	0	Corral	Yes	None	NA	13
Arizona . .	359	0	Corral	Yes	None	NA	7
Arizona .	834	0	Corral	Yes	None	NA	12
Arizona .	1,436	0	Corral	Yes	None	NA	16
California .	550	0	Corral	Yes	None	NA	9
California . .	1,436	0	Corral	Yes	None	NA	16
Northwest:							
Washington .,	140	51	Free stall	No	Silage	Trench	2.96
Idaho	200	400	Corral	No	Most	Trench	5.0
Idaho . .	550	0	Corral	No	None	NA	10.5

[a] Housing types are
- *Stanch/on* A conventional barn with locking stanchions In which cows are Im ıl ked and fed
- *Free* sta// A covered barn w{th Indlvldual stalls In wh{ch cows freely enter and exit
- Open *fie/d* A field where cows are kept that IS large enough to mal ntal n p!ant cover
- *Corra/* A drvlot open pen where cows are kept and fed at a fencel ıne feeder

[b] Labor In worker equivalents of 2,500 hours annuall Y

NA—not applicable

SOURCE Off Ice of Technology Assessment

TECHNOLOGIES AND PRACTICES

The technologies and practices assumed for each of the 22 dairy operations were based on discussions with dairy producers, university and Government employees, and equipment representatives. The objective of these discussions was to describe efficiently organized dairy operations that use proven technologies and practices for each specified herd size. Therefore, the dairy operations in this analysis are not the average of what exists, but rather approximate modern sizes and types of operations.

The 52-cow dairies in Minnesota, Pennsylvania, and New York use the conventional stanchion barns for housing and milking cows (table 5-2). For larger herds in the Lakes States, the Northeast, Washington, and Georgia, free-stall housing and milking parlors are assumed.

Cows are kept in open corrals throughout the Southwest and on larger Idaho dairies. Sun shades in the corrals are assumed in New Mexico, Arizona, and California (Southwest), but not in Idaho, Cows are milked twice a day in milking parlors and fed at fenceline bunks from a feed wagon or truck.

Open fields with sun shades are assumed in Florida. one-half acre per cow is provided, allowing fields to remain grass-covered to minimize mud problems. Cows are milked twice a day in a milking parlor, After leaving the milking parlor, they are fed concentrates in a

feed barn before being released back to the field. Roughage is fed loose in the open fields,

The source of feed follows the common practice existing in the various States. For New Mexico, Arizona, California, and Florida, most feed is purchased from off the dairy operation. The same is assumed for the 550-cow Idaho dairy, Dairy operations in Pennsylvania, New York, and Georgia purchase most of the concentrates but produce most of the forage used by their dairy herds. All feed is assumed to be produced on-farm for the Minnesota and the ZOO-cow Idaho dairies.

POLICY AND TECHNOLOGY SCENARIOS

Eight representative dairy operations of the 22 presented in table 5-2 were selected to simulate selected policy and technology scenarios. The likelihood of a particular dairy remaining solvent under alternative policies is directly affected by its financial characteristics. A policy change can have quite different implications for the operator of a dairy with a high level of debt than one with a low level of debt. The average financial situation that exists on the eight dairies of the size and location selected are shown in table 5-3. The averages were approximated from the U.S. Department of Agriculture (USDA) farm financial survey.

[2]The current version of the Firm Level Income Tax and Farm Policy Simulator (FLIPSIM V), developed by James W. Richardson and Clair J. Nixon, was used to simulate the representative farms in each region.

The eight dairy operations in three regions were simulated for 10 years under the alternative scenarios described below. Seven policy scenarios (including the 1983 base described in a previous section) and two technology scenarios were simulated for each dairy. The assumptions and policy values associated with each scenario were held constant across all dairies to allow direct comparison of their impacts on different size dairies in different regions.

Two financial stress scenarios (interest subsidy and debt restructuring) were evaluated for the Minnesota 52-cow and 125-cow, Arizona 359-cow, and Florida 350-cow dairies, assuming an initial high debt position and assuming a new entrant with high debt position. Each scenario is described below, along with the ex-

Table 5-3.—Financial Characteristics Assumed for Eight Dairy Operations in Four States

	Herd size in:							
	Minnesota		Arizona	California		Florida		
Financial characteristics	52	125	359	550	1.436	350	600	1.436
Value of:								
Cropland and farmstead ($1,000). 293.4	679.1	39.4	160.0	312.0	262,5	450.0	1,074.0	
Buildings ($1,000) 92.7	176.7	192.8	284.4	512.6	87.9	108.9	211.7	
Farm machinery ($1,000). 104.1	159.0	120.3	183.1	303.0	114.6	180.0	260.7	
All livestock ($1,000) 77.9	181.4	599.6	960.7	2,505.0	525.5	981.4	2,344,3	
Off-farm investments ($1,000) 5.5	13.1	0	0	0	0	0	0	
Beginning cash reserves ($1,000) 12.0	62.5	89.8	137.5	35.9	70.0	212.0	505.5	
Debt:								
Long-term ($1,000) 111.2	213.9	67.3	155.5	288.6	143.7	218.0	475.7	
Intermediate-term ($1,000) 57.1	88.5	230.4	308.8	842.4	160.0	243.9	468.9	
Initial net worth ($1 ,000) 417.1	969.4	744.2	1,261.3	2,537.5	756.9	1,464.7	3,343.0	
Equity ratio (fraction) 0.71	0.76	0.71	0.73	0.69	0.71	0.76	0.76	
Family living:								
Minimum ($1,000). , ... 20.0	25.0	25	27	30	25	27	30	
Maximum ($1,000) 32.0	35.0	30	38	40	30	38	40	
Marginal propensity (fraction) 0.3	0.4	0.3	0.4	0.4	0.35	0.4	0.4	
Off-farm income ($1 ,000) 0	0	0	0	0	0	0	0	

SOURCE Office of Technology Assessment.

pected results and the observed results from the analysis. Appendix B contains summary tables of the analysis for each farm size by region.

Farm Policy Scenarios

Current Policy

The current policy assumes the continuation of the Dairy and Tobacco production Stabilization Act of 1983 through September 30, 1985. The Government stocks of dairy products are assumed to be high enough through 1985 and 1986 to trigger a 50-cent drop in support price on April 1, 1985, and again on July 1, 1985, as specified in the 1983 act.

All features of the 1983 act are scheduled to expire on September 30, 1985. It is assumed that the support price will remain at the 1985 level through 1986, then rise to $13.11 for manufacturing milk through the end of the lo-year simulation period.

Results Expected.—Under current policy, it is expected that a well-managed dairy of average size would about break even after paying expenses and farm overhead and making withdrawals for family living. It is also expected that well-managed dairies in all regions should be able to survive under a continuation of the current program. Farms that are not in a position to realize most of the economies of size in dairying would be gradually forced out of business. In other words, an extension of current policy would force dairies to compete on the basis of cost and efficiency.

Results Obtained:

- All dairies except the 52-cow Minnesota operation were able to increase their real net worth over the l0-year planning horizon. The 52-cow dairy experienced a 54-percent reduction in net worth.
- The larger the dairy, the greater its financial success. Dairies in Florida and the Southwest were more profitable than dairies in Minnesota. The Florida dairy benefited greatly from higher milk prices.
- The 52-cow dairy had the lowest probability of survival (0o percent) due to having the highest unit cost of production. It lost an average of $27,000 annually in net farm income.

A Crop Acreage Reduction Program

The present feed grain program was assumed through 1985. From 1986 to 1992 a 15-percent set-aside with a 5-percent diversion for corn, cotton, rice, sorghum, and wheat was assumed. This program results in dairy feed prices being 9 percent higher than those under current policy.

Results Expected.—Feed cost represents about 50 to 60 percent of total costs per cow. A crop program that results in a 9 percent higher feed cost is roughly equal to a 5-percent reduction in the price of milk. This would have an adverse impact on a dairy's ability to increase net worth, reduce debts, and achieve as high an internal rate of return as under current policy. In the short run, dairies that raise most of their feed would be less directly affected. The probability of survival would most likely be reduced for dairies operating at or below the break-even point under the current policy because they would be unable to absorb the higher feed costs.

Results Obtained:

- The associated higher feed prices had the greatest adverse financial impact on dairies that purchased most of the feed from off the farm. For example, compared to that of the current policy, the average annual net farm income of the 1,436-cow California dairy declined 64 percent from $375,000 to $136,000.
- The probability of survival was reduced for all dairies except the 1,436-cow Florida dairy and the 125-cow Minnesota dairy.
- There was relatively little impact on Minnesota dairies, where most feed is raised on the dairies.

No Crop Programs

There is much discussion of a desire to move to more market-oriented crop programs. Removing all price supports and income supports would increase the variability of feed prices,

subjecting the dairyman who purchases feed to greater risk. For this scenario the Commodity Credit Corporation (CCC) loan, farmer-owned reserve (FOR), and target price provisions were eliminated for all years in the planning horizon (1983-92). This increased the variability in feed costs facing dairy operations. The impact of this variability was evaluated.

Results Expected.–Feed prices paid by dairies would be higher in some years but lower in other years. Over time, high and low price years would be expected to balance out, leaving a surviving dairy about as prosperous as under the current policy. However, the cost associated with possible borrowing to tide a dairy over periods of high feed costs might be expected to affect somewhat adversely its ability to retire debt and increase net worth. Dairies under tight financial conditions under current policy would be expected to have a lower probability of survival without crop programs because they would be less able to absorb the effects of periods of relatively high feed prices. This would be less a problem for dairies in a relatively strong financial position under current policy because they would be better able to absorb these shocks.

Results Obtained:

- The increased variability in feed prices, associated with eliminating all crop programs, had little financial impact on all dairies compared with the results under the current policy. Average net present value declined less than 2 percent for all dairies,
- Increased price risk did not reduce the probability of survival for any of the farms.

Fifty Cents Lower Price

All the assumptions of the current policy were retained except that the mean milk prices were reduced 50 cents per hundredweight (cwt) and the variability of milk price is increased. This scenario was included in the analysis because of the current high level of Government stocks and program costs.

Results Expected.—Lower support prices would be expected to affect adversely the dairies' net incomes as well as their survival and growth. The dairies most adversely affected would be those that are already in financial difficulties under the base policy.

Results Obtained:

- All farms were more negatively affected by this policy than by current policy. All farms experienced more losses under this policy in net farm income, net present value, and net worth.
- The largest dairies in each region experienced little reduction in the probability of survival.
- The greatest adverse impact was on the smallest Minnesota dairy, where the probability of survival declined from 70 to 38 percent and the probability of a positive net present value declined from 24 to 14 percent, Other dairies that were adversely affected included the smaller Florida and California farms. Therefore, reduced price supports would force many small dairies out of business.

No Dairy Program

With no dairy program, the price of milk would drop about 8 percent across the regions (about $1/cwt) to the variable cost of production in Minnesota and California as excess stocks and production are eliminated. It was assumed that this would take 4 years. After that, prices were expected to increase 6.6 percent ($0.80 /cwt), equal to the average total cost of production for large-scale dairies in Minnesota and Californians Historical price relationships were maintained,

[3]The variation of milk prices without a dairy price support program was developed from the following study: Cameron S. Thraen and Jerome W. Hammond, *Price Supports, Risk Aversion and U.S. Dairy: An Alternative Perspective of the Long-Term Impacts,* Economic Report ER83-9, Department of Agricultural and Applied Economics, University of Minnesota, June 1983.

Results Expected.—Without a dairy price support program there would be no guaranteed price floor. In some years milk prices would be higher, while in other years they would be lower than under current policy. However, they would still fluctuate about the long-term equilibrium price. Over time, favorable and unfavorable prices should balance out, meaning that the ability of a dairy to increase net worth, repay debt, and achieve a favorable internal rate of return would not be seriously affected. However, the probability of survival for dairies in tight financial situations would be adversely affected.

Results obtained:

- The probability of survival fell for all farms, with the greatest reduction experienced by the moderate and large farms analyzed. The lowest probability of survival was 34 percent for the 52-cow Minnesota dairy.
- Net present value declined significantly for all farms. For example, the very 1arge California dairy experienced a 43-percent decline in net present value and a 27-percent decrease in net worth.
- However, the very large farms were still able to survive in all regions.

Supply Control

All assumptions of the base current policy were retained, except that mandatory quotas were imposed on dairies. Quotas equal to 96,5 percent of a producer's normal production would, over time, be expected to maintain milk prices $1 above those under current policy. Herd size would be reduced about 4 percent in order to reduce milk production 3.5 percent, assuming that poorer-than-average cows would be culled in complying with the quota.

Results Expected.—The financial performance of all dairies would likely be improved as a result of permanently higher milk prices, despite those dairies having to reduce total milk produced within the designated quota. The probability of survival would increase along with a greater ability to reduce debt and increase net worth for dairies existing at the time the program is implemented, However, this economic advantage could be capitalized into the quota value, thereby eroding the advantage for new entrants or producers who would have to purchase quotas to expand milk production.

Results Obtained:

- Probability of survival was increased for all farms of all regions. The 52-cow Minnesota dairy experienced the largest increase in the probability of survival from 70 percent under the base scenario to 92 percent,
- Average net present value increased for all dairy farms. The 52-cow Minnesota dairy increased from negative $77,000 to $22,000,
- Ending net worth was increased for all dairies due to retained earnings and repayment of debt.
- Net farm income for Minnesota dairies was increased by $15,000. These dairies previously had the lowest income.

Tax Policy Scenarios

All assumptions of the current policy were retained except for more restrictive Federal income tax provisions, including the following:

- Machinery, livestock, and buildings were depreciated using the straight-line cost recovery method.
- First-year expensing provisions were eliminated for all depreciable items.
- Maximum investment tax credit provisions were eliminated.
- The maximum annual interest expense that could be used to reduce taxable income was $15,600.
- The operator must sell obsolete machinery upon disposition rather than trading it in on new replacements, thus forcing recapture of excess depreciation deductions.

Results Expected.—These tax policy changes would have an adverse impact on the ability of a dairy to reduce debt, increase net worth, and, if in a tight financial situation, reduce the probability of survival, All tax changes increase the tax liability, reducing the net income of the operation and leaving less for debt retirement and increases in net worth.

Results Obtained:

- Eliminating the tax benefits increased tax liabilities and reduced the net present value and net worth for all farms. These reductions, however, were relatively small —in the range of 1 to 10 percent,
- The increased tax liabilities were not large enough to reduce significantly the probability of survival.

Technology Scenarios

Computer-Controlled Feeding

A technology now available but not widely adopted is individual cow feeding by using computer-controlled feed stalls. with this technology concentrates fed to individual cows can be controlled in total and over time. One experiment suggests that average daily milk production per cow can be increased 2 pounds with a 0.1 percent higher butterfat content without increasing total feed fed to the herd (Wildhaber, et al., 1984). The estimated added investment costs for computer feeding for the three largest dairies were:

Minnesota 125-cow herd	$18,750
Florida 1,436-cow herd	$157,960
California 1,436-cow herd	$157,900

Investment included a neck responder for each cow, a feeder stall with storage and auger feeder, and a computer, It was assumed that this technology would be adopted only by the largest dairies in each region; thus, only three dairies were analyzed.

All other assumptions of the current policy were retained except that allowances were made for added investment and operating costs and for higher average milk production per cow. The gain in milk production was expected to exceed the added cost, giving dairy producers a more favorable financial position,

Growth Hormone

A technology not yet in commercial use but demonstrated in experimental work is bovine growth hormone. Injecting milk cows with this hormone every other day would result in increased milk production. preliminary results are that with this technology, milk production per cow during the last two-thirds of the lactation period is increased 30 to 40 percent without additional feed (about 23 percent annually). The cost for the hormone can be expected to decline since it can probably be produced cheaply.

Injections given every other day and costing $1 each are assumed in this analysis. Combining this cost with increased hauling and other costs of added milk results in about a $185-increase in cost per cow per year. Once again, it was assumed that only the largest farms would adopt, and allowances were made for added cost and yields,

Results Expected

The expected impact of adopting these technologies is to improve greatly the financial performance of the larger adopting dairies. The probability of survival and all measures of financial performance would be improved for the adopting dairies. The disparity in costs and returns for moderate and very large dairies could be significantly increased,

Results Obtained:

- Large increases in net farm income, net present value, and net worth were experienced by the adopting dairies, These increases were significantly larger for the bovine growth hormones.
- Any lag in the adoption of new cost-reducing technologies seriously adversely affected the ability of dairies to compete.

FiNANCIAL STRESS SCENARIOS

The assumed beginning financial conditions for four of the eight dairies were changed to reflect high-debt operators and new entrants. Debt load was doubled to reflect high-debt situations. For new entrants all equipment was assumed to be new, which increased both the initial value of the machinery and the total debt load.

Two policies were considered for high-debt dairies. One was to subsidize interest rates on all debt so that the effective rate for all loans paid would be 8 percent rather than the higher rates used in the current policy. The second was to restructure the debt by converting a portion of intermediate debt into long-term loans and/or to extend the length of intermediate-term loans. In the second case, interest rates, total debt loads, and other assumptions of the high-debt dairies remained the same as under current policy.

The impact of higher feed costs and eliminating the dairy price support program was evaluated for new entrants with a high-debt position. The results obtained included the following:

- The probability of survival for any dairy depends greatly on its initial financial position. Dairies and new entrants with high debt had significantly lower probabilities of surviving than dairies with initial financial situations assumed in current policy.
- Neither interest subsidies nor opportunities for debt restructuring greatly improved the chances of high-debt dairy farms remaining solvent.
- The probability of survival for both Minnesota dairies was zero for all policy scenarios. The implication is that high-debt producers in this region cannot survive under even the current dairy policy.

IMPLiCATiONS FOR THE 1985 FARM BILL

- Policies and technologies that are favorable for the dairy industry provide greater financial opportunities for large rather than small dairies.
- Policies that adversely affect the dairy industry such as higher feed costs, fewer income tax benefits, and no dairy price support program will negatively affect small dairies more than larger dairies,
- The major advantage enjoyed by larger dairies is more related to the efficiency of operation than to specific dairy policies.
- There will be a continued trend to fewer and larger dairies in all regions. Milk production can be expected to continue to increase in the lower cost regions of the Southeast and Southwest.
- Traditional dairy regions will continue to experience increased competitive pressure from larger scale, more efficient producers in other parts of the United States, Substantial restructuring of dairies in the Lake States and Northeast will be required for them to compete.
- Dairy price supports must be sufficiently flexible to adjust to the increased production and lower costs spurred by technological change. This could be accomplished either by adjusting the price support level to changes in production costs per unit of output or by adjusting the level of CCC purchases.
- Current geographic price alignment systems in Federal milk marketing orders are becoming increasingly outdated. A comprehensive study is needed of changes required to modernize the Federal order system in light of technological changes.