

Water - Drought (41)

Return to NFA

IMPACT OF REDUCED WATER SUPPLIES ON CENTRAL VALLEY AGRICULTURE

By
Don Villarejo

Team Summary: irrigation in
an environmentally sound use of
lands

Published by
**The California Institute
for Rural Studies**

Funded by
**The Public Welfare Foundation,
The North Shore Unitarian
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The Ford Foundation, and
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Final Summary - irrigation in
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Impact of Reduced Water Supplies on Central Valley Agriculture

By Don Villarejo

This publication was made possible by grants from The Public Welfare Foundation, the North Shore Unitarian Universalist Veatch Program, The Ford Foundation, and The Rosenberg Foundation.

Editing and Layout by Lynn Kusnierz

FEBRUARY 1995

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Acknowledgements

THIS WORK WAS SUPPORTED BY GRANTS FROM THE PUBLIC WELFARE FOUNDATION AND THE North Shore Unitarian Universalist Veatch Program made to the Community Alliance with Family Farmers Foundation. Support for dissemination of this work was provided by grants to the California Institute for Rural Studies from the Ford and Rosenberg Foundations.

The author is grateful for the helpful comments and support provided by Merrill Goodall, Laura Hoover, Betsy Marchand, Judith Redmond, and the activists and members of the Community Alliance with Family Farmers. Members of the Rural Water Impact Network (R-WIN) also played a constructive role in their discussions of many of the ideas found in this report.

The author also thanks Lynn Kusnierz who was both a thoughtful and careful editor as well as producer of this report. Other CIRS staff members—Ed Adams, Gretchen Bradfield, Helen Cai, Anne Mabuchi, Sarah Ramirez, Rosario Ruiz-Dark—also helped to make this work possible. Of course, any errors are the sole responsibility of the author.

Executive Summary

THE 1987-92 CALIFORNIA DROUGHT SUBSTANTIALLY REDUCED THE SUPPLY OF FEDERAL AND state irrigation water available to farmers in the Central Valley. Overall, the reduction amounted to more than 50 percent when the pre-drought period 1984-86 is compared with the final years of the drought.

The Central Valley Improvement Act (CVPIA), passed in 1992, mandated a major shift of irrigation water from farms to urban and environmental restoration uses. The act is expected to affect the Central Valley in much the same way as the drought, and the areas hit hardest by the drought will likely be the most severely affected.

Several independent reports of harvested cropland were used to determine the drought-related decline in harvested acres. It is estimated that approximately 176,700 acres were lost due to the drought. The greatest declines in harvested cropland were found in Fresno County, especially on the west side of the San Joaquin Valley.

Of all the crop categories, field and seed crops experienced the largest net decrease in harvested acres within the Central Valley Project service area. Harvested acreage for vegetable crops, however, grew during the same period, though the entire increase was accounted for by processing vegetable crops, especially tomatoes. Fresh vegetable acreage showed a net decrease; melon acreage was especially affected.

As a result of cutbacks in production, labor demand was reduced by an estimated 4 million hours, a decrease equivalent to 2,350 people working full-time. According to statewide employment reports, the impact was mixed; employment rates varied from county to county. Fresno County did witness a significant decline in on-farm employment, but, at the same time, the on-farm employment rate in Kern County rose. The western Fresno County community of Mendota was particularly affected: its official unemployment rate grew to 41 percent. While some of this increase may be attributed to California's recession, the effect of drought-induced cutbacks on hired farm workers has been substantial.

Social and community impacts of new federal environmental laws, such as the CVPIA, must be determined prior to implementation, and mitigation measures must be developed and adopted. In addition, **sustainable farming practices should be encouraged by recognizing irrigation as an environmentally sound use of water.** Finally, more thorough measures of water use should be mandated, including water meters, if necessary.

CALIFORNIA'S CENTRAL VALLEY IS THE WORLD'S MOST PRODUCTIVE AGRICULTURAL VALLEY, measured both by physical volume and value of production. Within the valley there are two primary sub-regions, the San Joaquin and the Sacramento valleys, which together cover a total of eighteen counties. The federal Central Valley Project (CVP), operated by the Bureau of Reclamation (U.S. Department of Interior), provides irrigation water to more than twenty thousand farms comprising more than two million irrigated acres, about one-third of the Central Valley's irrigated land area.

As a result of recent legislation, water delivery commitments to Central Valley farmers will drop significantly in the years ahead. Urban environmental advocates and development interests have joined together with a common agenda to shift water supplies from farms to cities and environmental restoration.

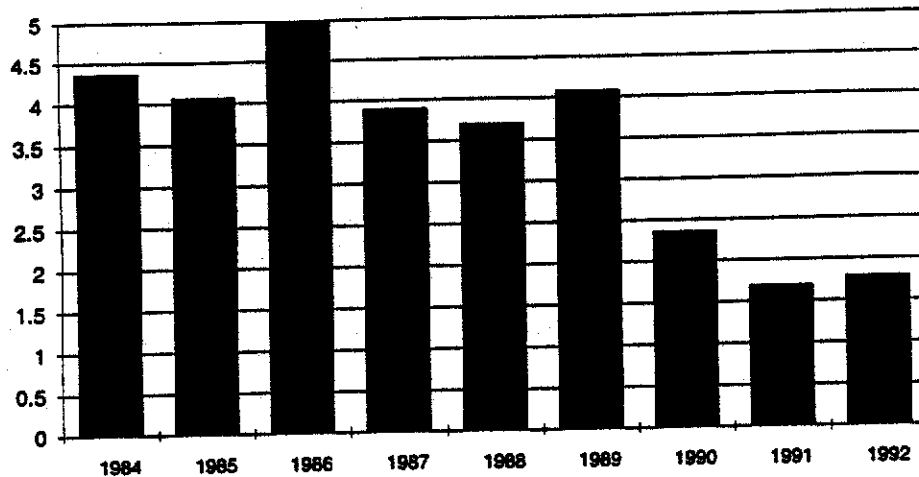
In 1992, Congress passed the Central Valley Project Improvement Act (CVPIA). The CVPIA contains two new provisions which assure that irrigation water for farming will continue to dry up. First, 800,000 acre-ft. per year—enough water for four million urban dwellers—is to be reallocated from farms to environmental restoration. Second, for the first time, farmers who are under contract to purchase federal irrigation water from the Bureau of Reclamation are authorized to resell it to the highest bidder, presumably at a large profit.

While no one can be certain how much water deliveries to agriculture will shrink as a result of the CVPIA, the act's effects are likely to be substantial. For example, during the past fifteen years (1979-93), total CVP water deliveries to agriculture averaged 3.7 million acre-ft. per year¹—lower than the amounts specified in contracts with the Bureau because of protracted periods of drought. Nevertheless, the legislatively mandated 800,000 acre-ft. reduction represents a sizeable fraction of current water deliveries.

The purpose of this report is to examine the impact of reduced CVP water deliveries on agricultural production and to discuss related policy issues. The recent extended period of drought in California (1987-92)—and the accompanying reductions of federal irrigation water to Central Valley agriculture—provides a real-world case study of the likely effects of permanent cuts in water for farming. For this reason, this report examines:

- the extent of cutbacks in water deliveries to Central Valley farms;
- the corresponding decrease in irrigated land and harvested acreage;
- the implied decrease in labor demand resulting from fewer harvested acres.

**Figure 1: Water Deliveries to Farms
Central Valley Project Service Area
(in millions of acre-feet)**



The drought dried up CVP water deliveries

Each year the Bureau of Reclamation reports the quantity of water delivered to farms.² Figure 1 shows the total amount of water supplied by the CVP to farms in the project service area for each of the years 1984 through 1992. In the three pre-drought years, 1984–86, total irrigation water deliveries averaged 4.5 million acre-ft. per year. But in the final three years of the drought, the annual average fell to slightly under 2 million acre-ft. According to these figures, the drought accounted for a reduction of about 2.5 million acre-ft. in CVP deliveries, or 56 percent of pre-drought levels.

While the overall reduction of water deliveries was large, not all CVP service areas were equally affected. The eight project divisions are located in different areas of the state, with the degree of water availability depending upon the amount in storage in that particular region's reservoirs.

Four of the eight divisions of the CVP were most heavily affected by these water cutbacks:³ the Sacramento River, Friant, Delta, and West San Joaquin divisions. In quantitative terms, the West San Joaquin Division experienced the greatest drop in irrigation water deliveries, losing 854,657 acre-ft., or 61 percent of previous levels.

Reduced water deliveries led to less irrigated land

The quinquennial *Census of Agriculture* found a large reduction in the amount of irrigated land in the Central Valley during the drought period.⁴ The most recent Census, conducted in 1992, placed the amount of irrigated land in the Central Valley at 5.7 million acres, roughly the same as in the previous Census year, 1987, the first year of the drought. However, the amount of irrigated land reported in Census year 1982 was 6.4 million acres, the same as was found for the prior Census year, 1978.

These data suggest that nearly three-quarters of a million acres of formerly irrigated land were left unirrigated during the two Census drought years, 1987 and 1992. This figure must be interpreted with great caution, however. First, the Central Valley includes both land irrigated with federal project water as well as land irrigated with water from non-federal sources, e.g., the State Water Project or privately owned wells. Second, substantial amounts of Central Valley land have been converted to non-agricultural use in recent years, a process that has little direct relationship to reduced CVP deliveries. Also, in 1987, a significant portion of Central Valley land was taken out of production under federal crop acreage reduction programs.⁵

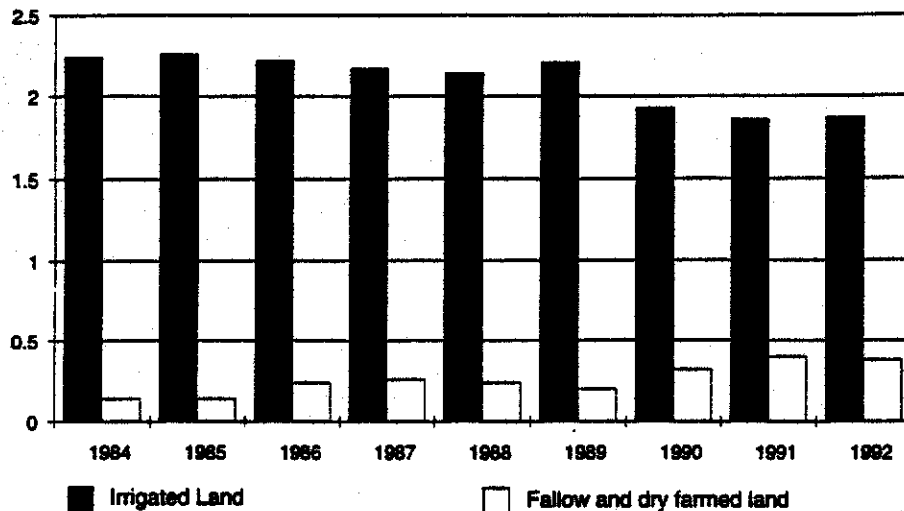
Because the *Census of Agriculture* surveys farms only once every five years, this relative infrequency of reporting limits the ability of the researcher to identify possible confounding factors that might independently contribute to reduced production, such as adverse market conditions, weather abnormalities other than the drought (freeze or flood), government acreage diversion programs, or pest problems.

For these reasons, several other sources were used to determine changes in irrigated land, harvested crop acreage, and fallow land. These figures can be combined with the Census findings to provide a fuller understanding of shifts in the actual pattern of land use caused by the extended drought.

One such independent estimate was developed using the Bureau of Reclamation's annual reports.⁶ The Bureau obtains detailed data on land irrigated with federal project water from each water or irrigation district with which it has a contract. Figure 2 shows the amount of both irrigated and fallow (or dry crop) land reported by the Bureau for the CVP service area for each year from 1984 to 1992.

According to the Bureau's figures, land irrigated with federal CVP water dropped by 352,072 acres between 1984 and 1992, out of a total of roughly two million irrigated acres. This determination was made by comparing the amount of Central Valley land

**Figure 2: Agricultural Land Use
Central Valley Project Service Area
(in millions of acres)**



reportedly irrigated with federal water in the three-year period just prior to the beginning of the drought (1984–86, annual average) with the corresponding amount for the final three drought years (1990–92, annual average). Care must be exercised in concluding that this figure accurately represents the loss of irrigated land in the Central Valley since some portions of the land irrigated with federal water in the period 1984–86, but not in the later period, may have received irrigation water from a non-federal source, e.g., from ground-water pumping.

Note again that the three years prior to the drought were compared only with the final three years of the six-year drought period. This was done for several reasons. First, agricultural producers may respond differently to a short-term crisis than they do to a large-scale, long-term factor, like the drought. In the short term, a plowed field may be abandoned or a new well drilled. Long-term adjustments may be quite different: a portion of the farm's land may be permanently retired and cropping patterns changed from, say, cotton or barley to vegetables or tree fruit.

Second, water deliveries continued at a relatively high rate in the first several years of the drought because California's storage capacity is designed to carry the state through one or two years of moderate drought before reservoirs are empty. For the initial drought years, those responsible for water management decided to exhaust the reserve supply. It is

likely that some farmers had relatively little incentive to make major adjustments until well into the middle of the six-year period.

Finally, calculating the annual average over three-year periods reduces the effect of spurious factors. Irrigated agriculture in the West differs from crop industries in other regions in that changes in production may be caused by a greater variety of factors. As previously suggested, fluctuations in crop market conditions, government acreage diversion programs, non-drought weather factors, and conversion of land from agricultural to non-agricultural uses may all play a role in changing land use patterns.

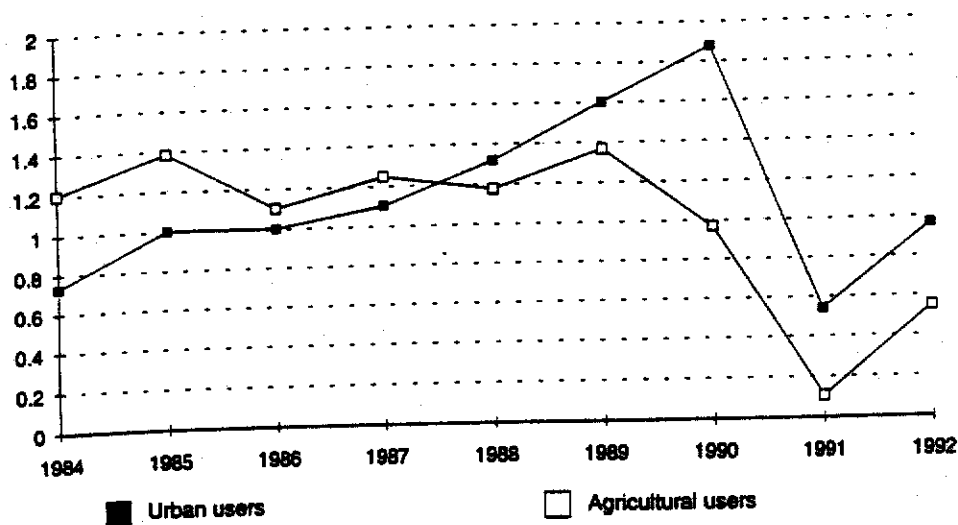
Another independent source was used to examine harvested crop patterns throughout the entire Central Valley: the County Agricultural Commissioners' *Annual Crop Reports*.⁷ According to these reports, in the three-year pre-drought period, annual harvested crop acreage averaged 7,051,190 acres, including irrigated pasture. For the last three years of the drought, the corresponding figure was 6,874,477 acres.

These figures suggest that the actual reduction in harvested crop acreage in the Central Valley during the drought totaled 176,713 acres. This number does not take into account possible reductions in crop yield or other forms of production loss associated with drought conditions. For example, livestock producers saw a drastic drop in the quality of dry land forage as well as an increase in prices for feed crops, both of which were induced by diminished plantings of these crops.

A fourth estimate was based on published Bureau of Reclamation figures for fallow or dry farmed land in the federal CVP service area.⁸ Again, a comparison of the three-year period prior to the drought with the final three years of the drought indicates that an additional 190,108 acres were left fallow or dry farmed during this time period. This figure is remarkably close to the one for harvested crop land loss based on the county crop reports cited above. However, this apparent agreement may be coincidental because the latter is based on a determination of agricultural land use for the entire Central Valley while the former refers only to land in the smaller CVP service area.

The California Institute for Rural Studies (CIRS) obtained records of water deliveries by the California State Water Project (SWP)—the largest of the non-CVP agencies—for the period 1984–92. Figure 3 shows annual SWP water deliveries to agricultural and, separately, to non-agricultural water users.

Figure 3: SWP Deliveries to Urban and Agricultural Users
Central Valley Project Service Area
 (in millions of acre-feet)



Nearly all of the agricultural land served by the SWP is located in Kings and Kern counties in the southern Central Valley. As Figure 3 demonstrates, prior to the drought the majority of SWP water went to agricultural users. But starting in 1987, water deliveries to urban users began to climb and, by 1989, were significantly larger than SWP deliveries to agriculture.

In 1990, SWP irrigation water fell sharply but, remarkably, urban water deliveries shot up. By the next year, agriculture's share of SWP water was cut to nearly zero, a move that triggered an unprecedented crisis in the Central Valley portion of the SWP service area. While urban deliveries also dropped off dramatically, nearly all of the available water was shipped to Southern California municipalities.

According to SWP staff, "There is no precedent for the severe water and acreage declines experienced in the service area between 1990 and 1991." More than 90 percent of the land historically irrigated with SWP water was affected by this reduction. Just 38,385 acres were irrigated with SWP water, compared with 300,000 acres or more in prior years. In 1992 there was a small recovery, but urban SWP deliveries still greatly exceeded those to agriculture.

The effect of the drought on agricultural water users in the Central Valley portion of the SWP service area was severe; water deliveries fell by more than one half. During the

three years prior to the drought, the SWP delivered about 1.23 million acre-ft. per year to agricultural users. In the years 1990-92, SWP deliveries averaged 541,215 acre-ft. per year.

Land irrigated with SWP water dropped by 216,234 acres, or more than one half, again comparing the 1984-86 annual average with that for 1990-92. Of course, many farmers and land owners sought to replace this loss with groundwater pumping, in many cases from newly drilled wells.

Table I summarizes these independent determinations of changes in land use. Both the Census and the County Agricultural Commissioner numbers refer to *all* Central Valley lands, those irrigated with federal CVP water as well as those irrigated with other water sources. In contrast, Bureau of Reclamation and SWP figures refer exclusively to Central Valley land at least partially irrigated with federal or state water. Clearly, the latter data are a subset of the former.

Table I: Changes in Central Valley Agricultural Land Use

AGENCY	LAND USE	PERIOD	CHANGE (ACRES)
Census	Irrigated land	Avg. (1987,1992) vs. Avg. (1978,1982)	-740,000
Reclamation	Irrigated land (CVP Service area)	Avg. (1990-92) vs. Avg. (1984-86)	-352,072
Ag Comm	Harvested acres	Avg. (1990-92) vs. Avg. (1984-86)	-176,713
Reclamation	Fallow & dry farm (CVP Service area)	Avg. (1990-92) vs. Avg. (1984-86)	+190,108
CA DWR	Irrigated land (SWP Service area)	Avg. (1990-92) vs. Avg. (1984-86)	-216,234

Source: See text.

Based on these figures, the *net* decline in harvested acreage in the Central Valley probably averaged approximately 176,700 acres for the final three years of the drought. This figure represents the net change in harvested acres, and not the total amount of fallow acreage at the time in question. In fact, the Bureau's data show that fallow and dry farmed land in CVP service areas alone totaled 400,777 acres in 1991 and 379,994 acres in 1992.

For the San Joaquin Valley, Northwest Economic Associates (NEA) found a drought-induced decline of 253,200 harvested acres in 1991⁹ and 172,000 harvested acres in 1992.¹⁰ However, the NEA estimate can not be compared directly with our estimate of 176,000 harvested acres lost, because NEA obtained data only for major portions of the San Joaquin Valley, not the entire Central Valley. Also, NEA asked respondents to compare conditions in specific drought years to conditions corresponding to "normal water supplies."

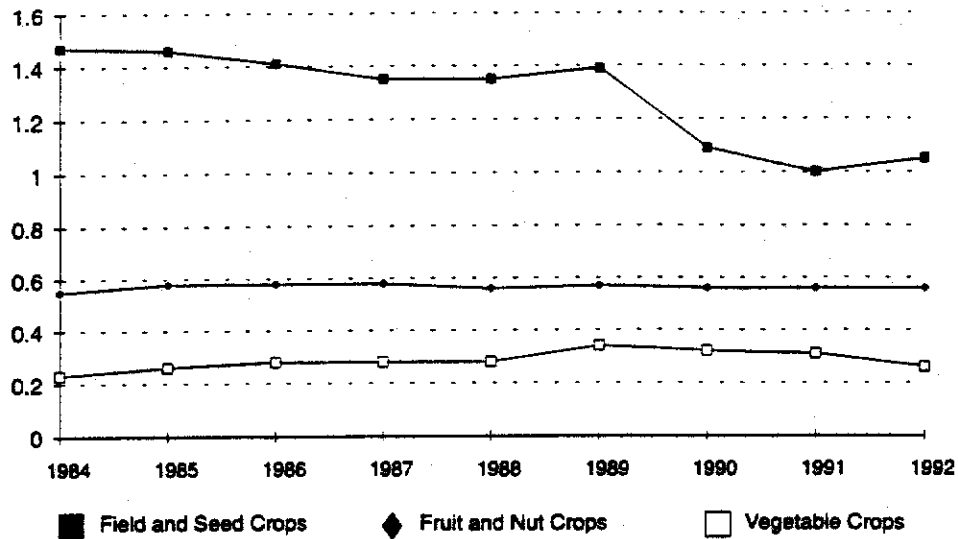
The estimate of a 352,000 acre reduction in land irrigated with CVP water, derived from Bureau of Reclamation reports, probably overstates the amount of irrigated land actually lost. Since Bureau of Reclamation figures refer only to land irrigated with CVP water, they presumably do not include land that was irrigated only with groundwater when CVP supplies were no longer available.

Groundwater partially offset cutbacks in water delivery

There is strong evidence that Central Valley farmers used groundwater during the drought to at least partially offset the loss of surface water supplies. The California Department of Water Resources (DWR) found that the annual number of water well completion reports doubled in the final three years of the drought as compared with the three-year pre-drought period.¹¹ DWR also reports that while groundwater storage in the San Joaquin Valley grew by 2.4 million acre-ft. in the pre-drought period, it dropped 8.8 million acre-ft. over the final three years of the drought.¹² NEA reports that several thousand new wells were drilled in the San Joaquin Valley for irrigation purposes during the six-year drought, and that farmers considerably increased groundwater pumping to compensate for loss of surface water deliveries.¹³

In the southern San Joaquin Valley, it has been a long-standing practice to recharge groundwater for long-term use. In years with adequate project deliveries, several water districts allocate large amounts of water for this purpose. For example, in 1986—a very wet year—about 750,000 acre-ft. were added to groundwater storage.¹⁴ The following year, at the start of the drought, some 400,000 acre-ft. were removed.¹⁵

Figure 4: Harvested Crop Acres
Central Valley Project Service Area
 (in millions of acres)



In addition to these deliberate efforts to store groundwater, experts now realize that normal irrigation practices result in substantial recharge. According to the DWR, "In many cases, about 15 to 20 per cent of the water applied for irrigation moves past the root zone and results in recharge of the groundwater basin. The amount of such deep percolation varies in different cases."¹⁶

Reduced water deliveries changed crop production patterns

Bureau of Reclamation data was also used to determine changes in the pattern of crop production during the drought. CIRS obtained data for all years 1984–92 and for each crop specified by the Bureau.¹⁷ Harvested acreage data for each individual crop was aggregated according to major crop type (field and seed crops, vegetable crops, or tree fruit and nut crops). Acreage figures for nursery crops and home garden crops were excluded from consideration because the amounts were found to be negligibly small. Aggregate harvested acreage data for the three major crop types are shown in Figure 4.

Most significant is the precipitous drop in field and seed crop harvested acreage. In contrast, both vegetable crop and tree fruit and nut crop harvested acreage show relatively little variation during this period. Despite the sharp decline in field and seed crop acreage, it is evident from Figure 4 that there has not been any significant shift of crop production *from* field and seed crops *to* either vegetable crops or tree fruit and nut crops in the CVP service area.

These data provide an overall measure of how reductions in irrigation water deliveries changed the pattern of major types of crop production. However, for many individual crops the fluctuations in harvested acreage were much greater.

The crop with the largest net decline in harvested acreage for this period was cotton, down 114,748 acres, or 22 percent; barley ranked second, followed by corn and alfalfa hay. Acreage devoted to irrigated pasture also dropped dramatically, falling by 16,407 acres, or 26 percent.

Labor intensive crops—vegetables, melons, grapes, and tree fruit—exhibited a mixed pattern. For example, harvested melon acreage declined by 10,963 acres, or 26 percent, during this period, and harvested grape acreage fell by 17,295 acres, an 8 percent drop. In contrast, harvested acreage of processing vegetables, mostly processing tomatoes, increased by 47,866 acres, or 55 percent. But, excluding this increase in tomato acreage, all other vegetable and melon acreage showed a decline.

Reduced water deliveries caused a decline in farm employment

Bureau of Reclamation crop production summaries were used to determine how reduced production affected labor needs in the CVP service area. First, the change in harvested acreage for each crop was determined, again comparing the three-year pre-drought annual average against that for the final three years of the drought. Second, published labor demand coefficients,¹⁸ which represent hours of labor required annually to produce a specific crop, were multiplied by the corresponding change in harvested acreage. Finally, the differences in hours of labor demand were summed over all crops to obtain the estimated total change in hours of labor.

It is important to note that the above procedure provides only an estimate of the shift in labor demand associated with the reduction in reported harvested acreage. This labor demand estimate differs from the water delivery and acreage figures in that it is based on a calculation and not on any direct measure of change.

Labor demand, determined in this manner, dropped by at least *4.7 million hours*. In other words, an estimated 4.7 million fewer hours of labor were required to produce all crops in the CVP area during each of the final three years of the drought than were required during the three-year pre-drought period.

As a result of reductions in water deliveries to the CVP service area, farm employment declined by an estimated 2,350 full-time-equivalent positions. (One full-time-equivalent

employed person equals 2,000 hours of work). However, the number of actual farm employees displaced is estimated at 3,560, and was calculated in the following way: The average California farm employee is able to find 33 weeks of farm employment a year, which corresponds to about 1,320 work hours. Therefore, on average, 4.7 million hours of work would be performed by 3,560 farm workers.

Unfortunately, this estimated loss of employment can not be compared with changes in on-farm employment reported to the Department of Employment Development (EDD).¹⁹ EDD agricultural employment figures refer to countywide totals and can not be disaggregated by sub-region. Also, the predicted employment loss represents just over 1 percent of total on-farm employment in the Central Valley, which is approximately 184,000. Annual variations in this total are six times larger than the estimated decline. Therefore, losses of on-farm employment within the CVP service area may be too small to detect in aggregate data.

Also, most agricultural jobs in California are short-term, particularly at peak season when the largest number of workers are employed. This results in an unusually large month-to-month variation in reported employment; published employment reports are subject to both over- and under-reporting. Employers are required to report only the number of workers on the payroll in the pay period that includes the twelfth day of the month. Individuals who are employed at that time but not later in the month are counted as though they were employed for the entire month. On the other hand, people who are employed later in the month, after the reported pay period, are not counted at all.

The estimate of labor displacement in this report differs somewhat from the values reported by NEA.²⁰ For 1991, NEA estimated a "job loss" of 5,000, but in 1992 that figure dropped to 1,600. Evidently, NEA used monthly employment numbers for the entire San Joaquin Valley to come up with the 1991 estimate, comparing June through November agricultural employment, as reported by EDD, against the corresponding 1990 data. For 1992, NEA relied on a calculated value derived from an economic model that provides estimates of labor reduction for specified crop acreage decreases. Its figures do not refer either to full-time-equivalents or to number of people actually employed. Rather, they refer to a count of jobs at a particular time of the year. Perhaps coincidentally, the average of the NEA estimates for the two years is 3,300, quite close to the value CIRS determined.

Fresno County had the biggest decrease in crops and jobs

Fresno County experienced the largest net reduction of harvested crop acreage in the entire Central Valley, followed by Kern and Sutter counties. As noted previously, the largest decrease in CVP irrigation water deliveries occurred in the West San Joaquin Division, located primarily within Fresno County. Our estimate of an 854,657 acre-ft. net decline represents 34 percent of the net reduction in water supplies to the entire CVP.

Based on the reported change in crop production and the corresponding shift in estimated labor demand, at least 1,200 farm employees were displaced as a result of water delivery cutbacks in the West San Joaquin Division area. It is likely that the net displacement was larger given the fact that those crops experiencing the greatest proportionate declines in production—cotton, alfalfa, cantaloupes and melons, and grapes—are produced mainly in the San Joaquin Valley and are concentrated in Fresno County.

According to EDD, on-farm loss of employment in Fresno County was substantial. For the years 1984–86, EDD on-farm employment in Fresno County averaged 53,243,²¹ but dropped to 49,869 for the final three years of the drought²²—a loss of 3,374 jobs.

In contrast, on-farm employment in Kern County, as reported by EDD, rose from an average of 27,484 for 1984–86, to an average of 30,541 for 1990–92.²³ This growth in reported on-farm employment appears, on its face, to be in disagreement with the Bureau of Reclamation data showing a decline in CVP-irrigated acreage in Kern County. However, as in the case of EDD's statewide farm employment figures, farm employment data for Kern County do not refer to the CVP service area only, and so prevent further analysis. Also, detailed crop-by-crop analysis of the CVP service area land in Kern County would be needed to determine if smaller total acreage of labor-intensive crops may have replaced large acreage of low-labor field crops.

Widespread anecdotal reports of significant job loss in the western Fresno County agricultural community of Mendota clearly correlate with cutbacks in CVP water deliveries and the associated decline in harvested crop acreage. The reported unemployment rate in Mendota was 40.7 percent in 1992, up substantially from the mid-1980s.²⁴ While it is possible to attribute a portion of this increase to the recession of the early 1990s, the local decline in crop work also played a significant role.

Are factors other than changes in water supply reducing crop production?

It is tempting to attribute harvested crop acreage losses entirely to the drought. This could be misleading, however, since confounding factors may have independently influenced crop planting and harvest decisions.

A significant effort has been made in this study to compare averages for three-year periods (pre-drought vs. final drought years). In so doing, it is expected that fluctuations due to crop market conditions, non-drought weather factors (such as the December 1990 freeze), unusual pest problems, and other "normal" fluctuations in agriculture have been taken into account.

One important factor not considered in computing these three-year averages is the conversion of cropland to residential and commercial development. Dr. Alvin Sokolow, a University of California Cooperative Extension specialist on changes in land use patterns in the Central Valley, has compiled detailed county-by-county reports on the conversion of farm land to urban uses, as well as other measures of agricultural land loss. While preliminary, his data clearly show that in Fresno County agricultural land (not just irrigated land) shrunk by 21,435 acres between 1984 and 1990,²⁵ but this accounts for only about 10 percent of the reduction in harvested acres in the county for this period.

The conversion of cropland to development apparently does not account for the bulk of the harvested cropland loss found in this study. At the same time, it is a factor that warrants additional attention. Farmers who are faced with difficulties in securing adequate irrigation water might find a purchase offer from a private developer quite attractive.

The requirements of USDA price and income support programs present another potentially confounding influence. Such programs may include "set-aside" or diversion requirements which mandate that farmers temporarily fallow a portion of their land in return for cash payments. If program requirements changed significantly during the period of study, their effects must be factored out. However, the 1992 *Census of Agriculture* found that the amount of "set-aside" land actually *decreased* by a large factor between 1987 and 1992,²⁶ from 389,181 to 78,550 acres. Significantly more land was diverted from production in the first year of the drought than in later years. In reality, USDA-mandated set-aside lands shrunk at the same time as the amount of harvested crop land in the CVP service did.

Policy Recommendations

1. Agricultural communities already adversely impacted by water supply cutbacks need direct emergency assistance. Thousands of people are either without work or have significantly diminished employment opportunities.
2. Farm operators and businesses providing services to agriculture need a definite time line for the determination of future water supplies. The present climate of uncertainty adversely influences business decisions of all kinds in the affected communities.
3. Comprehensive direct measurements of groundwater utilization and recharge are needed throughout agricultural areas in California. At present, it is not even clear how many new agricultural wells are being drilled each year, let alone how much groundwater is being pumped. This could be accomplished most easily by requiring farm operators to document their pumping with electrical consumption receipts. If this does not prove adequate, then water meters should be required on all agricultural wells, as is done in Arizona.
4. New programs are needed to assist those displaced by CVPIA-induced reductions in agricultural production.
5. Social and community impact assessments should be required prior to implementation of CVPIA-mandated changes in irrigation supplies to agriculture.
6. New inter-basin water transfers, including the water marketing initiatives contemplated under the CVPIA, should be suspended until the direct and third-party impact can be determined.
7. The Western Rural Development Center, an agency supported by the USDA, should be asked to host a workshop and conference in Fresno to identify and respond to adverse local impacts of CVPIA-mandated water supply cutbacks.

8. Groundwater recharge, whether through spreading (as is done in the San Joaquin Valley) or through normal irrigation practice, should be recognized and sanctioned as an environmentally sound use of water.
9. More information is needed on the Central Valley's groundwater table, especially the degree to which it can be relied upon as a supply during extended periods of drought.
10. Ecological farm operators should be encouraged by recognizing their farming practices as an environmentally sound use of water.
11. Agricultural water use practices should be examined in the context of open space management. For example, farmers could become sanctioned custodians of open space. In such a context, natural resource management might very well include irrigated farming as an environmentally beneficial practice.

References

- 1 U.S. Department of Interior, Bureau of Reclamation, *Summary Statistics. Water, Land & Related Data*, Table 11. Water Distribution, Annual, 1984-92, Denver, CO.
- 2 Ibid.
- 3 Ibid.
- 4 U.S. Department of Commerce, Bureau of the Census, *1992 Census of Agriculture*, Vol. 1, Part 5, California State and County Data, Table 1, pp. 8-9, September 1994, Washington, DC.
- 5 *1987 Census of Agriculture*, op. cit., County Data, Table 5, p. 191. Central Valley farmers reported land under federal acreage reduction programs totaled at least 389,181 acres in 1987 vs. 115,232 acres in 1982. For confidentiality reasons, 1987 figures were not disclosed for the following Central Valley counties: Butte, Colusa, Placer, Sacramento, Shasta, Sutter, and Yuba. These counties accounted for 26 percent of the reported Central Valley acreage reduction total in 1982.
- 6 U.S. Department of Interior, op. cit., Table 4, Irrigation and Gross Crop Value Data by Region.
- 7 County Agricultural Commissioner *Crop Reports* are produced annually by each county's Department of Agriculture. They summarize reports from individual producers for each year. Reports were obtained from each of the eighteen Central Valley counties for each of the years 1984-93.
- 8 U.S. Department of Interior, op. cit., Crop Production Report.
- 9 Northwest Economic Associates, "Economic Impacts of the 1991 California Drought on San Joaquin Valley Agriculture and Related Industries," March 16, 1992, p. 15.
- 10 Northwest Economic Associates, "Economic Impacts of the 1992 California Drought and Regulatory Reductions on the San Joaquin Valley Agriculture Industry," December 31, 1993, p. 17.
- 11 *California Water Plan Update*, Vol. 1, Department of Water Resources, The Resources Agency, State of California, Bulletin 160-93, October 1994, Figure 4-6, p. 102.
- 12 Ibid, Table 4-4, p. 100.

- ¹³ Ibid, pp. 10-11 and 15-16.
- ¹⁴ *Management of the California State Water Project, Appendix F, San Joaquin Valley Post-Project Economic Impact, 1986 & 1987*, State of California, The Resources Agency, Department of Water Resources, Bulletin 132-88, December 1988.
- ¹⁵ Ibid.
- ¹⁶ *California Water Plan Update*, State of California, The Resources Agency, Department of Water Resources, Bulletin 160-93, October 1994, p. 100.
- ¹⁷ U.S. Department of Interior, op. cit., Crop Production Report.
- ¹⁸ John W. Mamer and Alexa Wilkie, *Seasonal Labor in California Agriculture: Labor Inputs for California Crops*, California Agricultural Studies, Report No. 90-6, Employment Development Department, Labor Market Information Division, December 1990, Sacramento, CA.
- ¹⁹ *Agricultural Employment*, State of California, Department of Employment Development, Employment Data and Research, Bulletin 882-A, Calendar Year 1987-92. For the years 1984-86, CIRS obtained unpublished data from EDD. Care must be taken in using these figures. CIRS uses the term on-farm employment to refer to all 01xx, 02xx, 071x, 0721, 0722, 0723 and 076x SIC codes. It is these activities which are on-farm and contribute directly to the production of an agricultural commodity. Thus, Cotton Gin employment (SIC 0724) has been excluded even though it is described as "Agricultural Employment" because it is an off-farm post-harvest activity. The largest figures for Agricultural Employment excluded in this way are for Lawn & Garden Services (0782) and Veterinarian Services, Pets (0742). Clearly, neither activity results in the production of an agricultural commodity for sale.
- ²⁰ Northwest Economic Associates, op. cit., p. 35 (1991) and p. 38 (1992).
- ²¹ *Agricultural Employment*, op. cit.
- ²² Ibid.
- ²³ Ibid.
- ²⁴ Robert L. Chapman, Manager, Mendota office, Employment Development Department, State of California, unpublished memo, May 1, 1993.

²⁵ Dr. Al Sokolow, Department of Applied Behavioral Sciences, University of California, Davis, private communication. The author is grateful to Dr. Sokolow for making these unpublished data available.

²⁶ Bureau of the Census, *op. cit.*, Table 7. Land Use and Acres Diverted: 1992, 1987, and 1982, p. 17.

Appendix

Appendix 1: Farm Employment, 1984, 1985, and 1986—EDD

07x includes 071, 072, 076; all other 07x are excluded, except 0724 (cotton ginning) is reported in Fresno, Kern, Kings, Madera, Merced, and Tulare counties.

1984

County	SIC*	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE**
Butte	01	2405	2330	2302	2276	2562	2355	2370	2841	3045	3066	2631	2226	2534.08
	02	107	110	113	111	113	115	88	88	88	127	109	117	107.17
	07x	379	388	375	353	517	414	473	586	452	747	693	518	491.25
Colusa	01	920	1136	1633	2581	2528	2557	2558	2612	2501	2228	1513	1225	1999.33
	02	33	34	37	53	88	83	68	81	79	26	59	26	55.58
	07x	232	232	227	317	343	347	328	317	323	258	214	191	277.42
Fresno	01	26945	20849	18904	25529	30816	36383	35774	49249	69779	25644	23168	27383	32535.25
	02	2844	2834	2877	2979	2980	3111	3023	3026	3053	2910	2918	2892	2953.92
	07x	12951	10634	10541	16999	23250	28881	28949	32596	31543	12219	11484	13580	19468.92
Glenn	01	1021	1007	1019	1020	1026	1059	1048	1152	1219	1617	1274	1135	1133.08
	02	314	324	367	355	373	420	360	369	361	398	374	366	365.08
	07x	251	276	200	430	308	272	343	341	316	339	251	314	303.42
Kern	01	15629	13341	12248	15544	19013	22411	22846	19033	15551	11251	10964	12599	15869.17
	02	878	887	910	908	928	913	861	856	817	914	937	974	898.58
	07x	10410	8376	8262	9452	14054	16947	16086	16397	16700	11187	10946	10224	12420.08
Kings	01	3571	3619	3826	4397	5600	6335	5458	5163	5164	4195	4265	3975	4630.67
	02	707	710	733	737	826	829	758	779	863	746	719	775	765.17
	07x	632	559	669	1309	1806	2029	1316	1309	1479	916	940	816	1148.33
Madera	01	5223	4086	3161	3100	3812	4278	4379	6368	11281	4216	2906	4437	4770.58
	02	478	551	581	494	490	481	432	456	567	532	532	528	510.17
	07x	1415	1070	936	1138	1634	1702	1775	3841	4708	1832	1803	2590	2037
Merced	01	4430	4336	4578	5030	6422	7605	8619	10177	9439	6449	4578	4536	6349.92
	02	1589	1646	1693	1750	1897	1895	1788	1754	1794	1838	1707	1680	1752.58
	07x	1111	1027	1168	1531	1918	2613	3387	3409	3739	2798	2286	1835	2235.17
Placer	01	330	317	334	438	434	420	383	370	344	321	253	309	354.42
	02	145	136	139	146	141	142	130	132	142	126	122	128	135.75
	07x	—	—	—	—	—	—	—	—	—	—	—	—	—

* Stands for "standard industrial classification" code of the U.S. Department of Commerce.

** Stands for "average employees", and is the average of the twelve monthly figures.

1984 (cont.)

County	SIC	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE
Sacramento	01	1554	1500	1516	1915	1995	2034	2516	2637	2254	1737	1531	1627	1901.33
	02	377	371	389	434	444	449	438	401	386	414	423	393	409.92
	07x	502	471	377	866	1140	1187	654	1037	822	367	235	265	660.25
San Joaquin	01	7850	6874	9425	11809	15792	14456	10022	9508	9208	9778	7473	6954	9929.08
	02	1597	1646	1653	1824	1695	1668	1103	1096	1096	1682	1620	1636	1509.67
	07x	2221	1804	2467	3297	7071	9301	5929	6184	8985	3864	2368	2482	4664.42
Solano	01	844	872	1167	1812	1915	2101	2060	2393	1991	1385	1065	869	1522.83
	02	137	135	146	148	164	172	143	132	126	166	126	132	143.92
	07x	168	210	282	563	852	1056	642	681	594	213	142	108	459.25
Stanislaus	01	4918	4523	4525	4792	6291	8000	7600	9087	9991	6444	4826	4526	6293.58
	02	3014	3019	3014	3069	3079	3094	3066	3048	3083	3214	3132	3175	3083.92
	07x	1383	1266	1300	2582	3263	4748	4888	4426	5059	3628	2808	2133	3123.67
Sutter	01	1937	1869	2012	2517	3469	3591	4078	6163	4916	2778	2267	1937	3127.83
	02	74	77	94	116	111	114	111	121	111	83	80	75	97.25
	07x	209	216	358	347	392	470	523	443	546	540	539	366	412.42
Tehama	01	769	527	564	633	630	688	694	853	1029	1315	744	920	780.5
	02	217	216	214	234	234	223	190	194	182	220	206	193	210.25
	07x	20	12	14	21	24	22	67	85	107	254	47	40	59.42
Tulare	01	11600	13226	25173	11519	13659	17953	15664	16972	19589	13121	10417	10110	14916.92
	02	1649	1703	1740	1807	1895	2007	1891	1977	2077	1820	1791	1810	1847.25
	07x	10650	10244	9358	12157	14296	15555	12528	13460	17070	12011	10573	10013	12326.25
Yolo	01	1506	1809	2372	3745	4250	4530	4841	4876	4716	3294	2534	1753	3335.5
	02	93	104	97	99	101	108	82	87	74	83	120	132	98.33
	07x	676	711	834	2010	2128	2449	2440	1616	1509	1153	910	875	1442.58
Yuba	01	924	1201	1151	1196	1424	1384	2294	2884	2042	1299	1129	1141	1505.75
	02	54	53	52	83	74	68	55	57	73	64	50	49	61
	07x	372	308	318	238	277	340	235	354	195	80	72	36	235.42
Total														190,260.58

1985

County	SIC	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE
Butte	01	1973	1834	1749	2199	2542	2310	2364	2700	2745	3704	2289	1923	2361
	02	73	76	87	91	96	85	75	74	71	73	70	65	78
	07x	510	493	417	434	525	524	513	289	348	1171	638	609	539.25
Colusa	01	958	1119	1416	1898	2153	2119	2229	2304	2185	2132	1431	1026	1747.5
	02	34	63	35	45	61	34	28	54	28	26	59	26	41.08
	07x	141	131	188	364	298	303	292	228	246	225	190	145	229.25
Fresno	01	24772	20278	16950	22583	26920	31867	32534	43916	66689	29645	19492	25605	30104.25
	02	2971	2909	2808	2886	3054	3216	3165	3090	3038	2911	2710	2641	2949.92
	07x	12285	11008	10371	16649	23018	30702	28351	34932	33836	17858	14732	16222	20830.33
Glenn	01	1021	1007	1019	1020	1026	1059	1048	1152	1219	1617	1274	1135	1133.08
	02	314	324	367	355	373	420	360	369	361	398	374	366	365.08
	07x	251	276	200	430	308	272	343	341	316	339	251	314	303.42
Kern	01	11655	9372	9307	13905	15460	15803	21906	18440	13397	11735	10313	12507	13650
	02	894	836	858	795	788	770	846	816	803	833	845	842	827.17
	07x	10403	9791	8923	11174	14557	16262	18966	17381	15420	11657	10737	10595	12988.83
Kings	01	3149	3248	3249	4054	4835	5669	4874	4578	4264	4340	4165	3594	4168.25
	02	667	617	648	689	707	818	735	715	756	761	673	677	705.25
	07x	579	575	514	944	1486	1316	1756	1423	1518	1028	914	781	1069.5
Madera	01	5056	3897	3115	3406	4446	4599	3721	5486	9665	5924	2435	4140	4657.5
	02	445	438	449	431	482	461	404	425	470	451	451	417	443.67
	07x	1873	1484	1195	1338	1605	1975	1701	3745	5636	2123	1570	1653	2158.17
Merced	01	3957	3677	3789	4351	5406	5996	6439	8030	7588	6028	4162	3866	5274.08
	02	1459	1534	1529	1661	1777	1764	1715	1728	1676	1678	1535	1503	1629.92
	07x	1121	1584	1453	2063	2868	3301	4695	5079	6090	3909	3129	2589	3156.75
Placer	01	330	317	334	438	434	420	383	370	344	321	253	309	354.42
	02	145	136	139	146	141	142	130	132	142	126	122	128	135.75
	07x	—	—	—	—	—	—	—	—	—	—	—	—	—
Sacramento	01	1441	1470	1290	1604	1756	1803	2160	2679	2382	1595	1636	1625	1786.75
	02	372	400	380	416	443	437	393	386	384	409	396	388	400.33
	07x	467	557	276	529	568	456	714	877	627	374	212	303	496.67

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1985 (cont.)

County	SIC	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE
San Joaquin	01	6547	6131	7264	10807	13548	12110	9208	12583	15479	9881	7084	6928	9797.5
	02	1550	1579	1575	1617	1613	1630	1619	1596	1597	1645	1660	1647	1610.67
	07x	1781	1633	1634	2681	6804	8072	5235	5217	7323	4475	2475	2198	4127.33
Solano	01	667	768	854	1781	2061	1913	2067	2414	1950	1467	1100	947	1499.08
	02	114	117	121	107	113	119	108	105	112	119	110	107	112.67
	07x	112	122	176	475	743	996	542	725	648	153	97	86	406.25
Stanislaus	01	4380	4396	4278	4946	6257	7366	7586	9039	9002	6888	4716	4286	6095
	02	3039	3019	3062	3093	3188	3348	3306	3190	3714	3188	3130	3162	3201.58
	07x	2808	1785	1862	3123	3597	4920	5386	6282	7376	4586	4067	3657	4122.42
Sutter	01	1669	1676	1788	2341	3373	3370	4277	6285	5235	2745	2094	1757	3050.83
	02	74	77	94	105	102	95	111	121	111	76	90	74	94.17
	07x	173	180	187	270	365	317	700	624	447	646	339	197	370.42
Tehama	01	805	574	579	624	653	647	781	839	1101	1499	770	1023	823.75
	02	181	190	182	191	194	195	172	178	173	220	184	176	186.33
	07x	53	20	46	19	20	24	46	66	66	164	128	112	63.67
Tulare	01	10142	9711	8369	10929	13532	17233	15930	16601	19064	13447	9267	9395	12801.67
	02	1728	1757	1751	1775	1825	1823	1754	1790	1748	1783	1675	1706	1759.58
	07x	10407	8392	9475	11103	12921	15821	12811	14859	15819	15268	11574	11691	12578.42
Yolo	01	1335	1579	2050	3869	4321	4443	4179	4746	4490	2973	2123	1675	3148.58
	02	100	91	88	97	92	86	77	80	78	81	85	100	87.92
	07x	584	665	822	1455	1737	1938	2137	2280	1749	1074	899	769	1342.42
Yuba	01	1024	1061	1113	1322	1483	1458	2642	3368	2254	1410	1279	1128	1628.5
	02	54	53	52	66	60	62	55	57	73	64	50	49	57.92
	07x	58	72	80	100	192	112	189	329	152	207	162	124	148.08
Total														183,699.92

1986

County	SIC	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE
Butte	01	1701	1452	1455	1827	1930	1819	2018	2464	2552	3494	2360	2162	2102.83
	02	66	65	71	83	80	66	73	70	63	74	65	62	69.83
	07x	565	368	497	667	804	698	652	641	526	1248	850	821	694.75
Colusa	01	764	766	915	1679	1997	2145	2200	2339	2044	2206	1449	1022	1627.17
	02	23	51	34	35	48	32	32	32	30	25	23	36	33.42
	07x	120	140	157	233	287	276	243	224	234	240	180	118	204.33
Fresno	01	25384	19912	17065	25808	29394	33061	31915	46858	53607	24997	20882	26190	29587.75
	02	2515	2310	2260	2563	2776	2772	3332	3343	3370	2514	2565	2508	2735.67
	07x	12790	11144	10297	19426	23163	26227	25522	28638	31094	14383	14239	15881	19400.33
Glenn	01	773	648	739	881	913	960	1013	1048	1186	1478	1044	950	969.42
	02	316	329	379	336	350	278	302	283	320	294	284	283	312.83
	07x	193	221	218	297	339	331	346	426	375	297	230	379	304.33
Kern	01	11090	9473	9606	11741	14104	14035	22155	15830	12205	9828	10005	12245	12693.08
	02	846	811	824	852	851	831	793	788	787	821	805	827	819.67
	07x	9421	9508	8948	11790	16045	16417	18771	18592	16562	12612	11949	12606	13601.75
Kings	01	3176	3064	3088	3959	4343	4717	4173	4109	4310	3894	4093	3616	3878.5
	02	666	663	681	742	767	821	714	697	722	676	830	685	722
	07x	428	411	462	948	1637	1364	2320	2322	2184	1317	1321	1120	1319.5
Madera	01	4237	3359	2653	2651	2846	3454	3527	5380	7085	4408	2582	4227	3867.42
	02	427	421	414	413	403	418	383	370	384	473	447	448	416.75
	07x	1230	1222	1315	1279	1727	1842	1638	3300	5018	7410	11544	3727	3437.67
Merced	01	3385	2966	3087	4175	4987	5241	6478	7885	7378	6401	5115	4687	5148.75
	02	1419	1420	1463	1577	1652	1604	1599	1622	1537	1563	1531	1416	1533.58
	07x	1088	1290	1211	1977	2229	2771	3933	4244	5240	3865	3156	2577	2798.42
Placer	01	254	305	312	385	416	380	358	360	315	342	337	359	343.58
	02	121	116	117	138	141	143	129	129	132	129	126	128	129.08
	07x	—	—	—	—	—	—	—	—	—	—	—	—	—
Sacramento	01	1489	1319	1174	1394	1558	1681	3126	2237	2083	1584	1607	1585	1736.42
	02	364	365	371	388	407	400	389	391	371	407	399	392	387
	07x	637	578	383	437	618	653	794	795	529	269	176	254	510.25

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1986 (cont.)

County	SIC	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	AVE EE
San Joaquin	01	5884	5740	8362	9142	11339	9637	8997	12703	13978	9093	6857	6864	9049.67
	02	1575	1624	1632	1610	1631	1604	1596	1590	1612	1652	1663	1655	1620.33
	07x	1405	2030	2735	3161	5153	6162	4420	5275	5661	3162	2190	2029	3615.25
Solano	01	738	702	1169	1563	1864	1671	1989	2039	1677	1365	1049	912	1394.83
	02	97	106	103	115	114	111	107	101	96	112	114	109	107.08
	07x	62	60	78	496	610	655	703	563	273	158	103	110	322.58
Stanislaus	01	3891	3794	3823	3534	4972	5653	7131	8597	8150	6241	4717	4301	5400.33
	02	3053	3074	3156	3151	3148	3207	3203	3111	3143	3000	3046	3007	3108.25
	07x	1693	2054	2184	2998	3829	4903	4209	5592	6978	4320	2925	2871	3713
Sutter	01	1398	1349	1548	2262	3064	2982	4572	5563	4089	2631	2096	1945	2791.58
	02	76	70	93	87	97	90	117	120	110	54	154	62	94.17
	07x	173	165	192	229	301	272	335	619	477	445	407	189	317
Tehama	01	830	603	596	675	618	733	679	918	923	1619	1061	1331	882.17
	02	165	178	185	196	192	189	167	176	163	178	177	179	178.75
	07x	8	11	12	52	43	40	18	55	227	267	104	22	71.58
Tulare	01	8991	8218	7910	11076	12490	15454	14524	17483	17413	13703	8847	9981	12165.83
	02	1692	1686	1721	1789	1789	1849	1868	1764	1717	1783	1772	1744	1764.5
	07x	11205	10564	10940	13629	15169	16942	14609	14847	16325	17705	12694	13336	13997.08
Yolo	01	1131	1213	1532	3211	3971	4051	3853	4100	3810	2830	2051	1603	2779.67
	02	87	85	85	98	73	87	99	80	75	100	108	136	92.75
	07x	711	715	855	1283	1823	1994	1980	1875	2095	1105	900	642	1331.5
Yuba	01	933	1020	1138	1267	1532	1505	2711	2971	1945	1348	1171	1132	1556.08
	02	48	45	50	54	56	53	53	54	61	58	54	51	53.08
	07x	85	72	82	89	171	160	239	347	94	123	78	61	133.42
Total														177,926.58

Appendix 2: Harvested Acres—County Ag Commissioner Crop Reports

County	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Butte	233391	218722	210806	208568	212540	216944	222233	200560	205390	206225
Colusa	221575	235755	219090	224714	231927	268895	249470	239745	229245	277647
Fresno	1393074	1396150	1278741	1299506	1312319	1207931	1249351	1156518	1151191	1227352
Glenn	209199	218298	205972	203913	210873	216180	210944	198760	207056	241095
Kern	888467	807915	782236	825347	863795	846435	899276	766533	778159	806702
Kings	494356	508670	498436	517689	518049	508684	536479	495627	492113	512949
Madera	287702	304533	292560	329821	328491	299121	314328	308985	311350	308669
Merced	520307	487808	472987	493015	507921	526177	547258	545572	540638	554155
Placer	51790	50502	50219	51282	47644	50116	50301	51231	52873	53046
Sacramento	193771	180435	152590	153180	157610	155440	159100	145990	154250	158440
San Joaquin	538160	546110	519150	498630	507500	527170	524720	481320	487430	544800
Solano	227127	233361	222616	217917	212586	232318	218838	202130	206508	224787
Stanislaus	424522	407792	403485	412840	405610	406302	450200	455300	454050	440580
Sutter	355950	333790	285838	240677	245504	250284	252026	225319	245742	273088
Tehama	91744	90715	85333	84540	82809	77647	76999	77593	77200	77256
Tulare	728799	711803	672741	680251	676464	674301	732611	762212	780976	775615
Yolo	326023	342730	322147	317700	307722	339597	343407	326108	344156	353480
Yuba	74797	69283	73498	67417	65510	73100	73100	77007	77953	77379

Crop Summaries

Fruit & Nuts

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
SJ Valley	1263135	1297130	1318365	1303841	1306674	1295443	1331289	1339516	1352490	1407185
Sac Valley	231176	264101	269340	276658	273047	276928	283090	283200	288575	300721
Total	1494311	1561231	1587705	1580499	1579721	1572371	1614379	1622716	1641065	1707906

Field & Seed

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
SJ Valley	3627618	3487198	3218517	3323240	3390020	3238721	3401727	3106282	3158378	3218168
Sac Valley	1632047	1596755	1449499	1387035	1387128	1476076	1429120	1301670	1383296	1490695
Total	5259665	5083953	4668016	4710275	4777148	4714797	4830847	4407952	4541674	4708863

Vegetables

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
SJ Valley	384634	386453	383454	430018	423455	461957	521207	526269	485039	545469
Sac Valley	122144	112735	109270	106215	114550	127517	144208	159573	128502	151027
Total	506778	499188	492724	536233	538005	589474	665415	685842	613541	696496

Appendix 3: CVP Crop Production Report, Harvested Acres

The following are harvested acreage figures broken down by specific category and crop. "Change" refers to the difference between the 1984-86 three-year average (pre-drought) and the 1990-92 three-year average (end of the drought).

	1984	1985	1986	1987	1988	1989	1990	1991	1992	Change*	% Chng
Cereals—Total	494977	503860	457365	382648	383063	440551	346868	260769	306765	-180700	-37.23
Barley	47978	49801	47526	32238	23263	32695	18981	10055	16628	-33247	-68.64
Corn	80296	81563	80908	45959	36213	37888	18144	19048	27001	-59491	-73.55
Oats	1351	5399	10217	5940	5547	13113	6336	7267	7536	+1390	+24.58
Rice	209887	192238	186758	165656	215460	229971	196519	169621	175179	-15521	-7.91
Rye	0	0	0	0	0	0	0	0	0	—	—
Sorghum	15611	9737	15475	4346	2917	4410	2308	1743	1842	-11643	-85.57
Wheat	139349	147136	114450	127425	96626	121030	101663	53193	76987	-56397	-42.20
Others	505	18706	2131	1084	3027	1644	817	842	1593	-6030	-84.76
Forage—Total	241805	248994	286355	261230	225883	272430	191272	217217	196516	-56383	-21.77
Alfalfa hay	146974	152487	165594	166501	145229	170862	120527	134616	117051	-30950	-19.97
Other hay	11579	17600	38068	22042	16147	18811	14520	14790	14222	-7911	-35.28
Irr Pasture	68546	58759	61372	53819	48524	58501	49048	45329	45077	-16408	-26.09
Corn fodder	0	0	0	0	0	0	0	0	0	—	—
Silage	13817	18294	16662	10383	11744	11539	5144	15175	17667	-3596	-22.12
Root crops	0	0	0	0	0	0	0	0	0	—	—
Others	889	1854	4651	8485	3939	16717	2033	7507	5498	+2548	+103.37
Misc Field—Total	689483	685065	618445	682809	689743	636335	814508	487436	518660	-148866	-22.82
Beans, dry	54220	62234	63893	57890	60252	65543	41148	33762	36835	-22867	-38.04
Cotton	571947	540514	474998	532168	562856	490491	415350	373967	365252	-137630	-26.01
Cotton, pima	390	210	222	505	649	170	581	33630	29857	+22882	+8351.09
Sugar beets	32169	38589	44513	46806	46505	41004	23520	21649	22172	-15976	-41.58
Soybeans	0	444	5	10	0	0	0	0	0	—	—
Others	30323	23513	32099	25240	19681	39077	28509	24428	44544	+3879	+13.55
Vegetables—Total	230014	285320	278780	275085	283604	335285	317831	311203	282571	+42407	+18.65
Asparagus	1351	1258	1375	1890	737	1390	1050	3058	1286	+470	+35.39
Beans, proc	9249	7114	3590	4485	6875	9064	11420	12759	5587	+3271	+49.18
Beans, fresh	111	2832	967	3121	1584	3113	3544	1461	512	+569	+44.80
Broccoli	1710	4128	7472	7892	7254	3684	2343	4438	8562	+11	—
Cabbage	63	69	160	125	1258	935	756	924	980	+789	+814.43
Carrots	6384	4099	4570	5693	5599	5378	2321	6418	5878	-145	-2.90
Cauliflower	1980	1571	1473	2302	2722	1940	3621	1673	1496	+589	+35.16
Celery	78	83	0	106	517	560	700	819	225	—	—
Corn, sweet, proc	1343	556	0	168	77	35	170	13	90	—	—
Corn, sweet, fresh	112	2069	2812	3695	11174	12177	2392	1366	1961	+249	+14.96
Cucumbers	246	130	388	300	382	198	484	578	284	+194	+76.08
Greens	382	1533	1427	2119	2032	1084	555	500	1235	-350	-31.51
Lettuce	9149	15235	20980	15820	17720	17108	15313	12632	12860	-1323	-8.87
Cantaloupes	35588	49700	42657	40291	38053	41222	35372	30507	29276	-10964	-25.69
Honeydew, etc	6587	4431	18024	17507	13105	16985	8775	8162	7051	-1684	-17.40

IMPACT OF REDUCED WATER SUPPLIES ON CENTRAL VALLEY AGRICULTURE • 27

	1984	1985	1986	1987	1988	1989	1990	1991	1992	Change	% Chng
Watermelons	5434	1527	2812	2475	2283	1823	1322	1180	1247	-2008	-61.84
Onions, dry	12595	14515	25211	16011	17256	18825	17288	10574	8338	-5373	-30.81
Onions, green	0	20	10	0	0	0	16	40	1514	—	—
Peas, proc	6301	3984	2120	1120	2627	2600	3036	2085	1496	-1929	-46.66
Peas, fresh	215	754	445	41	184	3675	1474	1125	638	+608	+129.09
Peppers	2442	2489	4254	4319	6038	3880	5245	4839	5943	+2281	+74.49
Potatoes, spring	19233	23039	16992	18097	15579	9975	20564	18420	18452	-609	-3.09
Potatoes, fall	0	0	0	0	0	99	0	30	0	—	—
Squash	42	75	472	371	160	228	172	287	359	+76	+39.29
Tomatoes, proc	104321	98829	102068	96144	108487	144274	154786	163818	127813	+47066	+46.26
Tomatoes, fresh	3785	5274	9620	4363	11557	10113	8282	4339	4991	-356	-5.70
Others	1213	10006	9541	26840	10244	25110	16530	19158	16475	+5026	+72.63
Seed—Total	40685	43590	49319	46353	46884	35735	42382	38483	35074	-5882	-13.21
Alfalfa	25791	27801	36647	33908	28648	21378	13127	21025	15651	-13412	-44.69
Clover	1728	2078	2028	2538	2291	1749	581	1145	903	-1068	-54.94
Corn	149	0	0	0	0	0	0	0	0	—	—
Grass	0	184	1299	0	0	0	0	0	0	—	—
Lettuce	196	176	0	0	5	0	0	0	0	—	—
Onions	83	12	59	87	116	226	93	108	111	+53	+103.92
Peas	0	0	0	0	30	282	18	179	40	—	—
Potatoes	0	0	0	0	0	0	0	0	0	—	—
Sugar beets	0	177	216	0	0	165	97	0	0	—	—
Others	12738	13374	9117	9848	15928	12040	28333	16051	18372	+9176	+78.14
Fruits—Total	400283	428363	423855	425214	407257	414304	406472	402808	407711	-11830	-2.83
Apples	1208	1821	2875	4264	5277	5503	6760	7291	8035	+5461	+287.2
Apricots	11585	11712	11286	10241	12773	12478	13872	12231	12307	+1276	+11.07
Berries	259	265	153	102	201	205	296	325	360	+101	+44.69
Cherries	1846	2028	1949	2055	1068	1112	1407	1224	1354	-613	-31.58
Grapenfruit	37	43	43	43	57	74	101	133	154	+88	+214.63
Lemons & limes	2985	2824	2735	2872	2673	2574	2454	2580	3020	-163	-5.72
Oranges & tang	83269	86607	86508	90982	98425	98161	93540	97157	96216	+9510	+11.04
Dates	0	0	0	0	0	0	0	0	0	—	—
Grapes, table	76884	10545	13954	64516	34051	33009	40723	35950	34133	+3141	+9.29
Grapes, other	159794	234687	228282	175019	188510	193492	183228	185664	192562	-20436	-9.84
Olives	14195	14682	15116	15206	15187	15233	15273	15428	14981	+563	+3.84
Peaches	12237	12631	12241	12246	10477	12447	13016	10367	10288	-1146	-9.26
Pears	2547	2765	2633	2410	4267	2389	2175	2058	2023	-563	-21.26
Prunes & plums	18494	19034	19707	20220	20154	21130	19961	19845	20345	+695	+3.59
Others	14923	28089	24373	25038	14137	15497	13666	12555	11933	-9744	-43.38
Nuts—Total	147182	154789	185007	158114	148417	157869	154394	157246	149686	+1456	—
Almonds	111729	116351	116409	118120	113276	117822	116932	116287	108688	-861	—
Pecans	1091	1005	1276	1147	1095	2207	928	1184	1098	-54	-4.80
Walnuts	28743	31173	30628	30592	29756	29147	28961	28547	27624	-2471	-8.19
Others	5589	6270	6694	8255	4290	8393	9573	13228	12276	+5508	+89
Total	2,182,411	2,231,114	2,185,568	2,147,901	2,122,362	2,182,269	1,910,132	1,831,635	1,842,336	-341,663	-15.51

