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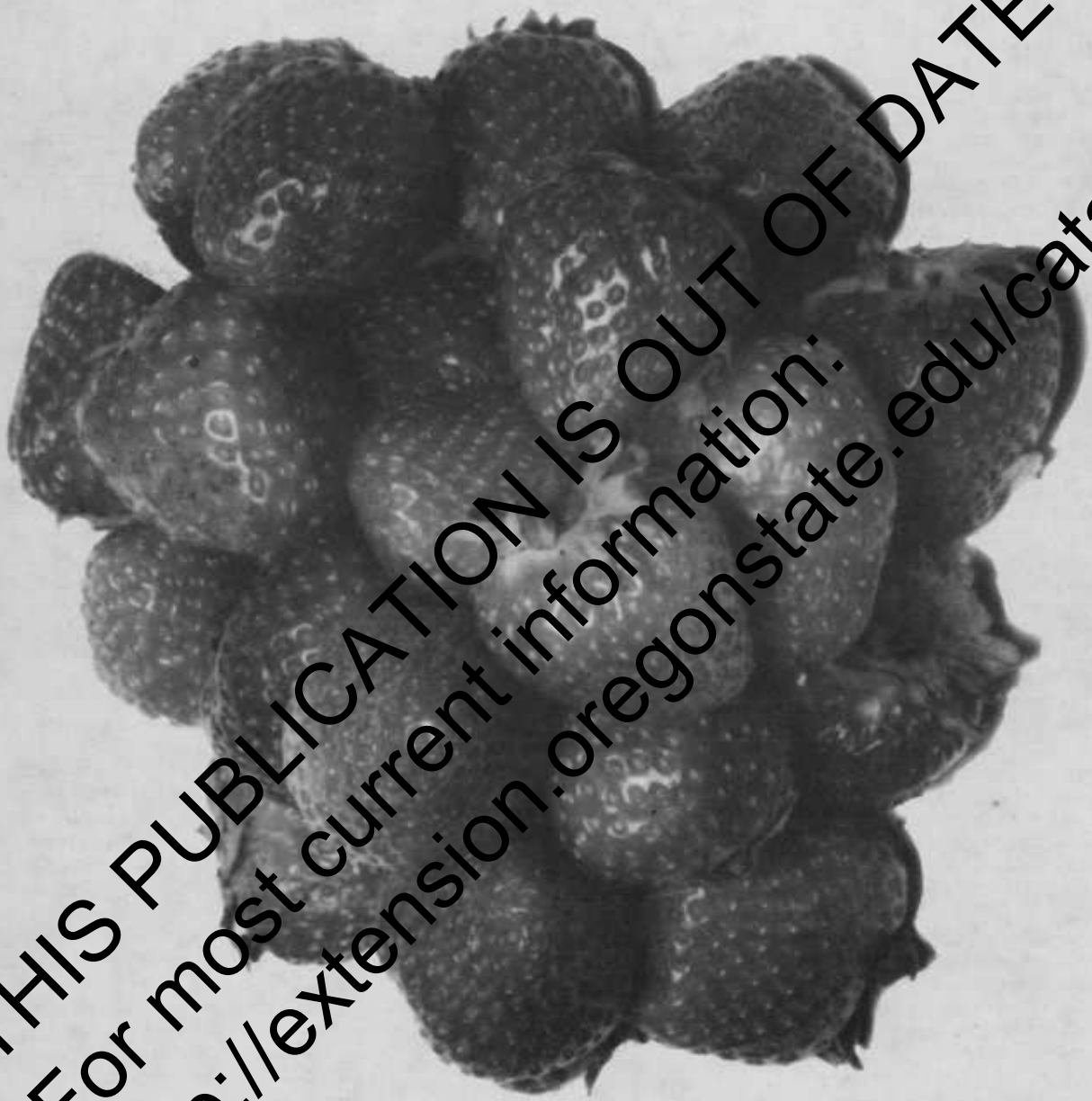
Strawberry Production, Returns, and Costs in Oregon and Washington



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OREGON STATE UNIVERSITY EXTENSION SERVICE

Summary and Conclusions

Despite declining Oregon and Washington strawberry acreage and production through most of the 33-year period, 1950-1982, the value of production to growers mostly increased during that period. Value of production increased again in 1983 to a record $38.5 million. Helping to offset acreage declines in Oregon was a steady yield increase per acre.

In the 1950's, the yield averaged just over 4,000 lb an acre. By the early 1980's, that figure had increased to about 9,400 lb annually. In 1983, Oregon's yield was a record 11,500 lb an acre.

Contributing to increasing value of production over the period were generally rising prices in the two states. After declining slightly in the late 1950's and early 1960's, grower prices for strawberries generally followed an upward trend that accelerated in the last decade of the period. A large percentage of the crop was processed during the 1950-1982 period.

We gathered cost of production information for both Oregon and Washington and updated it to 1982 price levels. We estimated the break-even prices needed to cover all costs (including establishment amortization) to be 35¢ a pound for Oregon and 41¢ a pound for Washington. We assumed that a sizable portion of the Washington crop had been harvested for the fresh market and thus at a higher harvesting cost.

To offset possible harvest labor shortages, mechanical strawberry harvesters have been developed for processing berries. In study results, net savings from using a mechanical harvester (over hand harvesting) were shown to be as high as $585 an acre. The only drawback was the lack of a strawberry variety that would satisfactorily withstand the rigors of machine harvest. Provided that a suitable variety is developed, the mechanical harvester could be a viable harvesting alternative in the future compared to hand harvesting.

Table 1.—*U.S. strawberry acreage harvested, yield, production, and processed percentage, by growing area, 1981*

Growing area	Acreage harvested (acres)	Yield (lb/acre)	Production (× 1,000 lb)	Processed production (percent)
California	10,900	49,500	539,550	27
Oregon	5,500	9,300	51,150	90
Florida	3,200	21,000	67,200	[a]
Washington	2,800	6,000	16,800	80
Michigan	2,700	6,500	17,550	30
U. S. Total	36,600	20,200	739,320	28

[a] Negligible amount processed.

Source: OSU Extension Economic Information Office.

Introduction

The value of Oregon and Washington strawberry production has been growing rapidly in the past few years. In contrast, strawberry acreage and total production have declined steadily since the 1960's. In 1982, the value at farm level of strawberries produced in the two states was over $33.5 million. In 1983 it reached a record $38.5 million.

Our strawberries are considered a high quality berry, but because of the relatively short harvest season, the majority of harvested berries go to processed markets (table 1). In 1981, over 90% of Oregon's crop went to processing while about 80% of Washington's crop was processed.

California is a major strawberry producer, with more acreage in 1981 than Oregon and Washington combined. Only 27% of California's strawberry crop was processed in 1981. Virtually all of Florida's crop is shipped fresh.

Oregon and Washington strawberries are grown predominantly west of the Cascade Mountain Range. The Willamette Valley is the major production area in Oregon. Strawberry production in Washington is in the inland area bordered by the Cascades on the east.

Most commercial strawberry producers have a diversified farm; approximately 10 to 15 acres are used for strawberry production. Raspberries, blackberries, tree fruits, and/or vegetables are other crops that are typically grown.

Purpose of the study and procedures

For a number of years, public policymakers in Oregon and Washington have tried to deal with a wide range of rural community development concerns such as maintaining adequate agricultural productivity, improving environmental quality, and understanding the role of the agricultural economy in the two states.

The study reported here is part of a broad project to enhance such understanding. It deals with a single commodity sector of agriculture—horticultural production. The strawberry crop information assembled in this report together with that gathered by other researchers on other important crop and livestock sectors should provide a valuable agricultural data base to help policymakers establish sound recommendations on important rural development questions.

The specific focus of this research was to determine the trends of the strawberry crop, a segment of horticultural production that continues to be important to many growers, processors, and consumers—even nationally.

Specific objectives of this study were to:

1. Assemble and analyze data on acres, production, and value of Oregon and Washington strawberries.
2. Assemble and analyze strawberry cost of production data.
3. Assemble and analyze data on mechanical vs. hand harvest of strawberries in the two states.

Strawberries are the only berry crop discussed in this report. An earlier report was done on the "other" berry crops.* We collected all available data on acreage production, value, and costs from various sources. We summarized these data for Oregon, Washington, and two states combined. The assembled data cover a 33-year period, 1950-1982. The information included acreage harvested, annual production, and value of production.

We updated the estimated production cost budgets for Oregon to 1982 values by using indexes, including variable and ownership costs. The base yields we assumed for these budgets were those considered typical of well-managed commercial farms. Be cautious when you use these budgets—they are based on cost studies for specific areas.

Berry crop use

Processed strawberries are used for juice stock, puree, individual quick freeze, and frozen sliced strawberries. They are also used in ice cream, jams and jellies, juices, flavorings, dessert toppings, and yogurt.

In 1982, approximately 67 million pounds of the strawberries produced in the two states were processed (table 2). That amounted to about 87% of all strawberry production. There was a general downward trend in both total production and the amount of production going to the processed market, starting in the early 1970's.

Processed production gradually increased during the 1950's and early 1960's. In 1964, a record 136.5 million pounds was produced. By the early 1970's, processed production was declining. In the last few years of the period, only about 86% of the crop was being processed each year.

Total production followed a pattern similar to processed production. In the 1950's and early 1960's, total production increased slightly. Total production reached a record level in 1964 when 141 million pounds of strawberries were produced. A record 97% of the crop was processed in that year. In the early 1970's, total production began to decline. In the early 1980's, the level of production was steady.

The percent of total production going to processed markets increased very slightly in the 1950's and early 1960's. In the early 1970's, the percentage of the production that was processed started to decline slightly. In the early 1980's, the percentage of the crop being processed was steady.

*Burt, L. A., M. E. Wirth, and L. S. Burt, *Production, Value and Cost Trends of Selected Pacifc Northwest Berry Crops,* Washington State University, College of Agriculture Research center, Buletin 0899 (Pullman, 1981).

Table 2.—*Oregon and Washington strawberry production, processed and total, percent processed, 1950-82*

Year	Processed production (× 1,000 lb)	Total production (× 1,000 lb)	Percent processed
1950	60,246	66,452	91
1951	46,750	52,830	88
1952	82,073	89,346	92
1953	98,330	105,915	93
1954	94,602	102,733	92
1955	115,300	122,745	94
1956	76,500	80,353	95
1957	124,300	134,000	93
1958	102,600	109,140	94
1959	126,900	135,120	94
1960	112,200	117,300	96
1961	108,200	114,500	94
1962	125,400	132,800	94
1963	106,200	111,200	96
1964	136,500	141,000	97
1965	84,500	88,000	96
1966	126,900	134,900	94
1967	120,400	126,940	95
1968	102,800	109,000	94
1969	89,400	95,700	93
1970	95,100	100,400	94
1971	102,900	108,700	94
1972	72,400	79,200	91
1973	64,500	70,400	92
1974	57,800	64,200	90
1975	58,600	64,900	90
1976	63,400	72,900	87
1977	48,100	55,100	87
1978	44,400	51,500	86
1979	52,100	59,000	88
1980	54,800	63,700	86
1981	57,900	68,000	85
1982	66,900	76,600	87

Sources: OSU Extension Economic Information office; U. S. Department of Agriculture, *Agricultural Statistics*, selected years; Washington Department of Agriculture, *Berry Crops*, selected years.

Acreage, production, and value trends

Acreage trends

Acreage devoted to strawberries generally declined between 1950 and 1982. Acreage harvested in Oregon reached its highest point in 1957, when 18,500 acres were harvested (table 3). The most rapid rate of decline occurred in the late 1960's and early 1970's. Oregon experienced the largest rate of decline during that period.

Table 3.—*Strawberry acreage harvested in Oregon and Washington, 1950-82*

Year	Oregon (acres)	Washington (acres)	Total (acres)
1950	14,000	7,200	21,200
1951	14,500	8,000	22,500
1952	15,300	8,300	23,600
1953	15,500	8,500	24,000
1954	15,200	8,500	23,700
1955	17,500	8,500	26,000
1956	16,800	3,500	20,300
1957	18,300	8,000	26,300
1958	15,600	7,500	23,100
1959	15,600	7,000	22,600
1960	14,500	6,900	21,400
1961	13,000	6,800	19,800
1962	14,000	7,300	21,300
1963	14,000	7,100	21,100
1964	13,900	6,200	20,100
1965	11,500	4,700	16,200
1966	12,500	5,600	18,100
1967	13,200	5,600	18,800
1968	12,000	5,300	17,300
1969	12,000	4,500	16,500
1970	11,000	4,100	15,100
1971	10,000	4,100	14,100
1972	8,200	3,800	12,000
1973	7,400	3,600	11,000
1974	6,700	3,600	10,300
1975	5,800	3,400	9,200
1976	5,200	3,000	8,200
1977	5,300	3,300	8,600
1978	5,000	3,300	8,300
1979	5,200	3,100	8,300
1980	5,200	2,900	8,100
1981	5,500	2,800	8,300
1982	5,800	3,000	8,800

Source: OSU Extension Economic Information Office.

Table 4.—*Strawberry yield per acre in Oregon and Washington, 1950-82*

Year	Oregon yield (lb/acre)	Washington yield (lb/acre)	Total yield (lb/acre)
1950	3,070	3,260	3,134
1951	2,220	2,580	2,348
1952	3,610	4,110	3,786
1953	4,020	5,130	4,413
1954	3,890	5,130	4,335
1955	4,770	4,620	4,721
1956	4,210	2,750	3,958
1957	5,000	5,300	5,091
1958	4,400	5,400	4,725
1959	5,700	6,600	5,979
1960	5,000	6,500	5,484
1961	5,200	6,900	5,784
1962	6,100	6,500	6,237
1963	5,000	5,900	5,303
1964	7,200	6,600	7,015
1965	5,200	6,000	5,432
1966	7,700	6,400	7,298
1967	6,900	6,400	6,751
1968	5,900	7,200	6,298
1969	5,800	5,800	5,800
1970	6,500	7,300	6,717
1971	8,300	6,500	7,777
1972	6,700	6,390	6,602
1973	6,600	6,000	6,404
1974	6,200	6,300	6,235
1975	7,200	6,290	7,048
1976	9,190	7,700	8,645
1977	6,600	6,090	6,404
1978	6,800	5,300	6,204
1979	8,200	5,300	7,417
1980	8,900	6,000	7,862
1981	9,300	6,000	8,187
1982	10,000	6,200	8,705

Source: OSU Extension Economic Information Office.

(about 6% annually). Washington declined at a rate of about 5% annually.

The rates of decline diminished in the late 1970's and early 1980's. Oregon's growers harvested 6,900 acres in 1983, the largest number in 10 years. Washington harvested 3,100 acres in 1983, the highest in 4 years.

Although acres harvested declined, yields per acre increased over this period (table 4). Oregon experienced the most rapid increase; since 1975, the yield per acre has increased at an average annual rate of more than 4%.

In 1982, Oregon reached a record high per acre yield for the period, 10,000 lb. Another record was set in 1983 when Oregon experienced a yield of 11,500 lb an acre.

Washington experienced a rapid increase in yield per acre during the 1950's and early 1960's. This increase was at a rate of about 4% annually. In the late 1960's and early 1970's, the yield per acre in Washington began to decline slightly.

The decline was slightly higher in the late 1970's and early 1980's. Washington's yield, despite the downward trend, had a record of 7,700 lb per acre in 1976.

In the two states combined, the yield per acre was increasing over this period because of Oregon's influence. In the 1950's and early 1960's, the average yield per acre increased at an average rate of about 4% annually. In the early 1970's, the average rate of increase slowed, primarily because of a slight decline in Washington's yield.

Late in the period, the average growth rate increased somewhat. In 1982, the two states reached the highest average yield per acre during the 33-year period, about 8,700 lb an acre.

Production trends

Production of strawberries was variable during the 1950-1982 period. Total production in Oregon increased from 1950 to 1964 at an average annual rate of about 2% (table 5). In 1964, over 100 million pounds of strawberries were produced—the most ever produced in Oregon during the period.

Starting in 1965 to about the mid-1970's, the growth rate declined; total production dropped at an average rate of about 4% a year. In the latter part of the period, production was steady. Because of the higher acreage yield, Oregon's production in 1983 was 79.4 million lb, the highest in 16 years.

As the amount of total production in Oregon increased or decreased, so did the amount of production that went to processed markets. This percentage remained fairly constant from 1950 to the early 1970's. Following that time, the percentage production that was processed began to decrease slightly. In the last few years of the period, the average rate of decline slowed, and the percentage that was processed remained fairly constant (about 91%).

Total production of strawberries in Washington declined more in terms of percentage than Oregon did during the time

Table 5.—*Oregon strawberry production, processed and total, percent processed, 1950-82*

Year	Processed production (× 1,000 lb)	Total production (× 1,000 lb)	Percent processed
1950	41,086	42,980	95
1951	30,570	32,190	95
1952	53,073	55,235	96
1953	60,330	62,310	97
1954	56,202	59,128	95
1955	80,700	83,475	97
1956	68,300	70,728	96
1957	86,300	91,600	94
1958	66,300	68,640	97
1959	85,100	88,920	96
1960	70,400	72,500	97
1961	63,500	67,600	94
1962	80,800	85,400	95
1963	66,100	69,300	95
1964	96,600	100,100	97
1965	56,700	59,800	95
1966	93,000	96,300	97
1967	88,100	91,100	97
1968	68,200	70,800	96
1969	66,900	69,600	96
1970	68,400	71,500	96
1971	79,500	83,000	96
1972	51,400	54,900	94
1973	45,800	48,800	94
1974	37,600	41,500	91
1975	39,000	41,800	91
1976	41,600	47,800	87
1977	31,200	35,000	89
1978	30,400	34,000	89
1979	38,700	42,600	91
1980	42,000	46,300	91
1981	46,700	51,150	91
1982	53,500	58,000	92

Source: OSU Extension Economics Information Office; U.S. Department of Agriculture, *Agricultural Statistics*, selected years.

Table 6.—*Washington strawberry production, processed and total, percent processed, 1950-82*

Year	Processed production (× 1,000 lb)	Total production (× 1,000 lb)	Percent processed
1950	19,210	23,472	82
1951	16,180	20,640	78
1952	29,000	34,113	85
1953	38,000	43,605	87
1954	38,400	43,605	88
1955	34,600	39,270	88
1956	8,500	9,625	88
1957	38,000	42,400	90
1958	36,000	40,500	89
1959	41,800	46,200	90
1960	41,800	44,800	93
1961	44,700	46,900	95
1962	44,600	47,400	94
1963	40,100	41,900	96
1964	39,900	40,900	98
1965	27,800	28,200	99
1966	33,900	38,600	88
1967	32,300	35,840	90
1968	34,600	38,200	91
1969	22,500	26,100	86
1970	26,700	29,900	89
1971	23,400	26,700	88
1972	21,000	24,300	86
1973	18,700	21,600	87
1974	20,200	22,700	89
1975	20,600	23,100	89
1976	22,100	25,100	88
1977	16,900	20,100	84
1978	14,000	17,500	80
1979	13,400	16,400	82
1980	12,800	17,400	74
1981	11,200	16,800	67
1982	13,400	18,600	72

Source: OSU Extension Economics Information Office; U. S. Department of Agriculture, *Agricultural Statistics*, selected years; Washington Department of Agriculture, *Berry Crops*, selected years.

period (table 6). Production in Washington increased slightly from 1950 to the mid-1960's. In 1962, Washington had its best year—it produced more than 47 million pounds of strawberries.

Starting in 1965, Washington experienced a general decline in production (the average annual *rate* of decline was about 5% from 1965 to about 1975). In the late 1970's and early 1980's, the average rate of decline increased slightly to about 6% annually. Washington production in 1979 was only 16.4 million lb—a record low for this period. By 1983, that figure had increased slightly to 19.2 million lb, the most in 6 years.

In Washington, as the amount of total production decreased, the amount of production that went to processed markets decreased even more. The amount of processed production increased somewhat in the late 1950's and early 1960's.

In 1965 to the early 1970's, the average annual portion of the crop processed began to decrease slightly. In the ending years of the period, the percent of the crop processed was decreasing at an even greater average annual negative rate (about 8%).

Value trends

The price level for strawberries differs according to the market in which they are sold. Strawberries sold in the fresh market generally received a higher price during the period than those sold for processing.

The fresh price for Oregon strawberries gradually increased (table 7). From the early 1950's to the late 1960's, the Oregon fresh price for strawberries increased only slightly.

The lowest price year was 1957—only 12.7¢ a lb. From the late 1960's to the early 1970's, the average annual growth rate was about 4%. In the last years of the period, the average annual growth rate was about 6%. The highest price for fresh strawberries in Oregon in the 33-year period was 1982 (54.0¢ a lb).

The price for Oregon strawberries for the processed market increased to a greater degree than fresh strawberry prices. In the 1950's to early 1960's, the processed price decreased slightly. The lowest year for processed prices was 1957 (only 8.1¢ a lb). In the late 1960's to early 1970's, the price of strawberries for the processed market increased at an average annual rate of about 5%.

In the last decade of the period, the average rate of increase was about 7% annually. The highest amount paid for processed strawberries during the 33-year period was in 1982 (43.0¢ a lb).

Table 7—*Oregon strawberry prices, fresh and processed, 1950-82*

Year	Fresh price (¢/lb)	Processed price (¢/lb)	Weighted average price (¢/lb)
1950	28.1	22.1	22.4
1951	18.1	17.1	17.2
1952	16.7	15.3	15.4
1953	19.4	15.9	16.0
1954	21.7	14.7	15.1
1955	20.0	15.6	15.8
1956	15.2	15.4	15.5
1957	12.7	8.1	8.4
1958	25.1	12.0	12.4
1959	26.2	13.0	13.6
1960	17.6	14.1	14.2
1961	15.1	12.1	12.3
1962	15.2	12.9	13.0
1963	24.0	12.1	12.7
1964	24.7	13.9	14.3
1965	29.3	15.3	16.0
1966	23.0	17.3	17.5
1967	17.0	14.1	14.2
1968	23.2	16.5	16.8
1969	23.0	17.0	17.2
1970	24.0	15.6	16.0
1971	23.1	14.7	15.1
1972	28.8	17.2	17.9
1973	32.1	23.4	23.9
1974	36.1	24.5	25.6
1975	32.9	22.0	23.0
1976	35.2	27.5	28.5
1977	36.0	27.6	28.5
1978	33.0	26.3	27.0
1979	41.0	33.0	33.7
1980	45.0	31.9	33.1
1981	45.8	34.4	35.4
1982	54.0	43.0	44.0

Source: OSU Extension Economic Information Office; U. S. Department of Agriculture, *Agricultural Statistics*, selected years.

Because a large percentage of the crop is processed, the average price for all Oregon strawberries followed the same general pattern as the processed price. The overall average grower price for 1983 in Oregon declined somewhat to 39.0¢ a lb.

Table 8.—*Washington strawberry prices, fresh and processed, 1950-82*

Year	Fresh price (¢/lb)	Processed price (¢/lb)	Weighted average price (¢/lb)
1950	24.7	23.7	23.9
1951	21.4	17.1	18.0
1952	20.6	15.2	16.0
1953	21.1	15.9	16.6
1954	19.2	15.6	16.0
1955	20.3	16.2	16.7
1956	20.4	15.8	16.3
1957	13.0	8.0	8.5
1958	16.0	12.0	12.4
1959	18.5	13.7	14.2
1960	21.7	14.4	14.9
1961	16.5	12.1	12.3
1962	22.8	13.1	13.7
1963	18.5	12.0	12.3
1964	21.6	14.3	14.5
1965	26.0	18.7	18.8
1966	26.0	16.6	17.7
1967	26.1	15.0	16.1
1968	24.3	16.9	17.6
1969	26.0	17.1	18.3
1970	26.2	15.8	16.9
1971	24.4	14.6	15.8
1972	23.5	18.0	18.8
1973	27.0	23.7	24.1
1974	29.3	25.[illegible]	25.7
1975	25.8	21.[illegible]	21.5
1976	30.4	27.[illegible]	27.7
1977	31.1	27.[illegible]	28.0
1978	31.2	24.0	25.4
1979	38.0	34.0	34.7
1980	45.0	31.0	34.7
1981	47.0	34.0	38.3
1982	47.0	42.[illegible]	43.0

Source: OSU Extension Economic Information Office; Washington Department of Agriculture, *Berry Crops*, selected years.

The fresh price for Washington strawberries also generally increased over the 33-year period (table 8). The fresh price had a slightly decreasing trend from the 1950's to about the mid-1960's. The lowest price received for Washington strawberries was in 1957 (13.0¢ a lb). From the late 1960's to early 1970's, the fresh market price increased at an average annual rate of about 2%.

During the final decade of the period, the average annual rate of growth in the fresh price was about 7%. The highest price for Washington fresh strawberries during this period was earned in both 1981 and 1982; the grower price was 47.0¢ a lb.

The processed price for Washington strawberries followed a pattern similar to the Oregon processed price. In the 1950's and early 1960's, the process market price followed a slight downward trend. The lowest price received for Washington processed strawberries was also in 1957; the grower price was 8.0¢ a lb.

In the late 1960's and early 1970's, the processed price began to increase gradually (the average annual *rate* of growth was about 4%). In the last decade of the period, the average rate of growth increased to 6% annually. The highest prices received in the processed market for the period occurred in 1982; the grower price was 42.0¢ a lb. The 1983 price also declined to about 39.0¢ a lb.

In Washington, the average price received for all strawberries declined in the 1950's and early 1960's, and then began to increase. In the 1950's and early 1960's, the average price was steady. In the late 1960's to early 1970's, the average price began to increase at an average rate of about 4% annually. In the latter years of the period, the average price for Washington strawberries increased at an average annual rate of about 7%.

The value of strawberry production in Oregon, Washington, and the two states combined generally increased throughout the 1950-1982 period (table 9). During the 1950's, the value of Oregon's strawberry production averaged $9.5 million. During the late 1960's, the value of Oregon's crop actually declined on an average annual basis.

By the late 1970's and early 1980's, Oregon's value of production was increasing rapidly, including an 8% average annual growth rate in the last few years of the period.

The production value of Washington strawberries was also increasing at about the same average rates as Oregon, but at considerably lower dollar levels. In the 1950's, Washington's value of production averaged $5.2 million a year. By the early 1980's, the value had only increased to an average $6.8 million.

Table 9.—*Value of strawberry production in Oregon and Washington, 1950-82*

Year	Oregon (× $1,000)	Washington (× $1,000)	Total (× $1,000)
1950	9,615	5,606	15,221
1951	5,521	3,721	9,242
1952	8,481	5,461	13,942
1953	10,356	7,224	17,580
1954	8,897	6,991	15,888
1955	13,144	6,554	19,698
1956	10,968	1,571	12,539
1957	7,650	3,612	11,262
1958	8,609	5,040	13,649
1959	12,064	6,493	18,557
1960	10,448	6,685	17,133
1961	8,641	5,775	14,416
1962	11,445	6,487	17,932
1963	8,766	5,178	13,944
1964	14,292	5,911	20,203
1965	9,583	5,303	14,886
1966	16,848	6,128	22,976
1967	12,932	5,765	18,697
1968	11,803	6,716	18,519
1969	12,063	4,782	16,845
1970	11,372	5,057	16,429
1971	12,512	4,222	16,734
1972	9,791	4,556	14,347
1973	11,680	5,215	16,895
1974	10,620	5,823	16,443
1975	9,610	4,992	14,602
1976	13,622	6,945	20,567
1977	9,979	5,626	15,605
1978	9,183	4,452	13,635
1979	14,370	5,696	20,066
1980	15,333	6,038	21,371
1981	18,126	6,439	24,565
1982	25,435	8,072	33,507

Source: OSU Economic Information Office; Washington Department of Agriculture; U. S. Department of Agriculture, *Agricultural Statistics*, selected years.

The highest value of production in the two states as a whole was reached in 1982, when growers received over $33.5 million (growers in the early 1980's averaged $26.5 million a year). In contrast, growers received only an average $14.8 million a year for the crops produced in the 1950's.

Production costs and returns

We estimated production cost budgets for both Oregon and Washington (tables 10 and 11). The two studies were done at different times and under dissimilar cultural conditions. The base yield used for both Oregon and Washington was 5 tons an acre.

We estimated production costs per acre for strawberries in Oregon to be $3,171 (assuming 20 acres of strawberries on a 200-acre farm). We estimated Washington production costs to be $4,106 an acre (assuming a 10-acre strawberry operation).

Preharvest costs in Washington were higher, primarily because of heavier use of chemicals. Harvest costs were also higher in Washington because part of the crop was assumed to be harvested for fresh market. This necessitated higher labor and container charges.

Postharvest and overhead charges were higher in Washington because of greater tractor and machinery expenses. We estimated break-even prices to be 32¢ pound for Oregon and 41¢ for Washington.

Every 3 years, a strawberry field is plowed under and the field replanted. Total establishment costs for Oregon were $1,537 an acre (table 12). Washington establishment costs were $2,337 an acre (table 13). Establishment costs were higher in Washington because of greater expenses for chemicals, machinery operations, and labor.

For both budgets, establishment costs were amortized over 3 years at 13% interest. We prorated the establishment costs included in the Oregon production cost budget (table 10) at $651 an acre. We estimated the amortized establishment cost in Washington to be $982 an acre (table 11).

Future alternative—mechanical harvesters

In the past few years, a recessionary economy brought plentiful harvest labor. But when the economy starts an uptrend, such as in 1983, labor for harvesting drops off. To offset periods of low labor availability, a mechanical strawberry harvester was developed and tested.

There are drawbacks. One is that no variety of strawberry has been developed that will satisfactorily withstand harvest by machine. There are several qualities that this strawberry needs, so that it can be harvested by machine.

The berries must be firm, resistant to disease, and have high yield capabilities. Plants also need an upright fruiting habit to minimize damage. Most of the fruit should mature at the same time so that a higher percentage of the crop is picked.

Another drawback is the acceptability of the strawberries to processors. Some processors do not have the capability of handling the extra bulk (leaves and stems) associated with mechanical harvesting.

Processors may place a price discount on machine-harvested strawberries. This discount would also take into account bruised or damaged strawberries. Machine harvest enthusiasts hope that if a new variety of strawberry is developed, such discounts would not be necessary.

When comparing the cost of hand-harvesting strawberries to machine-harvesting them, we can see different cost relationships. Total usable product (tons/acre) in recent studies was estimated to be higher for hand-harvested strawberries than for machine-harvested strawberries: 3.66 tons/acre for hand-harvested berries compared to 2.71 tons/acre for machine-harvested.

However, harvest costs were considerably lower for machine-harvested strawberries than for hand-harvested ones. Total harvest cost plus extra processing costs were only $196 an acre for machine-harvested strawberries.

The results of these studies comparing harvest methods are highly dependent on the relative yields between a hand-harvested and machine-harvested berry. For a hand-harvest yield (3 pickings) more than twice the yield of machine-harvest (1 picking), the advantage of hand-harvest was estimated to be $210 an acre. In another study, the savings per acre ranged from $623 in favor of mechanical-harvest to $187 in favor of hand-harvest.

The differences resulted from variation in yields and efficiency. Using a composite format compiled from several of the studies, 1982 costs and yields, and the 1982 estimated prices for fresh and processed strawberries in Oregon, we estimated that there would have been $545 net savings per acre in favor of machine-harvest in 1982 (table 14).

For hand-harvested strawberries, total harvest costs were $1,764 an acre. Product value for hand-harvested strawberries, after deducting those costs, was $2,166 an acre. In contrast, the product value for machine-harvested strawberries, net of harvest costs, was $2,711.

Mechanical harvesting may be a viable alternative for future use if the present varietal drawbacks can be overcome. Since a high percentage of Oregon and Washington strawberry production goes to processed markets, mechanically picked strawberries could be feasible.

Mechanization would reduce the labor uncertainty routinely experienced by growers. With new varieties developed for mechanical harvest, higher per-acre yield levels might be reached than those observed in the cited studies.

Table 10.—*Production costs for strawberries in Washington county, Oregon, July 1982*[a]

Cost items	Inputs per acre					
	Labor		Other			
	Hours	Value $	Machinery $	Item	Value $	Total cost $
Preharvest cultural operations						
Cultivate (3×)	3.0	29.00	14.00			43.00
Hoeing	8.0	48.00				48.00
Insecticide & fungicide spray or dust (3×)	1.0	10.00	10.00	mtl.	52.00	72.00
Irrigation (2×, 2" ea.)	2.0	12.00	23.00	elec.	4.00	39.00
Harvest costs						
Picking & supervision labor	(17¢/lb)	1,700.00				1,700.00
Hauling		69.00	58.00			127.00
Bookkeeping, recruiting, etc.		95.00		supplies	10.00	105.00
Postharvesting operations[b]						
Irrigation (2×, 2" ea.)	2.0	12.00	23.00	elec.	4.00	39.00
Clip tops	.33	8.00				8.00
Weevil control (banded)	1.0	2.00	2.00	mtl.	23.00	27.00
Cultivate & runner control (2×)	2.0	19.00	11.00			30.00
Subsoil	.50	5.00	8.00			13.00
Herbicide	.20	2.00	2.00	mtl.	8.00	12.00
Side dress fertilizer[c]				fert.	61.00	61.00
Other charges						
Land charges					150.00	150.00
Operating capital interest @ 14%					24.00	24.00
General overhead					22.00	22.00
Total cash costs		1,772.00	62.00		358.00	2,192.00
Total noncash costs		234.00	94.00		0	328.00
Total annual production costs		2,006.00	156.00		358.00	2,520.00
Amortized establishment costs						651.00
Net cost/producing year						3,171.00
Cost/lb @ 6-ton yield	29.5¢					
Cost/lb @ 5-ton yield	31.7¢					
Cost/lb @ 4-ton yield	35.4¢					
Cost/lb @ 3-ton yield	42.7¢					

[a]Based on (1) 20 acres on a 200-acre farm; (2) 3 bearing years, 5-ton/acre average; (3) operator's labor @ $9.50/hour; (4) hired labor @ $6.00/hour; (5) 3 tractors: 90-100 hp @ $11.00/hour, 50 hp @ $9.00/hour, 25 hp @ $4.00/hr. Rates for operator's and hired labor were updated from a *Washington County Strawberries Enterprise Sheet*, OSU Economic Information Office, February 1979 (includes Social Security, Workman's Compensation, and other labor expenses).

[b]Postharvest costs not incurred in third year.

[c]Generally done but not required in all cases.

Table 11.—*Strawberry production costs—full production for direct processing and marketing western Washington 10-acre enterprise—1982 (assuming a 5-ton yield per acre)*

Costs	Unit	Price/unit $	Quantity	Total cost $
Preharvest				
Tenoran	lb	7.60	2.00	15.20
Guthion	lb	6.00	.50	3.00
Metasystox R	gal	34.00	1.50	51.00
Ronilan 50 WP	lb	25.00	1.00	25.00
Furadan	gal	51.50	1.50	77.25
10-20-30	ton	0.118	400.00	47.40
Devrinol 50 WP	lb	8.30	4.00	33.20
Machinery repair	acre	2.33	1.00	2.33
Tractor repair	acre	2.68	1.00	2.68
Irrigation repair	acre	35.04	1.00	35.04
Irrigation fuel	acre	8.24	1.00	8.24
Labor (tractor & machinery)	hour	4.50	12.91	58.09
Labor (irrigation)	hour	4.00	8.00	32.00
Interest on operating capital	$1	0.12	188.85	22.66
Overhead	$1	0.05	2,522.40	126.12
Harvest				
Harvest preparation	hour	4.50	4.00	18.00
Hand labor	flat	1.50	400.00	600.00
Hand labor	flat	2.00	375.00	750.00
Supervisory labor	hour	10.00	36.00	360.00
Cleanup labor	hour	4.50	2.00	9.00
Flats	flat	.50	400.00	200.00
Machinery repair	acre	6.93	1.00	6.93
Machinery fuel	acre	30.00	1.00	30.00
Machinery lube	acre	4.50	1.00	4.50
Labor (tractor & machinery)	hour	4.50	7.20	32.40
Fixed				
Machinery depreciation	acre	73.43	1.00	73.43
Machinery interest	acre	61.43	1.00	61.43
Machinery insurance	acre	3.07	1.00	3.07
Tractor depreciation	acre	33.01	1.00	33.01
Tractor interest	acre	39.61	1.00	39.61
Tractor insurance	acre	1.98	1.00	1.98
Irrigation depreciation	acre	43.84	1.00	43.84
Irrigation interest	acre	65.76	1.00	65.76
Management charge[a]		2,550.04	.05	127.50
Prorated establishment cost	acre	2,336.93	.42	981.51
Land rent	acre	125.00	1.00	125.00

Total preharvest costs	$ 539.22
Total harvest costs	2,015.81
Total fixed costs	1,556.14
Total production costs	4,106.18

[a]Management charge is 5% of variable cost.

Compiled from *1982 Strawberry Enterprise Budget for Western Washington*, Washington State University, Cooperative Extension Service, Bulletin 1077 (Pullman, 1982).

Table 12.—*Establishment costs for strawberries in Washington county, Oregon, July 1982*[a]

Cost items	Inputs per acre					
	Labor			Other		
	Hours	Value	Machinery	Item	Value $	Total Cost $
Cultural operations						
Subsoil	.5	5.00	8.00			13.00
Plow	.4	4.00	8.00			12.00
Disc & harrow (3×)	.75	7.00	15.00			22.00
Field cultivator	.5	5.00	9.00			14.00
Fumigation[b]	.5	5.00	7.00	mtl.	182.00	194.00
Cultimulcher (2×)	.33	3.00	7.00			10.00
Fertilize (broadcast)	.17	1.00	1.00	fert.	16.00	18.00
Preplant insecticide	.2	2.00	2.00	mtl.	56.00	60.00
Lime (2 tons)[b]				custom	58.00	58.00
Plant trimming	3.0	18.00				18.00
Planting, 11,000 plants/acre; 5 people (5 acres in 8 hours)	8.0	53.00	16.00	plants	439.00	508.00
Roll plants	.2	2.00	2.00			4.00
Fertilizer[c]				fert.	51.00	51.00
Herbicide	.2	2.00	2.00	mtl.	59.00	63.00
Irrigation (3×, 6" total)	3.0	18.00	68.00	elec.	7.00	93.00
Cultivate (3×)	3.0	29.00	14.00			43.00
Herbicide (fall)	.2	2.00	2.00	mtl.	26.00	30.00
Hand weeding (crew)	8.0	48.00				48.00
Pest control	.2	2.00	2.00	mtl.	18.00	22.00
Other charges						
Land charge (cash rent basis)					150.00	150.00
Operating capital interest (@ 14%)					53.00	53.00
General overhead					53.00	53.00
Total cash costs		91.00	65.60		1,168.00	1,324.60
Total noncash costs		114.00	98.40		0	212.40
Total establishment costs		205.00	164.00		1,168.00	1,537.00
Annualized for 3 years at 13%						651.00

[a]Based on (1) 20 acres on a 200-acre farm; (2) 3 bearing years; (3) operator's labor @ $9.50/hour; (4) hired labor @ $6.00/hour; (5) 3 tractors: 90-100 hp @ $17.00/hour, 50 hp @ $9.00/hour, 25 hp @ $4.00/hour. Rates for operator's and hired labor were updated from *Washington County Strawberries Enterprise Sheet*, OSU Economic Information Office, February 1979 (includes Social Security, Workman's Compensation, and other labor expenses).

[b]Generally done but not required in all cases.

[c]Applied during another operation and includes soil insecticide.

Table 13.—*Establishment costs, establishment year, western Washington data, 10-acre enterprise, 1982 (assuming a 5-ton yield/acre)*

Costs	Unit	Price/unit $	Quantity	Total cost $
Variable				
Soil test	acre	4.50	1.00	4.50
Nematode test	acre	2.50	1.00	2.50
Roundup	gal	33.00	.75	24.75
Cust. plow	acre	25.00	1.00	25.00
Dolomite	tons	97.50	1.00	97.50
Cust. lime	acre	3.50	1.00	3.50
Cust. fumigate	acre	30.00	1.00	30.00
Terrocide 54/45	gal	27.00	11.00	297.00
10-20-20	lb	0.118	500.00	59.25
Strawberry plants	head	4.00	110.00	440.00
10-15-15	lb	0.113	600.00	68.10
Strawberry plants (replant)	head	4.10	5.50	22.55
Hand weed	hour	4.50	6.00	27.00
Metasystox R	gal	30.80	1.50	46.20
Devrinol 50 WP	lb	8.30	4.00	33.20
Tenoran 50 WP	lb	7.60	2.00	15.20
Overhead	$1	0.05	1,615.96	80.80
Plant labor	hour	4.50	8.00	36.00
Replant labor	hour	4.50	1.50	6.75
10-20-20	lb	0.118	400.00	47.40
Machinery repair	acre	5.87	1.00	5.87
Tractor repair	acre	5.43	1.00	5.43
Irrigation repair	acre	35.04	1.00	35.04
Irrigation fuel	acre	8.24	1.00	8.24
Labor (tractor & machinery)	hour	4.50	26.16	117.74
Labor (irrigation)	hour	4.00	8.00	32.00
Interest on operating capital	$1	0.12	737.94	88.55
Fixed				
Machinery depreciation	acre	90.64	1.00	90.64
Machinery interest	acre	74.34	1.00	74.34
Machinery insurance	acre	3.72	1.00	3.72
Tractor depreciation	acre	66.90	1.00	66.90
Tractor interest	acre	80.28	1.00	80.28
Tractor insurance	acre	4.01	1.00	4.01
Irrigation depreciation	acre	43.84	1.00	43.84
Irrigation interest	acre	65.76	1.00	65.76
Management charge[a]		1,697.57	0.05	84.88
Land rent	acre	125.00	1.00	125.00

Total variable cost	$1,697.57
Total fixed cost	639.36
Total establishment costs	2,336.93

[a]Management charge is 5% of variable cost.

Compiled from *1982 Strawberry Enterprise Budget for Western Washington*, Washington State University, Cooperative Extension Service, Bulletin 1077 (Pullman, 1982).

Table 14.—*Comparison between mechanical harvest and hand-picking harvest costs*

Calculation steps	1982 Estimate	Your estimate
Usable product under mechanization[a]		
Average total yield (ton/acre)	5.00	
Berries recovered by the harvester (ton/acre) (5.0 × .76)	3.80	
Less culls (3.80 × .11)	(0.42)	
Total usable product (tons/acre)	3.38	
Revenue ($/acre) for machine harvest		
Total revenue 3.38 tons × 43.0¢/lb[b]	$2,907.00	
Harvest costs ($/acre) with mechanization		
Direct labor costs[c] (4 hours @ $9.50) + (4 hours @ 12.00)	86.00	
Repair costs (4 hours @ $10.00/hour)	40.00	
Depreciation (4 hours @ $9.06/hour)	36.[illegible]	
Tax & housing (4 hours @ .68/hour)	2.70	
Insurance (4 hours @ .07/hour)	.30	
Interest (4 hours @ 3.49)	4.00	
Fuel (4 hours @ 1.79/hour)	7.20	
Processing cost ($/acre)[d]	9.80	
Total harvest and extra processing costs	$ 196.00	
Product value net of harvest costs	$2,711.00	
Usable product under hand-picking		
Average total yield (tons/acre)	5.00	
Berries actually picked (5 tons @ .95)	4.75	
Less culls (4.75 @ .037)	(0.18)	
Total usable product (tons/acre)	4.57	
Revenue ($/acre) for hand-picked harvest		
Total revenue (4.57 tons @ 43.0¢/lb)	$3,930.00	
Harvest costs ($/acre) for hand-picked strawberries		
Total harvest costs (19.3¢/lb × 9,140 lb)	1,764.00	
Product value net of harvest costs	$2,166.00	
Net savings as a result of using the harvester ($2,711 − 2,166)	545.00	

[a]Using the SKH&S harvester sponsored by the Stayton Canning Cooperative.

[b]1982 Oregon processed price (table 7).

[c]The direct labor cost was estimated using wage rates of $9.50/hour for the machine operator and $5.00/hour for two assistants. It takes 4 hours to harvest 1 acre.

[d]This includes wage rates and fringe benefits of employees.

[e]The estimated harvest cost for hand-picking was about 19¢/lb, including costs of recruiting, labor, transportation and supervision, hauling and handling of berries, and bookkeeping.

Compiled from:

Hussen, Ahmed M., William G. Brown, Dean E. Booster, Francis J. Lawrence, Lloyd W. Martin, and George Varseveld, *Estimated Costs and Returns from Mechanical Strawberry Harvest in Oregon: A Progress Report*, Oregon State University Agricultural Experiment Station Special Report 556 (Corvallis, 1979).

Kim, Chong S., William G. Brown, and R. Ronald Langmo, "Economic Feasibility to Oregon Growers of Mechanically Harvested Strawberries," in *Strawberry Mechanization*, Oregon State University Agricultural Experiment Station Bulletin 645 (Corvallis, 1980).

Price and cost reports from the Oregon State University Economic Information Office.

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