

AVOCADO PRODUCTION ECONOMICS¹

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The profitability of growing avocados in California, like many fruit industries, has followed long-term cycles of profitability. The California avocado industry is currently in its second expansion period since World War II. Improved returns in the 1940's led growers to expand total hectareage by almost 50%. The resultant larger crops in the late 1950's and early 1960's brought depressed markets and a low level of new plantings. As a result, state bearing hectareage remained stable during the 1960's and annual production, while varying widely from year to year, averaged around 45,000 m. tons.

Grower returns improved since the early 1960's as a result of more effective marketing procedures and strategies by growers and handlers, the extensive trade promotion program operating under a state marketing order in California and a more favorable supply and demand relationship in the industry. The rate of new plantings since 1969 has been high and expanded levels of hectareage and production are projected for the remainder of the 1970's and into the 1980's. Projections also indicate a changing composition of cultivars in the years ahead. The trend is toward an increased percentage of 'Hass' relative to 'Fuerte' and a proportionately larger spring, summer and fall crop than in past years.

The future profitability to growers of an avocado orchard will depend, as in the past, on the relationship of the 3 profit factors, *i.e.*, the price growers receive for fruit, the yield per ha and the cost of production. Net returns per ha equal yield per ha times on-tree price less per-ha cost of production. It is the purpose of this paper to discuss these 3 profit factors in terms of the California industry.

Trends in Supply, Demand and Price for California Avocados

Commercial plantings of avocados in California started in the 1920's with a noticeable expansion in the 1950's. The current expansion began in the late 1960's. California currently has 15,645 ha of avocados, most of which are planted in the southern counties of the State: San Diego, Ventura, Santa Barbara, San Luis Obispo, Los Angeles, Orange, Riverside and San Bernardino. A small but expanding area is developing in the San Joaquin Valley (mainly Tulare County).

The California avocado industry has operated since the 1960-62 season under a state marketing order designed to increase the demand for California avocados. A comprehensive trade promotion and advertising program for California avocados has been financed through grower assessments which have totaled \$16 million since the beginning of the program in 1962. A state inspection and certification program has been in effect since April 1973. Under this program a mandatory lot-by-lot inspection is made for variety, maturity, count and weight of every shipment destined for market.

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Total California Hectarage

Bearing hectarage, a measure of the production potential of the industry, increased in the early 1950's, plateaued during the late 1950's and 1960's and is currently expanding. Favorable returns following World War II led to heavy new plantings and an expansion of state bearing hectarage of 50% from 1945 to 1959. Larger crops resulted in lower returns and a diminishing interest in establishing new plantings. Nonbearing hectarage reached a low of 495 ha in 1964. The second expansion period was well underway by 1975 and nonbearing hectarage had risen to 5,242 ha (Table 1) with heavy new plantings a certainty through 1976.

Table 1. California avocado bearing, non-bearing and total hectares, 1910 to 1975.

Crop year	Hectarage		
	Bearing	Nonbearing	Total
1910	Beginning of commercial industry		
1925	198	-	-
1935	2,957	-	-
1945	5,292	-	-
1950-51	4,859	3,425	8,285
1955-56	7,299	2,075	9,374
1960-61	8,112	1,772	9,883
1965-66	7,612	1,024	8,636
1970-71	7,438	1,845	9,283
1975-76	10,402	5,242	15,645

Source: California Crop and Livestock Reporting Service.

California Plantings by Cultivar

The 2 principal cultivars grown in California are 'Hass' and 'Fuerte'. 'Fuerte', a green-skinned fruit, is marketed mainly during November through April. 'Hass', a dark-skinned fruit, is marketed mainly during May through November, although some shipments occur during most other months of the year. Cultivars harvested during the fall and winter in addition to 'Fuerte', include 'Bacon', 'Zutano' and 'Rincon'. Principal spring and summer varieties are 'Hass' and 'MacArthur'.

A 10-year comparison of hectarage by cultivar is shown in Table 2. Projections for the current expansion indicate a continuation of the trend to more plantings of 'Hass', 'Bacon' and 'Zutano' and to less 'Fuerte'.

Avocado Grower Price

The inverse relationship between the size of the California avocado crop and the seasonal average price received by growers for fruit delivered to the packinghouse can be seen by studying the price and production data (Table 3). Although there were wide variations from year to year, the price trend was downward during the 1950's when the industry was first adjusting to higher levels of production. The low in prices was reached during the then record large crop in 1959-60. Price trends have been upward since that time, reaching a high of \$1.04/kg for the 1975-76 crop.

Table 2. California avocado hectareage by cultivar, 1965 and 1975.

Variety	Total ha standing		% of total	% change 1965 to 1975
	1965	1975		
Bacon	328	1,700	11	+ 418
Fuerte	4,802	4,108	26	- 14
Hass	1,954	7,774	50	+ 298
MacArthur	300	145	1	- 52
Rincon	234	120	1	- 49
Zutano	233	1,032	6	+ 343
Reed	-	149	1	-
Others	680	616	4	- 9
Total	8,530	15,645	100	+ 83

Source: California Crop and Livestock Reporting Service

Avocado Crop Value

The value of the California avocado crop delivered to the packinghouse door reached a record high of \$55 million for the 1975-76 crop—over 3.5 times the value of the crop 10 years previously, although the size of the crop was the same (Table 3). The gross returns at the packinghouse door on a per-bearing-ha basis also have increased significantly during the last 10 years, rising from \$1,997/ha in 1965-66 to \$5,288/ha for the 1975-76 season. It should be noted that these are gross returns and must cover the cultural and overhead costs of production and the cost of harvesting and hauling before a profit is realized.

Table 3. California avocado production, gross returns and crop value, 1925 to 1975.

Crop year	Production total (1,000 m. tons)	Crop value and gross returns		
		Total crop value (\$1,000)	Cents per kg	Dollars per bearing ha
1925	0.14	94	79.6	474
1935	8.44	809	9.7	274
1945	10.52	6,055	57.5	1,144
1955-56	18.14	8,280	45.6	1,134
1959-60	63.50	7,659	12.1	890
1965-66	52.62	15,196	28.9	1,997
1970-71	60.78	24,790	40.8	3,333
1974-75	93.89	48,500	51.6	5,216
1975-76	52.62	55,000	104.5	5,288

Source: California Crop and Livestock Reporting Service

The rising trend in grower prices, returns per bearing ha and crop value since 1960 has resulted largely from improved marketing procedures and strategies by growers and handlers, heavier marketing of summer and fall varieties, the extensive trade promotion program operating under a state marketing order, the more favorable supply and

demand relationship in the industry and the trend toward inflation in the nation's economy.

Future Supply and Demand Relationships

The avocado industry should be alert to the dangers of extensive expansion as well as the opportunities for orderly growth and market development. The profitability of avocado production in the future, as in the past, will be determined by the supply and demand relationships facing the industry. Forecasting and evaluating these relationships is difficult and uncertain due to the limited nature and availability of current data measuring the rate and extent of growth in the industry as well as the complexity of the supply, demand and price relationships.

It is clear that the California avocado industry is expanding at a significant rate. Also, history of most California fruit crops shows that fruit industries exhibit long-run cycles of profitability due to the long lead time between the decision to establish plantings and the harvest from mature trees. For this reason growers should continually study supply and demand information in order to evaluate the timing and effect of increased supplies on avocado markets and prices. The following factors should be considered:

Factors tending to increase future supply of avocados:

1. High returns in recent years from avocado orchards.
2. Tax motivation and desire to hedge inflation. Future changes in the tax law could reduce tax incentive.
3. Changes in cultural methods and cultivars could result in increased plantings and production, *i.e.*, new irrigation systems and methods, better management, larger commercial hectarage, shifts to higher yielding cultivars.

Factors tending to decrease future supply of avocados:

1. Limited availability of orchard sites with water and suitable soil and climatic conditions for successful avocado production. This has resulted in some new plantings in less than favorable locations.
2. Availability of nursery trees, irrigation equipment and the rising cost of developing avocado properties.
3. Loss of existing avocado trees due to ravages of root rot fungus, *Phytophthora cinnamomi*.
4. Loss of avocado land to urbanization.

Factors tending to increase future demand for avocados:

1. Favorable prospects of increasing per capita consumption of avocados based on their unique characteristics and appeal as a food item.
2. Opportunity of growers and handlers to expand markets, provide for orderly marketing and efficient handling.
3. Opportunities for increased demand for avocados resulting from the California Avocado Advisory Hoard program of advertising, trade promotion and market research.
4. Opportunities to develop and expand markets for avocados outside the Far East and Europe.

Yield per Ha

Crop yield or production per ha for avocados can best be described as variable. Large yield differences can be found in any crop year from different orchards in the same district as well as from orchards in different districts. Additionally, the avocado tree, particularly certain cultivars such as 'Fuerte', exhibits strong alternate-bearing characteristics. Consequently, orchard and total production alternate between heavy and light crop years.

The yield and quality of fruit in any specific orchard are influenced by a number of factors, many of which are predetermined when the orchard is planted. These include location and exposure, topography, soil type and depth, water quantity and quality, cultivar suitability to climate, disease hazard and climatic conditions of frost, freeze, extreme heat, wind and air pollution. Some of these predetermined factors can be modified or changed to enhance yields, but it is often difficult and costly to do this. Careful and intelligent management can sometimes minimize predetermined problems and good cultural practices of irrigation, nutrition, tree management, disease and pest control are necessary in any orchard to attain high yields.

Table 4. California avocado industry average yield per bearing ha, by cultivar, 1963-64 to 1972-73^z.

Season	Yield, kg/ha ^y			
	Fuerte	Hass	Others	All cultivars
1963-64	4,530	6,621	<u>3,941</u>	4,787
1964-65	1,409	<u>4,366</u>	4,224	<u>2,494</u>
1965-66	5,103	<u>11,204</u>	6,940	6,913
1966-67	<u>9,468</u>	7,801	<u>8,618</u>	<u>8,970</u>
1967-68	2,476	9,524	4,365	4,477
1968-69	6,799	6,964	7,637	7,127
1969-70	2,419	7,152	4,647	4,101
1970-71	6,247	10,576	8,299	8,173
1971-72	<u>1,317</u>	4,812	4,898	3,061
1972-73 ^x	<u>6,350</u>	<u>11,408</u>	7,261	8,003
10-year average	4,612	8,043	6,083	5,774
10-year high	9,468	11,408	8,618	8,970
10-year low	1,317	4,366	3,941	2,494

^z High and low yield underlined.

^y Total production divided by bearing hectareage, with bearing defined as trees five years of age and older. Preliminary.

Source: California Crop and Livestock Reporting Service and Federal-State Market News Service.

Growers should study actual orchard production records, such as pack-out statements, when estimating orchard yields. Conservative estimates of yield should be made for

orchards with sketchy production history, particularly in new areas. An average yield over several crops should be used for analysis purposes because of the variation from year to year in avocado yields.

Table 4 shows average industry yield per bearing ha by cultivars as a further guide to estimating yield per ha. Industry average yield per bearing ha indicates a 10-year average of 4,612 kg for 'Fuerte', 8,043 kg for 'Hass', 6,083 kg for other cultivars and 5,784 kg for all cultivars. These are average yields derived by dividing total production from trees of all ages by estimates of the state's bearing hectareage. Bearing hectareage is defined as all plantings 5 years of age and older.

Yields from good, commercial, mature orchards are normally higher than industrial average. Table 5 shows sample yield per ha from selected mature, high-yielding orchards in California. These records indicate that long-term average yield per ha for selected 'Fuerte' orchards has ranged from 5,534 to 9,928 kg. For the 'Hass' variety these sample orchards indicated yields ranging from 8,854 to 14,986 kg/ha.

Table 5. Sample yield per ha from selected mature high-yielding commercial avocado orchards in California.^z

Vicinity and orchard no.	Size (ha)	Yield (kg/ha)					5 year average ^y
		1965-66	1966-67	1967-68	1968-69	1969-70	
Fuerte							
1	4.0	9,083	12,658	5,356	11,611	10,930	9,929
2	3.2	3,499	12,591	2,172	9,206	10,128	7,520
3	4.0	9,052	6,432	7,628	2,832	1,729	5,534
4	7.3	8,477	4,513	6,904	5,729	5,133	6,151
5	18.2	8,255	8,265	6,012	7,190	6,717	6,780 (12-yr)
6	23.5	3,678	9,030	2,679	8,670	2,957	5,877 (6-yr)
7	3.6	4,920	14,773	4,945	15,395	6,639	9,537 (6-yr)
Hass							
8	1.6	15,694	12,695	8,884	17,712	8,688	13,079 (6-yr)
9	2.0	31,164	538	9,910	25,245	7,309	14,496 (10-yr)
10	4.0	16,367	7,309	13,676	16,815	11,792	11,524 (6-yr)
11	4.0	23,496	10,537	16,187	15,111	6,322	13,811 (6-yr)
12	8.1	20,412	8,345	9,425	11,281	7,200	11,332
13	4.0	23,535	4,548	15,985	2,032	2,954	9,811
14	6.5	14,200	6,558	6,793	7,530	9,748	8,966
15	18.6	19,217	6,970	10,111	7,998	7,269	8,854 (11-yr)

^z Sample orchards located in San Diego, Riverside, Orange and Ventura Counties and selected on the basis of recognized high yield and availability of orchard yield records.

^y Except as noted.

Source: Grower records.

Cost of Production

Production costs can conveniently be divided into 3 categories for purposes of cost analysis: 1) cash cultural costs, 2) cash overhead costs and 3) non-cash investment cost.

Cash Cultural Costs

Variation is found in the cost of the cultural operations. The cost of a ha-cm of water in

California, for example, varies from \$1.62 to \$10.13, depending on the source and orchard location. Water use also varies among districts. In addition, topography and location affect the cost of orchard operations. While not included in an analysis of preharvest costs, harvesting and hauling costs also are variable. The recent development of avocado orchards on very steep slopes almost assures higher harvesting costs.

Table 6. Sample production costs for California avocados, 1975.

Item	Range of sample costs for San Diego, Ventura and Santa Barbara Counties (\$/ha)		
	Low	Midpoint	High
Cultural cash costs			
Fertilization	111	180	247
Irrigation (water & labor)	346	1,023	1,700
Pest control (ants, snails, and rodents)	54	89	124
Weed control	114	161	210
Pruning and thinning	247	284	321
Miscellaneous (tree care, erosion etc.)	133	173	210
Total cash cultural costs	1,011	1,910	2,812
Cash overhead costs			
Taxes	124	309	494+
Maintenance and repair	99	235	371
General expense	124	185	247
Management charge	148	178	208
Total cash overhead costs	717	907	1,320
Total cash preharvest costs	1,727	2,817	4,132
Investment overhead			
Depreciation	1,016	1,510	2,004
Total cash preharvest costs plus depreciation	2,743	4,445	6,135
Interest on investment	1,520	2,120	2,721
Total preharvest cost	4,262	6,447	8,856

Note: Total costs indicate range of totals of county cost sheets and not a summation of ranges indicated in table. In addition to preharvest costs, harvesting cost varies from 7.5 cents to 13 cents per kg depending on tree size, yield per tree, terrain etc.

Source: Avocado Cost Data Sheets for San Diego, Ventura and Santa Barbara Counties.

Cash Overhead Costs

Cash overhead costs include taxes, maintenance and repair, management charges and general expense. Taxes vary among areas as much as any cost item, ranging from \$125/ha in rural areas to over \$500/ha in urbanized areas. Management may be a cash cost to absentee owners, a non-cash cost to owner-operators, or a combination of costs. The amount charged for management varies, depending on, among other things,

the functions and services performed by management. General expense covers the cost of office, telephone, travel, dues *etc.*

Non-cash Investment Overhead Cost

Investment overhead includes depreciation and interest on investment. Depreciation is charged on trees, irrigation systems and necessary equipment and buildings, interest on investment is charged on the investment in land in addition to the items above.

Sample costs to produce avocados in California in 1975 are shown in Table 6. Because of the variation in costs within the industry, these sample costs are presented not as industry average costs but as the range in costs of typical commercial orchards in the principal producing districts of California. Using the midpoint sample costs, cash cultural costs amounted to \$1,910/ha, cash overhead costs amounted to \$907/ha, for a total preharvest cash cost of \$2,817/ha. A charge for depreciation and interest on investment must be included if non-cash overhead costs are included in the analysis. The non-cash overhead costs are indicated as \$1,510/ha for depreciation and \$2,120/ha for interest on investment. The non-cash overhead costs are determined by the value of the land and orchard, the useful life of depreciable items and the rate of return expected on invested capital.

Returns

Gross returns per ha have to amount to \$1,910 to cover cash cultural costs alone and \$6,447/ha to cover total cash and non-cash cultural and overhead costs, assuming these sample preharvest cost of production estimates. The necessary combinations of varying prices received for fruit and yield to cover different levels of costs are shown in Table 7.

Table 7. Relationship of gross on-tree per ha to yield per ha and on-tree price.

On-tree price Cents/kg	Yield (kg/ha)					
	3,000	4,000	6,000	8,000	10,000	12,000
	Gross on-tree returns per ha					
\$0.30	\$ 900	\$1,200	\$1,800	\$2,400	\$3,000	\$3,600
0.40	1,200	1,600	2,400	3,200	4,000	4,800
0.50	1,500	2,000	3,000	4,000	5,000	6,000
0.60	1,800	2,400	3,600	4,800	6,000	7,200
0.70	2,100	2,800	4,200	5,600	7,000	8,400
0.80	2,400	3,200	4,800	6,400	8,000	9,600
1.00	3,000	4,000	6,000	8,000	10,000	12,000
1.20	3,600	4,800	7,200	9,600	12,000	14,400
1.40	4,200	5,600	8,400	11,200	14,000	16,800

Summary

The profitability of growing avocados in California, like many fruit industries, has followed long-term cycles and is currently in its second expansion period since World War II. Improved returns in the 1940's led growers to expand total hectareage by almost

50%. The resultant larger crops in the late 1950's and early 1960's brought depressed markets and a low level of new planting.

Grower returns in California improved since then as a result of more effective marketing procedures and strategies by growers and handlers, the extensive trade promotion program operating under a California state marketing order and a more favorable supply and demand relationship in the industry. The rate of new plantings since 1969 has been high in California and expanded levels of hectareage and production are projected for the remainder of the 1970's and into the 1980's. Projections also indicate a changing composition of cultivars in the years ahead. The trend is toward increased hectareage of 'Hass' relative to 'Fuerte' and a proportionately larger spring, summer and fall crop than in past years.

During the current period of expansion, the industry should be alert to the dangers of excessive expansion as well as the opportunities for orderly growth and market development. The price growers receive for avocado production in the future, as in the past, will be determined by the supply and demand relationships facing the industry. Forecasting and evaluating these relationships is difficult and uncertain due to the limited nature of current data as well as the complexity of supply, demand and price relationships.

Crop yield or production per ha for avocados can best be described as variable. During any crop year, large differences can be found in yield from different orchards in the same district as well as from orchards in different districts. Additionally, the avocado tree exhibits strong alternate-bearing characteristics. As a result, orchard as well as total industry production alternate between heavy and light crop years.

Cost of production, along with per-ha yield and grower price, is the third important factor in avocado production economics. Although production costs for avocados grown in different districts in California can be generalized with some degree of accuracy, there is a wide range in costs between orchards and districts. Avocado production costs can conveniently be divided into 3 categories: 1) cash cultural costs, 2) cash overhead costs and 3) non-cash investment overhead costs.

Cash cultural costs include the cost of fertilization, irrigation, pest control, weed control, pruning, orchard thinning and miscellaneous tree care. Cash overhead costs include property taxes, general expenses, maintenance and repairs and a management charge, if applicable. Non-cash investment overhead costs include depreciation and interest on investment.

The future profitability of avocado growing depends on the relationship of the 3 profit factors: 1) the price-growers receive for fruit, 2) the yield per ha and 3) the cost of production. Net returns per ha equal yield times on tree price minus cost of production.