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A Statistical Profile of Horticultural Crop Farm Industries in California

Hyunok Lee
and Steven C. Blank

Giannini Foundation Research Report 348
July 2004

University of California
Agriculture and Natural Resources

THE AUTHORS

Hyunok Lee is an associate researcher and Steven C. Blank is a Cooperative Extension specialist in the Department of Agricultural and Resource Economics, University of California, Davis. They are both members of the Giannini Foundation of Agricultural Economics.

ACKNOWLEDGMENTS

The authors want to recognize the contributions of many who helped us with this study. We thank Roberta Cook and Karen Klonsky for their useful comments during the design of the survey questionnaire and Warren Johnston for providing useful comments for the earlier version of the manuscript. We thank our collaborators from CASS/NASS (California and National Agricultural Statistics Services)—Martha Leighton, Bob Losa, Dwaine Nelson, Jim Tippett, and Vic Tolomeo—who were responsible for data collection and compilation. We also thank graduate research assistants Hyejung Kang and Yunshik Kim, who helped with charts and tables. Thanks to Gary Beall and Jonathan Barker of the UC Agricultural Issues Center, who provided editorial services. We thank William Murphy, leader of the western regional office of the USDA Risk Management Agency (RMA) for assistance and support. Finally, special thanks to RMA's David Fulk and Virginia Guzman, who coordinated this project, and to Daniel Sumner, who helped with comments and suggestions throughout the process.

This research was funded by a partnership agreement with the U.S. Department of Agriculture Risk Management Agency, Agreement 01-IE-0831-092.

The images for the cover of this publication were graciously provided by USDA's Agricultural Research Service Photo Unit and photographers Scott Bauer (horticulture, vegetables), Peggy Greb (produce variety), and Keith Weller (peaches).

This publication has been anonymously peer-reviewed for technical accuracy by University of California scientists and other qualified professionals.

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EXECUTIVE SUMMARY

Horticultural crops provide 60 percent of total farm revenue in California agriculture, and California provides 37 percent of the horticultural crop value in the United States. Clearly, these industries comprise an important part of the agricultural economy. This study provides a detailed statistical profile of California's horticultural crop industries at the farm level, based on a survey of specialty crop growers that was conducted during the spring of 2002. The Risk Management Agency of the United States Department of Agriculture supported the research, and the California Office of the National Agricultural Statistics Service helped conduct the survey.

Specialty crops, also referred to as horticultural crops, include tree and vine (fruit/nut) crops, vegetables, and ornamental crops. The statistical profile of California's horticultural farm industries presented here is the most comprehensive ever undertaken for these industries, drawing on survey data collected from approximately one-third of all horticultural crop producers in the state.

Specialty crops are diverse. They differ in their product characteristics, production processes, and market environments. Such heterogeneity extends to risk characteristics of the crops and to the ways farmers cope with various risks. As a preliminary step to development of effective risk management tools, it is important to better understand factors that affect these risks. This report is intended to provide such information to help us understand specialty crop industries, the sources of risk, and behavioral risk responses in these industries. The following summary of results is organized by topic.

Farm Size and Regional Profile

About 86 percent of the farms surveyed produced primarily (in terms of revenue share) orchard and vine crops, 5 percent produced vegetable crops, and 9 percent produced ornamental crops. About 25 percent of the farms were located in coastal areas, 13 percent in the Sacramento Valley, and 47 percent in the San Joaquin Valley. The remaining 15 percent were in the northern mountain areas, the Sierra Nevada, the Southern coast, and the deserts. Average farm size was 203 acres, but the median farm comprised only 34 acres. There were relatively few very large farms and many very small farms. The average number of acres per farm varied substantially among the three crop categories: fruits/nuts, vegetables, and ornamental crops. The average land holding by vegetable growers, 1,106 acres, far exceeded the average of 157 acres for fruits/nuts and 200 acres for ornamental crops. These land figures include land planted to secondary crops (as well as field crops). When we examined land planted only in primary crops, our data showed that fruit/nut and vegetable farmers held, on average, about 50 percent of their land in primary crops (for definition, see page 7). However, land for ornamental crops, on average, accounted for only 10 percent of the average 200 acres per farm.

Crop Diversification

Crop diversification has long been recognized as an important risk management tool. Our data showed that crop diversification was much less common for orchard farms than for vegetable farms. About 70 percent of fruit/nut farmers were single-crop growers as opposed to 26 percent for vegetable farms. The scope of diversification also differed. Fruit/nut farmers predominantly diversified their crops with other varieties of fruits and nuts; only 20 percent of them used crops other than fruits and nuts for diversification. Vegetable farmers, on the other hand, frequently used other crops for diversification; only one-third of the vegetable farms were diversified among only vegetable crops. Our survey also indicated that primary crop acreage increases with crop diversification for both fruit/nut and vegetable crops. Farms growing five or more vegetables were, on average, four times larger in vegetable acreage than farms growing a single vegetable crop.

In California, 6 percent of specialty crop farmers had some organic or transitional-organic land. In terms of crop category, these farms represented 6 percent of orchard farms, 14 percent of vegetable farms, and 4 percent of ornamental crop farms. Our data showed that these farms also engaged in conventional farming and that they devoted, on average, about one-third of their

primary crop lands to organic farming. Judging from acreage assigned to primary crops, the farms were about average in acreage for fruit/nut farms but much smaller than average conventional vegetable farms.

Marketing

Marketing is an important component of risk management. Marketing channels vary by product use (processing versus fresh). Processing crops are delivered in bulk directly to processing plants, whereas fresh-use crops are sent to operations to be sorted, packaged, cooled (or refrigerated), and distributed through marketing channels.

California producers were highly specialized in terms of use. Most fruit/nut farms produced mainly for processing use (71 percent) and most vegetable farms produced mainly for fresh use (67 percent). Only 7 percent of specialty crop farmers supplied both processing and fresh market outlets.

In processed-use markets, contracts played a major role (they were used by 57 percent of fruit/nut farmers and 88 percent of vegetable farmers) with contracts with a predetermined price being the most prevalent form. In fresh-use markets, grower/shippers, which combine the packing/shipping business with field production under one ownership, provide a form of vertically integrated business. Our survey showed that grower/shippers accounted for 13 percent of vegetable farmers and 3 percent of orchard farmers and that they mainly supply mass merchandisers (e.g., discount chains). The other fresh-market growers tended to use diverse marketing channels, including selling directly to consumers, marketing through cooperatives and independent shippers, and selling directly to commercial buyers. For fresh vegetable markets, "directly to consumers" (farmers markets, you-pick operations, roadside stands) was the most commonly used outlet (31 percent), not by volume of production but by number of farms using this marketing channel.

Yield, Price, and Profit Fluctuations

We investigated year-to-year yield variations using yield information for the preceding five years. Taking the average of the five annual yields as an individual's normal yield, we calculated the percent deviation from the normal yield and then arrived at sample mean deviations for sample categories. Our data indicated that annual yield deviated, on average, 15 percent for fruits/nuts and 8 percent for vegetables over the previous five years. For price and profit fluctuations, we elicited information on the range of the highest fluctuation experienced over the same five year period (from the level that the respondent considered normal). For both price and profit, the median of the accumulated distribution fell in the 25–49 percent range for fruits/nuts and the 10–24 percent range for vegetables, indicating that prices as well as profits tend to fluctuate less for vegetables than for fruits/nuts.

In response to a list of options as the main cause for the lowest profit, "poor yield," "low market price due to high domestic production," and "low market price due to imports" were the three most often cited causes for all crops except ornamentals. They accounted for 70 percent of the responses for fruit/nut and vegetable farmers. For fruit/nut crops, poor yield was the most cited reason for the lowest profit (31 percent), but for vegetables, low market price due to high production was cited most (29 percent), followed by low market price due to imports (21 percent). This underscores the relative importance of production risks for orchard crops and of market risks for vegetable crops.

Risk Management

Two sources of risk, adverse temperature and output price fluctuation, were listed as most important; input price fluctuation, pests, and disease were considered to be moderately important.

Crop insurance was a preferred risk management tool for orchard and vineyard farmers, and crop diversification was preferred by vegetable and ornamental crop growers. Diversified marketing was reported to be the second most preferred tool for all three crop categories.

We also surveyed farmers about the availability of risk management tools. As expected, their preferences were closely linked to availability. The most available tools were crop insurance for orchard crops (49 percent of farmers said it was available to them) and crop diversification for vegetables (40 percent) and ornamental crops (28 percent). Orchard and vineyard farmers reported

relatively limited availability of other risk management tools.

Crop Insurance

About 53 percent of fruit/nut farmers, 31 percent of vegetable farmers, and 13 percent of ornamental crop farmers said they had purchased crop insurance in the preceding five years and most of those farmers had purchased it for all five years

Single-peril insurance is mostly offered by private firms, most commonly for damage from frost, rain, and hail. This insurance was purchased by about 20 percent of fruit/nut farmers and about 10 percent of vegetable farmers.

Many farmers suggested that a higher yield guarantee would improve crop insurance. Further, most farmers strongly suggested the need for crop insurance that compensates in value terms, but they expressed no strong preference among compensations based on gross sales, profits, or production costs.

Financial Characteristics

Financial variables examined were off-farm incomes, gross sales, debts, and assets. Clearly, the portion of household income risk attributable to variation in farm income decreased as the share of off-farm income rose. For our sample, an average of 63 percent of income came from off-farm sources. A sizable segment of farmers, as many as 25 percent, derived less than 1 percent of their income from farming in the year sampled. This is consistent with the observation that many of the farms were quite small, many farms operated at a loss in any given year, and there was a relatively large number of so-called "hobby" farms in California.

Gross agricultural sales averaged about $0.4 million per farm for the entire sample. Vegetable farms averaged $1.1 million in sales, followed by ornamental crop farms with $0.8 million, and orchard farms with $0.3 million. About 6 percent of fruit/nut farms had sales of more than $1 million, compared to 29 percent for vegetable farms and 13 percent for ornamental farms.

Agricultural sales were negatively correlated with off-farm income share and positively correlated with acreage. Revenue per acre decreased as acreage increased. Given that specialty crops vary widely in unit value and in value per acre, this indicated that farms with fewer acres tended to grow crops with a high value per acre.

Farms in our sample had an average of $1.4 million in assets and $0.6 million in debts. The average debt-to-asset ratio was close to 0.5. This ratio is much higher than the 0.16 debt-to-asset ratio reported by the United States Department of Agriculture for all American agriculture in 2003. When viewing assets and debts as financial inputs necessary to generate revenue, the ratio of financial input to gross sales was highest for vegetables and lowest for orchard crops.

INTRODUCTION

This study provides a detailed statistical profile of an important segment of California agriculture, the horticultural crop industry. The information provided is based on a unique survey of growers of horticultural crops, also known as specialty crops, that was conducted during the spring of 2002 at the request of the Risk Management Agency (RMA) of the United States Department of Agriculture (USDA). This report presents data about horticultural industries in California and about the risk management attitudes, approaches, and needs of farmers producing these commodities.

Specialty crops are diverse. These crops can best be defined by exclusion—as all agricultural crops excluding grain crops (wheat, barley, rice, corn, etc.), oilseeds (soybeans, rapeseed, etc.), cotton, peanuts, and tobacco. The bulk of specialty crops consist of fruits and nuts, vegetables, and ornamental crops (nursery products, cut flowers, etc.).

The industries featured in this study accounted (at the farm level) for more than $16 billion of gross farm revenue in 2001. This value was more than 90 percent of the state's total crop value and 60 percent of total agricultural value produced in California at the farm level. These industries are also important nationally. California accounts for 37 percent of the total value of horticultural crop production in the United States. In the past, these industries have expanded steadily in California, adding more than 300,000 acres between 1992 and 1997 (1997 Census of Agriculture). In the future, California's horticultural industries are expected to continue to expand in size and importance.

For the most part, horticultural growers have not been major recipients of farm program subsidies and have had relatively little government support compared to growers of commodities such as grains, oilseeds, cotton, sugar, and dairy products. Some horticultural crops have been eligible for USDA crop insurance programs and ad hoc disaster assistance, promotion assistance, and miscellaneous support, but the degree of subsidy has been small—typically around 5 percent of total value, compared to 30 to 50 percent and higher for grains, oilseeds, and cotton (Sumner and Hart, Lee).

Horticultural crops differ from other kinds of crops in their product characteristics, production processes, and market environments and thus in their risk characteristics. The design of public policy for these crops must reflect management of their unique risks. Knowledge of market variables and grower risk behavior is essential to developing effective risk management tools for horticultural crops. Unfortunately, while studies on traditional crops abound, little research has been done on horticultural crops. The objective of this survey was to generate wide-ranging statistical information that can be used broadly to better understand the horticultural crop industry, its sources of risk, and typical responses to those risks. The statistical profile of California's horticultural producers presented here is the most exhaustive ever undertaken for this group. It draws on survey data collected from approximately one-third of all horticultural crop producers in the state.

This report presents a large volume of information concisely. To do so, we (1) summarize the methodology used to collect and tabulate the data; (2) provide an overview of the seven topics addressed; and (3) discuss the primary results. The discussion is organized by issue and includes a narrative describing the main findings for each topic. Selected figures and tables are included. The narrative is supplemented with a data section in the Appendix, which is organized into three parts. The first provides the response rate for each question in the survey. The second contains data tables organized by commodity category. The tables supplement the information presented in the narrative section with further disaggregated analysis. The last part of the Appendix provides the actual survey instrument.

DATA COLLECTION AND AGGREGATION

Data Collection Procedure

The first stage of the study, the survey of specialty crop growers, involved developing a questionnaire. The questionnaire was developed specifically for specialty crop growers based on the format of a survey instrument used previously (Blank and McDonald 1993), with input from RMA and from researchers who conducted an identical study in Florida, Pennsylvania, and New York. The California Agricultural Statistical Service (CASS, which is a regional office of USDA's National Agricultural Statistical Service (NASS)) assisted in formatting the questionnaire to facilitate its implementation. The final version of the survey instrument is presented in Appendix 3.

We established the sample frame by defining a minimum number of acres required for a farm to qualify for the study using information from CASS's database. To be included in the study, a farm had to have at least five acres of perennial crops (mainly tree or vine crops) or at least two acres of annual specialty crops (mainly vegetables, strawberries, or melons). This limit was designed to exclude very small farms that were unlikely to be commercial operations. The acreage criterion was applied to CASS's database, which contains information on more than 60,000 farms in California (the total number of farms and ranches in the state is estimated by USDA at about 80,000). A total of 31,864 farms met the acreage limit with the crops selected for the survey.

CASS conducted two rounds of mailings and one round of telephone interviews to collect completed surveys. In total, the two survey mailings garnered 7,391 responses. Those mailings were followed by telephone interviews of growers who had not responded by mail, which collected an additional 7,746 responses. In total, 15,137 responses were received (a 46 percent response rate). Relatively few farmers answered all 25 survey questions, which required responses in 192 cells. Under some "usability" criteria on the completeness of the answers, some responses were discarded.[1] In total, 10,410 observations were entered into an electronic database file that was then transferred to the authors.

Our primary analysis used only the horticultural-crop-based sample, which consisted of 10,200 observations.[2] Among noncrop categories, aquaculture producers provided the largest number of observations, allowing some statistical analysis of that industry. We provide data tables for aquaculture in Appendix 2 but omitted aquaculture from the narrative analysis.

Note that sample size used in our analysis varies depending on the question being analyzed. Survey responses varied in degree of completeness, and valuable information could have been lost if only fully completed responses were used. (In Appendix 1, the response rate for each survey question is reported.) Thus, to maintain the maximum sample size, different subsamples were used, depending on the usability and appropriateness of the data provided, in analyzing particular issues. Information on sample size is included in most of the table presentations.

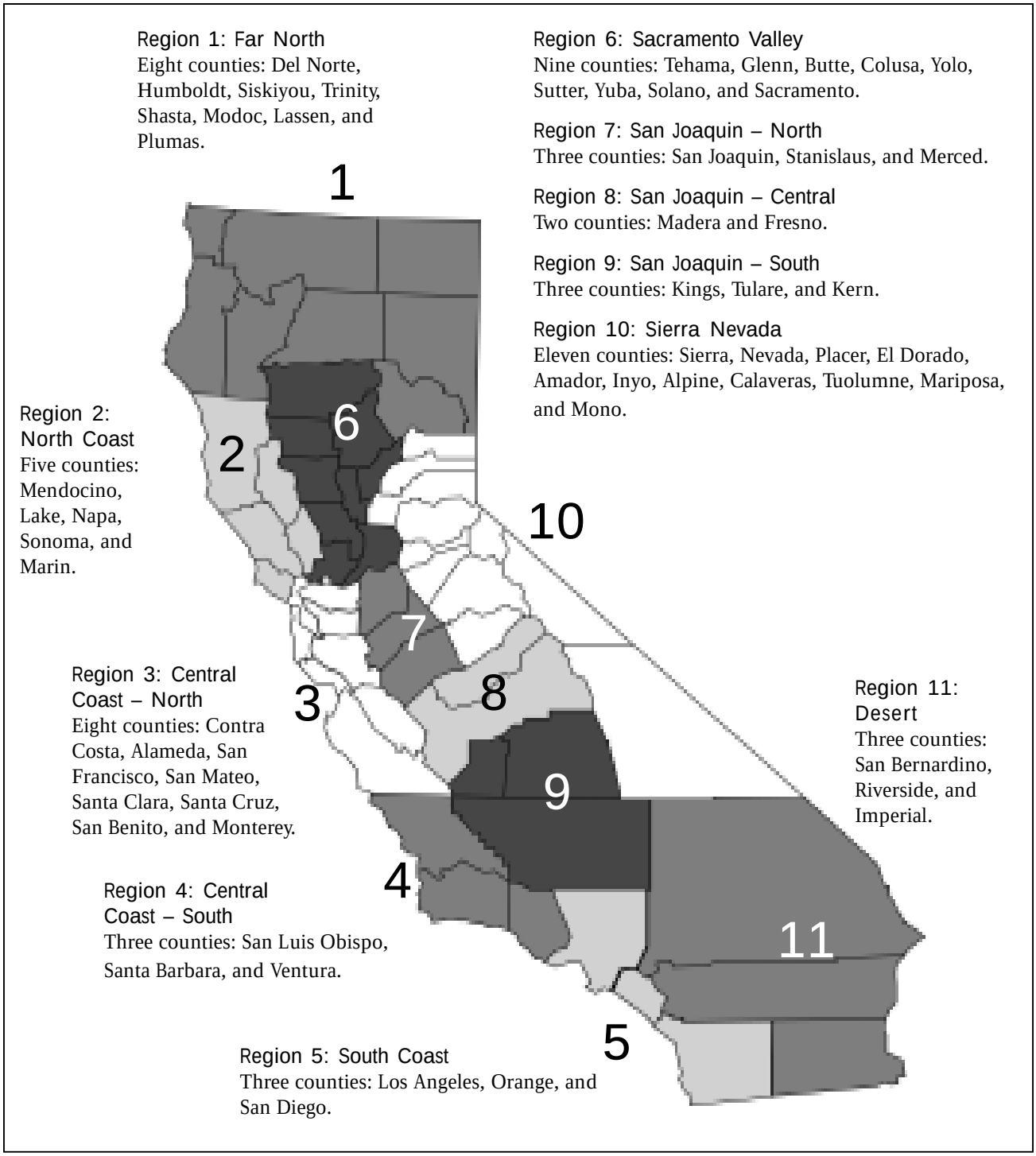
California Geography and Regional Aggregation

Several mountain ranges in California create the dominant Central Valley and smaller coastal valleys where much of the state's agricultural production is concentrated. The large Central Valley consists of the Sacramento Valley, which lies north of the San Francisco Bay Delta, and the San Joaquin Valley, which lies south of the delta. The Central Valley is encircled by the Cascade ranges and Klamath Mountains to the north, the Sierra Nevada Mountains to the east, the coastal ranges to the west, and the Tehachapi Mountains to the south. The coastal ranges also create a long strip of valleys, including, for example, Napa Valley and Salinas Valley.

[1] We identified 12 survey questions that we considered essential. To be considered complete, a survey had to provide answers to those questions. (If a question asked the respondent to rank choices, we considered the question answered if the respondent provided a rank for at least three items). We established these criteria to minimize unnecessary data entry effort.

[2] USDA's broad definition of specialty crops includes commodities in aquaculture and apiculture. Thus, our original data observations included a small number of these noncrop producers. To keep the consistency of land-based crop data, we excluded these noncrop commodities from our main data analysis (as reported in the narrative analysis). Further, to restrict the focus to specialty crops, observations were excluded if the largest revenue crop was a field crop.

Figure 1. **Aggregation of Counties into Eleven Regions**



(Johnston, *http://geoimages.berkeley.edu/GeoImages/BainCalif/CalClickMap.html*).

Climates in the region are affected by the cool currents of the Pacific Ocean and various mountain ranges. Temperatures in coastal regions are relatively mild while inland areas are hotter. Almost all of the state's rain and snowfall occurs during late fall and winter (November through March). The majority of California's water supply originates in the northern mountain regions of the state. Land for specialty crops is nearly all irrigated via ground water and various district, state, and federal water storage and distribution systems (Parker and Howitt).

California has 58 counties. In our analysis, we aggregated the counties into 11 regions with similar

geographic and climatic characteristics as shown in Figure 1. The Sacramento Valley and San Joaquin Valley (Regions 6–9) are together referred to as the Central Valley.

Commodity Aggregation

California's specialty crops include more than 200 individual crops. To facilitate a manageable analysis, crop aggregation was needed. Crop codes were developed using three levels of classification. First, all the commodities were assigned to one of five basic categories: (1) field crops, (2) fruits and nuts, (3) vegetables, (4) ornamental crops, and (5) noncrop commodities. The last category included a small number of apiary and aquaculture farmers, but for category-specific analyses, we considered only aquaculture farmers because there were too few apiary farmers for any statistical analysis. Fruits/nuts, vegetables, and ornamentals, which were our focus, were then further divided into subcategories of similar types of crops (such as berries). The third level of classification identified specific crops. Our data analysis used mostly the first two levels of classification. See Table 1 for a detailed description of the classifications.

While classification of fruits and nuts into the second level is self-evident, such classification of vegetables needs discussion. A wide variety of vegetables appears in the

Table 1. Commodity Aggregations

Category	Subcategory	Specific Crop
Field Crops (F)	Field Grains	Rice, wheat, corn, rye, barley, tricale, etc.
Fruits and Nuts (Fn)	Berries	Strawberries, blueberries, raspberries, etc.
	Citrus	Oranges, tangerines, grapefruits, lemons, etc.
	Grapes	Wine grapes, table grapes, raisin grapes Other grapes (use not specified)
	Nuts	Almonds, walnuts, pistachios, other tree nuts
	Apples and Pears	Apples, pears
	Stone Fruits	Apricots, cherries, nectarines, peaches, plums, prunes, pluots
	Tropicals	Avocados, olives, other (bananas, cherimoya, dates, figs, guavas, kiwifruit, loquats, mangos, jujube)
	Botanical Name	
Vegetables (Vg)	V1: Legumes	Beans, peas, various sprouts
	Alliums	Garlic, leeks, onions, shallots
	V2: Brassicas	Cabbages, argula, kale, mustard greens, cauliflower, broccoli, Brussels sprouts, radishes, turnips, etc.
	Chenopods	Chard, spinach, beets, sugar beets, etc.
	Composites	Lettuces, endive, chicory, artichokes, etc.
	V3: Cucurbits	Cucumbers, gourds, melons, pumpkins, etc.
	V4: Solanaceous	Tomatoes, peppers, eggplants, tomatillo
	V5: Succulents	Asparagus, mushrooms, etc.
	Umbells	Celery, parsley, herbs, carrots, etc.
	V6: All Unspecified Vegetables	
Ornamentals (Or)	Floriculture, Nursery, Christmas Trees	
Aquaculture (Aq)	Aquaculture	

data and choosing transparent and intuitive yet manageable groups was difficult. Following USDA guidelines, nine botanical classifications of vegetables were aggregated into six groups, guided by climatic growing conditions (e.g., cool weather versus warm weather vegetables) and by the number of observations available.

TOPICS ADDRESSED

The narrative and tables are presented in seven topical sections.

- farm size and regional profile
- crop diversification
- marketing
- yield, price, and profit fluctuations
- risk management
- crop insurance
- financial characteristics

Farm Size and Regional Profile discusses regional distributions of production for commodity categories and subcategories. It also provides mean acreage and acreage distributions. Mean acreages have relatively large standard deviations. To supplement this information, the distribution of farmers by acreage class has been included. Information provided on this topic pertains to Questions 1 through 6 (Cells 1–48).

Crop Diversification provides information on patterns of crop diversification across crop categories and subcategories. For example, do farmers of perennial crops diversify into annual crops in the same way that annual crop farmers diversify into perennial crops, or do they tend to diversify within the same crop category? This section also includes information on organic farming. Information provided in this section was obtained primarily from Questions 4 and 5 (Cells 5–47).

Marketing issues include whether a crop is designated for processing or fresh use, the types of marketing channels used, and whether a farmer's operation involves both growing and shipping or growing only. Marketing channels typically differ according to end use (processing versus fresh). Whether an operation grows and ships or only grows concerns crops intended for fresh use only; shipping and packaging are not issues for crops destined for processing, which are typically delivered to the plants in bulk. This section also explores the issue of whether price is predetermined through a contract before the time of sale. This section pertains to Questions 6, 7, and 8 (Cells 48–63) in the survey.

Yield, Price, and Profit Fluctuations for the preceding five-year period were explored next. Respondents were asked to provide actual yields for those five years; identify the highest fluctuation in yield, price, and profits during the same period; and indicate the main cause for their lowest profits. From this information, we examined fluctuation patterns that could exist specific to a region or crop category and linked the information with the main source of the lowest profit. Information presented for this topic was obtained from Questions 9, 10, and 11 (Cells 64–100).

Risk Management examined farmers' perceptions of risk and, in particular, the extent to which risk management tools are available and used. Respondents were asked to rank ten risk sources in order of importance and eight risk management tools in the order of preference. For each risk management tool, the survey also asked about its availability and whether it had been used by the farmer. Also included was information on their receipt of government disaster payments or loans. This section used data from Questions 12, 13, and 14 (Cells 101–152).

Crop Insurance was one of the risk management tools covered in the previous section, but it was then given more extensive coverage. This section summarized information on respondents' history of crop insurance purchases, reasons why they did or did not purchase crop insurance, and suggestions for improving the role of crop insurance. Information presented includes the mean ranking and distribution of ranks. The relevant survey section for this data was Questions 15 through 22 (Cells 153–188).

Financial Characteristics deals with off-farm income, gross agricultural sales, assets, and debts to provide the distributions of these variables and examine the existence of any systematic distribution patterns. Questions 23, 24, and 25 (Cells 189–192) in the survey were relevant to this section.

MAJOR SURVEY RESULTS

To highlight the results, we limited our analysis to the three primary crop categories—fruits/nuts, vegetables, and ornamental crops. The basic data set used in this analysis included only specialty crop farmers by excluding respondents whose primary commodity (Cell 48) was listed as a noncrop or a field crop. (Appendix 2 includes a section dealing with aquaculture.) With this exclusion, our basic data set consisted of 10,200 observations. Note, however, that much smaller samples were used in the analysis of many of the issues (observation numbers are indicated in the tables and figures). In the following discussion we highlight only the major results for each topic. A fuller description of the data used for most charts and figures in this narrative can be found in Appendix 2.

A. Farm Size and Regional Profile

As a starting point, we present an overview of our sample and distributions of acreage and farms by region and by crop category. At the end of this section, we compare these distributions of survey respondents to those reported in the 1997 Census of Agriculture (USDA 1999) to illustrate the representativeness of the farms surveyed.

Table A1 presents the share of farms and mean acres per farm by region and by crop category. Standard deviations are provided to give readers some sense of the variation in acreage. The three San Joaquin Valley regions accounted for 47 percent of the sample, the Sacramento Valley added another 13 percent, and the four coastal regions added 33 percent. The Far North, Sierra Nevada, and Desert regions comprised a substantial portion of the state's land area, but only 7 percent of specialty crop growers in the sample were located in those regions and the average acreage per farm in those regions was below the state average. Fruit/nut growers represented about 86 percent of the sample; therefore, any data analysis on all crops tends to be dominated by the characteristics of fruit and nut farms.

As shown in Table A1, mean acres varied considerably across crop categories but much less across regions. The average acreage for vegetable farms (1,106 acres) was substantially larger than the averages for fruit/nut and ornamental farms. On the other hand, average farm acres across regions were within the narrow range of 100–280 acres (except for the mountainous Sierra Nevada region). The standard deviations for all acreage distributions reported in Table A1 were relatively high, meaning that the distributions were spread widely. To compare the degree of spread between distributions, the ratio of the standard deviation to the mean (i.e., the coefficient of variation or CV) was calculated. The CV was seven for the whole sample and much higher in some regions. The South Coast's CV of 15 was the largest. Of the crop categories, ornamentals had the largest variation in acreage.

Table A2 provides the distribution of farms across finer crop classifications (subcategories) for each of the three

Table A1. Distributions of Surveyed Farms by Region and Crop Category

	Distribution	Mean Acres per Farm	Standard Deviation
All	**n = 10,200**	**203**	**1,412**
By Region			
Far North	1%	121	367
North Coast	12%	100	420
Central Coast – North	5%	248	991
Central Coast – South	8%	132	534
South Coast	8%	274	4,128
Sacramento Valley	13%	280	916
San Joaquin – North	17%	185	754
San Joaquin – Central	17%	208	819
San Joaquin – South	13%	268	1,263
Sierra Nevada	2%	62	133
Desert	4%	149	614
By Crop Category			
Fruits and Nuts	86%	157	676
Vegetables	5%	1,106	4,944
Ornamentals	9%	75	522

Table A2. Distributions of Farms by Crop Category and by Crop

Crop Category	Distribution
Fruits and Nuts	
Berries	2%
Citrus	12%
Grapes	33%
Nuts	31%
Apples and Pears	2%
Stone Fruits	9%
Tropicals	11%
Vegetables	
V1: Beans, peas, garlic, onions, leeks	12%
V2: Lettuce, cabbages, other leafy vegetables, broccoli, cauliflower, artichokes, radishes	16%
V3: Melons, cucumbers, squash, other gourd family	15%
V4: Tomatoes, peppers, eggplants, tomatillo	31%
V5: Carrots, celery, asparagus, mushrooms, parsley, other herbs	15%
V6: Other unspecified vegetables	12%
Ornamentals	
Floriculture	24%
Nursery	67%
Christmas Trees	9%

main crop categories. Observations were classified into a subcategory based on farmers' responses on their primary crops.[3] Some facts stand out. Grape farms and nut farms each comprised more than 30 percent of all fruit/nut farms, and nurseries comprised 67 percent of all ornamental farms. While almost one-third of vegetable farms grew tomatoes (for both fresh and processed use), the rest of the subcategories of vegetables were fairly evenly distributed.

Table A3 provides the cumulative distributions by acreage class, which indicated that median per-farm acreage was between 21 and 30 acres for fruits/nuts and about 70 acres for vegetables. The same distributions are provided pictorially in Figure A1. About 40 percent of both fruit/nut and vegetable farms were concentrated around the land classes of 20 acres or less. Such high density of relatively small farms was common in the farm acreage distributions. However, what is unusual in Figure A1 is the relatively high density observed near the tails of the distributions, at acreage ranges of 101–300 for fruits/nuts (17 percent) and of 201 acres or more for vegetables (38 percent). Nevertheless, fruits/nuts and vegetables showed very different patterns in the very large acreage classes—only 3 percent of fruit/nut farms in the sample were larger than 500 acres, compared to 24 percent of vegetable farms.

Finally, the survey data were compared with data from the 1997 Census of Agriculture conducted by USDA to examine how closely the survey represented the overall population of growers. Table A4 presents selected summary statistics from both sources. Given that vegetable farmers in our survey represented 5 percent of respondents but were 8 percent of farmers in the census,

Table A3. Cumulative Distribution (Percent) of Farms by Acreage Class

Acres	Fruits and Nuts	Vegetables	Acres	Fruits and Nuts	Vegetables
0–10	22%	28%	71–80	76%	53%
11–20	42%	39%	81–90	78%	53%
21–30	51%	42%	91–100	80%	56%
31–40	61%	44%	101–200	89%	62%
41–50	66%	46%	201–500	97%	76%
51–60	70%	48%	501–1,000	99%	88%
61–70	73%	50%	1,000 and greater	100%	100%

[3] The primary crop was defined in the survey as the crop for which the farmer had the highest percentage of sales.

Table A4. Comparison of Specialty-Crop Survey (2002) with Census (1997) Data

General Characteristics	Census Number	(Share)	Specialty Crop Survey Number	(Share)
No. of Farms				
All Crop Categories	43,055	(100%)	10,200	(100%)
Fruits and Nuts	35,422	(82%)	8,785	(86%)
Vegetables	3,348	(8%)	459	(5%)
Ornamentals	4,285	(10%)	965	(9%)
Mean Acres per Farm[a]				
Fruit and Nut Land per Fruit and Nut Farm	117		110	
Vegetable Land per Vegetable Farm	550		477	
Ornamentals Land per Ornamentals Farm	46		75	
Mean Sales per Farm[a]				
Fruits and Nuts ($1,000)	221		330	
Vegetables ($1,000)	1,201		1,112	
Ornamentals ($1,000)	516		814	
No. of Farms with Sales of $50,000 or More[a]				
Fruits and Nuts	14,216	(40%)	3,798	(43%)
Vegetables	2,458	(73%)	299	(65%)
Ornamentals	1,922	(45%)	471	(49%)

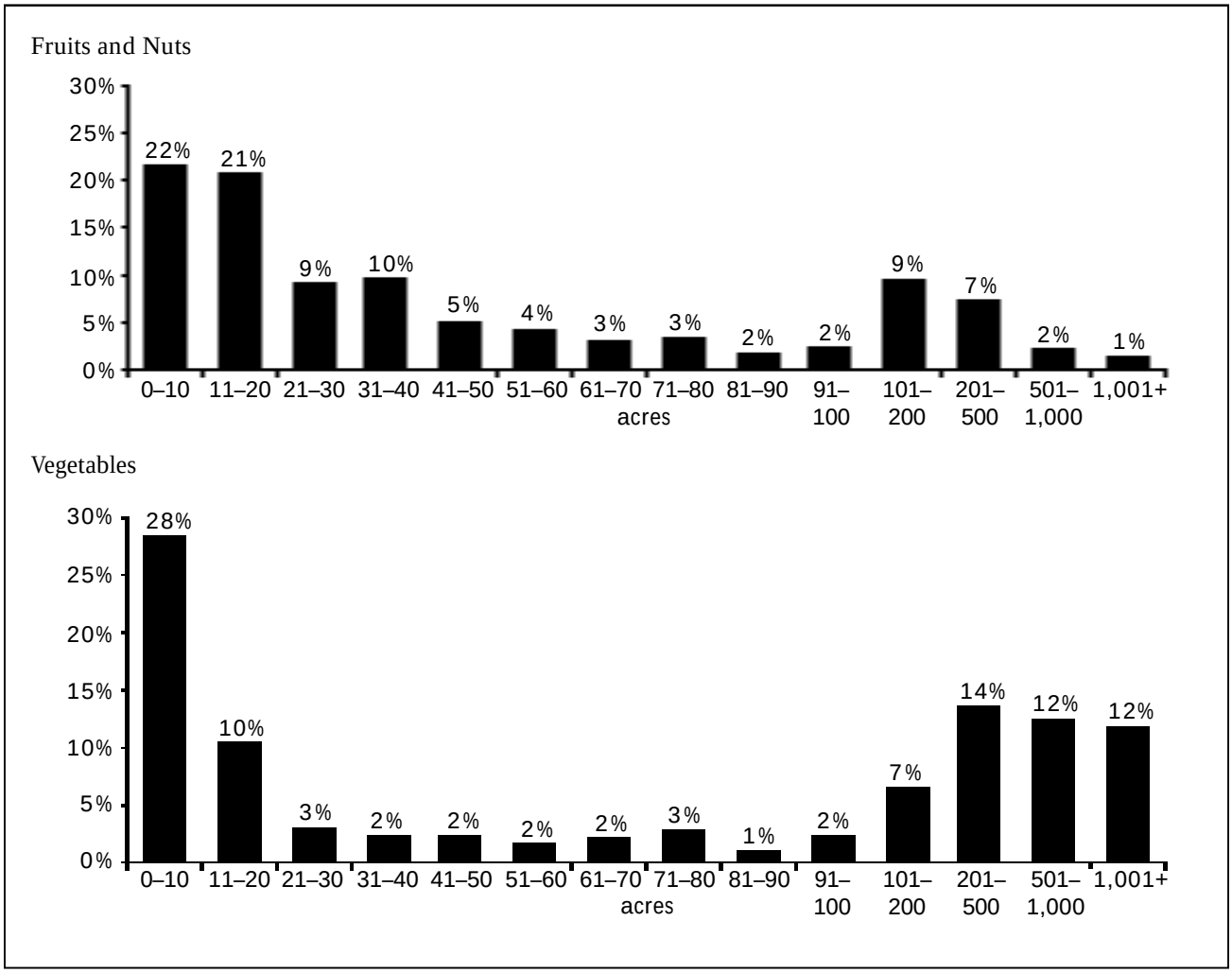
Distribution by Acreage Class

Acreage Class	Fruits and Nuts		Vegetables		Ornamentals	
	Census	Survey	Census	Survey	Census	Survey
1–9	30.4%	21.5%	31.4%	28.4%	58.1%	75.7%
10–49	39.7%	44.2%	21.2%	17.8%	29.6%	16.3%
50–69	5.9%	7.2%	3.9%	3.6%	2.8%	3.51%
70–99	5.8%	7.1%	3.6%	5.9%	2.1%	
100–499	14.6%	16.6%	16.5%	20.1%	5.6%	
500–999	2.1%	2.1%	9.2%	12.4%	1.1%	3.59%
1000 and more	1.6%	1.3%	14.2%	11.7%	0.8%	

[a] Even though our basic sample consisted of 10,200 observations, the calculations of mean acres and mean sales used subsets of the basic sample because some observations had incomplete information on crop-specific acreage and sales data.
Source for census data: *www.nass.usda.gov/census/census97/volume1/us-51/us2_o2.pdf*.

our sample tended to under-represent vegetable farmers. The acreage class distribution indicated that this under-representation was especially noticeable in the largest acreage class. We had a very close match with the census data for fruits/nuts, indicated by mean acres, mean sales, and acreage distributions. For ornamental crops, the sample appears to have a higher representation of farmers with relatively small acreage than does the census, as indicated by the distribution by acreage class presented at the bottom of the table.

Figure A1. Distribution by Acreage Class



B. Crop Diversification

Crop diversification is well recognized as a risk management tool (Blank 1996; Boehlje and Lins; Pope and Prescott). However, little information is available concerning the extent of diversification or the mix of crops used in diversification by horticultural producers. As a risk-reducing tool, crop diversification plays a role in pricing crop insurance and is likely to be incorporated as a discount factor in future crop insurance premiums. To implement degree of diversification into the crop insurance premiums structure, decision makers need to know the extent to which crops have been diversified. This section sheds some light on the issue.

Figure B1 shows the share of fruit/nut and vegetable farmers who grew a single crop. Seventy percent of fruit/nut farmers were single-crop growers as opposed to 26

Figure B1. Shares of Single-Crop Growers for Fruits/Nuts and Vegetables

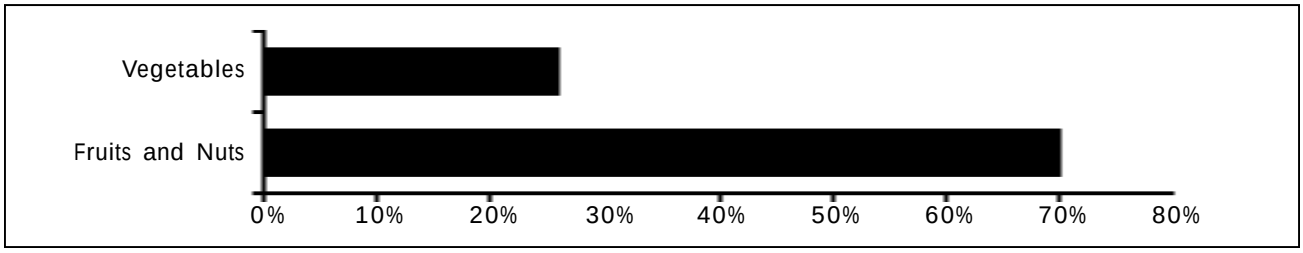


Table B1. Diversification Pattern and Mean Acres

	Share of Farms	Mean Acres per Farm
Fruits and Nuts (n = 8,669)[a]		*Average Acres in Fruits and Nuts*
No Diversification (Single Crop)	70%	67
Diversification		
Diversified Only with Fruits/Nuts (Average No. of Crops = 2.56)	24%	225
Diversified with Non-Fruits/Nuts (Field, Vegetable, and/or Ornamentals)	6%	159
Vegetables (n = 437)[a]		*Average Acres in Vegetables*
No Diversification (Single Crop)	26%	299
Diversification		
Diversified Only with Vegetables (Average No. of Crops = 3.59)	26%	632
Diversified Only with Field Crops	26%	547
Diversified Only with Fruits and Nuts	11%	144
Diversified with Field Crops and Fruits and Nuts	9%	842
Diversified with Ornamental Crops and Other	2%	15

[a] The number of observations, n = 8,669, is less than the total number of basic observations, n = 8,785 (reported in Table A4) because some observations had incomplete information for acreage and diversification. The same is true for vegetables. Of the 459 vegetable farms used in the basic set, data for 437 farms included complete diversification information.

percent of vegetable farmers. This implied that crop diversification was more common for vegetable growers than for fruit/nut growers, which was consistent with our expectation that diversifying into multiple crops is more manageable for annual crops than for perennial crops. The tendency toward single-crop production, however, varied by crop. For example, for fruits/nuts the share of single-crop farmers ranged between 35 and 83 percent, depending on the crop. As shown in Figure B2, grapes were most commonly a single crop (83 percent), while stone fruits were least frequently so (35 percent).

Table B1 presents the diversification patterns and mean acreages. The patterns and extents of diversification for fruit/nut and vegetable farms were very different. Of the 30 percent of fruit/nut farms that were diversified, most (26 percent) were diversified with other fruit/nut crops. However, of the 74 percent of diversified vegetable farms, only 26 percent were diversified using other vegetable crops; 48 percent were diversified with crops in other categories. This indicated that fruit/nut farmers rarely diversify into other crop categories and that diversification across crop categories is more common for vegetable farms, particularly with field crops. Furthermore, even among the growers who diversified within their own crop category, the scope of diversification was smaller for fruit/nut farming, as indicated by the average number of crops, 2.56 for fruits/nuts and 3.59 for vegetables (Table B1).

Table B1 also presents mean acreages. Note that the acreage figures in the table are for land that was planted in fruits/nuts or vegetables only. We did this to exclude often extensive field-crop areas and to examine the scale of farmers' operations for their primary crops relative to various patterns of crop diversification. A cursory observation of the acreage figures indicated that primary crop acreage increased with crop diversification for both fruits/nuts and vegetables (Pope and Prescott).

Also, farms that diversified within a crop category were relatively large. We revisit this issue with more detailed vegetable data later in this report.

Table B2 shows the pattern of crop mix for fruit/nut farms, which are diversified predominantly with other fruit/nut crops. The table lists the two types of crops most commonly used for diversification in each subcategory. Judging by the percent of farmers, growers of berries, citrus, stone fruits, and tree nuts have made substantial

use of same-category crop diversification. For tree nuts and stone fruits, the diversification patterns were symmetric with substantial cross-diversification between the two groups. The diversification trends for citrus and tropical crops were interesting. While 66 percent of sampled tropical crop growers diversified with citrus, only 28 percent of citrus farmers (their primary crop was citrus) diversified with tropical crops (60 percent diversified within citrus).

We now turn to vegetables. Table B3 summarizes the pattern of diversification for farmers who grew only vegetables (about half of the vegetable farmers) and shows the distributions of those farmers by the number of vegetables grown. While half of the vegetable-only farmers produced a single crop, 9 percent produced more than six different vegetable crops. When we shifted from all vegetables to the subcategories, diversification patterns varied considerably. This was illustrated with Groups V2 and V5, which showed the highest and lowest levels of diversification. Table B3 also provides mean vegetable acreages for vegetable-only farmers. There was a tendency for farmers with more acres of vegetables to grow a larger variety of vegetable crops, suggesting that large-scale commercial farms engaged in more diversified vegetable production. In other words, the "scope" of diversification was positively related to the scale of the operation.

This report does not include a discussion of crop diversification for ornamental crops because of a lack of information. The finest level of diversification we could investigate with the data for ornamental crops was diversification patterns across the three subgroups in the category: floriculture, nursery products, and Christmas trees. Our data indicated that ornamental growers rarely diversified across these groups.

Organic farming information is summarized in Table B4. The table combines acres of "organic" and "transitional-organic" plantings and presents the combined area as "organic acreage" (to be certified as organic, land must have been under organic practices

Table B2. Diversification Pattern of Growers Who Diversified within Fruits and Nuts

Primary Crop	Category of Crops Used to Diversify	Share of Total Farms
Berries	Berries	41%
	Stone Fruits	24%
Citrus	Citrus	60%
	Tropicals	28%
Grapes	Stone Fruits	31%
	Nuts	27%
Nuts	Nuts	41%
	Stone Fruits	27%
Apples and Pears	Apples and Pears	23%
	Stone Fruits	23%
Stone Fruits	Stone Fruits	52%
	nuts	30%
Tropicals	Tropical Crops	14%
	Citrus	66%

Figure B2. Share of Single-Crop Fruit and Nut Growers by Crop

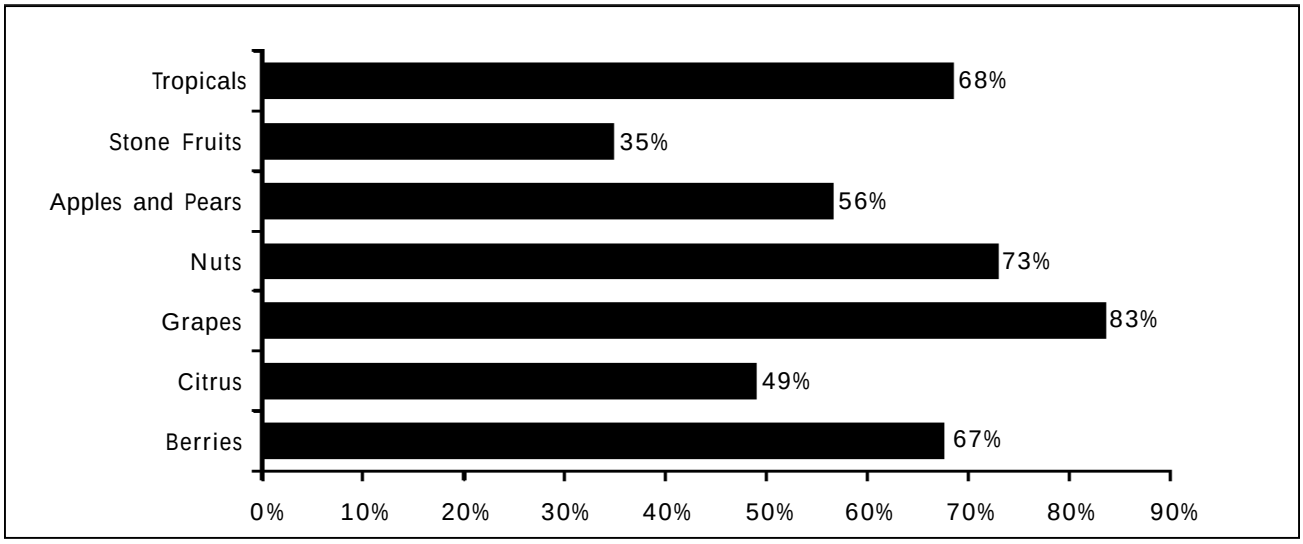


Table B3. **Distribution of Vegetable-Only Farmers by the Number of Different Vegetable Crops Grown**

Number of Vegetables Grown		One[a]	Two	Three	Four	Five	Six or More
All Vegetables	n = 228 (100%)	49%	18%	9%	10%	5%	9%
Mean Vegetable Acres		299	455	321	483	1,280	1,065
By Crop							
V1: Beans, peas, garlic, onions, leeks		50%	31%	4%	8%	8%	0%
V2: Lettuce, cabbages, other leafy vegetables, broccoli, cauliflower, artichokes, radishes		18%	18%	11%	21%	8%	23%
V3: Melons, cucumbers, squash, other gourd family		58%	19%	12%	8%	0%	4%
V4: Tomatoes, peppers, eggplants, tomatillo		22%	38%	19%	5%	8%	8%
V5: Carrots, celery, asparagus, mushrooms, parsley, other herbs		77%	3%	8%	3%	5%	5%
V6: Other unspecified vegetables		90%	3%	0%	5%	0%	3%

[a] Where the number of vegetables grown is listed as one, the farm grew only a single crop with no diversification.

Table B4. **Distribution of Organic Farms and Mean Acreage**

	Total Number of Farms	Percent of Farms with Organic Land	Mean Acres per Organic Farm: Total Land in Primary Crops	Mean Acres per Organic Farm: Land in Organic Crops
Fruits and Nuts			**Fruit and Nut Acres**	
All Fruit and Nut Crops	8,790	6%	146	45
By Crop				
Berries	144	15%	70	19
Citrus	1,021	6%	358	32
Grapes	2,887	5%	151	66
Nuts	2,776	5%	66	40
Apples and Pears	218	17%	58	37
Stone Fruits	798	5%	187	44
Tropicals	946	7%	160	34
Vegetables			**Vegetable Acres**	
All Vegetable Crops	443	14%	153	66
By Crop				
V1: Beans, peas, garlic, onions, leeks	51	6%	13	13
V2: Lettuce, cabbages, other leafy vegetables, broccoli, cauliflower, artichokes, radishes	71	21%	350	75
V3: Melons, cucumbers, squash, other gourd family	67	9%	18	20
V4: Tomatoes, peppers, eggplants, tomatillo	137	13%	395	66
V5: Carrots, celery, asparagus, mushrooms, parsley, other herbs	65	12%	22	14
V6: Other unspecified vegetables	52	27%	120	119

for three years, and during that three-year period, the land is referred to as transitional-organic land). Table B4 shows that 14 percent of vegetable growers practiced organic farming, compared to 6 percent of fruit/nut growers, although organic fruit/nut farms were more numerous. Most organic farmers also grew conventional crops and, on average, they devoted more land to conventional production than to organic production.

C. Marketing

This section summarizes the survey results on types of output use (i.e., processing or fresh), marketing channels, and types of operations (e.g., vertical integration into a packing/shipping business). Figure C1 shows the distribution of farmers by type of use for their fruits/nuts and vegetables (ornamentals are supplied almost exclusively for fresh use). The two types, "mainly fresh" and "mainly processing," were defined to include cases in which more than 80 percent of output volume was designated to the listed use. For fruits/nuts, 71 percent of farmers were characterized as mainly processing and 23 percent as mainly fresh. These figures were almost reversed for vegetables—67 percent of vegetable farmers specialized in fresh-use crops and 26 percent in processing-use crops. For both fruits/nuts and vegetables, only 7 percent of farms supplied both fresh and processing uses (a minimum of 20 percent of their volumes went to each use). This implied that production of fruits/nuts and of vegetables in California tends to be specialized for either processing or fresh use.[4] Also, these figures were consistent with the common observation that, for both vegetables and fruits/nuts, specific uses dictate the varieties grown. For example, Cling peaches are typically destined for canning and the Roma variety of tomatoes is usually made into paste.

Relevant marketing channels are determined by whether the crop goes to the fresh market or for processing since the two uses require different postharvest handling techniques. Once harvested, processing crops are shipped directly to a processing plant. Fresh-use crops are usually sorted, packed, and refrigerated before being shipped to wholesale or retail buyers. This implies that specific marketing channels emerge to accommodate the postharvest handling required for each use.

Figure C1. Use-Type (Processing/Fresh) Distribution

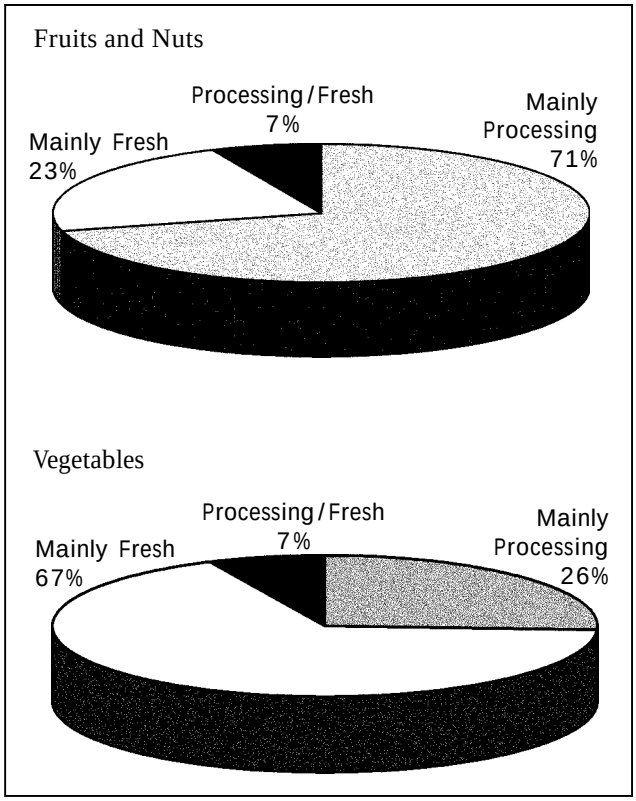
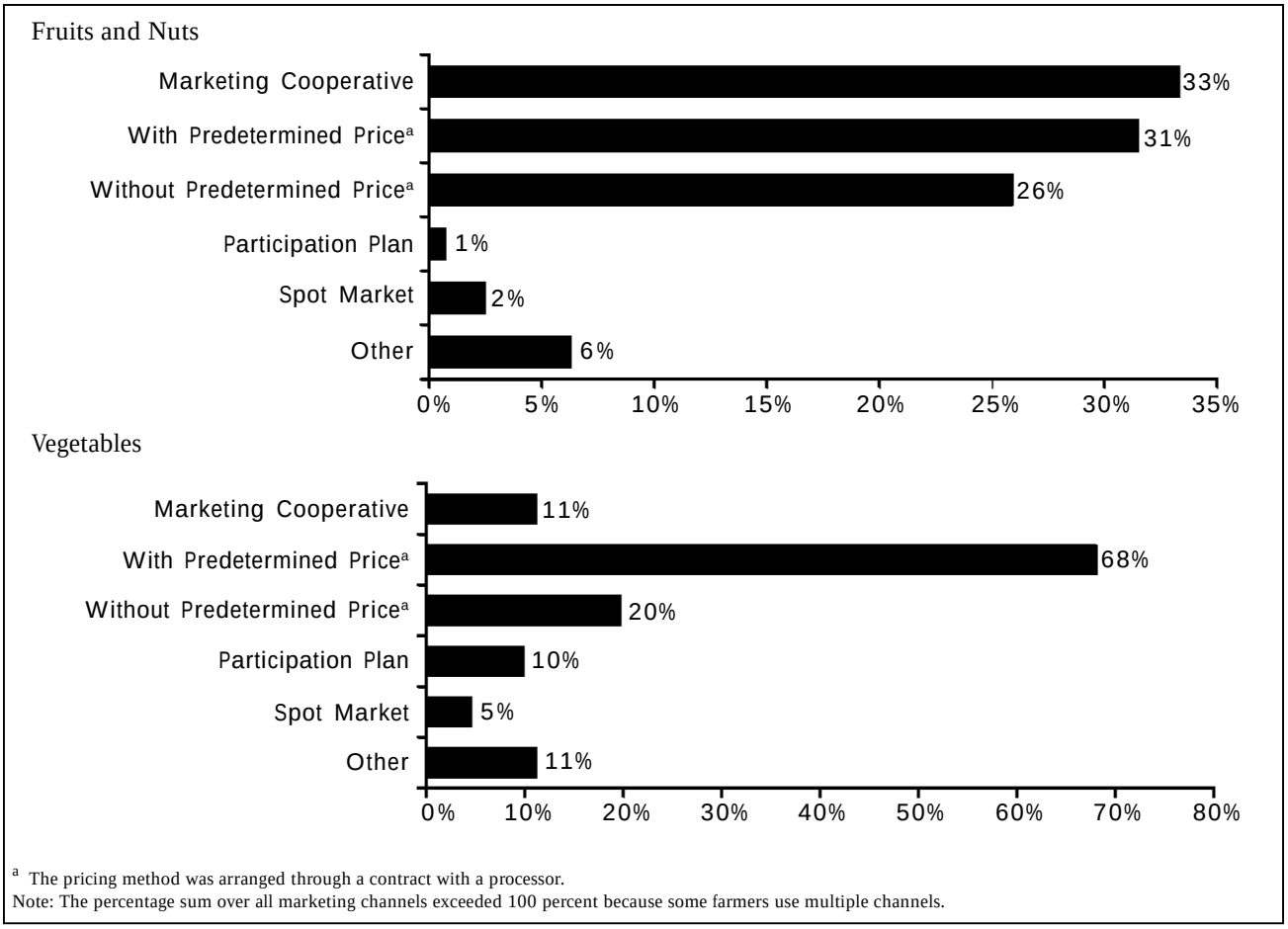


Figure C2 lists the marketing channels available for processing crops and the share of farms that used those channels. For fruits/nuts, marketing cooperatives and contracts with a processor (both with and without a predetermined price) were the most widely used marketing channels, accounting for 90 percent of the farms. However, for processed vegetables, marketing cooperatives played a relatively small role. Instead, contracts with a processor arranged at a predetermined price predominated. While contracts with processors were an important marketing avenue for both the fruit/nut and the vegetable categories, the patterns of pricing arrangements with processors were distinctly different. For fruits/nuts, contracts with and without predetermined prices were almost equally important (31 percent and 26 percent), whereas for processed vegetables, contracts with processors were mostly arranged under predetermined prices (68 percent versus 20 percent).

[4] We further investigated the case of tree nuts (for which use is not immediately clear). Ninety-three percent of tree nut farmers reported that all of their crops were designated for processing and only 4 percent of tree nut farmers reported mainly fresh use (for more detail, see Table Fn.C1 in Appendix).

Figure C2. Marketing Channels for Processed Crops



[a] The pricing method was arranged through a contract with a processor.
Note: The percentage sum over all marketing channels exceeded 100 percent because some farmers use multiple channels.

Table C1. Selected Marketing Channels for Processed Fruit and Nut Crops[a]

		Specific Marketing Channels		
	Total Observations	Marketing Cooperative	Sold to a Processor under Contract with a Predetermined Price	Sold to a Processor under Contract without a Predetermined Price
Citrus	150	53%	9%	30%
Grapes	2,548	17%	52%	19%
Nuts	2,447	51%	11%	33%
Apples and Pears	55	13%	38%	27%
Stone Fruits	373	36%	35%	23%
Tropicals	349	26%	36%	29%

[a] Data include farms where processing use was greater than 80 percent of volume.

Given the importance of processing use for fruits/nuts, we further investigated their marketing channels by disaggregating the category and looking at subgroups of the crop, as shown in Table C1. Marketing patterns were substantially different for specific subgroups. Cooperatives were especially important for citrus crops (53 percent of citrus growers used cooperatives) and tree nuts (51 percent), and predetermined price contracts were particularly prevalent for grapes (52 percent). The bulk of the grape growers produced wine grapes and, according to a recent survey, 90 percent of wine grape growers in California have either written or oral contracts with

Table C2. Fresh-Use Crops: Number of Grower/Shippers

	Total No. of Farms Supplying Fresh Use Crops	Share of Farms That Are Grower/Shippers	Share of Farms That Are Growers Only
Total	2,772	9%	91%
Fruits and Nuts	2,462	3%	97%
Vegetables	310	13%	87%

wineries (Goodhue et al.). Overall, the data in Table C1 underscored the prevalent role of contracts in the processed fruit/nut industry. For vegetables, crop-specific marketing channels did not deviate much from the overall marketing pattern reported in Figure C2 and disaggregated information is not presented here.

Postharvest handling is a crucially important component in marketing fresh-use crops. Thus, large commercial growers sometimes integrate field production with postharvest packing and shipping activities under the same owner. These growers are often referred to as grower/shippers (as opposed to growers only). Table C2 indicates that 9 percent of the fresh-use growers who responded to the survey were grower/shippers. The vegetable industry had the largest proportion of grower/shippers (13 percent); next was the ornamental industry (11 percent), followed by fruit/nut operations (3 percent). There is no parallel notion of postharvest handling for ornamentals and, thus, the remainder of the grower/shipper discussion mostly relates only to fruits/nuts and vegetables.

Grower/shippers operate on large scales and usually supply large-scale buyers such as grocery chains and mass-merchandisers (discount stores), often at a pre-negotiated price. Negotiating the price before market conditions are known has important implications for price risk. Even though the net effect of prefixing the price depends on the structure of market power, a contract with a fixed price tends to reduce price risk. Our survey indicated that 51 of 75 fruit/nut grower/shippers sold, on average, 85 percent of their products at a predetermined price. However, for vegetables, the data indicated that only one grower/shipper sold product at a predetermined price.

Table C3. Marketing Channels for Fresh-Use Crops (Grower-Only)[a]

		Distribution of Farmers Using Specific Marketing Channels[b]				
	Total Observations	Direct to Consumers	Marketing Cooperatives	Independent Shipper/ Brokers	Direct to Commercial Buyers	Other
Fruits and Nuts						
All Fruit and Nut Crops	2,311	10%	35%	40%	11%	4%
By Crop						
Berries	112	19%	11%	48%	20%	3%
Citrus	785	5%	54%	30%	9%	2%
Grapes	167	8%	16%	43%	17%	16%
Nuts	222	15%	41%	28%	13%	3%
Apples and Pears	139	32%	11%	42%	14%	2%
Stone Fruits	353	10%	8%	68%	10%	4%
Tropicals	533	7%	39%	38%	11%	4%
Vegetables						
All Vegetable Crops	327	31%	6%	31%	28%	4%

[a] The percentages in this table are based on farmers who were growers only (i.e., excluded grower/shippers) and produced fresh-use crops.
[b] The row sum may exceed 100 percent because some farmers use more than one marketing outlet.

While grower/shippers typically supply their crops directly to large retailers or wholesalers, the grower-only group tends to market its crops through contracts with shippers or other means. As shown in Table C3, the two major outlets for fruits/nuts are marketing cooperatives and independent shipper/brokers. On the other hand, for vegetables, cooperatives have a minor role, and major roles are played by three marketing channels: direct marketing to consumers (e.g., farmers markets, roadside selling, you-pick operations), independent shipper/brokers, and direct marketing to commercial buyers.

Comparing marketing channels between processed and fresh-use crops, two observations stand out. With no single dominant marketing channel, fresh-use crops are generally marketed through various channels. Nevertheless, for fruits/nuts, the importance of cooperatives is significant—cooperatives are widely used in marketing both fresh and processed fruits/nuts.

D. Yield, Price, and Profit Fluctuations

Production risk is closely linked to yield risk (Smith and Mandac). As a way to measure yield risk, fluctuations in yields were investigated. The survey asked for information on actual annual yields from 1997 to 2001, and complete five-year yield data were obtained from about 45 percent of the respondents (46 percent of fruit/nut growers and 42 percent of vegetable growers). Using the five-year yield data, average yield deviations in percentage were calculated and are reported in Table D1. To arrive at average yield deviations, for each observation we first calculated the simple average using the five-year yields. The percentage deviation from the average yield was then computed for each year (absolute values were used for calculating percentage deviations). The all-year average deviation was the average of the five-year yield deviations. Table D1 presents the sample mean of all-year deviations by crop category and by crop-specific group. (Yield measurement is not relevant to ornamental crops so that category was not included in the table.) The mean values of the all-year deviations indicated that vegetable yields fluctuated less (8 percent) than fruits/nuts in aggregate (15 percent). This was consistent with our intuition. Unlike many perennial crops, vegetables have short growing seasons. In California, they are planted and harvested continuously throughout the year, which results in relatively smooth yield fluctuations on an annual basis. Crop-specific deviations are also presented in Table D1 (no particular regional patterns were found). Except for tropical and V5 crops (carrots, celery, asparagus, mushrooms, and herbs), the deviations tended to be around the mean. We also investigated the deviation at the regional level. No particular regional pattern was observed for fruits/nuts. For vegetables, less variation was observed in all of the coastal areas except the north coastal region (for further information, see the table labeled All.D1 in Appendix 2).[5]

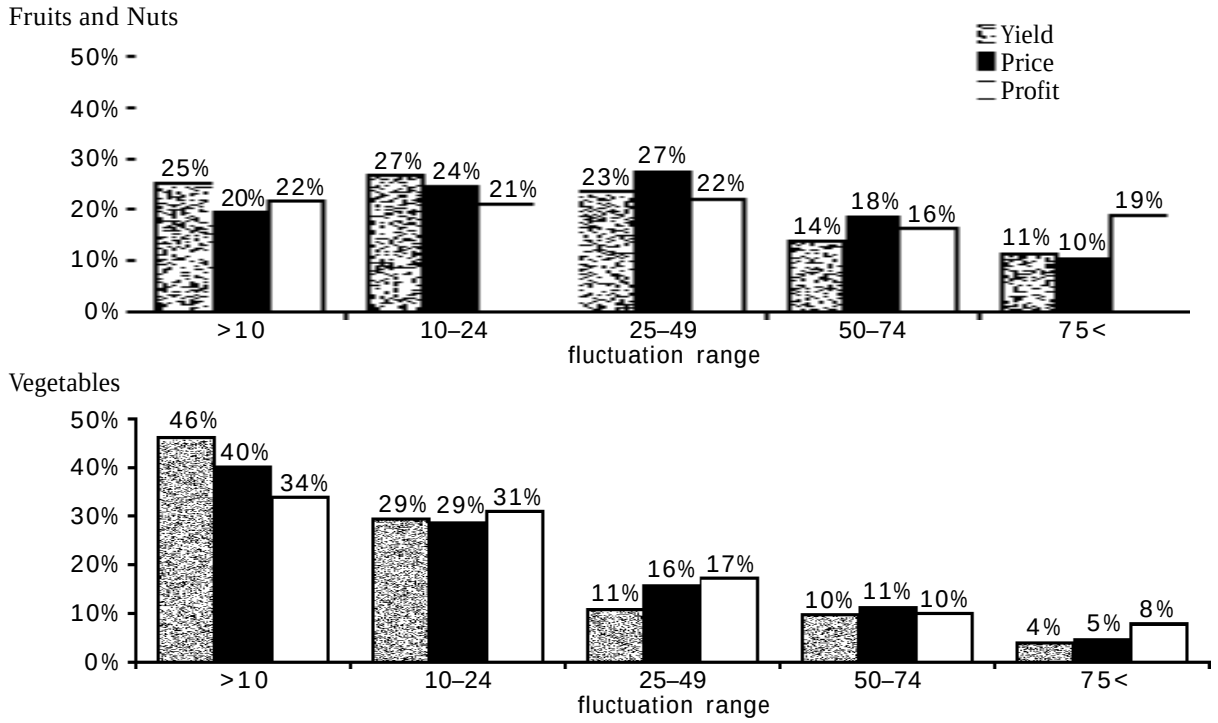
Table D1. **Yield Variation: All-Year Average of Yield Deviation (Percent) from the Five-Year Average**[a]

	Yield Deviation	All-Year Mean[b]
All Fruit and Nut Crops	n = 4,057	15%
Berries		10%
Citrus		15%
Grapes		13%
Nuts		16%
Apples and Pears		15%
Stone Fruits		16%
Tropicals		21%
All Vegetable Crops	n = 195	8%
V1: Beans, peas, garlic, onions, leeks		9%
V2: Lettuce, cabbages, other leafy vegetables, broccoli, cauliflower, artichokes, radishes		6%
V3: Melons, cucumbers, squash, other gourd family		9%
V4: Tomatoes, peppers, eggplants, tomatillo		7%
V5: Carrots, celery, asparagus, mushrooms, parsley, other herbs		12%
V6: Other unspecified vegetables		6%

[a] Data include only the observations that included yields for all five years.
[b] Yield deviations were calculated by taking absolute value.

[5] Given that only half of the sample provided the five-year yield information, we examined the possibility of selectivity problems related to this subsample by performing a cross-check of the data. We did not find any selectivity, at least from the data distributional characteristics.

Figure D1. Shares of Farms: Largest Yield, Price, and Profit Fluctuation in Last Five Years



Fruits and Nuts: The numbers of observations used were 6,765 for yield, 5,773 for price, and 5,456 for profit.
Vegetables: The numbers of observations used were 372 for yield, 343 for price, and 330 for profit.

Respondents were asked to indicate the range of the highest fluctuation in yield, price, and profit experienced in the past five years. Figure D1 reports the resulting distributions of farms by fluctuation range. The yield distribution was consistent with the information in Table D1. Vegetables showed higher densities at lower fluctuation ranges than fruits/nuts. As was true for yields, vegetables fluctuated less than fruits/nuts with regard to prices and profits. However, profits in general tended to fluctuate more than yields or prices, as demonstrated by the fact that more farms were associated with higher fluctuations and fewer farms with lower fluctuations. Given that profit is a function of yield and price, some relationship between these three variables was expected. To investigate this relationship, we estimated the level of correlation between them. Estimated correlation coefficients were 0.38 between yield and price, 0.41 between yield and profits, and 0.64 between price and profits, with all p-values below 0.0001. The fluctuation of profits had a stronger correlation with the price fluctuation than with the yield fluctuation, indicating that profits are more sensitive to price fluctuations than to yield variations.

Producers were asked to indicate what they thought was the main cause for their lowest profits by selecting from one of seven causes listed. Table D2 reports the distribution of those responses. Poor yields, low market price due to high domestic production, and low market price due to imports were the three most cited causes for low profits for both fruits/nuts and vegetables. The primary importance of those factors, however, differed by crop category. For fruits/nuts, poor yield was the most frequently cited reason, indicating the importance of risk related to natural conditions. For vegetables, low market prices due to high production was the most cited cause, followed by low market prices due to imports, indicating the relative importance of market conditions in vegetable industries.[6]

[6] Grower magazines and newsletters are often sources of market information for growers. Even though we believe that the majority of growers are well informed about the market, the reported statistics were based on growers' perceptions and we do not claim that they have accurate information about whether the low output price was due to high domestic production or imports.

The crop-specific distributions (not reported) reinforced the general patterns just described. Two groups of crops represented the extremes: 44 percent of tropical crop growers chose "poor yields" as the cause for their lowest profits, and 51 percent of V2 (lettuce, broccoli, etc.) farmers chose "low price due to high production" as the cause (Table Vg.D3 in Appendix 2). It is worth pointing out that the primary concern of V2 vegetable growers was "the good year's large harvest," not the bad year's poor harvest.

Table D2 also presents the distributions of farmers' main causes for their lowest profits by use and by grower/shipper status. Two interesting observations stand out from those distributions. Even though quality was not generally a dominant concern, it was considerably more important for fresh-use crops than for processed-use crops. Second, responses to the two causes of low market prices seemed to differ by crop use. Growers supplying mainly processing crops were more concerned about price declines from high domestic production than from increased imports (31 percent versus 13 percent), but no such distinction was found for fresh-crop growers (19 percent versus 18 percent). Next, the information was sorted by grower/shipper status because grower/shippers' vertically integrated, large-scale operations likely entail risk implications that are different from those of the majority of farmers, who engage only in crop production. Sixty percent of grower/shippers chose low market prices as a main cause of low profits compared to 43 percent of grower-only farmers (Table D2), indicating that low market prices are a larger concern for grower/shippers.

Finally, we evaluated the issue of whether there was any pattern in processor pricing methods (i.e., contracts with processors with or without predetermined prices). This question, which was included in the survey under marketing channels, dealt with growers producing only processing crops. As expected, for both fruit/nut and vegetable farmers, low market prices were chosen as a main cause for the lowest profit less often among growers who received a predetermined price than among those did not (not reported in the table). The regional distribution was also examined (but not reported) and

Table D2. **Shares of Farms: Main Cause for Lowest Profit by Crop Category, Use, and Grower/Shipper Status**

	Total Observations (n)	Poor Yield	Poor Quality	High Input Cost	Low Market Price due to Domestic Production	Low Market Price due to Increased Imports	Inability to Market Crop due to Quarantine	Other
		Percent of Farmers Who Gave this Category as Main Cause of Lowest Profit						
All Crops	9,169	29%	4%	7%	27%	16%	1%	17%
By Crop Category								
Fruits and Nuts	7,898	31%	4%	6%	28%	16%	1%	15%
Ornamentals	840	12%	6%	19%	15%	15%	1%	33%
Vegetables	431	19%	5%	14%	29%	21%	0%	13%
By Use[a]								
Mainly Processing	5,690	32%	3%	6%	31%	13%	0%	15%
Mainly Fresh	2,951	25%	6%	10%	19%	18%	1%	20%
By Grower/Shipper Status								
Grower/Shipper	118	21%	6%	6%	33%	27%	0%	7%
Grower Only	2,487	28%	6%	7%	21%	22%	1%	15%

[a] "Mainly processing" (or "Fresh") was indicated by the output volume share being greater than 80 percent.

indicated that in the Far North, North Coast, and Sierra Nevada regions, particularly high proportions of respondents listed poor yields as a main cause for low profits.

E. Risk Management

This section includes mainly a discussion of ranking questions related to risk management. The specific topics analyzed are ranking of risk sources in order of importance, preference ranking of risk management tools, availability and utilization of risk management tools, and the history of receiving government disaster payments or loans.

Figure E1 presents the mean ranking for each risk source listed in the survey. Ten risk sources were listed, and respondents were asked to rank the sources from one (the most important risk source) to ten. In general, as a risk source became less important, fewer respondents provided a ranking for it. Among the listed sources, adverse temperature and output price fluctuation were the two highest ranked sources, with average rankings of 2.0 and 2.3, respectively. The next most common sources were diseases, input price fluctuation, and pests, with the mean ranks ranging between 3.0 and 4.0.

Mean ranks at more disaggregated levels were also examined (although not reported). Those ranking patterns were similar to the overall pattern, with no distinct dissimilarities among the three crop categories. Further examination of the mean ranks within the vegetable category showed a slightly pronounced pattern for the V4 class (tomatoes, peppers, and eggplants). Output price fluctuation received the mean rank of 1.6, input price fluctuation and pests both received 1.9, and adverse temperature received 2.3, indicating the relative importance of price fluctuations and pests for these growers compared to growers of other crops.

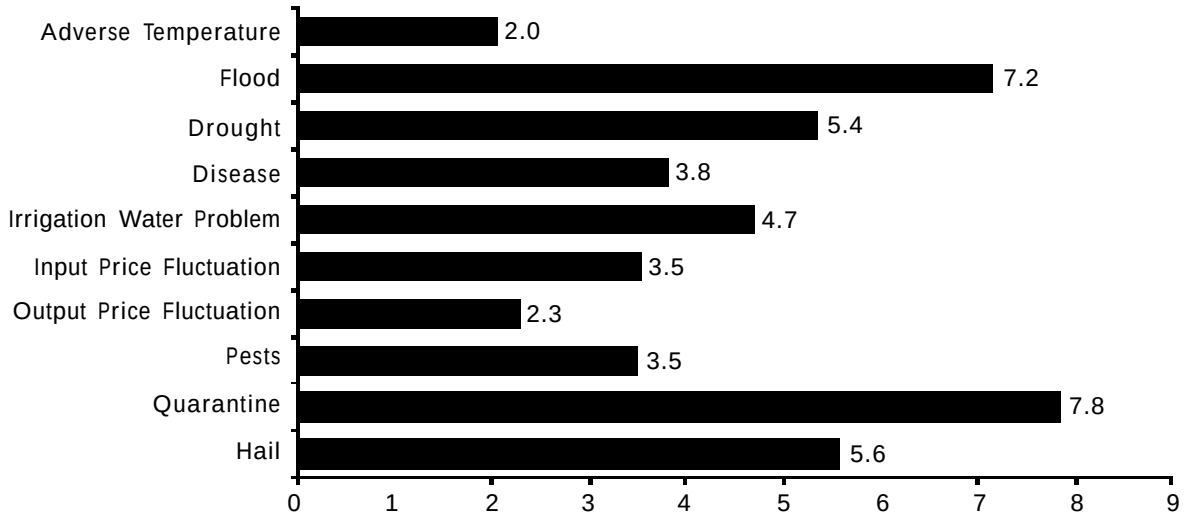
When the mean ranks by region were examined, adverse temperature remained one of the most important risk sources in all regions. Given that risks related to irrigation water and hail can vary by region in California, the regional pattern of rankings of drought, irrigation water supply problems, and hail were examined. As expected, water-related risks varied more by region than did other risk sources, ranging from 3.2 for irrigation water problems for South Coast growers to 5.8 for drought for the Sacramento Valley. Overall, water-related sources were relatively more important in regions such as the South Coast, Sierra Nevada, and Desert, where adequate supplies of irrigation water are known problems. Hail was a relatively low-priority concern (mean ranking of below seven) everywhere except the Central San Joaquin region (with a mean ranking of 3.93).

Next, growers' preferences for risk management tools and the availability and their use of those tools were examined. Table E1 presents the mean preference ranking of various risk management tools. Rankings for all crops indicated that crop insurance was most preferred, followed by diversified marketing and multiple commodities. However, preferences by specific crop category showed different patterns. The difference was most obvious with regard to crop insurance and multiple commodities; fruit/nut farmers strongly preferred crop insurance, whereas vegetable and ornamental crop farmers had a strong preference for multiple commodities. One explanation for this difference may be the level of availability of these tools; i.e., farmers may feel that a tool is "less preferred" when that tool is "less available."

Given that preferences can be affected by availability, the availability of each risk management tool was investigated. Table E2 reports the rate of availability as a ratio of the number of farmers who said the tool was available to them compared to the total number of respondents for that question. Again, the largest differences across crop categories arose with the two tools previously mentioned, crop insurance and diversification across multiple crops. Crop insurance was available to 49 percent of fruit/nut producers, 29 percent of vegetable growers, and 18 percent of ornamental crop producers. Responses for the availability of diversification into multiple crops showed almost the reverse: 17 percent for fruits/nuts, 40 percent for vegetables, and 28 percent for ornamental crops. These responses were consistent with our casual observations that, generally, fewer crop insurance programs are available for vegetables than for fruits/nuts and that diversifying into new crops is naturally more difficult for perennial crop growers than for annual crop growers. Diversified marketing was available to between 16 and 26 percent of growers across the three crop categories. Forward contracts were more available for vegetable growers (21 percent) than for fruit/nut growers (13 percent).

The interpretation of availability requires some caution. While interpreting the availability of

Figure E1. **Mean Ranking of Risk Sources in Order of Importance**[a]



[a] The numbers of observations used in tabulating mean rank varied for risk sources. In general, more respondents provided the rank for relatively more important sources. For example, the rank for adverse temperature, which was found to be most important, was provided by 7,781 respondents, and the rank for quarantine was provided by 2,824 respondents (for more information, refer to Table All.E1 in the Appendix).

crop insurance and government programs is straightforward, evaluating the availability of other risk tools such as crop/location diversification is not clear-cut. How individuals view the availability of such tools reflects, to some extent, their preferences for various tools. In this respect, the availability rates reported here are possibly downward-biased and can be understood as lower bound for the rates.

The second column in Table E2 reports the utilization rate, calculated as a ratio of the number of users to the number of farmers who said the tool was available. Most utilization rates, except for a few less important tools, exceeded 60 percent. This indicated that as long as the tools were available, the majority of growers made use of them to manage risk. Utilization rates were generally higher for vegetable farmers than for fruit/nut growers.

Diversification into multiple commodities deserves special attention, with its utilization rate of 87 percent being the highest reported. Crop diversification was the mostly preferred, most widely available (40 percent), and most frequently used (87 percent) risk management tool for vegetable growers. In fact, 87 percent of utilization

Table E1. **Mean Ranking of Preference for Risk Management Tools**[a]

	Crop Category			
	All Crops	Fruits and Nuts	Vegetables	Ornamentals
Crop Insurance	2.1	1.9	3.1	3.4
Different Regions	4.8	4.9	3.9	3.7
Multiple Commodities	3.0	3.2	2.1	2.1
Government Programs	3.9	3.8	4.1	4.7
Hedging with Futures or Options	5.7	5.7	5.6	6.0
Forwarding Contracting	3.6	3.5	3.5	3.8
Diversified Marketing	2.9	3.0	2.9	2.4
Others	2.6	2.6	2.7	2.1

[a] The number of observations differed for each tool considered and ranged from 5,793 for crop insurance (all crops) to 2,064 for hedging (all crops). For more information, refer to Table All.E3 in the Appendix.

given 40 percent availability implies that 35 percent (87 percent times 40 percent) of vegetable farmers were practicing crop diversification as a risk reducing tool. Using only the observations that indicated the tool was available, the preference ranking was re-examined and the results are reported in the last column of Table E2. These mean rankings were positively correlated with the utilization rates and the ranks were higher than those in Table E1.

F. Crop Insurance

The topics explored in this section include information on farmers' crop insurance purchases, private insurance

Table E2. Shares of Farms: Availability and Utilization of Risk Management Tools

	Availability Rate (Percent)[a]	Utilization Rate (Percent)[b]	Mean Ranking
Fruits and Nuts			
Crop Insurance	49%	69%	1.8
Different Regions	7%	39%	3.7
Multiple Commodities	17%	63%	2.4
Government Programs	15%	60%	3.0
Hedging with Futures or Options	3%	27%	4.5
Forward Contracting	13%	67%	2.4
Diversified Marketing	16%	60%	2.4
Other	3%	75%	2.4
Vegetables			
Crop Insurance	29%	71%	2.6
Different Regions	15%	47%	3.0
Multiple Commodities	40%	87%	2.0
Government Programs	20%	67%	3.1
Hedging with Futures or Options	7%	52%	5.0
Forward Contracting	21%	77%	2.8
Diversified Marketing	25%	79%	2.7
Other	3%	62%	2.8
Ornamentals			
Crop Insurance	18%	37%	3.0
Different Regions	11%	45%	3.0
Multiple Commodities	28%	78%	1.6
Government Programs	4%	36%	3.9
Hedging with Futures or Options	2%	19%	4.9
Forward Contracting	9%	66%	2.8
Diversified Marketing	26%	73%	2.1
Other	4%	74%	2.1

[a] The availability rate was calculated as the ratio of the number of observations with availability divided by the total number of observations.
[b] The utilization rate was calculated based on the number of observations with availability. The utilization rates are not provided by crop due to the small number of observations that reported using the tool.

Table F1. History of Crop Insurance Purchases

	Fruits and Nuts	Vegetables	Ornamentals
Purchased at Least Once in Last Five Years	53%	31%	13%
Purchased All Five Years[a]	64%	71%	48%

[a] The numbers in this row were based on observations in which the farmer purchased insurance at least once in the last five years.

purchases, reasons for purchasing and not purchasing crop insurance, and suggestions for modifying crop insurance.

Table F1 reports the percent of farmers that purchased any crop insurance within the last five years. Crop insurance here refers to government crop insurance as well as to private coverage such as frost insurance. Purchase rates varied considerably across crop categories. Table F1 shows that crop insurance was purchased most extensively by fruit/nut farmers (53 percent), followed by vegetable farmers (31 percent), and ornamental crop farmers (13 percent). The table also presents the percent of crop insurance buyers who made purchases in all five years covered by the survey. The majority of the buyers purchased insurance all five years, indicating the high likelihood of continuous purchases by farmers once they chose to purchase.

Table F2 shows the extent of peril-specific crop insurance purchases by growers across crop categories. Peril-specific insurance policies are offered mostly by private firms, while multi-peril insurance is provided by the government. Among fruit/nut growers in general, frost (freeze) insurance was the most frequently purchased single-peril coverage. This was particularly the case for citrus growers; more than one-third of that group purchased frost insurance. However, rain insurance was the most popular with grape growers (likely for raisin grapes) with about one quarter of them purchasing the coverage. Finally, hail insurance was the most common coverage purchased by stone fruit growers (32 percent). In general, vegetable growers tended to purchase less single-peril crop insurance than fruit/nut growers. Crop-specific information showed that, among vegetable growers, growers of V4 crops (tomatoes, peppers, and eggplants) used single-peril coverage fairly frequently, especially rain insurance (34 percent). It is likely that such high rates were observed for V4 growers relative to other vegetable growers because of the potential damage that late rains can do to the market acceptability of these crops (i.e., the "marketable" yield). Single-peril insurance was rarely used by growers of ornamentals.

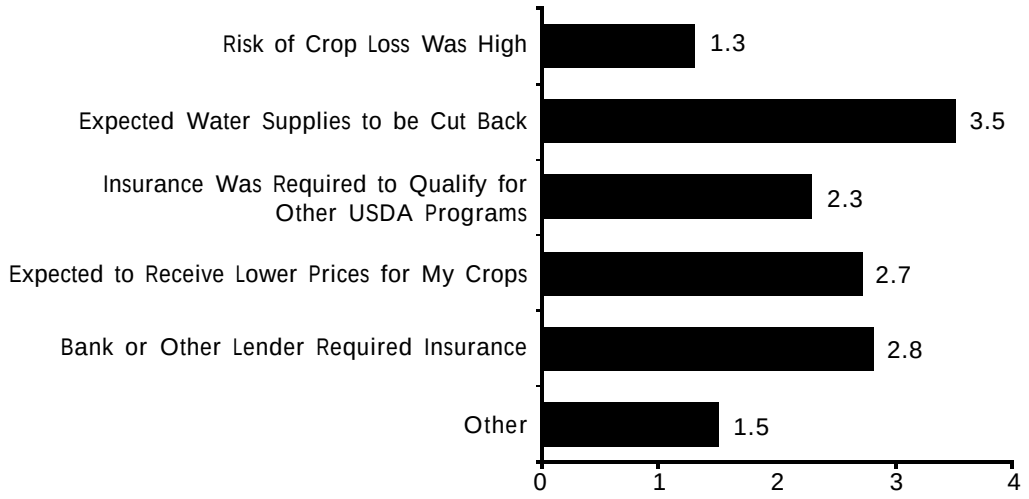
Respondents were asked to rank their reasons for purchasing crop insurance. Figure F1 presents the mean ranking for the reasons listed in the survey. No information is reported separately by crop category because no obvious distinctions were observed across crop categories. "Crop loss" still ranked first as a reason for purchasing crop insurance, in part indicating the prevalence of

Table F2. Purchase of Private (Single-Peril) Crop Insurance

		Share of Farmers that Purchased Peril-Specific Insurance			
	Total[a]	Fire	Frost or Freeze	Rain	Hail
All Fruits and Nuts	n = 8,791	5%	20%	17%	17%
Citrus	n = 1,021	5%	36%	10%	18%
Grapes	n = 2,888	5%	21%	24%	21%
Nuts	n = 2,776	5%	16%	14%	14%
Stone Fruits	n = 798	5%	25%	25%	32%
All Vegetables	n = 443	9%	9%	14%	9%
V4: Tomatoes, peppers, eggplants, tomatillo	n = 137	15%	17%	34%	18%
Ornamentals	n = 936	4%	3%	3%	3%

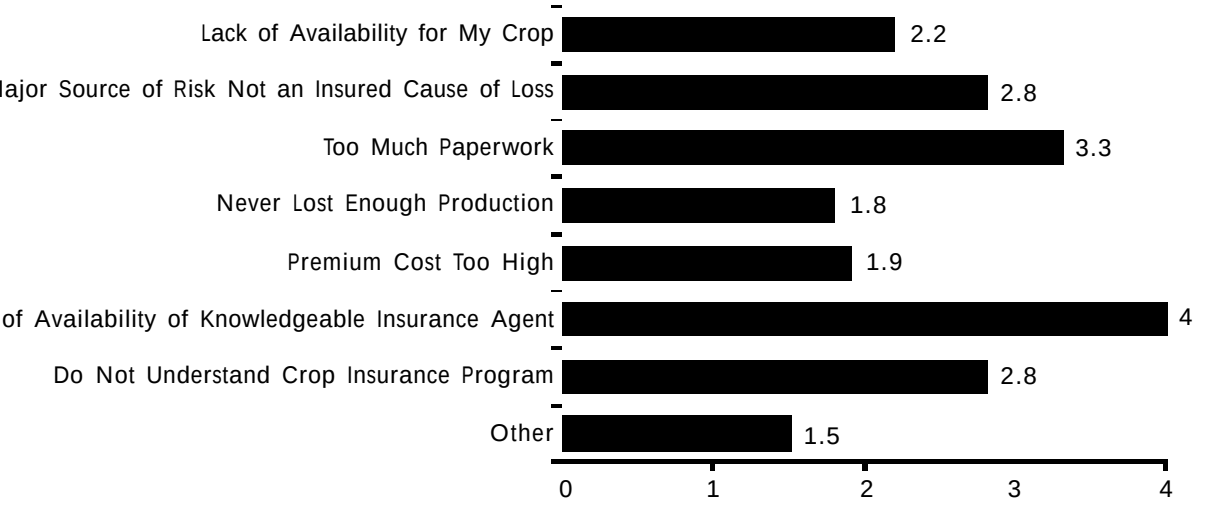
[a] The sum of the farmers over all perils is not equal to the total number because many respondents did not answer this question.

Figure F1. **Mean Ranking of Reasons for Purchasing Crop Insurance**[a]



[a] The number of observations used differed for each reason and ranged from 3,602 for "risk of crop loss was high" to 1,044 for "expected water supplies to be cut back."

Figure F2. **Mean Ranking of Reasons for Not Purchasing Crop Insurance**[a]



[a] The number of observations used differed for each reason and ranged from 2,722 for "have never lost enough production" to 1,167 for "lack of knowledgeable insurance agent."

yield-based crop insurance. The second highest ranking reason was "required to qualify for USDA programs." Some linkage exists between crop insurance participation and USDA farm program benefits (Lee et al.). Farmers who wish to remain eligible for some USDA program benefits must obtain catastrophic insurance or higher levels of coverage. Given the relatively few government programs available for specialty crop growers, this ranking may be associated with the specialty crop growers who have diversified into field crops. However, it is worth mentioning that not even one-quarter of potential respondents (in this case, insurance buyers) provided the rank for the reason for purchasing crop insurance except for "crop loss," which was chosen by more than three-quarters of the insurance buyers. This indicated that many felt that any reason other than crop loss was remotely related.

Reasons for not purchasing crop insurance and their mean ranking are presented in Figure F2. "Never lost enough production" and "premium is too high" ranked highest among the choices offered except "other." This reflected the relatively low degree of yield variability in many specialty crops grown in California. "Lack of availability for my crop" was next. Particularly among vegetable growers, lack of availability was ranked as the primary reason for not purchasing crop insurance, with a mean rank of 1.6 (not shown in the figure). Further, "major source of risk is not an insured cause of loss" and "do not understand the program" were not trivial. Finally, for almost all crop categories, "other" ranked as the primary reason for not insuring. This may imply that there is substantial "catch up" to be done for both growers and insurance providers—that more efforts are needed to inform growers about crop insurance and for authorities to learn the unique reasons why growers of particular crops do not purchase insurance.

Table F3 provides the average ranking of suggestions to improve crop insurance.[7] Suggestions listed were mostly related to compensation schemes. For fruit/nut and vegetable farmers, "raising the yield guarantee," "compensating for revenue or profit," and "guaranteeing cash production costs" ranked high, while for ornamental growers, "compensating for revenue or profit" and "guaranteeing placement costs of an inventory" ranked high. For fruit/nut farmers, guaranteeing the cost of establishing an orchard was not as preferred as compensation of cash production costs, and a compensation scheme for ornamentals needs to be devised to accommodate their production systems because traditional yield-based production is not relevant to them. Overall, it was clear that specialty crop growers were more concerned with revenue and profit variability than they were with yield variability. This attitude is common among farmers in California's irrigated agricultural industry.

Recent research on crop insurance has consistently identified some level of demand, but that demand has been influenced by numerous factors (Coble et al.; Makki and Somwaru). A decade ago, research focused primarily on yield risk as the key determinant of demand for crop insurance. Studies of that period focusing on specialty crops found that growers' reluctance to insure was based on the fact that price variance was often more significant than yield variance (Dismukes, Allen and Morzuch; Weisensel and Schoney). This prompted the first assessments of revenue insurance as an alternative (Turvey). In recent years, revenue insurance has received wide attention. However, the few studies of specialty crop producers' demand for revenue insurance have shown a need for more detailed, crop specific analyses of market and grower factors (Miller, Kahl and Rathwell; Richards).

G. Financial Characteristics

The final section of analysis focuses on four financial variables: off-farm income share, gross agricultural sales, assets, and debts (from 2001). Previous research has shown that these factors have a significant influence on

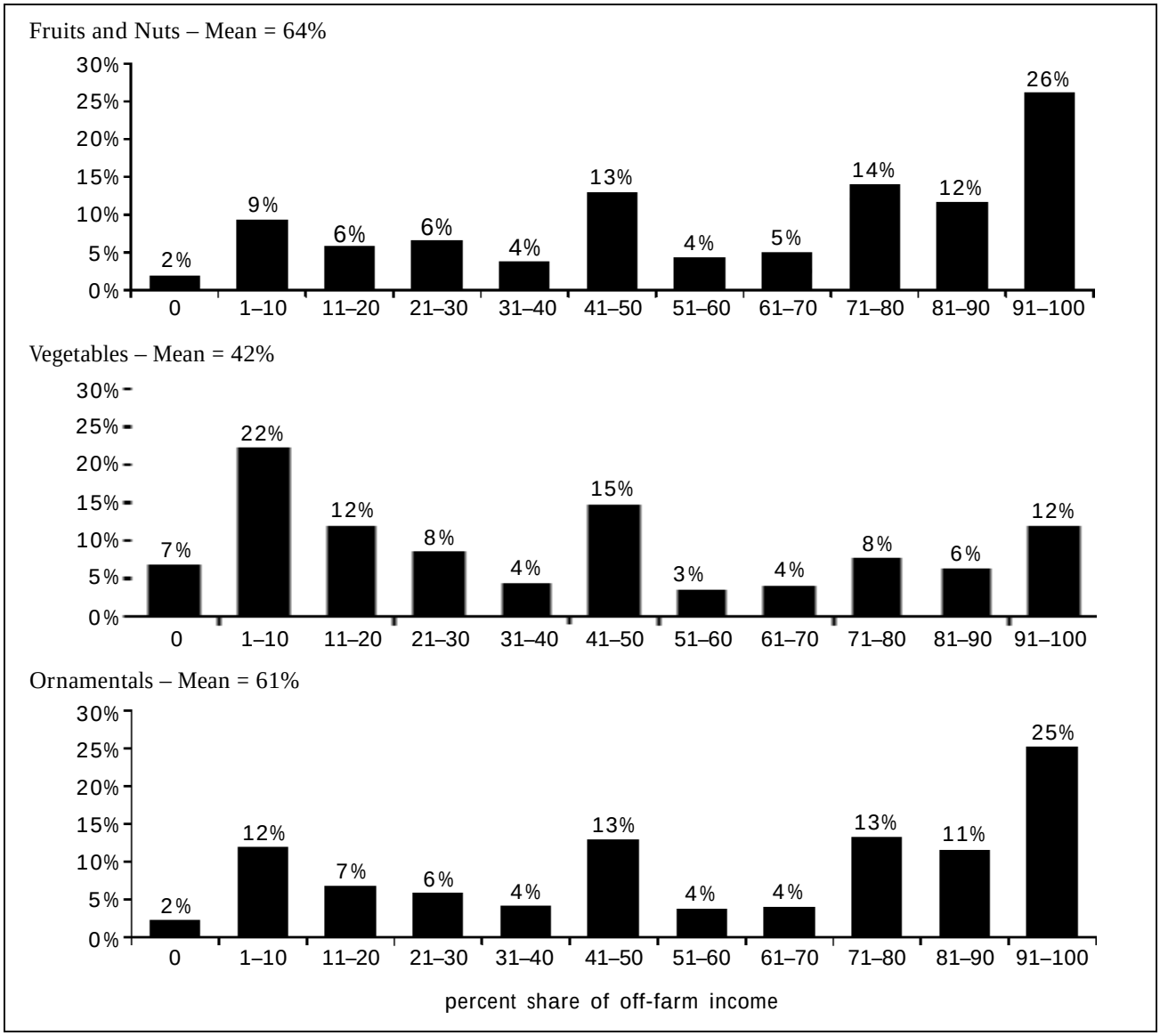
Table F3. **Mean Ranking of Suggestions to Modify Crop Insurance**[a]

Suggestions for Modifying Crop Insurance	Fruits and Nuts	Vegetables	Ornamentals
Compensate for a Higher Level of Production Loss	2.0	2.2	2.7
Compensate for a Loss of Gross Sales	2.3	2.5	2.3
Compensate for a Loss of Profit	2.1	2.4	2.5
Guarantee Cash Production Costs	2.4	2.2	3.0
Guarantee Costs of Establishing an Orchard or Vineyard	3.6	4.5	3.8
Guarantee Replacement of a Crop Inventory	3.5	3.4	2.3
Other	1.5	1.4	1.2

[a] The number of observations used differed for each suggestion and ranged from 3,840 for "compensate for a higher level of production loss" to 2,343 for "guarantee costs of establishing an orchard or vineyard."

[7] Note that a higher production guarantee would be possible only at a higher premium. It is possible that stating such conditions explicitly could alter the ranking. However, given our earlier results that average yield fluctuations were 8 percent for vegetables and 15 percent for fruits/nuts (Table D1), it was not surprising to see "higher production guarantee" commanding a relatively high ranking (regardless of premium levels).

Figure G1. Distribution of Off-Farm Income Share (Year 2001)



farmers' risk attitudes and, thus, on their risk management practices. For example, off-farm income supports most farms in the United States (USDA 2001). The cushion from off-farm income makes many of those farms less sensitive to income risk (Blank 2002), thus decreasing the demand for risk management tools (Briys and Schlesinger). In other words, off-farm income substitutes for other risk management tools to some extent.

Figure G1 presents the distribution and mean of off-farm income shares by crop category. The "share" refers to the percentage of total household income that comes from off-farm sources. The mean share for the entire survey was 63 percent (indicating that 37 percent of household income came from farming activities). In general, there seemed to be a common pattern in the distribution for each crop category. Each distribution showed relatively heavy densities at the 1 to 10 percent range and then in the mid-range at 41 to 50 percent. The density started to increase at the 71 to 80 percent range. Note that the 91 to 100 percent range showed the highest density among all ranges for both fruits/nuts (26 percent) and ornamentals (25 percent).[8] However, the distribution

[8] The category of farmers with an off-farm income share of between 91 and100 percent normally includes hobby farmers. However, in the survey we asked for the off-farm income share in 2001. Thus, this category included both farmers who had a disastrous year in 2001 and those who engaged in farming as a hobby.

Table G1. Mean Gross Agricultural Sales, Assets, and Debts

	Gross Ag. Sales ($1,000) Mean	Standard Deviation	Assets ($1,000) Mean	Standard Deviation	Debts ($1,000) Mean	Standard Deviation
All	413	(1,855)	1,415	(5,373)	582	(3,207)
By Crop Category						
Fruits and Nuts	330	(1,675)	1,373	(5,251)	598	(3,204)
Observations	n = 7,163		n = 4,553		n = 2,590	
Vegetables	1,112	(1,885)	1,889	(6,916)	940	(5,504)
Observations	n = 382		n = 237		n = 166	
Ornamentals	818	(2,922)	1,575	(5,625)	395	(2,018)
Observations	n = 815		n = 512		n = 529	

of farms in the vegetable category deviated from the other two categories. The distribution of vegetable farmers showed greater density in the ranges with relatively low off-farm income shares, indicating that vegetable growers tend to spend less time on off-farm activities and get more of their income from farming than do fruit/nut or ornamental growers.

Table G1 provides average values of gross agricultural sales, assets, and debts. Along with mean dollar figures, the table also reports the standard deviations in parentheses. There were substantial differences across crop categories. Consistent with the earlier findings on mean acreage, vegetable growers' mean gross sales were much higher than those of other categories—nearly three times that of fruits/nuts and one and a half times that of ornamentals. The standard deviations of the mean gross sales were relatively large, indicating substantial variation in sales figures across farms. Nevertheless, judging from the values of the coefficients of variation, it was possible to infer that the variation in gross sales was less severe for vegetable farms.

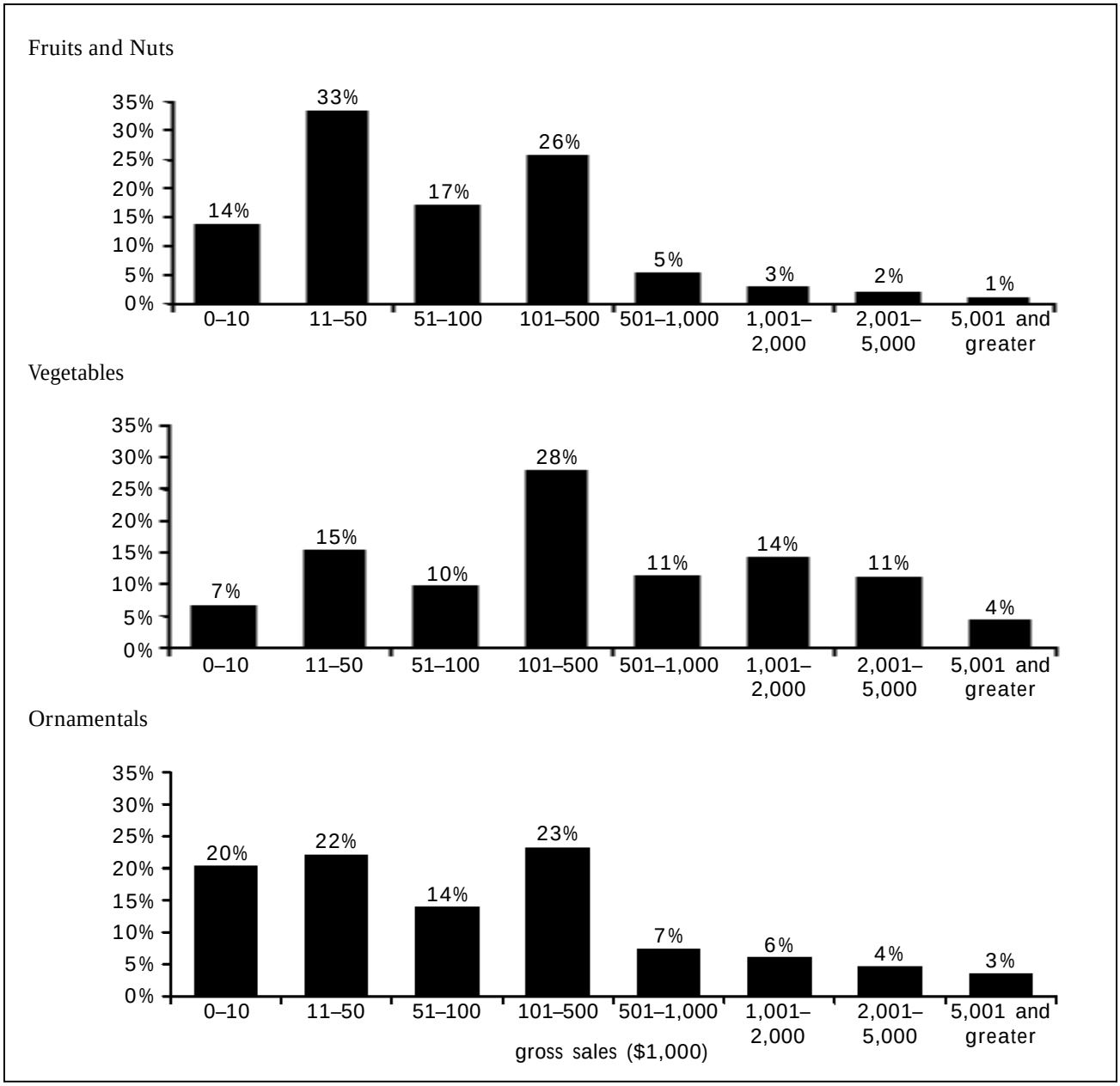
Vegetable operations also had the highest mean values for assets and debts.[9] The reported mean values of assets and debts gave debt/asset ratios of 0.42 for fruits/nuts and 0.50 for vegetables. (These are both much higher than the 0.15 debt-to-asset ratio reported by the USDA for all of American agriculture in the same year (USDA).) More importantly, when viewing assets and debts as financial inputs necessary to generate revenue, the ratio of gross sales revenue to the sum of assets and debts was highest for vegetables and lowest for fruits/nuts. This implies that one unit of financial inputs is associated with a higher level of revenue for vegetables than for fruits/nuts, or equivalently, one unit of revenue is associated with a lower level of financial inputs for vegetables than for fruits/nuts. This cursory observation may be linked to the relatively high (low) intensiveness of financial (or capital) inputs required, or the relatively low (high) performance of financial inputs in fruit/nut (vegetable) production.

The mean gross sales by region varied substantially. Gross sales data by crop category and by region indicated that the lowest gross sales were in the Far North region for both the fruit/nut and the vegetable categories, as expected because of those region's lack of suitability for such crops (livestock operations are dominant in the region). The highest mean sales for the fruit/nut category were the Central Coast – North's $0.6 million (the bulk of these sales are most likely from strawberry growers in the Salinas Valley of Monterey County); for the vegetable category, the highest mean sales were the Sacramento Valley's $1.8 million.

Figure G2 provides the distribution of gross agricultural sales by crop category. The median and mean

[9] Particular caution was required to process the asset data. We found a number of seemingly inconsistent responses to asset questions. Criteria for consistency and reasonableness were set and observations that did not meet the criteria were excluded.

Figure G2. **Distribution of Gross Agricultural Sales**



gross sales diverged considerably; the median was only about one-tenth of the mean value due to inclusion of some extremely high sales values for a few very large-scale operations combined with the large number of small-scale farms. In the vegetable category, there were relatively higher proportions of farmers in higher sales ranges. The proportions of farmers with more than $1 million in sales were 6 percent for fruits/nuts, 29 percent for vegetables, and 13 percent for ornamentals.

Figures G3 and G4 provide the mean gross sales by off-farm income share and by acreage class, respectively. Mean gross agricultural sales were negatively correlated with off-farm income share and positively correlated with acreage, confirming our expectation that higher agricultural revenues were generated by farms with larger acreage and farmers with less off-farm work. However, when sales revenue was computed as per-acre revenue, Figure G4 suggests that revenue per acre decreases as acreage increases. This is not counter-intuitive, given that specialty crops vary widely in unit value (and, thus, in value per acre) and the survey results indicated that smaller sized farms were, in general, associated with higher crop values.

Figure G3. Mean of Gross Agricultural Sales ($1,000) by Off-Farm Income Share

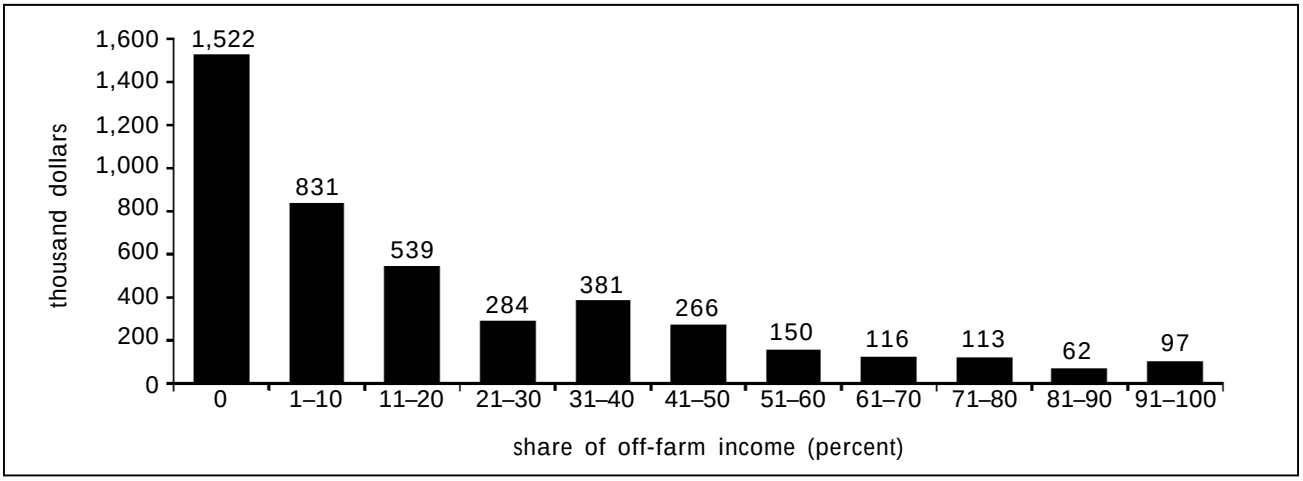
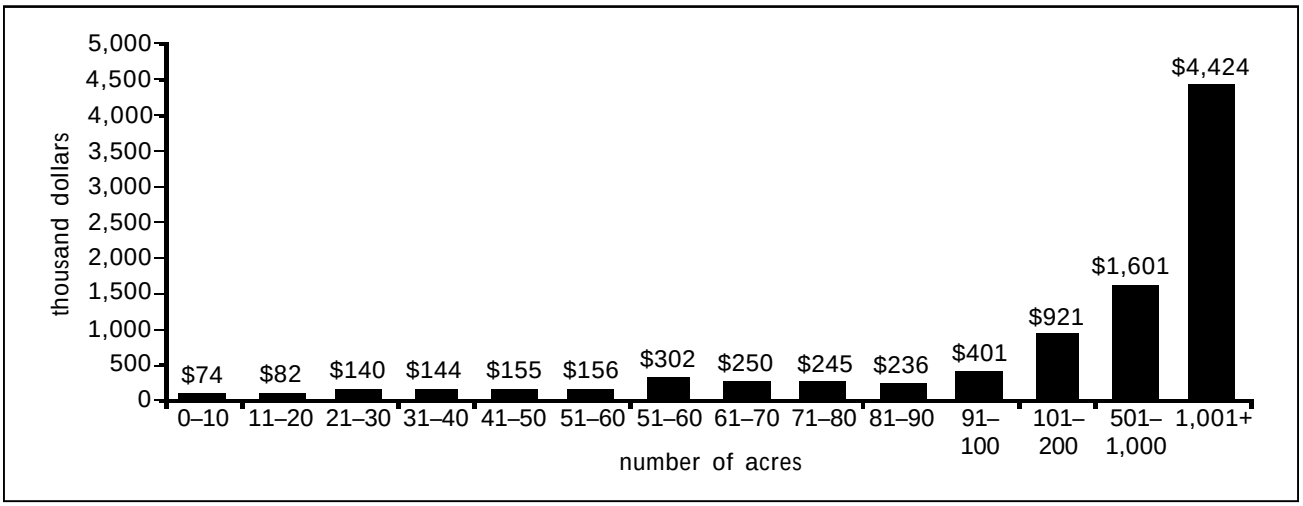


Figure G4. Mean of Gross Agricultural Sales ($1,000) by Acreage Class



SUMMARY AND IMPLICATIONS

This section first summarizes a few major empirical findings of the study. The discussion then turns to a few implications for risk management policy focused on California horticultural crop producers' demand for crop insurance. Finally, we consider some suggestions for further research.

Summary

The main purpose of this report was to provide detailed and unique survey-based information on the fruit/nut, vegetable, and ornamental crop industries of California. The main findings from these survey data are as follows.

California has fewer vegetable farms but, measured by gross sales and other dimensions, they are larger operations than fruit/nut farms are.

Diversification (i.e., the number of crops grown) increases with farm size, measured by acres. Fruit/nut farms are, on average, less diversified than vegetable farms, and when fruit/nut farmers diversify, they tend to use similar crops.

About 6 percent of fruit/nut and vegetable farms have some organic (or transitional-organic) land. These organic farmers represent 6 percent of fruit/nut farms, 14 percent of vegetable farms, and 4 percent of ornamental crop farms. Many of these farms also engage in conventional farming, and they devote, on average, about one-third of their primary crop land to organic farming.

California farms tend to grow produce for either processing or fresh use but not for both. About 71 percent of the sampled fruit/nut farms produced mainly for processing use. About 67 percent of sampled vegetable farms produced mainly for fresh use.

Contracts play a major role in marketing for specialty/horticultural crops. They are particularly important in markets for crops designated for processing. Nearly 60 percent of fruit/nut farmers and 90 percent of vegetable farmers marketed their processing commodities through contract arrangements. The majority of these contracts provided for a predetermined price.

About 13 percent of vegetable farms but only 3 percent of orchard farms are grower/shippers. These farms tend to be larger than average and supply to mass merchandisers. The grower-only group tends to use more diverse marketing channels. Among the various channels, "directly to consumers" (farmers markets, you-pick operations, roadside stands) was used by the largest share of farms (31 percent), but the farms tended to be smaller than average.

Yield variability is an important risk factor for growers. Orchard and vineyard crop yields tend to fluctuate more than vegetable yields. Orchard and vineyard crop yields deviated an average of 15 percent for the five-year moving-average yield, compared to an average of 8 percent for vegetable crop yields.

Despite considerable yield variation from year to year for these California crops, price variability is listed by growers as the most important risk source. Growers list price declines due to industry-wide overproduction as the number one concern.

Growers use diversification and some marketing channels to manage risk. Crop insurance is less available for vegetable crops than it is for fruit, vine, and nut crops. Vegetable producers view crop insurance as a "less preferred" risk management tool. When asked about crop insurance programs, many farmers suggested that a "higher yield guarantee" would improve crop insurance. Further, most farmers strongly suggested the need for crop insurance that compensates in value terms, but they expressed no strong preference among compensations based on gross sales, profit, or production costs.

Implications

The information provided in this study and the data set that underlies it will prove useful to agricultural business firms, including individual farms, as well as to government policy advisors and program designers. The study results provide a benchmark to industries that allows them to compare operations to the averages and medians for specific crops or locations. It also allows agricultural marketing and other service and supply firms to better understand their own potential supply and customer base for planning and product development. Such detailed data have not been available previously. The data are being used in risk management education efforts for growers and in summary form to provide objective data about grower operations and attitudes.

The data and results also have implications for public policy and implementation of public policy, especially relative to risk management. Some examples are provided here. We find that many growers use crop diversification to smooth their revenue streams, but some growers find diversification more difficult or costly. Even if more diversified farms tend to have less variability in farm income, the degree and form of diversification affects the probability and magnitude of losses. The importance of diversification and its variation across specific industries points to the conditions under which yield insurance may be of interest and where it is less important to a farm's annual revenue and thus less appealing as a risk management tool. The covariance between price and individual farm yield is another crucial piece of information in assessing farm revenue risk related to either price or yield variability. USDA's Risk Management Agency has been developing whole-farm revenue insurance products. The appropriate design of such products requires this kind of data.

Our analysis shows that no one risk management tool fits all growers. Some risk-related patterns may be observed broadly in certain segments of farms. However, those patterns change when smaller subcategories of crop producers are analyzed because risks and the way growers manage them depend on many complex factors. One implication is that insurance products that are designed and targeted for individual crops may miss the whole-farm interactions. In reality, an insurance product for a specific crop would work differently for different growers depending on their characteristics outside the specific crop.

It is also vital to better understand the risk management tools that growers currently use when designing public policy to help farmers manage risk. In many cases, public policy for risk management can be effectively designed to accommodate and complement rather than substitute for or conflict with the risk tools that growers already value and use.

Overall, the results of this survey suggest that one must proceed with caution when attempting to develop government-sponsored risk management programs. Programs may fail to meet objectives and may have serious unintended consequences unless the full set of opportunities and constraints facing farmers is well understood and the differences across farms are incorporated in the program design. This study shows the complexity of risk-related costs and revenues associated with the fruit, nut, vegetable, and ornamental horticulture industries in California.

The data summarized in this report also can be useful for further research. These data, together with information on grower costs and returns, can help analysts better understand variations among horticultural crop industries in California and elsewhere. Researchers are also pursuing more detailed analyses of the data. For example, these data are ideal for measuring patterns of diversification and, in some cases, vertical integrations and for examining the multivariate patterns of these with alternative measures of farm size. Assessing other, more detailed relationships among the variables is also on the research agenda. This report does not attempt to disentangle the various causal relationships among the data. Such research is on the horizon.

Finally, this survey provides a one-time cross-section on many important variables. Periodic re-surveys would allow researchers to track the path of adjustment and allow assessment of industry dynamics with rich, repeated cross-sectional information.

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APPENDIX 1
Response Rates

Relatively few farmers answered all 25 survey questions. Respondents found some questions easier to answer than others. In this section, we report the response rate for each survey question based on the 10,410 observations comprising our basic data set. We also report distribution information on the rate of response when it is relevant.

Q1. What is your farm size?
Response rate: 100 percent based on 10,410 observations.

Q2. Where is your largest operation located?
Response rate: 100 percent based on 10,410 observations.

Q3. Years of farming?
Response rate: 95 percent (9,845 observations) based on 10,410 observations.

Q4. What are your major crops?
Response rate: 99 percent based on 10,358 observations. Our data set include 52 observations of noncrop farmers (mostly in apiculture and aquaculture). This question was designed for crop farmers and thus the response rate was calculated based on crop farmers only.

Q5 (a). Do you have organic farming?
Response rate: 99.7 percent (10,386 observations) based on 10,410 observations.

Q5 (b). What are your organic crops?
Response rate: 100 percent based on 637 observations of organic farmers.

Q6. What is your primary specialty crop?
Response rate: 99 percent (10,298 observations) based on 10,410 observations.

Q6a. What are the crop shares of processing and fresh use?
Response rate: 97 percent (10,111 observations) based on 10,410 observations.

Note: For each observation, both processing and fresh output shares had to sum to 100 percent. When the percentages did not add up to 100 percent, we regarded those observations as nonresponses (five observations greater than 100 percent and 32 observations less than 100 percent).

Q6b. What are the marketing channels for your processed use crop?
Response rate: 99 percent based on 7,119 observations.

Note: The output share designated to each of the marketing channels had to add up to 100 percent. However, this sum was greater than 100 percent for 15 observations and less than 100 percent for 56 observations. These were regarded as nonresponses.

Q7. Are you a grower-shipper (relevant to fresh use)?
Response rate: 97 percent based on the 3,837 fresh-crop growers.

Q7a. If you are a grower/shipper, what is the output share sold at predetermined price?
Response rate: 82 percent (460 observations) based on 560 observations of grower/shippers.

Q8. If you are a grower only, what are your marketing channels?
Response rate: 99 percent based on 3,173 observations.

Note: The output share designated to each of the marketing channels had to add up to 100 percent. However, this sum was greater than 100 percent for 10 observations and less than 100 percent for 35 observations. These were regarded as nonresponses.

Q9. What are your actual yields per acre for 1997–2001?

The notion of per-acre yield was not relevant to two classes of farmers, noncrop farmers and ornamentals farmers. Thus, the response rate was calculated based on the set of 9,341 observations that excluded noncrop and ornamentals farmers. Furthermore, many people did not answer for all five years. Thus, we calculated the response rate for each year separately.

Year	Observations	Response Rate (Percent) Based on 9,341 Observations
2001	6,522	70%
2000	5,868	63%
1999	5,435	58%
1998	4,962	53%
1997	4,760	51%

Q10a. What is the largest yield fluctuation for the last five years?

Response rate: 77 percent (7,929 observations) based on 10,298 observations.

Q10b. What is the largest annual price fluctuation for the last five years?

Response rate: 67 percent (6,894 observations) based on 10,298 observations.

Q10c. What is the largest profit fluctuation for the last five years?

Response rate: 64 percent (6,549 observations) based on 10,298 observations.

Q11. What is the main reason for the lowest profit?

Response rate: 98 percent (10,055 observations) based on 10,298 observations.

Q12. Rank the importance of the sources of risk.

Rank	Observations	Response Rate (Percent) Based on 10,410 Observations
1	9,463	91%
2	7,358	71%
3	5,315	51%
4	3,604	35%
5	2,564	25%

Q13. Rank the preference of the risk management tools.

Fewer responses were provided as the ranking became lower. Therefore, we report the response rate by rank.

Rank	Observations	Response Rate (Percent) Based on 10,410 Observations
1	6,834	66%
2	4,249	41%
3	2,776	27%
4	1,836	18%
5	1,415	14%

Q14. Have you received government disaster payments or loans?

Response rate: 91 percent (9,450 observations) based on 10,410 observations.

Q15. Have you purchased any crop insurance within the past five years?

Response rate: 97 percent (10,138 observations) based on 10,410 observations.

Q15a. How many years have you purchased crop insurance within the last five years?

Response rate: 99 percent (4,792 observations) based on 4,845 observations where Question 15 was answered "yes."

Q16. Have you purchased single-peril crop insurance for the last five years?
Response rate: 100 percent based on 4,845 observations where Question 15 was answered "yes."

Q17. Rank the reasons for purchasing crop insurance.
Response rates were calculated based on the farmers who had purchased crop insurance before.

Rank	Observations	Response Rate (Percent) Based on 4,845 Observations[a]
1	3,969	82%
2	1,840	38%
3	939	19%
4	632	13%
5	556	12%

[a] Number of respondents who answered "yes" to Question 15.

Q18. Rank the reasons for not purchasing crop insurance.

Rank	Observations	Response Rate (Percent) Based on 5,293 Observations[a]
1	5,935	100%
2	2,729	52%
3	1,464	28%
4	618	16%
5	556	12%
6	552	10%
7	490	9%

[a] Number of respondents who answered "no" to Question 15.

Q19. How can crop insurance serve your needs better?

Rank	Observations	Response Rate (Percent) Based on 10,410 Observations
1	5,755	55%
2	3,796	37%
3	2,610	25%
4	1,781	17%
5	1,366	13%
6	1,196	12%

Q20. Has risk management become more important?
Response rate: 89 percent (9,303 observations) based on 10,410 observations.

Q21. Have you become more familiar with crop insurance?
Response rate: 90 percent (9,383 observations) based on 10,410 observations.

Q22. How many risk management education meetings and seminars have you attended?
Response rate: 26.6 percent (2,771 observations) based on 10,410 observations.

Q23. What is the share of nonfarm income?
Response rate: 69.6 percent (7,243 observations) based on 10,410 observations.

Q24. What are the gross sales of agricultural commodities?
Response rate: 87.6 percent (9,123 observations) based on 10,410 observations.

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University of California
Agriculture and Natural Resources (ANR)
Communication Services
6701 San Pablo Avenue, 2nd Floor
Oakland, California 94608–1239

Telephone: 800.994.8849 / 510.642.2431
Fax: 510.643.5470
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