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Labor Demand, Productivity and Overhead Cost Estimates for Harvesting the 1990 Strawberry Crop



Agricultural Experiment Station
Oregon State University

**Labor Demand, Productivity and Overhead Cost Estimates for
Harvesting the 1990 Strawberry Crop**

by

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Table of Contents

Introduction	1
Results.	3
Estimate of size and productivity of the work force	3
Reasons for the decline in the percent of domestic workers	7
Recruitment of workers	8
Cost of I-9 verification	9
Other payroll overhead costs.	10
Planting and harvesting intentions for 1991.	14
Summary.	14
Appendix A: Descriptive statistics for the 1990 survey of strawberry growers	17
Appendix B. Summary of completion rates	22
Appendix C. Estimation of the size and productivity of the work force.	23

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Introduction

This is the third study of farm labor the Agricultural Experiment Station has completed for the Oregon Strawberry Commission. The first was completed for the 1987 harvest season. The second was completed for the 1989 season. This report covers the 1990 harvest year. The strategy for the study has been to seek basic information, such as labor demand and productivity in each survey for the comparison of trends over time. Additional questions are investigated in each survey that are of timely interest to growers and may not be repeated every year. The report this year will cover information of continuing and special interest.

The year 1990 saw the full impact of the Immigration Reform and Control Act of 1986 (IRCA) on the recruitment and reporting of farm labor. The strawberry acreage declined nearly a third from 1987, when our first labor demand survey was completed. The number of workers employed dropped as well, about 40 percent according to our estimates. Productivity per worker, therefore, should have increased over the intervening three years to adjust for the impact of fewer workers for the acres harvested. A shift in the type of workers employed -- from fewer local teenagers and local adults to more productive alien migrants is expected to account for the difference.

The year 1990 also is the second year that growers were

required to complete employment verification of I-9 forms for all newly-hired workers, to note which workers have INS numbers in the A-90 million series and report names, A-numbers and days worked of such workers on an ESA-92 form. One criticism of IRCA has focused on the cost of record keeping and reporting. The 1990 survey investigated reporting costs and the results will show for the first time the estimated cost that growers are paying for I-9 verification. Other payroll overhead costs also are summarized.

Implementation of a new minimum wage law (from \$3.35 an hour to \$4.25 an hour) was in place for the 1990 picking season. Growers had to adjust their piece rate to guarantee the new minimum wage for each worker. The effect of the higher wage probably accounts for some shift to more productive workers, since growers had to pay the \$4.25 hourly rate regardless of the pounds of berries each worker picked per hour. The estimated percent of workers who could not make minimum wage and the percent terminated for that reason also is reported.

Data for the survey were gathered by self-administered questionnaires mailed to all known commercial strawberry growers in the state. Growers were asked about the number of 1990 acres in production, total pounds of berries harvest and left unharvested, estimated number of worker-days, the age and type of workers employed, recruitment activities, reporting costs, percent of the work force who could not

meet minimum wage (and the percent terminated for that reason), and, finally, planting and harvesting intentions for 1991.

Questionnaire items, marginal frequencies, and other summary statistics are reported in Appendix A. Completion rates are discussed in Appendix B. Methods for estimating the size and productivity of the work force are given in Appendix C.

Results

Estimate of size and productivity of the work force.

We estimate that 28,186 workers were required to pick the 1990 strawberry crop. Table 1 shows the frequency breakdown by type of worker.

Table 1. Frequency distribution for types of strawberry workers in Oregon, 1990

Type of worker	Number	Percent
Local workers between 12 and 16 years old.	1,578	6
Local workers over 16 years old .	1,527	5
U. S. migrant farm workers. . . .	6,027	21
Alien migrant farm workers. . . .	19,054	68
Total	28,186	100

The percent of teenage and local adults dropped dramatically and the proportion of alien migrants in the work force increased commensurately since 1987. Table 2

shows the work force proportions and differences for the two years.

Table 2. Proportion of workers who picked the 1987 and 1990 strawberry crop

Type of worker	1987	1990	Difference
	percent	percent	percent
Local workers between 12 and 16 years old	21	6	-15
Local workers over 16 years of age	19	5	-14
U.S. migrant farm workers . . .	15	21	6
Alien migrant farm workers . . .	44	68	24
Total	100	100	0
(N)	(39,119)	(28,186)	

Alien and U.S. migrants were the only types of worker who increased their proportion of the work force between 1987 and 1990. The other groups lost ground, 15 percent for local teenagers and 14 percent for local adults.

Productivity of the different types of workers varied as well, similar to the pattern observed in 1987. The differences between the three years are not comparable, since 93.6 million pounds of fruit were harvested in 1987, compared to only 65.6 million pounds in 1990. Also, we employed an improved statistical method for estimating worker productivity with the 1990 data (see Appendix C). Nevertheless, the differences among local, U.S. migrant and

alien migrant pickers, adjusted for acres harvested in 1990, are noteworthy.

Table 3. Productivity values for types of strawberry workers

Type of worker	Average number of pounds of strawberries harvested per worker during the 1990 season
Local workers between 12 and 16 years old.	1,020
Local workers over 16 years old .	1,679
U. S. migrant farm workers. . . .	1,947
Alien migrant farm workers. . . .	3,003

On average, a picker under 16 years of age harvested 1,020 pounds of fruit, while alien migrants harvested nearly three times that amount. Alien migrants also picked twice as much fruit as local adults and a third more than domestic migrants. Although alien migrants made up 68 percent of the work force, they picked about 79 percent of the crop in 1990.

The comparative advantage for type of worker on productivity can be assessed by looking at the ratio of pounds harvested for different pairs of worker types. For instance, if one wishes to find the relative advantage of hiring alien migrants, compared to other types of workers, one would divide the productivity value of each type of

migrants. The ratios show the relative advantage of alien migrants over other types of workers. If we wanted to compare the advantage of U. S. migrants to other types of workers, we would divide the values for other workers into that for U. S. migrants, and so on. The comparative advantage for each combination of farm workers is shown in Table 4.

Table 4. Productivity ratios (x 100) for types of strawberry workers (read down)

Type of worker hired	Type of worker replaced			
	Local teenagers	Local adults	U.S. migrants	Alien migrants
Local teenagers	100	165	191	294
Local adults	61	100	116	179
U.S. migrants	52	86	100	154
Alien migrants	34	56	65	100

Reading down the right-hand column of the table allows one to estimate the number of workers required to replace alien migrants. For example, 294 teenagers, 179 local adults or 154 U. S. migrants would be needed to replace 100 aliens. One also could estimate how many other types of workers are needed to replace 100 teenagers by looking down the first column of figures in Table 4. It would take 61 local adults, 52 U. S. migrants, or 34 aliens to do the strawberry picking of 100 local teenagers. Other

comparisons are possible simply by reading down the appropriate column in the table.

Reason for decline in the percent of domestic workers.

The general decline in the number of workers between 1987 and 1990 stems from fewer acres and therefore fewer berries to harvest. Reduced acres do not explain the shift in the percent of alien migrants hired between the two years. One possibility for the difference is an adequate supply of alien migrants plus the effect of an increased minimum wage on recruitment of alien pickers. Alien migrants have superior picking skills and are more likely to make minimum wage on a piece-work basis than domestic farm workers. The productivity differences are marked and growers are well aware of the advantage of hiring alien migrants to harvest their berries.

The availability of farm workers (who can also make minimum wage) remains uppermost in the minds of growers in all our surveys. For instance, when asked to list their major concern for the 1991 harvest, 61 percent of the sample responded in some way that worker availability was their major worry. (Twenty-three percent mention effect of the minimum wage law, 19 percent government regulation, 13 percent paperwork and reporting requirements, 7 percent weather and pests, 5 percent market price, 3 percent housing, and 2 percent organized labor.) The new minimum wage law gave growers an incentive to hire the most proficient pickers. They may have responded by hiring more

alien than domestic labor for their harvest work force. If our reasoning is correct, we can expect an even greater demand for aliens in 1991 when the minimum wage rises to \$4.75 an hour.

Even so, about 7 percent of the workers hired could not make minimum wage on a piece-rate basis and 3 percent were terminated for that reason.

Recruitment of workers.

Little has been reported about the methods growers employ to recruit farm workers. Conventional wisdom suggests that fear of labor shortages, IRCA reporting and enforcement requirements and new minimum wage levels will lead growers to rely more on labor contractors than on more traditional recruitment methods to supply qualified labor.

The data show that labor contractors do supply large numbers of local workers; 88 percent of our sample said they had used labor contractors for that purpose. Two-thirds employed a contractor to supply alien migrant pickers.

The data also indicate that growers rely on several recruitment methods. For example, nearly all growers (99 percent) said they received out-of-state phone solicitations in which offers to supply workers were made. Ninety-five percent said they had kept in touch with workers who had picked for them previously and updated them about crop status, working conditions and housing for the 1990 crop. (Fifty-four percent hire workers who return year after year.) Local newspaper want-ads were employed during the

picking season by 95 percent of the sample. Ninety-four percent said they sought workers through state employment offices. Employees for 58 percent of the growers recruited workers for their employer. And, 53 percent of the growers said they also hired walk-ons. These percents apply to alien migrants. The percents do not vary much for local workers or U. S. migrants. No single recruitment method was singled out. Rather, many methods were employed and most were used heavily.

However, labor shortages occurred for both the 1989 and 1990 picking season. An estimated \$1,804,506 was lost because growers could not find enough pickers to harvest all their fruit. Workers either had left to harvest other fields or had shifted to other crops where picking was more favorable to them.

Cost of I-9 verification.

Growers completed an estimated 50,993 I-9 forms for the 1990 season. A total of 47,443 were approved and 3,550 were rejected.

The survey indicates it takes an average of about ten minutes to complete and verify one I-9 form, with a range of three to thirty minutes per form. Growers or family members supervised 58 percent of the I-9 forms completed, and hired employees were involved in verifying 28 percent of I-9 forms completed. The remaining 14 percent of completed I-9 forms were verified by a combination of growers and hired employees. The average wage rate paid to hired employees

that verified I-9 forms was \$6.71 per hour. Valuing all individuals who supervise I-9 form completion at the average hired wage rate of \$6.71 per hour results in an estimated cost per form of \$1.17. The total cost for growers is estimated at \$59,662.

Strawberry growers also raise other labor-intensive crops, such as hops, caneberries, blueberries and cucumbers. We asked growers to provide information about "...this year's pickers" and have no way of separating reporting costs for strawberries from other commodities that may have been included in their response. Nevertheless, the \$1.17 per I-9 cost and the total estimate for strawberry growers, regardless of other crops they may raise, is useful for planning purposes.

Other payroll overhead costs.

Several other payroll overhead costs are paid by growers. These include workers' compensation insurance employment taxes, social security taxes, and other general payroll expenses.

Workers' compensation insurance. Virtually all Oregon employers are subject to workers' compensation laws. Workers' compensation insurance includes three costs for growers: an insurance premium, which can range from 2 percent to 4 percent of payroll in the strawberry hand-harvest job classification; a tax of 5.5 percent of premiums; and an assessments of \$0.28/worker/day, of which \$0.14 must be paid by the employer (some employers also pay

the employee's share of the assessment of \$0.14/day). Premiums are based on safety records in the industry and adjusted for individual employers' experiences.

Employment taxes. Oregon employment taxes must be paid by employers with cash wages of \$20,000 or more in a calendar quarter, or by employers who have 10 or more employees in each of 20 weeks during a calendar year. In 1990, tax rates are typically 3.3 percent, and range from 1.8 percent to 5.4 percent. The tax is paid on the first \$16,000 of each employee's wages in 1990.

Employers subject to Oregon Employment taxes must also pay Federal Unemployment Taxes (FUTA). In 1990, the Federal tax rate is 6.2 percent, but a credit of 5.4 percent is available to Oregon employers. Thus, FUTA cost 0.8 percent of taxable wages (the first \$7,000 of wages for each employee). However, farm worker aliens legally admitted to the United States to do farm work are exempt from FUTA taxes through 1992.

Social Security tax. Agricultural employers who paid an employee \$150 or more in cash wages during 1990, or paid total cash wages of \$2,500 or more during the year, are subject to social security taxes. The employer tax rate is 7.65 percent of wages, up to a maximum of \$50,400 per employee. Employees must also pay (through withholdings) an equal 7.65 percent tax. Hand-harvest workers meeting a fairly restrictive set of criteria are exempt from social security taxes.

Other general payroll expenses. As farm employers have been forced to comply with additional payroll taxes and immigration reforms, additional payroll administration expenses have incurred. All employers who hire authorized aliens as part of their work force must file form ESA-92, Work-Day Report, on a quarterly basis. I-9 completion and verification costs were discussed above. Withholding taxes, both federal and state, must be estimated reported, and paid according to taxing agency guidelines. W-2 and W-4 forms are completed and filed annually, and general record keeping requirements are increasingly demanding.

Based on the taxes and overhead costs discussed above, a typical total payroll cost is estimated in Table 5. This table assumes that employees are performing hand-harvest services, and worker's compensation premiums are based on strawberry harvest job classification premiums. Workers are assumed to earn base pay of \$5.50 per hour during 10 days of employment, and workdays average seven hours per day. Payroll administration costs are estimated at 5 percent of the total payroll, and this includes costs for I-9's, W-4 and W-2 forms, calculating and writing paychecks, and maintaining required records.

Table 5. Estimated payroll overhead costs for hand-harvest strawberry workers.¹

Item	Hourly Cost	Percent
Base pay	\$5.50	100.00
Workers' compensation insurance ²		
Premium	0.17	3.000
Tax	0.01	0.002
Assessment	0.04	0.727
Employment tax		
State	0.18	3.300
Federal	0.04	0.800
Social Security tax	0.42	7.650
Payroll administration	0.28	5.000
Total cost	\$6.64	120.479

¹ Assumes employment of seven hours per day for ten days, with the employer subject to state and federal employment taxes.

² Rates for strawberry hand-harvest job classifications are much lower than general strawberry farm job classification rates. Premium rates for general strawberry farm job classifications range from 10 to 20 percent of payroll.

The total hourly wage cost is estimated at \$6.64 per hour, or 120.5 percent of base pay. Thus, payroll overhead in this example amounts to slightly over 20 percent of the base payroll. Employers paying worker's compensation premiums above 3 percent incur larger overhead costs.

Planting and harvesting intentions for 1991.

Growers report they will plant 1,853 acres of strawberries the spring of 1991, about a third of the 1990 crop. They also indicate they plan to harvest about 5,700 acres in 1991 about 100 more acres than in 1990.

Summary

This third survey of labor demand and productivity sought to estimate farm labor needs of Oregon strawberry growers for 1990 and to compare the differences in labor demand for between 1987 and 1990. Through a mail survey of known growers in the state, questions were asked concerning the number of 1990 acres in production, total pounds of berries harvested and left unharvested, estimated number of picker-days required to harvest the crop, the age and type of worker employed, methods for recruiting farm workers, I-9 reporting and verification costs, and the number of workers who could not make minimum wage picking at piece-rate wages.

The results show that acreage dropped about a third between 1987 and 1990 (from 7,830 to 5,600). The number of workers hired to pick berries dropped about 28 percent (from 39,119 in 1987 to 28,186 in 1990). Productivity per worker remained about the same over the intervening three years. However, 1990 production required a shift in the type of worker employed to maintain 1987 levels. The typical work force in 1990 had 29 percent fewer domestic workers and a

commensurate increase in the proportion of migrants, compared to the 1987 work force. Aliens made up 68 percent of the harvest work force in 1990 and picked about 79 percent of the crop.

Productivity differences between domestic and alien workers continued to favor aliens for the 1990 harvest, with that group picking three times as many berries, worker for worker, than local teenagers, twice as many as local adults and a third more than domestic migrants. Implementation of a new minimum wage in 1990 (from \$3.35 to \$4.25 per hour) may explain the shift to alien migrants. Growers continue to worry about the availability of pickers who can make minimum wage on a piece-work basis. This incentive, plus an adequate supply of alien migrants, may account for the dramatic shift in the type of workers employed.

Growers employed a variety of recruitment methods for attracting farm workers. No single approach seemed to be favored. Labor contractors were used, but not to the extent of personal contact with former workers, contact with state employment offices, use of newspaper want-ads. No particular recruitment method was singled out. Rather, many methods were employed and they were used heavily.

Finally, 1990 is the second year that growers were required to complete employment verification I-9 forms for all newly-hired workers. Growers completed an estimated 50,993 I-9 forms. A total of 47,443 were approved and 3,550 were rejected. Each I-9 cost an average of \$1.17 to

complete and verify. The total cost to growers is estimated at \$59,662.

Assuming workers earn a base pay of \$5.50 per hour during ten days of employment and workdays average seven hours per day, payroll overhead costs are estimated at 20.5 percent of the total payroll. This estimate includes costs for worker compensation, insurance, payroll taxes, and payroll administration. The total hourly wage cost is estimated at \$6.64, or 120.5 percent of base pay.

APPENDIX A: DESCRIPTIVE STATISTICS FOR 1990 SURVEY OF STRAWBERRY GROWERS

1. Did you harvest any strawberries for commercial processing in 1990? (Circle one number)

(N) PERCENT

(0) 0 NO (PLEASE SKIP NOW TO QUESTION 21)
(142) 100 YES

2. How many acres of strawberries did you raise in 1990?

(N = 142) MEAN = 25.04; MIN = 1; MAX = 200; SUM = 3,556

3. How many pounds of strawberries did you harvest in 1990?

(N = 138) MEAN = 299,465; MIN = 2,000; MAX = 3,602,000;
SUM = 41,326,617

4. And, how many pounds of strawberries would you estimate were left in the field unharvested?

(N = 135) MEAN = 20,988; MIN = 0; MAX = 500,000; SUM = 2,833,380

5. What was the average number of pickers in the field per harvest day? Just your best estimate please.

(N = 142) MEAN = 71.96; MIN = 2; MAX = 60; SUM = 10,218

6. And, how many days, altogether, did it take to harvest your crop?

(N = 135) MEAN = 16.76; MIN = 1; MAX = 60;

7. Considering all your pickers, about what percent would you estimate worked for each of the time periods listed below during your harvest season? (If none, please write "0")

	<u>PERCENT</u>	<u>(N)</u>
a. Those who worked three days or less . . .	28.16	(135)
b. Those who worked four days to one week. .	22.85	(135)
c. Those who worked from one to two weeks. .	16.69	(135)
d. Those who worked over two weeks	32.30	(135)

8. Compared to this year, would you rate the supply of strawberry pickers as higher, lower, or about the same as that for the 1989 harvest? (Circle one number)

(N) PERCENT

(32) 23 HIGHER
(31) 22 LOWER
(78) 55 ABOUT THE SAME

9. About what percent of your workers were from each of the following groups? (Fill in your best estimate for each category. (If "none", please write "0".)

	<u>PERCENT</u>	<u>(N)</u>
a. Local workers between ages 12 to 16.	8.15	(139)
b. Local workers over 16 years of age	12.52	(139)
c. U.S. migrant farm workers	28.81	(138)
d. Alien migrants	50.52	(138)

10. How certain are you of the estimates you have given concerning the percent of workers you estimated for the four groups in Question 9 -- very certain, somewhat certain, not too certain or not at all certain? (Circle one number)

(N) PERCENT

(57)	40	VERY CERTAIN
(74)	52	SOMEWHAT CERTAIN
(9)	9	NOT TOO CERTAIN
(0)	0	NOT AT ALL CERTAIN
(2)	1	UNABLE TO RATE

11. Please indicate if you used each of the following sources of information for the estimates you made for the percent of workers in Question 9. (Circle one number for each)

	<u>YES,</u> <u>USED</u> %	<u>NOT</u> <u>USED</u> %	<u>(N)</u>
a. Farm records	44	56	(142)
b. Consultation or discussion with others (contractors, foremen, family)	61	39	(142)
c. Your own memory	25	75	(142)

12. Looking again at these sources, which was your main source of information for the estimates you made for the percent of workers in Question 9 -- was it from farm records, consultation, or your own memory? (Circle only one number)

(N) PERCENT

(56)	40	FARM RECORDS
(24)	17	DISCUSSION WITH OTHERS
(59)	42	MY OWN MEMORY

13. How would you compare the overall quality of the strawberry pickers you hired this year to those who picked your 1989 crop -- were they more productive, less productive, or about the same? (Circle one number)

(N) PERCENT

(23)	16	MORE PRODUCTIVE
(23)	16	LESS PRODUCTIVE
(94)	67	ABOUT THE SAME

14. Please tell us whether or not you used each of the following methods to hire local workers, to hire U.S. migrants, and to hire alien migrants for your 1990 crop. (Please answer for each method by circling one number under each worker group)

<u>Method</u>	Local Workers		U.S. Migrants		Alien Migrants	
	<u>% YES</u>	<u>(N)</u>	<u>% YES</u>	<u>(N)</u>	<u>%YES</u>	<u>(N)</u>
a. Walk-on's (no recruitment) . . .	47	(141)	53	(133)	53	(138)
b. Labor contractor	88	(139)	67	(137)	66	(139)
c. Word of mouth by employees . . .	57	(131)	60	(131)	58	(134)
d. State employment office.	93	(141)	91	(137)	94	(138)
e. Workers who return year after year	53	(149)	57	(137)	54	(137)
f. Out-of-state phone solicitations that offer to supply workers .	100	(140)	99	(138)	99	(139)
g. Newspaper want-ads	84	(141)	96	(136)	95	(135)
h. Other (Specify _____)	95	(141)	98	(137)	98	(138)

15. Earlier this year, before the harvest, did you receive mail or phone calls from workers who had picked for you asking about crop status, working conditions, or housing for this year's harvest? (Circle one number)

(N) PERCENT

(135) 95 YES
(3) 5 NO

16. One of the costs of harvesting strawberries is complying with the reporting requirements of the 1986 Immigration Reform and Control Act (IRCA). About how many I-9 forms were completed and approved for this year's pickers, and how many were completed and rejected?

	<u>MEAN</u>	<u>(N)</u>
a. I-9 forms completed and approved . . .	192.14	(113)
b. I-9 forms completed and rejected . . .	16.64	(98)

17. From your experience, about how many minutes does it take to complete and verify one I-9 form?

(N = 114) MEAN = 10.48; MIN = 3; MAX = 30; SUM = 1,194

18. Who usually supervised the completion of an employee's I-9 form, was it you, a family member or a hired employee? (Circle one number)

(N) PERCENT

(69) 58 YOU OR A FAMILY MEMBER
 (33) 28 HIRED EMPLOYEE
 (17) 14 BOTH

- 18a. What is the hourly wage rate of this hired employee? Do not include benefits or payroll costs.

(N = 120) MEAN = \$6.71; MIN = \$4.25; MAX = \$15;

19. Did you pay your pickers an hourly wage or by piece-rate?

(N) PERCENT

(3) 2 HOURLY WAGE
 (131) 94 PIECE-RATE
 (6) 4 BOTH

- 19a. What percentage of your workers, if any, could not make minimum wage on a piece-work basis?

(N = 122) MEAN = 6.75; MIN = 0; MAX = 11.31;

- 19b. How many workers, if any, were terminated because they could not earn enough to make minimum wage?

(N = 121) MEAN = 3.02; MIN = 0; MAX = 96;

20. Did you lose any portion of a strawberry crop due to a lack of documented labor in 1989 or 1990? (Circle one number)

(N) PERCENT

(98) 71 NO
 (41) 29 YES

- 20a. How many acres of strawberries did you lose?

(N = 36) MEAN = 6.09; MIN = 0; MAX = 100;
 SUM = 219

- 20b. And, what is your estimate of the value of the strawberries you lost?

(N = 38) MEAN = \$21,752; MIN = \$2,000;
 MAX = \$235,000; SUM = \$826,576

21. How many acres of strawberries, if any, are you planting in the spring of 1991?

(N = 140) MEAN = 7.97; MIN = 0; MAX = 65; SUM = 1,156

22. And, about how many acres of strawberries, if any, do you intend to harvest in the 1991 season?

(N = 142) MEAN = 25.19; MIN = 0; MAX = 315; SUM = 3,577

23. Finally, what is your major concern for the 1991 harvest?

<u>Topic</u>	<u>%</u>
Worker availability	61
Minimum wage law	23
Government regulation ..	19
Paper work	13
Weather, pests	7
Market price	5
Housing	3
Organized labor	2
Total	<u>133</u>
(N)	(108)

APPENDIX B. SUMMARY OF COMPLETION RATES

Names and addresses of all known commercial strawberry growers in the state were provided by the Oregon Strawberry Commission. A total of 419 names were available for contact. An eligible respondent was defined as a grower who had harvested at least one acre of strawberries for processing in 1990. Three waves of mail questionnaires and one telephone contact were made.

Results of the contacts were:

Returned	142
No berries raised in 1990. . . .	86
No commercial berries raised in 1991	28
Never raised berries	9
Undeliverable	6
Duplicates	6
Quit farming	3
Refused	3
Not returned	<u>136</u>
Total	419

An adjusted completion rate of 51 percent was achieved, after non-growers and other ineligibles were subtracted from the base.

A random subsample of 35 names and addresses was drawn from the group that had not responded. A telephone interview was completed to determine if they met our definition of an eligible grower. A total of 21 were eligible growers, 60 percent of the subsample. An adjusted completion rate, based on the results of the telephone interviews, increased our completion rate to 63 percent. This is nearly the same as the 65 percent achieved with the 1987 survey.

APPENDIX C. ESTIMATION OF THE SIZE AND PRODUCTIVITY OF THE WORK FORCE

Direct measures of the size and productivity of the work force was not possible from the data available. Methods used for estimation of these measures are described in the following sections.

Size of the work force

First, the number of workers for each farm is estimated as the ratio of the number of worker days required to harvest the crop (product of Questions 5 and 6) divided by the average number of working days per worker. The average number of working days per worker is calculated as the sum of products of the midpoints¹ of intervals for picking days and the corresponding proportion of workers in each interval (Questions 7a–7d). Next, the number of workers is multiplied by the worker–type proportions (Questions 9a–9d). The resulting number of workers of each type (locals 12–16 years old, etc.) are summed over the farms in the sample. Finally, these sample totals are adjusted to the population level by multiplying them by the ratio of the population and sample acres of strawberries harvested ($5,700/2,904.8 = 1.96$). The resulting work force estimates are presented in Table 1, page 3.

Productivity of the work force

The estimated average productivity of all workers on a farm is found by dividing the pounds harvested (Question 3) by the estimated number of workers on the farm. Such direct productivity estimates cannot be found by type of worker since pounds harvested are not segregated by worker type. In order to estimate productivity by type of worker, only those growers ($n=110$) who reported that more than 50 percent of their crop was harvested by one type of worker (locals 12–16 years old, locals over age 16, U.S. migrants, or alien migrants) were used. This stratified subsample represented 84 percent of the sample growers ($n=131$) whose responses were used in the analyses, 87 percent of the sample work force, and 92 percent of the sample acres harvested. Appendix Table C1 gives the distribution of worker types within the worker-type strata. Workers representing the "pure" type of their respective stratum were well above the 50 percent cutoff, with values ranging from 66 percent for the local age 12-16 stratum to 88 percent for the U.S. migrant stratum.

^{1/} Midpoints employed were: for Q7a, 2; for 7b, 5.5; for 7c, 10.5; and for 7d, $((Q6-15)/2) + 15$

Direct productive estimates for those farms that employed more than one type of worker would treat all worker types on the farm equally productive. Regression analyses were used to adjust the direct estimates for those farms that employed more than one type of worker. We found that two variables indicative of picking conditions: Y=crop yield measured as pounds harvested per acre, and D= density of pickers measured as pickers per acre were found to have statistically significant (p-value<0.0001) regression coefficients in the regression equation

$$\log(P) = a_1 + b_1 Y + b_2 D + e ,$$

where P denotes the productivity of all workers on a farm, $\log(P)$ a logarithmic transformation of P, a_1 the stratum – dependent intercepts, $b_1 (>0)$ and $b_2 (<0)$ the regression of coefficients of Y and D respectively, and e is the residual term. This regression equation produced the coefficient of variation of 81 % ($R^2 = .81$) for the stratified subsample of 110 farms. Let \hat{P}_i denote regression prediction of productivity for type- i workers on a farm with predictor values Y and D, and P the direct productivity of all workers on the farm. The productivity of type –i workers on a farm in stratum i is calculated as the ratio estimator

$$P_i = P \left(\frac{\hat{P}_i}{\sum_{j=1}^4 \hat{P}_j (N_j/N)} \right) ,$$

where the productivity estimate for all workers on the farm (P) is adjusted by the factor formed from the predicted productivity for type –i workers divided by the predicted productivity of all workers on the farm. Here, N_i denotes the number of type –i workers on the farm and N the total workers of all types. Note that no adjustment results ($P_i = P$) for pure worker-type farms ($N_i = N$). These worker-type specific estimates, P_i , were averaged over the farms within the corresponding worker-type stratum to give the productivity values reported in Table 3. These worker –type specific productivity estimates deviated from the corresponding direct productivity estimates for all combined worker types by less than 3.3 percent in each of the strata.

APPENDIX TABLE C1. Distribution of worker – type in each of the sample strata

Type of worker in sample	Workers selected by group			
	50% > Locals 12-16 years old	50% > Locals over 16 years	50% > U.S. migrant	50% > Alien migrants
	%	%	%	%
Locals 12 – 16 years old	66	21	2	1
Locals over 16 years	11	66	4	3
U.S. migrants	12	3	89	12
Alien migrants	11	10	5	84
Total	100	100	100	100
(Number of workers)	(860)	(446)	(1,817)	(11,241)
(Number of growers reporting)	(6)	(10)	(25)	(69)