The Economic Impacts of the Proposed Federal Bay/Delta Standards on the California Dairy Industry

Prepared for

Western United Dairymen

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Highlights

- **The California Dairy Industry is the Largest Sector in the California Agriculture Industry and a Critical Part of the State's Economy**

    - It generates $2.9 billion in farmgate receipts and $6.0 billion in statewide economic impacts per year.

    - California milk producers are among the most productive and efficient in the U.S.

    - The industry provides a wide array of healthful products to consumers at lower prices than in most other states.

    - The industry employs 27,000 people in milk production and 15,000 people in processing. The industry supports many other jobs in the feed production, transportation, storage, and equipment manufacture and distribution industries.

    - Demands for California dairy products have grown rapidly for the last two decades in response to population increases and higher income levels.

    - The California dairy industry will be affected directly and adversely by the proposed Federal Bay/Delta water quality standards

- **The Potential Impacts on Agriculture of the Proposed Federal Bay/Delta Standards Were Inadequately Estimated by EPA**

  - Meeting the requirements of the proposed standards would require increased Delta outflows and restricted export pumping for the State Water Project and the Central Valley Project.

  - EPA presented a range of estimates of Central Valley acreage that would be idled because of the standards. The study concluded that land fallowed would be significantly less than 200,000 acres. The distribution of this acreage among crops was not stated, however, and the fallowed land was estimated to have a gross annual value of only $40 million.

  - However, a more detailed examination of the agricultural impacts related to the proposed standards reveals that nearly 200,000 acres valued at over $250 million would be permanently idled. An additional 270,000 acres would be idled in critically-dry years. The resultant revenue, employment, and income losses will be much larger than those estimated by EPA

- **Alfalfa is the Most Important Roughage Used in the California Dairy Industry, and the Dairy Industry is the Single Largest User of Alfalfa in the State**

  - Statewide, minimum alfalfa feed per milk cow to assure animal health and productivity is 12 pounds per day. Feeding levels below 12 pounds for extended periods results in lower production, higher costs, and lower profits.

  - Alfalfa hay is a critical input to the dairy industry, but is bulky and costly to transport. Imports of alfalfa hay from other regions of the state or from other states are expensive.

  - Alfalfa is a high water-use crop and is vulnerable to reduced water supplies and higher water prices.

  - The dairy industry is also an important user of many agricultural byproducts which would otherwise have very limited productive value, including almond hulls, cottonseed meal, and sugar beet pulp.

- **The Proposed Federal Action Would Cause Permanent Reductions in Crop Acreage in the SWP and CVP Service Areas in the Short Run, and the Intermediate- and Long-Run Implications Are Much Worse**

    - The proposed federal action is likely to result in the permanent idling of nearly 196,000 acres, including 104,000 acres of cotton and field crops, 18,700 acres of grains, 21,350 acres of alfalfa, 41,400 acres of vegetables, and 10,000 acres of permanent crops. This represents an increase of 155,400 acres over lands that would be idled by current SWP operating requirements. The lands are expected to be primarily in the westside areas of the South San Joaquin Valley.

        - With the permanent idling of 21,350 acres of alfalfa, the dairy industry would need to offset the shortfall in production by increased purchases of alfalfa from outside the impacted area or by purchases of poorer quality feed substitutes that have lower nutrient contents.

        - Net income of San Joaquin Valley dairy producers would decline by $5.1 million or $0.18 per hundredweight of milk.

        - Net income of diary producers in other regions of the state would decline by $3.6 million or $0.02 per hundredweight of milk.

    - With the greater frequency of water shortages under the proposed action, lands remaining in production would be subject to much less certain water supplies in the future.

        - Agricultural contractors on the SWP could expect at least a 40 percent shortage in 4.5 years out of 10 in contrast to 2.5 years out of 10 currently. The annual shortfall in water deliveries would increase by 130,000 acre-feet to nearly 400,000 acre-feet.

        - Irrigators using CVP water could expect at least a 40 percent shortage in 4 years out of 10 in contrast to 1 year out of 10 currently. The annual shortfall in water deliveries would increase by 600,000 acre-feet to nearly 743,000 acre-feet.

        - In a critically dry year, with a delivery shortage of 65 percent, an additional 230,000 acres of San Joaquin Valley cropland would be idled, including an additional 56,200 acres of alfalfa. Total alfalfa land idled would increase to 77,550 acres.

        - Net income of San Joaquin Valley dairy producers would decline by $18.6 million or $0.67 per hundredweight of milk.

        - Net income of diary producers in other regions of the state would decline by $12.9 million or $0.07 per hundredweight of milk.

- These projected shortages and impacts should be viewed as a minimum, since they exclude the effects of the CVPIA and other regulations

- **The Implications for the California Dairy Industry Are Severe**

  - The reduced income impacts will force some dairy producers out of business, particularly less efficient producers in the San Joaquin Valley.

  - The income implications for dairy producers in other parts of the state are not as significant, but may be sufficient to force some marginal operations out of business.

  - The income impacts for dairy producers in both the San Joaquin Valley and the rest of California may be much larger if the alfalfa required is not available from other sources at the time it is needed, causing even more of an increase in hay prices.

- **The Implications for the California State Economy Include Losses in Income and Jobs**

  - Even if retail dairy product prices are not increased to reflect higher dairy production costs, employment losses statewide would range from 250 to 1,000 jobs, depending on the severity of the water shortage

  - Income losses would range from $20 million to $71 million

  - These figures, however, could be much larger if the cost of production increases to dairy producers are passed on to consumers.

Introduction

Overview of Issues

California has experienced two severe droughts in the last two decades, and California agriculture has been severely impacted. Those irrigators and regions with access to alternative sources of reasonably-priced water have adapted more successfully than others. Nonetheless, because of water shortages and reduced water supply reliability, large amounts of prime agricultural land in the Central Valley of the state have been idled, some permanently. Additional large amounts of prime land are seriously threatened by the reduced reliability of water supplies in the future.

While California water supplies have become less reliable, water demands have increased sharply due to rapid population growth and to large increases in environmental demands for instream and habitat water uses. Between 1980 and 1990, population in California rose more than 6 million to 31 million. Population growth will continue and by 2010 population is projected to reach 42 million [CDOF 1993]. Officials warn of statewide annual water shortages of 4 million to 6 million acre-feet by 2010, compared to about 35 million acre-feet of current developed supplies [ACWA 1993].

As water demands have increased and available supplies have stagnated or declined, agricultural water prices have increased, in some cases sharply. As a result, some lands have been idled temporarily and others have been idled permanently. In some cases, as permitted by market, climate, and available equipment, farmers have temporarily changed rotations or added different crops. However, the conditions mentioned prohibit large changes in crop acreage, particularly in the short run.

On December 15, 1993, the Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFW), and the U.S. Bureau of Reclamation (BOR) made a joint proposal for measures to improve environmental

conditions in San Francisco Bay, the Sacramento/San Joaquin Delta ("Delta"), and tributary areas. This joint agency group, called "Club Fed," identified operational requirements for increased water flows through the Delta under the ESA for the Delta smelt and the winter-run Chinook salmon as well as water quality standards proposed by EPA under the Clean Water Act (CWA). Club Fed prepared a Draft Regulatory Impact Assessment (RIA) to estimate the economic impacts of the proposed action on San Joaquin Valley agriculture. Because of unrealistic simplifying assumptions made in the analysis, the results significantly underestimate the potential impacts on San Joaquin Valley agriculture of the proposed action.

In particular, Club Fed posits that the water supply restrictions due to the proposed action will be met by idling 130,000 acres of hay and pasture land alone. In contrast, history indicates that it is far more likely that such water restrictions will affect not only hay and pasture acreage, but also cotton, vegetables, grains, and permanent crops. In addition, the analysis assumes that ground water pumping will not be increased to offset reduced surface water supplies. Evidence from the 1987-1992 drought proves just the opposite (See [CDWR 1993], [NEA 1992], and [NEA 1993]).

Although not usually considered in impact analyses related to water shortages, the California dairy industry is in fact very vulnerable to such shortages. The dairy industry is the largest single user of alfalfa in California, and alfalfa is the most important roughage material used in dairy feed rations. Further, dairies use large amounts of corn silage, cottonseed meal, sugar beet and tomato pulp, and other agricultural products and byproducts as concentrates and roughages in feed rations. Since all of these crops are directly vulnerable to the proposed federal action and other regulatory water restrictions, dairy producers are also directly vulnerable. The potential effects extend to input industries (such as chemicals, machinery, and finance) supplying growers of alfalfa and other crops used in dairy feeds; to industries supplying dairy producers and dairy plants; and to consumers.

Purpose and Approach of Study

The purpose of this study is to analyze the impacts of agricultural water restrictions on alfalfa and other crops and the resultant impacts on the dairy industry, related industries, and consumers. Because of the linkages from alfalfa to the dairy industry and those in turn from the dairy industry to consumers, an analysis of water restrictions which stops after estimating hay acreage reductions misses the many important forward linkages which must be considered.

The analysis begins with a discussion of the importance of the California agricultural sector and in turn of the importance of the dairy sector to agriculture and the economy. Following is an analysis of the structure of the California dairy industry, with emphasis on

characteristics of demand, prices, and regulations. Next is a discussion of the importance of alfalfa to the dairy industry, including physiological and nutritional factors that make alfalfa such an important input in dairy rations. Next is a review of potential water supply impacts of the Club Fed proposal and of other regulatory actions on agriculture overall and on the acreage of alfalfa and other crops. These developments are followed by an estimation of impacts of reduced alfalfa acreage on California dairy product availability and costs and the resultant impacts on consumers.

Both short-run and long-run impacts of water restrictions are considered. In the short run, the Club Fed proposal by itself will cause statewide declines in alfalfa acreage, and there will be impacts on dairy producers. In the intermediate and long term, however, much larger acreages of alfalfa and other crops will be affected because of the cumulative impacts of the Club Fed proposal, other regulatory water restrictions, and cyclical hydrologic droughts. As a result, the probability of much larger adverse impacts on dairy producers, on milk and processed product outputs and prices, and on consumers increases sharply as larger acreage adjustments occur.

Contributions of California Agriculture to the Economy

California agriculture is a basic, goods-producing industry that supports many other goods- and service-producing industries throughout the economy. The state produces about 250 crop and livestock commodities with an annual gross sales value of $20 billion. The state produces nearly half of total U.S. vegetables and nearly three-fourths of U.S. fruits and nuts, including at least 80 percent of the nation's broccoli, processed tomatoes, almonds, avocados, grapes, lemons, nectarines, olives, pistachios, plums, prunes, and walnuts. With only 3 percent of total U.S. farmland, California agriculture produces 11 percent of total U.S. agricultural value [CDWR 1993]. The sector not only represents an important source of jobs and economic activity, but also provides a reliable, low-cost, and safe supply of many different foods.

Agriculture has been a cornerstone of the California economy for more than 150 years and remains a vital component serving both domestic and foreign demands. Agriculture supports nearly 10 percent of the state's total jobs, not only in farming, but also in food processing, fertilizer and farm machinery production and sales, trucking, storage, and many related industries [Carter & Goldman 1992]. California also accounts for 10 percent of total U.S. agricultural exports and provides a unique variety of healthful foods to domestic and foreign markets at very low costs. It provides and maintains extended greenbelts, open space, and fish and wildlife habitat essential for quality of life for urban and rural residents and for environmental benefits. It has taken a lead role in ground water management, conservation, and habitat restoration.

Nonetheless, natural and manmade conditions are affecting California agriculture in many important ways. Hydrologic droughts have caused cyclical water shortages for centuries, but recent federal and state regulations hold the threat of permanent shortages. Since developed water supplies have not kept pace with increased water demands and are unlikely to do so in the foreseeable future, competition for those limited supplies will intensify. Agriculture will be under greater pressure as a result.

Importance of the California Dairy Industry

Milk is one of the most important foods in American diets, supplying for many people the majority of their intakes of essential vitamins and minerals. Because of the perishability of milk and because California is relatively isolated from the rest of the country, fluid milk imports from other states are very limited. Hence, regulations on minimum producer prices, marketing areas, and other aspects of the industry have been implemented to insure an adequate and continuous supply of pure, fresh, wholesome market milk. Because of the critical importance of an adequate supply of safe milk for human consumption, milk production is considered to be a business affected with a public interest [California 1993].

The California dairy industry is the largest single sector in California agriculture. In 1993, the industry had 1.2 million dairy cows[1] and registered $2.7 billion of sales, which represented about 13 percent of agricultural gross revenues [Estrada 1994]. The dairy industry also represents an additional $0.2 billion in annual sales from the culling of approximately one-third of the state's milk herd each year ([Goold 1994] and [Fresno Ag. Comm. 1993]). Using a sales "multiplier" of 2.0 from [Carter & Goldman 1992], the contribution of the dairy industry to the California economy is $6 billion per year.

Milk production in California has more than doubled since 1974 due to large increases in both numbers of milk cows and production per cow (see Figures 1 and 2). Over the same period, the number of dairies in California fell from 4,473 to 2,442 [Butler 1994].

The California dairy industry directly employs 42,000 people [MIG 1994]. This includes 27,000 on dairy farms and 15,000 in dairy processing plants, the latter for both fluid and manufactured products. In addition, the dairy industry supports employment in many sectors linked to it, including inputs such as feed, equipment, and finance; processing; marketing; and distribution [Butler 1994]. Connections with input-supplying businesses represent "backward linkages," while those with processing, marketing, and distribution entities are "forward linkages."

[1] Milk cows and heifers that have calved, on farms.

Figure 1

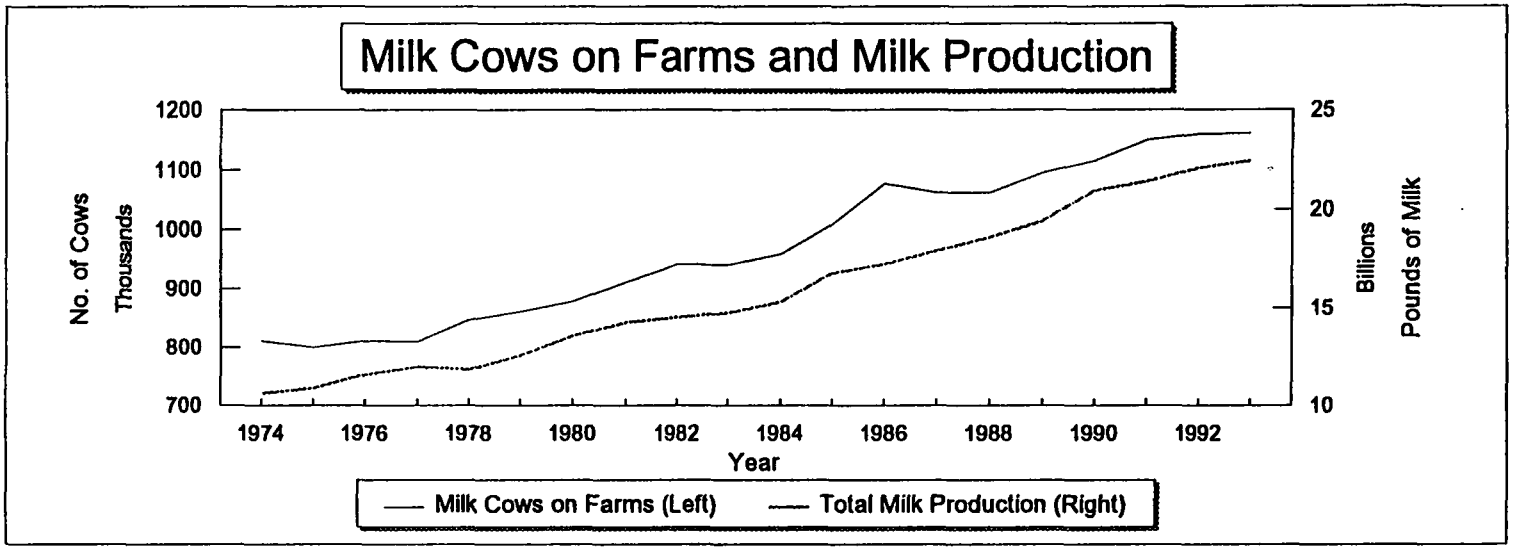
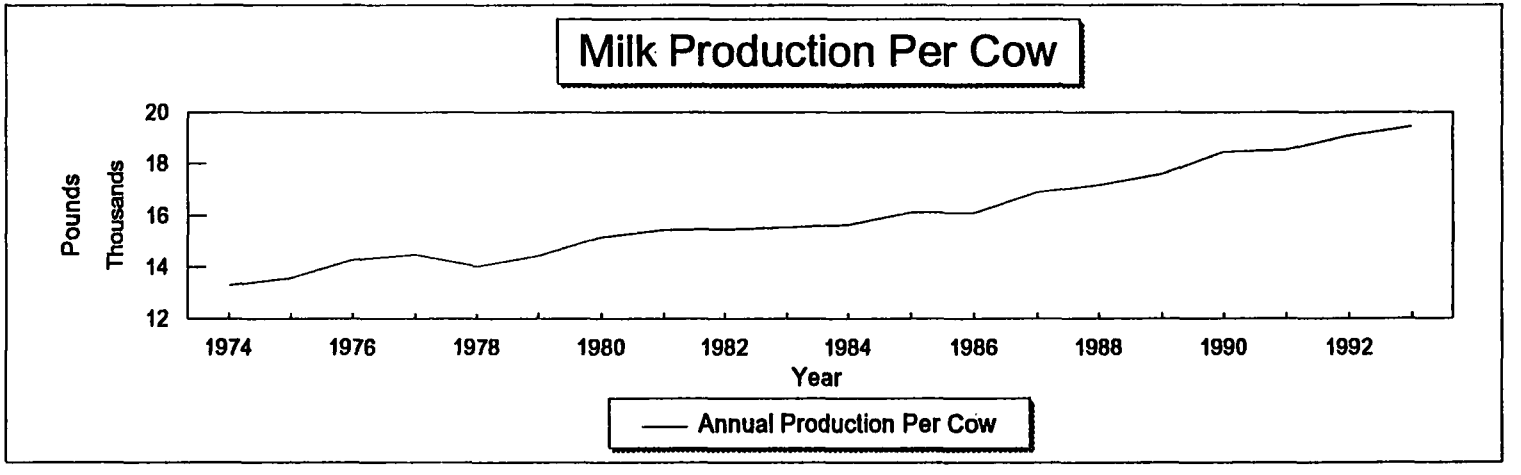


Figure 2



Structure of the California Dairy Industry

The "structure" of an industry refers to such descriptive measures as its size, number of businesses, employment, characteristics of supply and demand, and nature of government regulations, if any. Industry structure can be an important factor that affects the ability of individual firms to operate under increased costs and other economic conditions not within their control. Structure is also an important factor in determining the effects on final consumers of cost and other changes in an industry. The following section briefly summarizes some of the important elements of the structure of the California dairy sector, particularly as they relate to higher production costs facing the industry.

Regions and Production

California can be split into five dairy producing regions: Del Norte-Humboldt, North Bay, North Valley, South Valley, and Southern California [2]. In 1993, the 2,428 dairies in those regions produced 22.9 billion pounds of milk [CDFA, DMB 1994] or 15 percent of total U.S. production. Among the dairies, 2,248 produced market milk [3] and 180 produced manufacturing milk [CDFA, MSB July 1994]. Only two percent of the milk produced in the state was manufacturing milk [CDFA, DMB 1994].

The average herd size in California was 495 cows in 1993, although the average ranged from 113 in Del Norte-Humboldt to 807 in Southern California (see Table 1). Of the total milk

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2 The Southern California region is not covered by Western United Dairymen and thus is mentioned only briefly in this analysis. See Appendix A: Regions.

3 Dairies must meet certain sanitary standards (e.g. maximum bacteria counts and temperature levels, a thermometer and temperature device, and other minimum standards) to be classified as Market Milk Dairies. If they do not meet the requirements they are classified as Manufacturing Milk Dairies.

produced, the North Valley and the South Valley provided 35.4 percent and 34.9 percent, respectively, while Southern California provided 24.8 percent. Over the last two decades, the percentage produced in Southern California has declined as dairies in that region have moved north in response to population growth and other urban pressures [Butler 1992].

Table 1
Regional Location and Production of Dairies in California

Area	Total Number Dairies	Average Number of Cows per Dairy	Percent of Total Milk Produced	Average Produced per Cow/Day (lbs.)	Annual Produced Per Cow (lbs.)
Del Norte-Humboldt	141	113	1.1	42.75	15,604
North Bay	165	275	3.7	52.15	19,035
North Valley	1,158	360	35.4	53.25	19,437
South Valley	594	714	34.9	51.69	18,867
Southern California	370	807	24.8	52.11	19,020
State Total	2,428	495	99.9	52.23	19,066

Source: [CDFA, MSB July 1994]

While milk production has increased rapidly since 1970, the number of processing plants has fallen, and average plant size has increased because of economies of scale. In 1992, there were 51 plants reporting sales of fluid market milk [CDFA, DMS 1993] versus 322 in 1970 [Butler 1994]. Forty-nine percent of the plants in 1992 were located in Southern California, and half of those were located in Los Angeles County alone.

Statewide in 1993, there were 21 plants which manufactured butter and 42 which manufactured cured cheese [CDFA, MSB July 1994]. Many of the plants that manufactured butter also manufactured dry milk.

Thirteen dairy cooperatives operated in California in 1993, seven of which owned and operated processing plants [CDFA, MPB 1994]. No single cooperative dominated the state, although one or two strong cooperatives existed in each of the Southern California, Northern

California, and South Valley regions. All these cooperatives operated balancing plants manufacturing butter and powder, and many also manufactured cheese [Boynton 1992].

Milk is used in five classes of product as follows:

Class 1	fluid products, yogurt (in-state), sterilized or Ultra Heat Treated (UHT) milk (in-state), and lactose-reduced milks
Class 2	fluid creams, sour cream, cottage cheese, buttermilk, sterilized creams, yogurt (out-of-state), and UHT milk (out-of-state)
Class 3	ice cream, ice milk, light dairy dessert, frozen mixes, frozen yogurt, other frozen products
Class 4a	butter and dried milks
Class 4b	cheese other than cottage cheese

Product classes are established only by legislation in California [Boynton 1992]. In addition, all product standards are established legislatively.

Of the total market and manufacturing milk produced, 66 percent is available for manufacturing. Thirty percent of the market milk produced goes to Class 1 usage, 4 percent goes to mandatory Class 2 usage, and 66 percent goes to usage other than Class 1 and mandatory Class 2 [CDFA, DMB 1994].

Sales of Class 1 products in 1993 were as follows [CDFA, DMB 1994]:

Whole Milk	42 percent
Lowfat (2%)	37 percent
Skim	11 percent
Lowfat (1%)	8 percent
Half-and-Half and other uses	2 percent

From 1977 to 1992, gallon sales of whole milk and lowfat (2%) milk remained quite steady, although their proportion of total Class 1 sales fell from 90 percent to 78 percent during that period [CDFA, DMS 1993]. Skim milk sales have increased, lowfat (1%) milk sales have increased since their introduction in 1990, and half-and-half sales have increased.

Sales of Class 1 products vary by region of the state as indicated in Table 2. Southern California is the largest user, accounting for 49 percent or more of all products. Table 3

shows the percentage of sales by product, by region. Southern California accounts for the largest percentage of sales for all products at 59 percent, while the Valley Counties and San Francisco Bay have 21 percent and 20 percent, respectively [CDFA, DMB 1994]. Whole milk and lowfat milk (1% and 2%) together comprise 82 to 90 percent of sales in all regions, with a fairly even split between whole and lowfat milk.

Table 2
Regional Sales of Class 1 Products in California

May 1993 Sales				
Regions	**Whole Milk**	**Lowfat Milk**	**Skim Milk**	**Half-and-Half**
San Francisco Bay	17.5%	20.0%	25.0%	30.0%
Valley Counties	19.8%	24.9%	14.0%	21.0%
Southern California	62.5%	55.0%	61.0%	49.0%
Remainder of State	0.2%	0.3%	0.2%	0.3%
State Total	100%	100%	100%	100%
State Total (Gal.)	26,815,349	23,622,567	7,490,183	814,491

Source: [CDFA, DMB 1994]

Table 3
Percent of Class 1 Milk Sales by Product and Region

Product	San Francisco Bay	Valley Counties	Southern California	Remainder of State
Whole Milk	41.0%	43.0%	48.0%	36.0%
Lowfat Milk	41.0%	47.0%	38.0%	50.0%
Skim Milk	16.0%	9.0%	13.0%	12.0%
Half-and-Half	2.0%	1.0%	1.0%	2.0%
Region Total	100%	100%	100%	100%
Region Total (Gal.)	11,517,889	12,430,368	34,642,133	152,200
% of State Sales	19.6	21.2	59.0	0.2

Source: [CDFA, DMB 1994]

In 1993, there were 90 million pounds and 67 million gallons of Class 2 products manufactured. In addition, there were 167 million gallons of Class 3 products and 2 billions pounds of Class 4a and Class 4b products manufactured [CDFA, DMB 1994].

California Consumption of Dairy Products

No data collected by government agencies or other organizations directly measure California consumption of dairy products. However, some products either sold or manufactured in California reasonably represent the quantities consumed [CDFA, DMS 1993]. These products are neither imported nor exported in significant amounts, nor are they storable for extended periods of time. These products include all Class 1 products and cottage cheese, buttermilk, and frozen products.

The 1992 estimated per capita consumption and sales of Class 1 products was 103.6 quarts. This included 80.4 quarts of fluid milk (whole and 2% lowfat), 10.8 quarts of skim milk, 8.4 quarts of lowfat (1%) milk, 1.3 quarts of half-and-half, 2.7 quarts of yogurt and miscellaneous Class 1 products, and 1.0 quarts of fluid buttermilk [CDFA, DMS 1993]. Per capita consumption and manufacture of cottage cheese was 3.2 pounds. In addition, per

capita consumption and manufacture of frozen products was 19.7 quarts. This included 14.2 quarts of ice cream, 4.7 quarts of ice milk, 0.7 quarts of sherbet, 0.1 quarts of imitation ice cream, and less than one quart of imitation ice milk [CDFA, DMS 1993]. Historically, the per capita consumption of these selected dairy products in California has declined from 126.1 quarts in 1975 to 103.6 in 1992 [CDFA, DMS 1993].

Costs of Production

Costs of production vary widely within the California dairy industry. Costs depend on many factors, including rations fed, size of operation, transportation costs for both purchased inputs and milk, climate, and animal productivity. Since these characteristics differ throughout California, so also do the costs of the dairy industry.

The Milk Stabilization Branch of the California Department of Food and Agriculture (CDFA) collects, bimonthly, information on the costs and production of approximately 400 dairies in different regions of the state. This information is utilized to construct representative budgets for dairies of different sizes in different locations. The Director of the CDFA is required to collect and consider this information in the price-setting process for fluid milk. If the reported costs differ materially from the calculated costs using the Commodity Reference Price, the Director may recommend an adjustment in fluid milk price.

Representative budgets for the dairies in the San Joaquin Valley show that feed costs are 50-60 percent of total production costs, labor and other variable costs are 20-40 percent, and fixed costs are about 10-20 percent. Butler [1992] estimates that throughout California feed costs make up about 50 percent of total production costs.

Costs of production are important determinants of whether a business profits in the short run and survives in the long run. In the short run, long-lived machinery and other capital inputs (which in the dairy industry include cows) cannot be varied easily, and a business continues to operate so long as its revenues cover its variable costs. In the long run, however, revenues must cover all costs of production, both short-run and long-run, or the business will stop operations.

Milk production in California is characterized by economies of scale, in which average long-run costs of production decline (over at least some range of dairy size) as size of operation increases. Those producers who go out of business because of losses or other factors generally sell their cows to other producers rather than liquidate them. The numbers of milk cows on farms have declined in only two years since 1975 and numbers overall have increased 43 percent over that period [CDFA, DMS 1993]. Hence, if a dairy producer's higher costs of production due to such uncontrollable reasons as higher feed costs cause long-

term losses, the producer will go out of business. The producer's cows, however, will likely remain in production, either in California or other states.

Milk Pricing

Most U.S. milk pricing is regulated by the Federal Milk Marketing Orders (FMMO). California is an exception, as a state-regulated marketing program determines the milk price received by dairy farmers [CDFA, MSB 1990].

Through the state "Pooling System," processors pay producers of market milk according to the ultimate use of milk based on the five classes defined previously [CDFA, MSB 1990]. Class 1 milk receives the highest price, while Classes 2, 3, 4a, and 4b receive progressively lower prices. Pricing of manufacturing grade milk is not subject to state regulation, but is determined by competitive forces in local procurement areas [CDFA, MSB 1990]. The market milk pricing program does have some effect on the manufacturing grade milk prices.

Class 4a and 4b prices are determined first, followed by Classes 2 and 3, then 1. The Class 4a price is determined by the national prices for nonfat dry milk powder and grade AA butter. The Class 4b price is based on the national prices for block cheddar cheese and grade B butter.

Butter, cheese and powder (dry milk) are residual claimants for milk and are excellent barometers for supply and demand conditions for dairy products [CDFA, MSB 1990]. Class 4a and 4b prices thus reflect changes in supply and demand in the overall dairy industry. They give an overall picture of how producers and consumers interact in the market and measure both demand factors (consumer willingness to purchase, consumer preferences) and supply factors (cost of feed, returns from alternative enterprises, developments in new technology). However, it takes time to reflect these changes as resources tend to be fixed in the dairy industry.

Class 2 and 3 prices are determined from the Class 4a price by adding fixed differentials. The differentials are influenced by Class 2 and 3 product availability in California and in the other Western states. Class 1 prices are based solely on the national price indices used for Class 4a and Class 4b.

California has three separate but identical marketing orders in the state: Northern California, South Valley, and Southern California. Class 1, 2, and 3 prices vary slightly across the marketing regions of the state, although the method of minimum price determination is the same. Class 4a and 4b prices are uniform throughout the state. Class 1, 2, and 3 prices are determined bi-monthly, and Class 4a and 4b prices are determined monthly.

Milk Pooling

Once prices for the five product classes have been established, the blend price [4] producers receive for their milk can be determined by the Milk Pooling System. The Milk Pooling System is the producers' system and is paid for entirely by the producers through a monthly fee deduction from their milk payments.

Demand for Milk and Dairy Products [5]

The potential effects on consumers of changes in milk production costs and prices depend directly on the characteristics of demand for milk and milk products. Those characteristics have been responsible for several of the most significant changes which have occurred in the U.S. dairy industry over the past 25 years, including:

- A 17 percent decline in per capita consumption of fluid milk (excluding yogurt)
- A 24 percent decline in per capita consumption of butter
- A 126 percent increase in per capita consumption of cheese
- A 425 percent increase in per capita consumption of yogurt
- A large shift from whole milk to lowfat milk ([Chang et. al.1992], [Putnam & Allshouse 1992] and [Butler 1994]).

Dairy products in the aggregate account for about 3.5 percent of total consumer expenditures and about 25 percent of food expenditures [Haidacher 1992]. The demands for milk and milk products depend, as do those for other foods, on such factors as the prices of the products themselves and of competing products (including other milk products), prices of complementary products, income, population growth, age, sex, race, family size, health and nutrition concerns, product convenience, and advertising and promotion [Haidacher 1992]. The responsiveness of demand to each of these factors often is expressed as an "elasticity,"

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4 Under the Pooling System, producers are paid according to the market-wide utilization of milk by class [Jesse & Cropp 1985]. Overall market usage is determined by the milk handlers' monthly report of pounds of milk used in each class [CDFA, MPB 1990].

5 Most of the technical issues in the following discussion relate to characteristics of demand at the U.S. level.

which measures the percentage change in the demand for a product (in this case milk or cheese or nonfat dry milk or other dairy products) relative to the percentage change in the variable being examined, with all other factors held constant.

The elasticity of demand for all dairy products with respect to the price of dairy products has been estimated as -0.3046 [Haidacher 1992]. Hence, a 10 percent increase in the price of dairy products is expected to cause a 3 percent decline in the demand for dairy products (and vice versa for a 10 percent decline in dairy product prices). The demand elasticities for fluid milk and for other dairy products relative to their own prices ("direct" elasticities) are shown in Table 4.

Table 4
Direct Price Elasticities for Fluid Milk and Other Dairy Products

Product	Direct Price Elasticity
Fluid Milk	-0.2588
Evaporated Dairy Milk	-0.8255
Frozen Dairy Products	-0.1212
Cheese	-0.3319
Butter	-0.1670

Source: [Haidacher 1992]

The price elasticity shown for fluid milk, -0.2588, is relatively small, and indicates that for every 10 percent increase in fluid milk price, consumer demand declines 2.6 percent. Hence, higher fluid milk prices, all other factors unchanged, will cause greater total consumer expenditures for fluid milk since the percentage increase in price exceeds the percentage reduction in quantity demanded. Conversely, the figure for evaporated and dry milk, -0.8255, indicates that consumer demands are more responsive to changes in prices for these products than for fluid milk. Hence, higher evaporated and dry milk prices would also cause total consumer expenditures for these products to decline, but by proportionately less than for fluid milk.

Consumer income is also an important factor affecting the demand for dairy products. Income elasticity of demand measures the percentage change in demand for a product relative

to the percentage change in consumer (or other measure of) income. Haidacher [Haidacher 1992] summarizes the results of several income elasticity studies done over the last 15 years. Expenditures on fresh whole milk have been found to have a small negative income elasticity, meaning that consumer purchases decline slightly as income increases. However, more processed (and expensive) products such as cream, butter, cheese, yogurt, and ice cream, generally are more positively responsive to income changes. The income elasticity for yogurt, 0.76, is the largest among the dairy product measures reviewed by Haidacher [Haidacher 1992].

Short-term (year-to-year) changes in dairy product consumption are most influenced by changes in the prices of dairy products and other foods. Income changes and demographic factors are less important in the short run, but more important in the long run. Combined socioeconomic and demographic factors have limited effects on yearly changes in per capita consumption of dairy products [Haidacher 1992].

Demand Issues Specific to California

The direct price elasticities discussed above have important implications for the impacts on California consumers of higher water costs and higher dairy product prices. While per capita fluid milk consumption has declined in California since 1977, the absolute amount of fluid milk consumed has risen almost 14 percent [CDFA, DMS 1993]. During that same period, population has risen more than 40 percent [CDOF 1993]. Hence, fluid milk consumption has grown about 0.37 times as fast as population.

California population is expected to grow to 42 million by 2010, and fluid milk consumption could be expected conservatively to increase by at least 13 percent by then to at least 920 million pounds annually. Butler estimates that total milk production in California will need to expand from 21.5 billion pounds per year in the early 1990s to 36 billion pounds in 2010 to accommodate population estimated at 45 million [Butler 1994]. Assuming a population of 42 million rather than 45 million, required total milk production would rise to about 34 billion pounds by 2010.

Future California demands for milk products will also be boosted by expected income increases. From 1981 through 1991, per capita personal income rose an average 5 percent per year in California. Over the next 10 years, the California Department of Finance anticipates that total personal income (not adjusted for inflation) will grow about 6 percent per year, population will grow 1.7 - 2.0 percent per year, and that per capita income will consequently grow about 4 percent per year [Gibson 1994]. Given the positive and relatively large income elasticities for many processed dairy products, demands for dairy products should increase significantly in response to this projected income change.

Importance of Alfalfa to the California Dairy Industry

Supply and Demand

Alfalfa is one of the most important forage crops grown in California and the United States. California produces about eight percent of U.S. alfalfa production [USDA 1992]. It is the most important hay crop grown in the state and has represented an average of 83 percent of all hay produced here for the last 5 years [FSMNS 1994]. It is grown both for its direct commercial value in hay, pellets, and other products, and for its value as a rotation crop. Alfalfa is frequently rotated with cotton, vegetables, and grains. As a perennial crop, alfalfa is planted with a 3-5 year horizon. Given the time and costs required to establish the crop, alfalfa is not planted unless growers are confident of the long-run availability and reasonable prices of water and other essential inputs.

Since the early 1950s, alfalfa acreage harvested in California has averaged about one million acres annually [Nuckton & Johnston 1983] and [CDFA, CASS 1993]. Alfalfa acreage has responded to changes in the cotton farm programs [6] and in profitability of other crops, including tomatoes and other vegetables.

Alfalfa is a high consumptive user of water, and Central Valley application rates range from 2.5 to 5 acre-feet per acre per year. Alfalfa acreage has been affected directly by recent restrictions in water supplies. Since 1988, harvested acreage in the state has fallen from 1,100,000 acres to 920,000 acres in 1993, a 16 percent decline.

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[6] In some areas of California, alfalfa competes with cotton for land. From 1954-1972, cotton acreage allotment and set-aside programs reduced cotton acreage. Much of the affected land was planted to alfalfa [Knapp and Konyar 1990].

The number of cuttings made from alfalfa fields depends primarily on climatic conditions. Generally, more cuttings per year are made in the warmer San Joaquin Valley and Southern California areas than in the cooler Northern California areas. Yields in California are more than twice the U.S. average because of favorable climate and irrigation [Nuckton & Johnston 1983] and [USDA 1992].

In-state production provides most of the alfalfa available for animal consumption, as imports and exports each average 500,000-700,000 tons per year, and changes in ending inventories rarely exceed 600,000 tons (see Table 5). Last year was an exception, with ending inventories falling almost a million tons from the previous year [7].

Table 5
California Alfalfa Supply and Utilization, 1989-1993 (000 Tons)[1/]

	1989	1990	1991	1992	1993
Supply					
Beg. Inv. (5/1)	139	216	271	641	130
Production	6,834	6,996	7,035	6,432	6,348
Imports	704	688	619	529	720
Total Supply	7,677	7,900	7,925	7,602	7,198
Utilization					
Exports	13	10	699	599	634
End. Inv. (12/1)	1,502	1,609	2,321	2,373	1,396
Available for Consumption	6,162	6,281	4,905	4,630	5,168

1/ Consumption calculations for 1989 and 1990 are not comparable with 1991-1993 because of incomplete export information available prior to 1991.

Source: [FSMNS 1994]

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7 The decline in inventories last year was due in part to the large shipments to the Midwest to assist in feed depletion from the floods.

Alfalfa use by dairy cows has been estimated to account for about 50 percent of total California consumption [Konyar & Knapp 1986], which is consistent with the data in Table 5. In 1993, alfalfa available for consumption (defined as beginning inventory plus production plus imports minus exports minus ending inventories) was 5.2 million tons. Assuming the state's 1.2 million dairy cows consumed an average of 12 pounds of alfalfa per day [8], they consumed approximately 51 percent of the alfalfa available for consumption last year. The remainder was consumed by other dairy animals [9], beef cattle, and horses.

California alfalfa production in 1992 was 6.4 million tons, of which 41 percent was in the North Valley, 18 percent in the South Valley, and the remainder in Southern California [10]. Over time these proportions have remained relatively steady. Alfalfa is used primarily within the region where it is produced because of the high costs of hauling it long distances. Nonetheless, California imports between 400,000 and 800,000 tons per year from neighboring states [FSMNS 1994] and [Coelho 1994]. The largest quantities of such imports are, in ascending order, from Oregon, Utah, Arizona, and Nevada. The alfalfa imported from Oregon is primarily used on the coast, that from and Nevada in the Central Valley, and that from Utah and Arizona in Southern California [Coelho 1994].

Because of transportation costs, little hay is imported from more distant states. Imports were at a 6-year high in 1993 at 720,000 tons in response to strong demands and low beginning inventories. Generally, imports provide a short-run increment to supplies and do not represent a viable long-run growth source for California. Since 1985, total combined alfalfa production in Arizona, Nevada, Utah, and Oregon has ranged from 5 to 6 million tons [USDA August 1994] and [USDA 1992]. Increased milk production and population growth and the resultant pressures on agricultural water use in these other states will limit growth in alfalfa available for shipment to California.

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8 Based on [Knapp & Konyar 1990] that nearly 60 percent of alfalfa is used by the state's dairy industry and personal communication with dairy producers that the absolute minimum fed is 10 to 12 pounds per day.

9 Calves and yearlings (heifers that have not calved)

10 The alfalfa production regions coincide with dairy production regions, which are defined in Appendix A.

Nutritional Issues

Nutrition is the most important environmental influence on the health and productivity of a dairy cow. Nutrition refers not just to feeds and feeding, but also to the growth, maintenance, reproduction, and lactation [11] of a dairy cow. The dairy cow converts feed that cannot be used directly by humans into high-energy, high-protein milk and meat for human consumption. The dairy cow is a "ruminant" animal, while humans, pigs, and rats are "simple-stomached" animals. A ruminant animal has four compartments in its stomach, of which one is similar to simple-stomached animals. Ruminants are able to eat, digest, and utilize plants and byproducts of processed plants that simple-stomached animals are unable to utilize.

Feeds are utilized according to the available nutrients found in them. The five major nutrients required by a cow are energy, protein, minerals, vitamins, and water. The amounts required vary by species, age, and production level, although water is the most important nutrient. The second most important nutrient is energy. Without adequate energy, utilization of all other nutrients is impaired.

Feeds are either roughages or concentrates. Roughages are bulky, fibrous, and relatively low in energy, while concentrates have relatively more energy or protein and less fiber. Roughages include succulent feeds (pasture, green chop [12], and silage) and dry feeds (e.g. hay and cottonseed hulls) [Bath et. al. 1985]. Concentrates include grains, byproduct feeds, protein supplements, and other feed additives. Rations for most dairy cows are based on roughage. This is economically sound because nutrients from forage are generally cheaper than nutrients from concentrates [Bath et. al. 1985].

Historically, pasture was a main ingredient in dairy cow rations, and in some parts of the United States it remains important. However, as larger numbers of dairy cows have been concentrated on smaller acreages and as milk production per cow has increased, dairy producers have depended less on pasture and more on other feeds. This is especially true in California where drylots [13] dominate and where producers purchase most of their feed rather than growing their own. Moreover, as agricultural water costs have increased sharply since the mid 1980s, irrigated pasture acreage has fallen in California. Pasture is nonetheless still a

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[11] Lactation is synonymous with milk production.

[12] Fresh forage, such as pasture, that is cut and chopped in the field, then hauled to animals in confinement.

[13] Confined lots where dairy animals are housed and all feed is brought to them.

significant part of rations along the Northern California Coast and some portions of the North Valley.

Alfalfa hay is the most widely used forage crop in California. Alfalfa combines high dry matter yield with relatively high energy, protein, mineral, and vitamin content and is commonly supplemented with very simple concentrate mixes with excellent results [Bath et. al. 1985]. High milk production requires consumption of high quality alfalfa hay, which is made when it is cut at the right stage of maturity, generally the pre-bud stage. Other legumes, such as clover, are difficult to make into high-quality hay and are used as supplemental feeds.

Most of the other roughages available are byproducts such as cottonseed hulls and are included in a ration primarily for their fiber when other higher-quality roughages are not available or cannot be purchased at reasonable prices [Bath et. al. 1985]. These other roughages generally are not fed to milk cows because they are poor substitutes for high-quality forage.

Numerous byproduct feeds are available at various times of the year, often at reasonable prices and are used to supplements rations based on availability. These include wheat bran and millrun from the flour industry, hominy feed from corn, beet pulp from sugar beets, citrus pulp from fruit juice processing, distillers' grains from the liquor industry, brewers' grains from breweries, bakery waste, molasses from sugar cane and sugar beets, rice bran and polishings, and dried whey from cheese processing [Bath et. al. 1985]. These byproducts usually comprise minor portions of rations.

The availability of feeds in California varies by regions of the state. As Table 6 shows, the rations fed to dairy cows also vary by these regions. Pasture is a significant portion of the ration in the Del Norte-Humboldt region, but comprises none of the ration in Southern California. Grains and byproducts (concentrates) comprise approximately 50 to 60 percent of the ration in all regions except Del Norte-Humboldt. Alfalfa (dry roughage) comprises 25 to 34 percent of rations statewide.

Table 6
Ration Proportions by Region of California

Ration	Regions				
	Del Norte-Humboldt	North Bay	North Valley	South Valley	Southern California
Dry Roughage [1/]	23.0%	34.0%	24.0%	27.0%	33.0%
Wet Roughage [2/]	4.0%	11.0%	22.0%	17.0%	8.0%
Concentrate [3/]	39.0%	49.0%	53.0%	56.0%	59.0%
Pasture	34.0%	6.0%	1.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%

1/ Alfalfa
2/ Corn silage
3/ Grain and byproducts

Source: [CDFA, MSB Jan-Feb 1994]

Numerous types and combinations of feeds will allow a dairy cow to maintain good health and cost-effective milk production [Bath et. al. 1985]. While no one feed is essential, the feeds in a mix must balance nutrient requirements with the palatability of the ration. Ration formulation is complex for lactating dairy cattle because their nutrient requirements change with level of milk production, body weight, and voluntary feed intake [14]. These and many other restrictions are included in least-cost ration formulation programs, one of which was used in this study [University of California 1990].

A least-cost ration was formulated for the South Valley using *PC Dairy* [University of California 1990]. The formulation was based on a 1300-pound cow producing 65 pounds of milk per day and a milk blend price of $11.00 per hundredweight. The model was constrained to include at least 12 pounds of alfalfa per day for cow health and productivity.

[14] Maximum daily voluntary intake of forage by lactating cows ranges from 1.5 to 3 pounds of dry matter per 100 pounds of body weight.

Alfalfa hay was assumed to cost $140 per ton delivered. Table 7 lists other typically-available feeds and delivered prices in the South Valley.

Table 7
Dairy Feed Prices Used to Calculate Least Cost Rations

Feed	Price per Ton ($)
Almond Hulls	80
Barley, 49 lbs./bu.	136
Molasses, Dried Beet Pulp	130
Steamed Bone Meal	250
Brewers Grain 25% Protein Dried	130
Ground or Rolled Corn	125
Whole Cottonseed	185
Cottonseed Meal 41% Protein Solvent Extracted	181
Rice Bran 13% Fat	90
Corn Silage	30

Source: [Reed 1994] and [Higginbotham 1994]

The following least-cost ration resulted from these restrictions and assumptions:

Alfalfa Hay	13.90 lbs.
Corn Silage	20.17 lbs.
Beet Pulp	12.24 lbs.
Ground or Rolled Corn	8.97 lbs.
Rice Bran	6.18 lbs.
Brewers Grain	1.94 lbs.
Cottonseed Meal	1.70 lbs.
Total	65.10 lbs.

The resultant daily feed cost per cow is estimated at $3.19, and total gross daily income above feed costs is $3.96.

Alfalfa prices were then decreased and increased in increments of $20 per ton, and the least-cost formulation was recalculated. The results are shown in Table 8.

Table 8
Least Cost Rations at Various Alfalfa Prices

	Alfalfa Price ($/Ton)				
	$120	$140	$160	$180	$200
Roughage	Pounds per day				
Corn Silage	0.00	20.17	27.00	27.00	27.00
Alfalfa Hay	19.50	13.90	12.00	12.00	12.00
Concentrate					
Beet Pulp	12.32	12.24	12.19	12.19	12.19
Corn Grain	11.15	8.97	9.14	9.14	9.14
Rice Bran	6.36	6.18	4.62	4.62	4.62
Whole Cottonseed	2.16	0.00	0.00	0.00	0.00
Brewers Grain	0.00	1.94	2.80	2.80	2.80
Cottonseed Meal	0.00	1.70	2.15	2.15	2.15
Total	51.49	65.10	69.90	69.90	69.90
	$ per cow per day				
Optimum Daily Milk Production	7.15	7.15	7.15	7.15	7.15
Total Feed Cost	3.15	3.19	3.31	3.43	3.55
Total Daily Income Above Feed Cost	4.00	3.96	3.84	3.72	3.60

With each $20 per ton price increase for alfalfa above $140, total daily feed costs per cow increase by $0.12. Daily income above feed cost falls by the same amount. At alfalfa prices between $140 and $160 per ton, the alfalfa fed falls to the minimum requirement. Corn silage, corn grain, brewers grain, and cottonseed meal increase, while beet pulp and rice bran decrease, and total feed increases 4.8 pounds. It should be noted that these feeds can be substituted based on availability.

With the $20 per ton price decrease for alfalfa below $140, the total feed costs decrease by $0.04. Daily income above feed costs rise by the same amount. At alfalfa prices between $140 and $120 per ton, alfalfa fed increases by 5.6 pounds. Whole cottonseed is substituted for corn silage, brewers grain, and cottonseed meal, and total feed decreases by 13.6 pounds with more pounds of each feed.

The implications for dairy profitability are significant. As alfalfa consumption is restricted because of higher alfalfa prices, consumption of other feeds and total feed costs increase. For each $20 per ton increase in alfalfa price above $140, profit is reduced by $0.12 per day or (for a cow producing 65 pounds of milk per day) $0.37 per hundredweight. Although available data do not permit a determination of how many California dairy producers would no longer be profitable due to these changes, several budgets from the California Department of Food and Agriculture Milk Stabilization Branch indicate that many would be adversely impacted to a significant degree. If, as discussed in the following chapter, water restrictions also cause reduced acreages and higher prices for other feeds, the impacts on dairy producers would be even more adverse.

Potential Water Supply Impacts Related to the Proposed Bay-Delta Standards

Introduction

California agriculture has suffered from sharply reduced water availability since the beginning of the most recent drought in 1986. Many observers contend that the impacts of such shortages have been minimal and support that contention with data showing increased gross value of agricultural production since 1986. These data do not measure economic viability and potential business closures, however, as it is net revenues that determine long-run survival. The drought caused dramatic increases in agricultural water costs, resulting in direct reductions in farm profits [NEA 1992; NEA 1993]. The proposed Bay/Delta water quality standards, together with the CVPIA and other regulations, threaten to make significant water shortages for California agriculture a permanent rather than a temporary phenomenon.

This section reviews the potential effects of the proposed Bay/Delta standards on California agriculture. Estimates of economic impacts included with the proposed standards are reviewed and the inadequacies of the analysis are discussed. Alternative estimates of acreage, by crop groupings, that will be permanently or temporarily idled by those standards are provided. The alternative acreage estimates are based on an analysis prepared by the State Water Contractors in response to the Club Fed proposal [NEA 1994]. The effects of reduced reliability of water supplies and the significantly higher probability of much greater shortages in the future are incorporated into the estimates of acreage impacts. It is primarily a long-run rather than a short-run analysis, since the economic viability of individual farms and of the entire agricultural sector -- crop production, dairy production, livestock production -- are long-run issues.

December 15, 1993 Proposed Federal Action

On December 15, 1993, a joint proposal was made by the Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFW), and the Bureau of Reclamation (BOR) for measures necessary to improve the environmental health of the San Francisco Bay, the Sacramento/San Joaquin Delta, and their tributary areas. The measures identified by the joint agency group, known as "Club Fed," included operational requirements under the Endangered Species Act (ESA) for both the delta smelt and the winter-run Chinook salmon, along with water quality standards proposed by the Environmental Protection Agency under the U.S. Clean Water Act (CWA).

If the proposed federal action is fully implemented, significant reductions would result in SWP and CVP deliveries to water users throughout California.

Estimates of Economic Impacts Prepared by Club Fed

A *Draft Regulatory Impact Assessment* (RIA) prepared by Club Fed analyzed the economic impacts of the proposed federal actions. The potential impacts of the water quality standards under the CWA and the designation of critical habitat for the delta smelt under the ESA were evaluated. The proposed federal action, if fully implemented, would require increased water outflows to the San Francisco Bay from the Sacramento/San Joaquin Delta.

Club Fed had two goals in preparing the RIA. The first was to comply with Executive Order 12866 which requires federal agencies to assess the costs and benefits of proposed new rules. The second was to provide some direction to the state of California regarding the impacts of alternative implementation plans [Risler 1994]. To provide useful guidance about the impact of changing public policies, an economic analysis must identify the relevant cost and benefit categories, then measure them as explicitly as possible with accepted economic methodologies.

All economic analysis requires some simplifying assumptions to quantify economic impacts. Two measures of a defensible economic analysis are: 1) a logical and well documented development of these assumptions, and 2) some validation or "reality check" on the results of the models used in the analysis. Concerns were raised by a wide range of commentors that the economic analysis included in the RIA did not adequately consider the reality of the institutional framework and physical realities of water supply and water transfer opportunities within California.

The RIA Inadequately Estimated Potential Costs to Agriculture

Many simplifying assumptions were incorporated into the RIA analysis of potential economic costs to California agriculture resulting from the proposed federal action. Three potential implementation scenarios were analyzed. In the first, it was assumed that water reductions would occur within a very narrow geographic area (a portion of the Central Valley), that there would be no opportunities for water trading, and that no crop shifting would be feasible. In the second, implementation was considered over a wider geographic region, and some water trading was assumed. In the third, impacts were spread across the entire Central Valley, and perfectly operating water markets were assumed (i.e., water could be transferred at any time from any point to any other point throughout the Central Valley). These scenarios and the analytical framework developed for each are presented below, along with the estimated acreage impacts.

RIA Agricultural Implementation Scenario 1

Scenario 1 was analyzed using a very simplistic rationing model that allocates water to crops in relation to their average revenue products for irrigation water. The model assumes that all inputs including water are used in constant proportions. It is a short-run model that assumes farmers have very limited flexibility to shift crops or irrigation systems. The basic premise of the model is that farmers facing reduced water supplies will reduce production of the least profitable crops. In a small region with limited trading between water districts, some reduction in high-valued crops will occur in the rationing model. The model assumes that net revenues are proportional to gross revenues.

It was estimated that Scenario 1 would result in 213,000 acres idled, including 109,000 acres of cotton and grains, 36,000 acres of pasture and hay, 8,000 acres of vegetables, and 60,000 acres of other field crops.

RIA Agricultural Implementation Scenarios 2 and 3

Scenarios 2 and 3 were analyzed using the California Agricultural Resources Management model (CARM). CARM uses an optimization approach to examine the effects of price changes and input availabilities on agricultural cropping patterns. Given a change in water deliveries, the model structure assumes: a) that farmers will change their cropping patterns to reduce surface water requirements while preserving profits as much as possible, and b) that farmers will increase groundwater pumping. The economic costs estimated for RIA Scenarios 2 and 3 were based on an earlier study prepared by the University of California which examined the effects of water quality regulations in the Bay/Delta [Zilberman et al 1993]. Groundwater pumping was "turned off" in that analysis and in the RIA analysis, and no rationale was given for that assumption.

Scenario 2, considered by Club Fed to be the most representative of what might happen, resulted in total crop revenue impacts of about one-third those of Scenario 1. However, the actual number of acres expected to be idled was never stated. In Scenario 3, with no barriers to water trading, all of the crop adjustment to water shortage was accounted for by idling 130,000 acres of hay and pasture. This crop grouping was valued at $100 per acre and was identified as the least profitable crop, hence the most likely to be removed from production in response to water shortages. Alfalfa hay is typically valued at $800 to $1,100 per acre and was apparently not included in this crop grouping. Only minor scattered acreages of other hay (not alfalfa) and irrigated pasture are grown within the SWP and CVP service areas. The RIA analysis suggests that all of the acreage adjustments would occur in the north and east regions of the Central Valley.

According to the original study, "three overriding conclusions can be drawn from the results of the model. First, the cost per unit water reductions increases as the quantity of water transferred increases. Second, the cost of water reductions is very sensitive to the size of area on which reductions are imposed and on the groundwater resources and crops grown in the area. Third, the ability of markets to allocate the water cuts in an efficient and compensated manner reduces the total and per unit costs of the water reductions" [Zilberman et. al. 1993].

The intuitively obvious results of the original study actually point to the inadequacies of the RIA scenarios. The RIA scenarios, like the CARM scenarios, can only reveal what we already know — that allowing more trading will reduce the impact and that impacts will be less if spread over a larger area. Unfortunately, both the original scenarios and the RIA scenarios are only hypothetical abstractions of the realities of California agriculture. They ignore different operating rules under the Central Valley Project (CVP) and State Water Project (SWP), and other institutional constraints.

The CARM optimization model is an abstraction of the agricultural decision-making process. While an optimization framework is useful to analyze production possibilities, it is really a textbook world that is analyzed, i.e., one in which all resources are utilized at their economically optimum level.

The Realities of Water Shortage

The recent water shortages in California provide a large body of empirical evidence on the behavior of the agricultural economy under limited water conditions. California is not one large homogeneous economy. It has many different regional economies, some relatively more dependent on agriculture for example, over 30 percent of all jobs in the San Joaquin Valley depend on agriculture for employment, compared to less than 10 percent in Southern California. There was no attempt in the RIA, however to compare projected behavior in

different regions to the proposed federal action. A review of the impacts on the agricultural economy during the recent drought in California offers some insight into the nature of these different impacts.

Evidence from the drought shows that hay and pasture are not the only crops impacted by water shortages. California produces over 250 crop and livestock commodities valued at over $20 billion at the farm gate. These commodities can be affected by both surface and ground water shortages. In 1991 over 253,000 acres of cropland were idled in the San Joaquin Valley, including nearly 160,000 acres of cotton, 15,000 acres of vegetables and 9,000 acres of alfalfa.

The RIA analysis relies critically on the assumed ability to trade water into water short areas. However, no guidance was provided on the realities of accomplishing these trades. No long-run trading balance was done as part of the analysis. A water balance would indicate how much water could be made available and would indicate whether or not this quantity is sufficient to meet agricultural and urban demands. There was also no consideration of the impacts of the proposed federal action on the operational ability to make North of Delta-South of Delta water transactions.

In summary, the RIA analysis significantly underestimates the agricultural impacts of the proposed Bay/Delta standards. The primary reasons are the failure to account for:

- Differences in how irrigation districts and irrigators adjust to water shortages;
- Differences in operational rules causing differential impacts in CVP and SWP areas;
- The increased probability of water shortages under the Club Fed proposal;
- The interaction of groundwater and surface water supplies;
- The feasibility of crop shifting, with respect to market constraints and crop rotation requirements;
- The forward linkages from irrigated crop production to California's dairy and livestock industries, and to dairy product processing and other food processing and manufacturing industries.

Corrected Estimates of the Effects of the Proposed Federal Action

The following discussion of the more likely impacts of the proposed federal standards and rules for the Bay/Delta is based, in part, on an analysis prepared by the State Water Contractors in response to the RIA prepared by Club Fed [NEA 1994]. The acreage impacts would have a direct and significantly adverse effect on the California dairy industry and could cause movements in retail dairy prices.

Changes in San Joaquin Valley Water Supply Resulting from the Proposed Federal Action

The proposed federal action would require increased Delta outflows and restrictions to export pumping for the state and federal water projects. These actions would significantly lower available water supplies to agricultural water contractors in the San Joaquin Valley. In addition, the frequency of critical shortages would increase substantially above occurrences under state requirements. The expected shortages and frequency of shortages under state requirements and the proposed federal action are discussed separately for the state and federal projects in the sections below.

An analysis of the expected effect of the proposed federal action on available export supplies was conducted for the agricultural water contractors on the state and federal projects [15]. The export study was based on a hydro-planning simulation model developed and operated by the California Department of Water Resources (DWR). A series of alternative simulation runs was conducted by DWR at the request of Club Fed to examine the water supply impacts of meeting the proposed federal regulations. Results of the Delta simulation runs were then further analyzed to determine the effects of the proposed regulations on deliveries to the state and federal contractors.

Water Supply Changes for the SWP Agricultural Contractors

Under current state requirements, the SWP San Joaquin Valley agricultural contractors can expect, on average, to receive just 77 percent of their full entitlement deliveries of 1.2 million acre-feet. This is a shortfall of over 270,000 acre-feet. Under the proposed federal action, long-run average deliveries are expected to decline to only 67 percent of full entitlement, an average delivery shortage of nearly 400,000 acre-feet.

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15 The water supply study was conducted by David R. Schuster, a water management/policy consultant to the Kern County Water Agency, and Water Resources Management, Inc., Sacramento, CA, January 1994.

In addition, the frequency of all levels of shortage would increase. Under existing state requirements, growers can expect at least a 40 percent delivery shortage every 2½ years out of 10. Under the proposed federal action, the frequency of a 40 percent shortage would increase to every 4½ years out of 10. The frequency of full entitlement or near full entitlement deliveries would decline dramatically.

Expected long-run average deliveries to SWP agricultural contractors under current state requirements and under the proposed federal action are presented in Table 9.

Table 9
Long-Run Average Deliveries to the SWP Agricultural Contractors

Long-Run Average Shortage	Delivery Shortage (%)	Shortfall in Entitlement (AF)1/
State Requirements	23%	271,200
Proposed Federal Action	33%	399,600

1/ Based on full entitlement deliveries of 1,200,000 acre-feet for San Joaquin Valley agricultural contractors.

Source: [WRM 1994]

Water Supply Changes for the CVP Agricultural Service Contractors

For the CVP agricultural service contractors who rely on water exported from the Delta, the proposed federal action would dramatically increase the occurrences of delivery shortages. Presently, under state requirements, annual shortages of 7 percent, equivalent to a 137,000 acre-feet shortfall, are expected to occur on average. Under the proposed federal action, the average expected shortage from full entitlement would be 38 percent, an almost 750,000 acre-feet shortfall.

The frequency of shortage on the CVP would also increase with implementation of the proposed federal action. Under existing state requirements, growers can expect at least a 40 percent delivery shortage only 1 year out of every 10. Under the proposed federal action, the frequency of a 40 percent shortage would increase to every 4 years out of 10. The frequency of full entitlement or near full entitlement deliveries would decline dramatically. The

estimated project delivery impacts do not take into account the additional potential effects of CVPIA implementation.

Under the proposed federal action, CVP deliveries would be curtailed to 42 water districts of the Delta Division's Delta-Mendota Canal Unit, Mendota Pool and the San Luis Canal Unit; the Friant Division's Cross Valley Unit; and the San Felipe Division. Because of the high priority of their rights, the Exchange Contractors of the Delta Division would not be affected by the shortage except in the most extreme critically dry years.

Expected long-run average deliveries to CVP agricultural service contractors under current state requirements and under the proposed federal action are presented in Table 10.

Table 10
Long-Run Average Deliveries to the CVP Agricultural Service Contractors

Long-Run Average Shortage	Delivery Shortage (%)	Shortfall in Entitlement (AF)1/
State Requirements	7%	136,800
Proposed Federal Action	38%	742,700

1/ Based on full entitlement deliveries of 1,954,500 acre-feet for San Joaquin Valley agricultural service contractors affected by the proposed federal actions.

Source: [WRM 1994]

Current EPA Revisions to Water Supply Impacts

Based on comments and testimony received on their initial evaluation of the effects of the proposed federal action, EPA is currently revising their estimates of the expected water supply impacts related to the CWA and ESA requirements for the Delta. Their revised analysis is expected to include a significantly more detailed analysis of the effects of the proposed federal action on expected contract deliveries on both the State Water Project and the Central Valley Project. The revised analysis of water supply impacts is expected to focus both on long-run average deliveries and the expected frequency with which delivery shortages would occur [16].

16 The expected revisions to the RIA analysis were discussed by EPA at a series of technical workshops held during June 1994.

Impacts of Water Restrictions on Alfalfa Acreage

Farm-Level Adjustments to Water Restrictions

The proposed federal action would have a significant effect on farming operations in the San Joaquin Valley. Complying with the standards would mean higher water costs and lower average entitlement deliveries for users of both SWP and CVP water. Growers on both projects would see significant reductions in average long-run deliveries. The significant long-run water shortages to growers would cause productive lands to be both permanently and temporarily idled in the San Joaquin Valley.

The economic losses related to water restrictions grow at an increasing rate as the frequency, magnitude, and duration of water shortages increase. For those farmers without alternative surface and ground water supplies, the initial short-run response to shortage is to remove relatively low-profit crops from production. As water shortages worsen in the short run, the higher-valued crops are also affected. Consequently, economic impacts become increasingly more significant as the magnitude of the water shortage increases.

Over time, the increased frequency of shortages will adversely affect sustained returns to farming operations. If crop returns are not available to recover fixed land, equipment and water costs, acreage would be idled in the long run. The amount of land permanently idled would depend upon the frequency of water shortages, the expected increases in water costs, and the resulting impacts on average long-run returns.

For growers with access to supplementary water supplies, reductions in entitlement deliveries would be offset by increased groundwater pumping or through purchases of non-entitlement surface water supplies. Although net water use by these growers may remain unchanged, water costs would be much higher. Hence, net farm income would be adversely impacted in critical water years. Growers in some areas would become increasingly dependent on

groundwater, further compounding the problems of overdraft in the San Joaquin Valley groundwater basins.

Agricultural water shortages affect not only the production and yields of irrigated crops, but also the production of manufactured and processed food products as well as the forage and feed available to the dairy and livestock industries. The dairy industry is the largest single user of alfalfa in California, and it also utilizes large amounts of corn silage, cottonseed meal, sugar beet and tomato pulp, and other agricultural products and byproducts as concentrates and roughages in feed rations. Because the planted acreage of all of these crops may be directly affected by the proposed federal action, the dairy industry will also be impacted.

Estimates of crop acreage likely to be affected by the proposed federal action are presented in the following section. In particular, estimates are provided for irrigated crops utilized in the dairy industry.

Expected Acreage Impacts Related to the Proposed Federal Action [17]

Growers with limited access to alternative water sources currently face long-run average supplies significantly below full entitlement, diminished long-run average crop returns, and increased water costs. For some cropping patterns, the economic feasibility of long-run production has been jeopardized. The Club Fed proposal would further exacerbate the long-run adjustment to water shortage currently underway.

Acreage Adjustments in the State Water Project Service Areas

Ten agricultural contractors using SWP water. Kern County Water Agency (KCWA) is the largest. Acreage impacts from the proposed action are expected to occur substantially within KCWA. Therefore, the following analysis relates to the KCWA service area only.

The San Joaquin Valley portion of Kern County is organized into 24 public water districts providing irrigation deliveries to area growers. Of these districts, 14 are member districts of the KCWA. KCWA is the largest agricultural contractor to the SWP, with an annual agricultural entitlement of about one million acre-feet. The remaining districts have

[17] Estimates of acreage likely to be affected by the proposed federal action are taken from Economic Impacts of the *December 15, 1993 Proposed Federal Action on San Joaquin Valley Agriculture*, prepared for the Kern County Water Agency by Northwest Economic Associates, March 1994.

contracts with the federal project or rights to local surface water supplies [18]. Four of the KCWA member districts on the westside of the valley do not overlie the groundwater basin and depend almost entirely on SWP water. The remaining member districts have access to the main aquifers of Kern County's groundwater basins.

Nearly 840,000 acres are irrigated annually in Kern County. Annual crops account for 589,900 acres (70 percent), with 249,700 acres (30 percent) in permanent crops. Westside surface water districts have a total crop base of 203,600 acres, a little less than 25 percent of the Kern County total. Of this, 134,000 acres (66 percent) are in annual crops, and 69,600 acres (34 percent) are in permanent crops. The total crop base for groundwater member districts is 341,400 acres. Eighty-five percent, or 290,000 acres, is in annual crop production, while the remaining 51,400 acres (15 percent) is planted to permanent crops.

Most of the annual crops produced in the SWP service area are grown in three-, four-, and five-year rotations. Vegetables and cotton are generally the primary crops, with grains, hay, and cotton grown in rotation. It is expected that under current state requirements for the SWP, some acreage will be permanently idled.. The proposed action would cause a significant increase in the number of acres permanently idled.

To estimate the acreage that would be idled because of the proposed actions, acreage was allocated to cropping rotations typical for the region. Average long-run returns and production costs for these rotations were calculated. Expected returns were compared to water costs under a variety of production cost and water use scenarios; where net returns per acre-foot of water were estimated to be consistently below water cost per acre-foot, the acreage included in the rotation was considered likely to be idled over the next several years.

The westside member districts of the Kern County Water Agency have limited access to water sources other than the SWP. Some acreage in these districts would be idled as a result of the proposed federal action. Acreage likely to be idled was estimated using the procedure discussed above. The following rotations were identified in the westside districts: alfalfa/vegetables (4/1), cotton/vegetables, cotton/grain/vegetables (2/1/1), cotton/vegetables/ fallow (2/1/1), cotton/grain (3/1), cotton/fallow (3/1), and cotton/grains (7/3) [19].

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[18] Kern County water districts with federal contracts that would be affected by the proposed action are discussed in the following section.

[19] The figures in parentheses are the number of years the individual crops are grown in the rotation.

Permanently Idled Acreage in the SWP Service Area

Under current operations of the SWP, 40,500 acres in the westside districts will likely be idled in the long run, including 10,500 acres of permanent crops idled in the recent drought. With the proposed federal action, another 15,000 acres that would remain in production under existing conditions would likely go out of production. An additional 30,000 acres have marginal returns under state requirements and would have insufficient returns under the proposed action. It is uncertain whether to attribute the potential idling of these crops to state requirements or the proposed action.

It is certain, however, that under the proposed action long-run production cannot be maintained. Therefore, it is estimated that under current state requirements 40,500 acres will be idled in the westside water districts. Under the proposed federal action, it is estimated that an additional 45,000 acres will be idled as a result of higher water costs and lower net crop returns. The affected acreage would include cotton, vegetable, alfalfa, and grain crops. These lands are of excellent soil quality without drainage problems. They are graded as mostly Class I soils according to the land capability classification system of the U.S. Soil Conservation Service [KCWA 1992]. Acreage expected to be idled under the proposed action is shown in Table 11.

Table 11
Permanently Idled Acreage in the SWP Service Area
Attributable to the Proposed Federal Action

		Proposed Federal Action	
Crop Type	State Requirements	After Implementation	Net Change
Alfalfa	0	1,600	1,600
Cotton	23,400	53,125	29,725
Grains	4,775	12,800	8,025
Vegetables	1,825	7,475	5,650
Permanent Crops	10,535	10,535	0
Total	40,535	85,535	45,000

Temporarily Idled Crop Acreage in the SWP Service Area

The acreage impacts described above would lead to permanent economic losses in regional income and employment. Because of the increased frequency of water shortage under the proposed action, the lands remaining in production would also experience an increase in economic losses associated with the riskier water supply. It is expected that for annual shortages of 40 percent or greater, lands would have to be temporarily fallowed and economic losses would result [20]. Under the proposed federal action, shortages greater than 40 percent are expected to occur 4½ years out of 10 compared to 2½ years out of 10 under current state requirements. In critically dry years, represented here by delivery shortages of 65 percent, an additional 35,000 acres would be idled in the westside of the State Water Project service area. This would include 27,000 acres of cotton and field crops, 4,300 acres of grain, 1,700 acres of vegetables, and 1,200 acres of alfalfa.

Acreage Adjustments in the Central Valley Project Service Area

The proposed federal action for the Bay/Delta would impact 40 water districts served by the Central Valley Project in the San Joaquin Valley. These districts comprise almost 1,000,000 irrigated acres. Seventeen of the districts are served by the section of the Delta-Mendota Canal north of the O'Neill Forebay (NOF). A third of this region's 96,000 acres is in vegetables, and most of the remainder is divided almost equally among alfalfa, almonds/walnuts, and field crops. Many of the region's districts have alternative surface water supplies including rights to the San Joaquin River. Groundwater quality and availability in the region are poor.

The eighteen districts located south of the O'Neill Forebay (SOF) include those served through the section of the Delta-Mendota Canal south of the O'Neill Forebay, the Mendota Pool contractors, and the San Luis Unit contractors. Over one-half of the 647,000 acres in the region is planted to cotton and field crops and an additional one-fourth is vegetable acreage. The CVP provides nearly all of the region's irrigation water supply, with some groundwater pumping.

The remaining districts are served through the Cross Valley Canal (CVU) with CVP water wheeled through the state's California Aqueduct. A third of the region's nearly 150,000 acres is in cotton and field crops, and two-fifths is shared equally between grains and alfalfa.

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[20] It is expected that growers would continue to pay the SWP fixed costs on water that would have been applied to permanently idled land, in order to ensure that, in years with less than full entitlement, sufficient water supplies are available for lands remaining in production. These fixed cost payments are estimated at $6 million annually.

The remaining acreage is mostly in permanent crops including grapes, citrus fruits, deciduous fruit, and almonds/tree nuts. Normal irrigation water supply is split between the CVP and groundwater.

The three CVP regions will never be able to meet normal water demand if expected shortages under the proposed federal action are realized. Growers with limited alternative water sources will face long-run average supplies significantly below full entitlement, diminished long-run average crop returns, and increased water cost. For some cropping patterns, the economic feasibility of long-run production will be jeopardized.

Most of the annual crops in the CVP regions are grown in three, four, and five year rotations. Vegetables and cotton are generally the primary crops, with grains, alfalfa, and cotton grown in rotation. In the NOF region, typical rotations include alfalfa/vegetables, field crops/grains/vegetables, field crops/vegetables, and vegetables/fallow. Rotations in the SOF region include alfalfa/vegetables, cotton or field crops/grains/vegetables, cotton or field crops/vegetables, and cotton or field crop/vegetables/fallow. In the CVU region, rotations include alfalfa/vegetables, cotton or field crops/grains, alfalfa/fallow, and grains/fallow.

Permanently Idled Acreage in the CVP Service Area

The proposed federal actions would, if fully implemented, permanently idle an estimated 110,200 acres in the CVP regions. Acreage expected to be idled, by crop type, is presented in Table 12. In the NOF region, the permanently idled acreage would consist of nearly 5,000 acres each of vegetables and alfalfa. In the SOF region, 29,000 acres of vegetables, almost 15,000 acres of alfalfa, and over 50,000 acres of cotton or field crops would be permanently idled. In the CVU region, nearly 6,000 acres of grains would be permanently idled.

Table 12
Permanently Idled Acreage in the CVP Service Area
Attributable to the Proposed Federal Action

Crop Type	NOF Districts	SOF Districts	CVU Districts	Total
Alfalfa	4,950	14,800	0	19,750
Cotton/Field Crops	0	50,600	0	50,600
Grains	0	0	5,900	5,900
Vegetables	4,950	29,000	0	33,950
Total	9,900	94,400	5,900	110,200

Temporarily Idled Crop Acreage in the CVP Service Area

Although some acreage would be permanently idled in the affected CVP regions, the remaining acreage would continue to face water shortages if the proposed federal action were fully implemented. This acreage would either be in or out of production depending on available water deliveries. In the NOF region, the remaining acreage of grain, alfalfa, and field crops would be temporarily idled depending on the severity of the shortage. In the SOF and CVU regions, the remaining acreage of grain, alfalfa, field crops, and cotton would be impacted.

It is expected that for annual delivery shortages of 20 percent or greater in the CVP service area, lands would have to be temporarily fallowed *even after 110,000 acres have been permanently idled.* Under the proposed federal action, shortages greater than 40 percent are expected to occur 4 years out of 10 compared to 1 year out of 10 under current state requirements. In critically dry years, represented here by delivery shortages of 65 percent, an additional 236,000 acres would be idled in the Central Valley Project service area. This acreage would include 95,800 acres of cotton and field crops, 85,500 acres of grain, and 55,000 acres of alfalfa. The regional distribution of additional crop acreage expected to be idled in critically dry years is presented in Table 13.

Table 13
Additional Crop Acreage Idled in Critically Dry Years
CVP Service Areas

Crop Type	NOF Districts	SOF Districts	CVU Districts	Total
Alfalfa	10,000	30,300	14,600	55,000
Cotton/Field Crops	2,800	85,000	8,000	95,800
Grains	5,400	54,700	25,400	85,500
Vegetables	0	0	0	0
Total	18,300	170,000	48,000	236,300

Summary of Expected Acreage Reductions Related to the Proposed Federal Action

The joint proposal for the San Francisco Bay/Delta by the Environmental Protection Agency, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the Bureau of Reclamation would have significant economic impacts for agricultural producers in the San Joaquin Valley dependent on surface water deliveries from the state and federal water projects. Using information developed by the California Department of Water Resources, it has been determined that long-run average deliveries to agricultural contractors on the SWP would decline from 77 percent of full entitlement under state requirements to 67 percent of full entitlement under the proposed federal action. Deliveries on the federal CVP would decline from 93 percent of full entitlement under state requirements to just 62 percent of full deliveries under the proposed action.

If the proposed action is implemented, the resulting increase in long-run average shortage would mean an average annual reduction of 399,600 acre-feet to agricultural contractors on the state project. Deliveries on the federal project would decline by 742,700 acre-feet for a total reduction on both projects of 1,142,300 acre-feet. This is an increase of 734,300 acre-feet over expected reductions under state requirements.

In areas where alternative water supplies are not available to replace reductions in SWP and CVP irrigation deliveries, productive crop acreage would be idled. Under state requirements, 40,500 acres will be permanently idled in the San Joaquin Valley. With the proposed federal

action, an additional 195,700 acres would be permanently idled, an increase of more than 155,000 acres.

In critically dry years, represented in this analysis by delivery shortages of 65 percent, additional acreage would have to be idled due to insufficient irrigation water supplies to keep other land in production. It is expected that an additional 271,000 acres of cropland would be removed from production in critically dry years.

The distribution of crop acreage expected to be idled during average and critically dry years as a result of the proposed federal actions is presented in Table 14. The acreage impacts reflect those changes expected to occur directly in the water-short regions.

Table 14
Acreage Expected to be Idled as Result of Bay/Delta Requirements
Permanent Impacts and Critical Dry Year Additions

		Critical Dry Years	
Crop Type	Permanent Reductions	Additional Acres Idled	Total Acres Idled
Alfalfa	21,350	56,200	77,550
Cotton	103,725	122,800	226,525
Grains	18,700	89,800	108,500
Vegetables	41,425	1,700	43,125
Permanent Crops	10,535	0	10,535
Total	195,735	270,500	466,235

The Potential for Water Trading and Crop Shifting

Data presented above are estimates of irrigated crop acreage likely to be idled because of the proposed federal standards. The acreage figures represent adjustments that would occur in the absence of intraregional and/or interregional crop shifting. Further, the potential impacts of water trading and water marketing on regional cropping patterns are not taken into account. It is likely that the effects of both water trading and crop shifting will be to redistribute the acreage impacts from the areas of the South San Joaquin Valley directly affected by water shortage to other regions throughout the Central Valley.

An analysis of the redistribution of crop acreage likely to result through production shifts and water trades was beyond the scope of this analysis. However, it is likely that additional reductions in alfalfa acreage and other feed crops would result. Further examination by policymakers of the agricultural impacts related to implementation of the proposed standards should take into consideration the potential effects of crop shifting and water trading on the production of alfalfa and other feeds utilized by the dairy industry.

Other Estimates of Acreage Impacts Related to Water Restrictions

There have been many studies in recent years which have examined the effects of water shortages on California's agriculture industry. The studies have examined the impacts of shortages related to both natural drought and regulatory requirements which have restricted the delivery of agricultural water supplies. Results from several of these studies have been summarized in Table 15.

One of the most important points which can be drawn from the studies documenting actual responses by California agriculture that shortages affect a wide range of irrigated crops. Wide diversity exists within Central Valley agriculture. The extent to which planted acreage will be affected depends, in part, on:

- The feasibility of cropping options and crop rotation requirements;
- Grower production costs relative to market returns and potential access to alternative commodity markets;
- The frequency and magnitude of water shortages along with differences in operational rules affecting SWP and CVP deliveries;
- The availability and costs for substitute surface water;
- The availability and costs for substitute groundwater; and
- The institutional and operational limitations which limit water trading and water marketing opportunities.

Any evaluation of alternative implementation scenarios for the proposed Bay/Delta standards should take into account these important factors which determine the actual adjustments in irrigated acreage that might occur.

Table 15
Alternative Estimates of Idled Alfalfa Acreage Related to Regulatory and Natural Drought

Acreage Idled		
Total Acres	**Alfalfa Acres**	**Comments**
DWR California Water Plan		
365,000	187,000	Forecasted adjustment in California irrigated crop acreage, 1990-2020.
December 15, 1993 RIA Study prepared by EPA		
213,000	36,000	Based on RIA Scenario 1 (smallest area, no trading). Alfalfa acreage includes other hay and irrigated pasture. Estimates calculated using a rationing model.
130,000	0	Based on RIA Scenario 3 (Central Valley, with trading). Acreage idled includes only grass hay and irrigated pasture. Estimates calculated using the CARM model.
Comments to RIA prepared by KCWA		
195,700	21,500	Expected adjustments in acreage based on long-run economic returns under shortage, taking into account crop rotation requirements.
270,500	56,200	Additional annual adjustments to acreage with water shortages of 65%.
Comments to RIA prepared by Westlands Water District		
225,000	5,000	Estimates of acreage impacts based on district acreage adjustments from 1990 to 1991.

Table 15 (continued)
Alternative Estimates of Idled Alfalfa Acreage
Related to Regulatory and Natural Drought

Acreage Idled		
Total Acres	**Alfalfa Acres**	**Comments**
1991 DWR Emergency Drought Water Bank Study prepared by RAND		
90,043	0	Not planted.
76,050	10,219	Planted, not irrigated.
		420,000 AF of the 821,000 AF purchased by the 1991 water bank were through no irrigation contracts. Acres idled in north Central Valley.
San Joaquin Valley 1991 Drought Study		
253,207	9,109	Estimates of 1991 SJV irrigated acreage idled as a result of drought-related reductions in water supplies. Based on water district surveys.
San Joaquin Valley 1992 Drought Study		
171,795	24,632	Estimates of 1992 SJV irrigated acreage idled as a result of drought-related reductions in water supplies. Based on water district surveys.

Implications of the Proposed Water Standards on the California Dairy Industry

The proposed federal standards are expected to cause the permanent idling of 155,000 acres of San Joaquin Valley cropland in addition to those idled by current state requirements. These additional lands include 21,350 acres of alfalfa and 134,000 acres of other crops. In critically dry years, larger water shortages are expected to cause the temporary idling of an additional 230,000 acres of San Joaquin Valley cropland, including an additional 56,000 acres of alfalfa, 99,000 acres of cotton and field crops, and 85,000 acres of grains. There will be direct, adverse impacts on dairy producers both in the San Joaquin Valley and throughout the state. There may also be direct, adverse price impacts on consumers.

The following discussion begins with an estimation of the impacts of San Joaquin Valley alfalfa acreage reductions on availability and delivered prices of alfalfa hay, considering potential increases in both transport costs and grower prices. These increases are then related to higher costs of milk production and to income losses for milk producers in the San Joaquin Valley. The increased alfalfa prices are also related to higher production costs and income losses for dairies outside the San Joaquin Valley. The resultant income losses are then tied to employment and income losses throughout the state economy.

Impacts of Acreage Reductions on Alfalfa Hay Availability

The proposed federal action would permanently idle an estimated 21,350 acres of alfalfa in the southern San Joaquin Valley. It would temporarily idle an additional 56,000 acres in critically dry years, likewise in the southern San Joaquin Valley. The actual amount of alfalfa acreage removed from production in a particular year will depend on the degree to which water deliveries are restricted. Therefore, the expected impacts on dairy producers will also vary from year to year, depending on the magnitude of the water shortage.

Assuming a representative yield of 8 tons per acre, alfalfa production would be reduced by 170,800 tons per year in normal years and by 620,400 tons in critically dry years. While the alfalfa required to fill this shortfall would likely be available from alternative sources, it would be at substantially-higher prices.

Alfalfa production in California has averaged 6.7 million tons per year for the last 5 years [FSMNS 1994]. Based on historical cropping patterns, if production were reduced by 170,800 tons in the southern San Joaquin Valley, the 2.6 percent shortfall could likely be offset by increased shipments from Fresno, Madera, Merced, and other northern San Joaquin Valley counties. If production were reduced by 620,400 tons in critically-dry years, additional alfalfa would likely be drawn not only from those areas, but also from the northern Sacramento Valley, the Imperial Valley, and Nevada

Impacts of Acreage Reductions on Alfalfa Hay Prices

The primary impacts on southern San Joaquin Valley dairies of reduced alfalfa acreage would be due to higher transportation charges to haul hay from more distant areas. Shipments from the northern San Joaquin Valley would add an estimated $15-$20 per ton to delivered hay costs in the southern San Joaquin Valley [21]. Shipments from the northern Sacramento Valley, Imperial Valley, and Nevada would add an estimated $30-50 per ton to delivered hay costs.

In addition, however, the acreage reductions would likely have an impact on the grower price for alfalfa, which in turn would have an adverse impact on dairy producers throughout the state. An extensive analysis of the California alfalfa market [Knapp and Konyar 1990] suggests that the price elasticity of alfalfa relative to alfalfa acreage is -0.9144. Hence, a ten percent reduction in California alfalfa acreage, all other factors unchanged, would be expected to cause a 9.1 percent increase in grower price for the crop [22]. Grower price increases would likely occur throughout the state. Dairy producers throughout the state would be affected, as their costs of production would increase.

A reduction of 21,350 acres of alfalfa would represent a 2.32 percent decline from the 1993 California level of 920,000 acres. Based on the elasticity cited, grower prices for alfalfa

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21 Based on discussions with hay brokers and analysts at the Federal Market News Service.

22 See page 18 of their study, which summarizes the results of a simulation model of the industry used to analyze the response to higher water prices. Data from Table 12 on page 18 of that study were used by NEA to estimate the price elasticity.

would be expected to increase 2.12 percent over the 1993 level. Statewide, grower prices of alfalfa averaged $89.20 per ton in 1993. Premium alfalfa hay, the type required for dairy cows, sold for about $10 more per ton. [23] Average grower price of premium alfalfa hay was therefore likely about $99 per ton. The acreage reduction would therefore add about $2.10 to this price.

In critically-dry years, a reduction of 77,550 acres of alfalfa would represent an 8.43 percent decline from the 1993 California level of 920,000 acres. Grower prices would be expected to increase 7.71 percent over the 1993 level. Assuming a statewide grower price of $99 per ton of premium hay, the acreage reduction would therefore add about $7.60 to this price. [24]

Increased Costs of Production and Reduced Income for the San Joaquin Valley Dairy Industry

The effects of reduced alfalfa acreage on feed costs in the San Joaquin Valley dairy industry will depend directly on the number of acres idled. As more acres are fallowed because of water shortages, higher proportions of feed requirements must be made up by alfalfa purchases outside the region, resulting directly in higher dairy production costs and reduced net incomes.

The aggregate expected reductions in net income for dairy producers in the southern San Joaquin Valley are shown in Table 16. Income loss is measured by the net increased delivered costs of the alfalfa that must be purchased to make up for shortfalls in regional production. Estimates range from $5.1 million in "normal" years to $18.6 million in critically-dry years.

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[23] Based on [FSMNS 1994].

[24] The acreage and price changes in both cases are consistent with state-level data from 1982-1993.

Table 16
Expected Losses in San Joaquin Valley Dairy Income

	Idled Acreage		Reduction in
Water Shortage	Total Acres	Alfalfa Acres	Dairy Income
0%	195,735	21,350	$5.1 million
30%	271,335	22,750	$5.5 million
50%	360,735	57,650	$13.8 million
65%	466,235	77,550	$18.6 million

Water shortages of at least 30 percent can be expected to occur nearly 8 years out of 10 under the proposed water standards. Shortages of at least 50 percent would occur 3 years out of 10, while shortages of at least 65 percent would occur 2 years out of 10. Dairy producers consequently face not only the certainty of higher costs in normal years, but also the probability of much higher costs in other years. The timing of those higher-cost years is very uncertain, however, which makes long-run planning and investment by dairy producers extremely difficult.

The implications for individual dairies are severe. Based on a representative southern San Joaquin Valley dairy of 714 cows and on typical rations fed, the annual reduction in net income for such an operation ranges from $31,300 to $113,600 or $0.18 to $0.67 per hundredweight of milk. Budgets from the California Department of Food and Agriculture Milk Stabilization Branch show that such reductions would certainly drive some producers out of business.

Increased Costs of Production and Reduced Income for the California Dairy Industry Overall

The acreage reduction scenarios considered are expected to cause grower prices for alfalfa to increase by $2.10 - $7.60 per ton. The impacts on dairy producers outside of the southern San Joaquin Valley can be estimated by multiplying the average alfalfa fed per day by the total herd size outside the region. Assuming daily alfalfa fed is the previously-discussed minimum of 12 pounds and estimating the rest-of-California herd size as 778,000 cows from

Table 1 of this report, the impacts range from $3.6 million to $12.9 million. These impacts are in addition to those estimated for producers in the southern San Joaquin Valley.

Consequently, total direct income impacts for dairy producers throughout California, including the southern San Joaquin Valley, range from $8.7 million to $31.5 million. This would represent an average loss of $3,700 to $13,000 per dairy for the 2,428 dairies in the state. Losses for dairies in the southern San Joaquin Valley would be considerably higher.

Impacts on the State Economy

The income impacts on the dairy industry would have impacts throughout the California state economy because of the many sectors to which the dairy industry is linked. Under normal conditions, the $8.7 million direct loss in dairy income would cause an overall loss of $19.5 million in state income and the loss of 250 jobs (see Table 17). Under more severe conditions, the impacts increase. In a 65 percent shortage scenario, the $31.5 million loss in dairy income would cause an overall loss of $70.6 million in state income and the loss of 1,000 jobs. These estimates do not include the potential impacts of higher retail dairy prices, however.

Table 17
The Effects of Losses in Dairy Income on the California State Economy

		Economic Losses in California	
Water Shortage	Direct Loss in Dairy Income ($million)	Income ($million)	Employment (# of jobs)
0%	$8.7	$19.5	250
30%	$9.3	$20.8	300
50%	$23.5	$52.6	750
65%	$31.5	$70.6	1,000

The potential retail price impacts of higher costs of milk production are not estimated in this study. Those impacts can not be determined unless assumptions are made on three critical issues:

- Whether higher costs of production will be offset by higher dairy producer prices;

- To what extent dairy producer prices, if increased, will be passed on to retailers;

- To what extent higher prices to retailers will be passed on to consumers.

Costs of milk production are not included in current California milk pricing provisions. The Director of the California Department of Food and Agriculture may adjust Class 1 price to compensate for higher costs. The Director may also change the differentials applied to Class 4a price to adjust prices for Classes 2 and 3 products. However, the timing and extent of such adjustments, if made, are uncertain and are not included in this analysis. Consequently, the impacts on retailer costs and consumer prices are not estimated.

Other Issues for Additional Research

Several issues, including consumer price impacts, could not be included in this analysis. The discussion below summarizes some of these issues which could not be quantified, but which are felt to be important to the industry and the state. In some cases, available data and other information would provide a productive starting point for such efforts. For example, dairy production and cost data collected by the California Department of Food and Agriculture could be analyzed in much greater detail for insights into potential producer impacts in various regions of the state. Additional detail on alfalfa production trends and quality in other states would also be useful. It is very likely that this additional information would cause the estimated impacts of the proposed water quality standards to increase rather than decrease.

This analysis has assumed that the alfalfa production "lost" from acreage permanently or temporarily idled in the San Joaquin Valley can be obtained from other areas of California or other states. That assumption limits the increase expected for grower and delivered alfalfa prices as those acreage reductions occur. However, the water situation in California and other states could easily cause the price of alfalfa to increase by considerably more than what is estimated in this study. Further, California water restrictions will impact not only alfalfa, but also cotton, grains, vegetables, and other crops. As a result, prices for the byproducts from these crops used by the dairy industry could increase as well.

The estimated reduction in net income would likely cause some less-efficient dairy producers to leave the industry. In the short run, the cows from these operations would probably be sold to other producers, and overall herd size in California would not change. The margins of all remaining producers, however, would be reduced. In the long run, it can be presumed

that unless price relief is obtained, overall herd size would be reduced and there would be a reduction in available milk supplies in the state [25].

[25] This assumes no significant changes in production technology or other salient factors.

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Appendix A

Regions

Del Norte - Humboldt
Del Norte
Humboldt

North Bay
Mendocino
Sonoma
Napa
Marin

North Valley
Contra Costa
Santa Clara
Santa Cruz
San Benito
Monterey
Siskiyou
Lassen
Placer
Solano
Shasta
Tehama
Butte
Glenn
Colusa
Yuba
Sutter
Yolo
Sacramento
San Joaquin
Stanislaus
Merced
Madera

South Valley
Fresno
Kings
Tulare
Kern

Southern California
Santa Barbara
San Luis Obispo
Los Angeles
San Bernardino
Riverside
San Diego
Imperial