part TWO
Now that we have discussed the history of farming in the Islands and the physical and institutional environment of Hawaii’s diversified agriculture, we will consider each of the industries in detail.

**Market Supplies and Imports**

Hawaii’s total market supplies of vegetables in 1951 amounted to 100 million pounds of fresh produce, 0.9 million pounds of frozen vegetables, and an estimated 12.5 million pounds of canned vegetables and vegetable juices or pastes. (See Table B1.) All frozen vegetables and practically all canned vegetables were imported. Of the total fresh produce, 42 percent was imported. That was about a normal percentage for recent peacetime years, as indicated by both prewar and postwar statistics.* (See Tables B2 and B3.) Shipments from the mainland during World War II were sharply restricted by the government and cannot be used as an indication of normal imports.

Even in peacetime the armed forces purchase sizeable quantities of fresh vegetables in Hawaii. In 1951 they bought about 5 percent of all vegetables produced locally or imported by Island wholesalers.

To study possibilities of substituting locally raised produce for imports, fresh vegetables sold in Hawaii in 1951 were grouped into the following three classes:

1. Vegetables rarely grown in the Islands (less than 10 percent of Hawaii’s total market supplies Island-grown).
2. Vegetables both raised in Hawaii and imported in substantial amounts (from 10 to 90 percent of all supplies Island-grown).
3. Vegetables primarily or exclusively produced in Hawaii (more than 90 percent Island-grown). (See Table B4.)

Of the 30.6 million pounds of vegetables in Class 1, potatoes, onions,

*However, according to preliminary estimates, only 35 percent of total market supplies of vegetables was imported in 1952.
and garlic accounted for 29.0 million pounds. Only 1.2 million pounds of potatoes and onions, and no garlic, were grown in Hawaii. Onion farmers in the Kula district of Maui and potato producers in Kula and on the island of Hawaii were the only Island growers who found it profitable to compete with the low-priced mainland imports of these staples. No great increases in the Island output of these products can be expected under present production and market conditions.

1951 Island Vegetable Production and Imports

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<th>Island Production</th>
<th>Fresh Imports</th>
<th>Canned &amp; Frozen Imports</th>
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<td>57.6 million lbs.</td>
<td>42.4 million lbs.</td>
<td>13.4 million lbs.</td>
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Various types of melons other than watermelons made up the bulk of the remaining 1.5 million pounds of imports in this class. Melons can be grown in Hawaii but are highly susceptible to fruit flies, particularly the melon fly. If an effective and inexpensive control of these insects can be developed, local production might replace a portion of the mainland shipments. Watermelons, which bring high prices in Hawaii, are grown in the Islands despite the melon flies. Production methods are expensive and usually include covering of the fruit with paper and frequent spraying or dusting.

The other vegetables in this group, such as artichokes, asparagus, and Brussels sprouts, are of minor importance on the Honolulu market. Some of these crops, such as artichokes, can be grown in some localities in Hawaii, and the Island demand could be supplied by local farmers.

An estimated 29.8 million pounds of truck crops were in Class 2. Of the total, 58 percent was grown locally. The most important crops in this class were tomatoes, watermelons, lettuce, carrots, celery, sweet potatoes, and peppers. Possibilities of substantially increasing the Hawaiian production of vegetables are best in this group.

About 20.5 million pounds of western-type vegetables were primarily Island-grown. The major crops in this group were head cabbage, Oriental cabbage, cucumbers, snap beans, and green corn. Only 0.4 million pounds of these crops were shipped from the mainland.

Class 3 included 19.2 million pounds of Oriental and Hawaiian vegetables, none of which were imported. Among them were taro, daikon, watercress, burdock, and lotus root.

Canned and frozen vegetables selling in the largest quantities in Ha-
waii are peas, green corn, snap beans, and tomatoes. Sometimes it is said that fresh Island vegetables, if lower priced, could largely replace these canned and frozen imports. While some substitution would take place, it could be expected to be limited in amount. Other factors besides price affect the decisions of housewives to buy canned or frozen vegetables rather than fresh produce. Among these are longer storage life and the saving of time and labor in preparation for the table. Besides, certain imported canned and frozen vegetables, such as peas, are rarely grown in Hawaii, because they are not well adapted to the warm climate of the Islands.

In some cases and during some seasons, low growing costs in the continental United States are a limiting factor in substituting local produce for imports. Certain mainland vegetables are produced at lowest cost for the fall market. In contrast, the majority of Island farmers can raise truck crops most cheaply in spring and summer. The influence of production costs on the origin of Hawaii vegetable supplies has been demonstrated in the case of watermelons and tomatoes in recent years. The imported share of these vegetables in the local market is usually much larger in late summer or fall than earlier in the year.

Effect of Business Cycles and Long-term Trends on Island Vegetable Consumption

It is interesting to speculate what modifications in the civilian consumption pattern for fresh vegetables would be caused by changes in the business cycle and by long-term trends. The year 1947 fell in a period of postwar prosperity, full employment, and high prices in Hawaii. In 1949 many people were unemployed and a large number of firms cut salaries. It would be reasonable to expect a decline in the consumption of vegetables, particularly of the more expensive ones, during a depression. Between 1947 and 1949, Honolulu marketings of the 12 highest priced vegetables, all of which sold for more than 15 cents per pound wholesale, declined from 14.5 to 11.0 million pounds, or by 24.1 percent.

The sales of lower priced vegetables, not including potatoes and taro, were also lower in 1949 than in 1947. They decreased from 37.3 to 33.5 million pounds, or by 10.2 percent. Even the sales of three typical staple foods—rice, potatoes, and taro—declined from 89.8 to 83.5 million pounds, or by 7.0 percent.

It is probable that the decrease in marketings of vegetables and staples was at least in part brought about by a decline in consumption per capita and by a reduction of food waste at the consumer level. However, it must be remembered that the 1949 maritime strike, which lasted for half a year, brought serious dislocations in transportation. How much
of the decline in sales was due to lowered consumer incomes and how much to the strike cannot be determined on the basis of the available information.

The trend of vegetable consumption in Hawaii has been upwards during the past 50 years. This has been caused by the rapid population increase and by the rise in the standard of living. In the long run, vegetable consumption in Hawaii is likely to continue to grow. The main reason for this belief is the probability of a population increase as long as the present large excess of births over deaths continues.

There is likely to be a gradual decline in the relative importance of Oriental truck crops and an increase in the growing of western vegetables during the coming decades. This change will be caused by a continued shift of young people of Oriental ancestry to a western diet. This trend is accelerated at the present time by the fact that children of Oriental ancestry are becoming accustomed to western food in the public schools.

Exports

In the past, Hawaiian vegetable exports other than potatoes have been small. (See Table B7.) In most years they have been limited to Oriental vegetables such as lotus root, ginger root, and dasheen, mainly shipped to people of Oriental ancestry living on the West Coast.

The warm winter climate of Hawaii has led to repeated attempts to develop the export of winter vegetables to the West Coast. In 1933 potato shipments to California were begun. The crop was grown on lands that formerly had been used for the production of pineapples and sugar cane. Dwindling markets during the depression of the 1930's had thrown these lands out of production.

Hawaiian potatoes sold on the West Coast at high prices as "new" potatoes during the months of February through May. These shipments reached a peak of 4.9 million pounds in 1938. At the same time the importation of low-priced "old" potatoes from the mainland continued, amounting to 22.7 million pounds in 1938. However, Hawaii's potato exports were not very profitable, and by 1941 annual volume had declined to 1.3 million pounds. During World War II the total local production was used in Hawaii. Potato prices on the West Coast since the war have not been attractive enough to encourage resumption of exports from Hawaii.

Some fresh asparagus was exported to the mainland from 1935 to the outbreak of World War II. Most shipments were made from November through February. Exports never exceeded 23,000 pounds in any one year. During the war and the postwar period, the asparagus acreage greatly declined because of high labor requirements, and the crop is
no longer of commercial importance in the Islands.

Beginning in 1937 small shipments of green corn were made to the West Coast from December to April. In 1939 annual exports were largest, with 33,000 pounds. There were no exports during the war and the postwar period, but a few trial shipments have been made since 1950.

Until 1938 a federal quarantine regulation prevented export to the mainland of all crops attacked by the melon fly and Mediterranean fruit fly. In that year the perfection of a method to treat certain vegetables and fruits opened the way for mainland exports of additional winter vegetables. Trial shipments of tomatoes, cucumbers, squash, and sweet peppers were made during the 1939-40 winter and spring seasons, but the war interrupted further exports.

When in 1946 the Oriental fruit fly was discovered in Hawaii, mainland shipments of all crops attacked by that insect, including the four vegetables mentioned, were prohibited once more. The 1938 treatment was not satisfactory in destroying infestation of the Oriental fruit fly. Federal plant quarantine authorities approved a modified treatment for tomatoes in 1949, and trial shipments have been made since 1950. Trial shipments of snap beans, cucumbers, and bell peppers have been made since 1951, following the perfection of fumigation with ethylene dibromide gas.

Prospects are good for commercial exports from Hawaii of some of these vegetables, particularly snap beans, cucumbers, and green corn, if production and marketing costs can be kept low enough and providing the produce shipped is high grade. Exporters could probably sell most profitably varieties which are similar in appearance and taste to those familiar to consumers on the West Coast. Market preferences have become well established there over a long period of time and are difficult to change.

Quick-frozen green lima beans may be another potential export product for Hawaii. R. E. Burton, in 1948, found that there is a growing demand on the mainland for the quick-frozen green product. He pointed out that Hawaii has the advantage of being able to grow the crop at times of the year when the mainland is unable to produce it. Preliminary studies indicate that costs of production and yields per acre in Hawaii would compare satisfactorily with California, a center of the frozen lima bean industry. For profitable production, lima bean plantings would have to be on a scale large enough to use to full advantage mechanical cultivating and harvesting equipment and a processing and freezing plant.
Processed taro products have been sent occasionally to the mainland in small amounts since about 1890. The early undertakings do not appear to have been financially successful. Before the outbreak of World War II, two companies, one on Oahu and the other in California, used Island taro for the production of taro flour, taro powder, and taro baby foods. In 1940 exports of taro products from Hawaii totalled 129,000 pounds valued at $23,000. The war interrupted these exports.

In 1951 about 16,000 pounds of chilled or frozen fresh poi and 9,000 pounds of canned poi were shipped to the mainland. Most of these exports were bought by former tourists or former Island residents living on the mainland. This market could be expanded by improvement of the products, better merchandizing methods, and by some promotional effort.

According to a recent survey of Island physicians and dieticians, poi is recommended by professional people for many therapeutic and dietary purposes. Poi and other processed taro products, being highly nutritive and easily digestible, are excellent foods for babies, aged people, and convalescents. They are particularly valuable for diets in cases of digestive disturbances or food allergies. From this it would appear that such products have a large potential mainland market which could possibly be developed by a skillful advertising campaign directed mainly to medical doctors, hospitals, and dietitians.

**Price and Production Considerations**

West Coast prices greatly influence Hawaii's prices of fresh vegetables because of the large volume of imports. Island dealers will substitute cheaper imported produce for locally raised vegetables if prices of the latter get out of line.

In 1945, R. Elliott wrote as follows about the price differential between the Honolulu and San Francisco wholesale markets: "The San Francisco-Honolulu spread in price on the more perishable products such as broccoli, cauliflower, and lettuce is 3 cents to 5 cents per pound, and on less perishable items, 1 cent to 3 cents per pound." The mean spread between wholesale prices of winter tomatoes in San Francisco and Honolulu during the three seasons 1946-47 through 1948-49 was 5.3 cents per pound. These price differentials cover the cost of preparing goods for export, steamer freight, refrigeration in transit when needed, cartage, spoilage, and profit.

During World War II vegetable ceiling prices were set by the government, first by the Food and Price Control Sections of the Military Governor and later by the Office of Price Administration. The major aims of these agencies were to prevent an excessive inflation of produce prices, at the same time stimulating the local production of fresh vege-
tables to save shipping space. To achieve their second purpose the price controllers had to permit a substantial increase in vegetable prices. In 1943 the wholesale price index of 25 major vegetables (1938-41 prices equal 100) had risen to 198. (See Table B5.)

The production of two groups of crops was encouraged by the largest price increases: (1) low-priced vegetables such as head cabbage, sweet potatoes, beets, daikon, and dry onions, and (2) items extensively used in American dishes which had previously largely been imported, such as head lettuce and celery.

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<tr>
<th>Island Vegetable Output, 1941, 1944, and 1952</th>
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<td><img src="image1" alt="Vegetables 1941: 66 million lbs." /></td>
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Vegetable production increased from 66 million pounds in 1941 to 87 million pounds in 1944. (See Table B2.) However, this expansion was not entirely due to price increases. Farmers were deferred from the military draft, and production of vegetables by plantations and backyard growers was encouraged.

Among the crops which showed the greatest output increase were tomatoes, lettuce, celery, cucumbers, green corn, snap beans, carrots, onions, and potatoes. The production of luxury items such as watermelons and ginger root was discouraged by relatively small price increases, and their output declined.

After the war, prices increased further, particularly after the OPA abolished ceilings. The index of wholesale prices of 25 vegetables (1938-41 prices equal 100) stood at 268 in 1947. This amounted to a price increase of about one-third above the 1944 level.

Prices of two types of vegetables increased most during this postwar period. One group was Oriental and Hawaiian crops such as burdock, lotus root, yam bean root, and taro, which apparently had not received adequate price encouragement during the war. The other group consisted of vegetables with low nutritive value or luxury crops such as watermelons, ginger root, and cucumbers, the production of which had previously been discouraged. The marketings of both types of crops went up despite price increases. On the other hand, the prices of some vegetables declined, including such crops as celery, lettuce, and dry onions, which had been priced especially high by the OPA to encourage maximum local production. In 1951 fresh vegetable prices in Honolulu were on the average 9 percent higher than in 1947.
When war restrictions on mainland imports were lifted, Island vegetable production declined rapidly. Costs of growing truck crops in Hawaii were still substantially higher than on the mainland. Factors other than price which had stimulated production during the war were either no longer in existence or had greatly declined in importance. Most plantations had liquidated their vegetable enterprises, military draft laws no longer kept men of military age on farms, and backyard production had sharply decreased. As a result, Hawaii's vegetable output dropped from 87 million pounds in 1944 to 61 million in 1947. In 1951 it amounted to 58 million and in 1952 to 60 million. In comparison, the output in 1941, the last prewar year, was 66 million. Imports of mainland fresh vegetables amounted to 39 million pounds in 1947, about 42 million in 1951, and 33 million in 1952.

Vegetable production districts in Hawaii are of two types: upland and lowland areas. The major upland sections are the Kamuela and Kilauea Volcano districts of Hawaii and the Kula district on the western slope of Haleakala on Maui. The altitude of Kamuela is about 2,700 feet and the Volcano district slightly below 4,000 feet. The majority of Kula farms are located between 2,000 and 3,500 feet. Lowland truck crop areas are located from sea level up to elevations of 1,500 feet.

Upland districts are well adapted to the production of cool-season vegetables, such as head cabbage, head lettuce, celery, and cauliflower. Most other truck crops, such as snap beans, cucumbers, tomatoes, watermelons, and many root crops, can be grown either in high- or low-elevation districts, depending upon the season.

**Island Marketings**

Of the total commercial vegetable production of 57.8 million pounds in the Islands in 1951, Oahu raised 18.7, Hawaii 17.8, Maui 15.3, Kauai 5.0, and Molokai 0.9 million pounds. Honolulu was the principal outlet for Island-grown produce. All truck crops raised on Oahu were consumed on that island. In addition, 16.9 million pounds of vegetables were imported into Honolulu in 1951 from the neighbor islands. Unloads from these islands were as follows: Maui 7.7, Hawaii 6.3, Kauai 2.8, and Molokai 0.1 million pounds.

Considerable crop specialization exists in Hawaii by areas and some by seasons. At the same time there is a great deal of competition on
the Honolulu wholesale market among vegetable growers of the five major islands.

The total wholesale value of Island-grown vegetables on the islands of origin was 5.3 million dollars in 1951. Production on Oahu was valued at 2.0 million dollars and on the outside islands at 3.3 million.

Oahu farmers accounted for 32 percent of the quantity and 37 percent of the value of the vegetables raised in Hawaii. The main reason for the greater value of Oahu produce was the price spread existing between Oahu and the other islands. This is caused by the fact that Honolulu is the price-determining import market in the Islands. In 1951 the farmers on the outer islands exported 43 percent of their total production to Honolulu. Average annual wholesale prices were lower in these islands than in Honolulu, the difference being the cost of transportation and marketing between the neighboring islands and Honolulu. A portion of this expense was due to spoilage and deterioration of quality enroute.

Survey of Hawaii Vegetable and Fruit Farms

A survey of vegetable and fruit farms in Hawaii was made as of December 31, 1948. The purpose was to gather information about their size, ownership pattern, and mechanization. (See Tables B8 and B9.) Since both vegetables and fruit are grown on many farms, no attempt was made to get separate statistics for vegetable and fruit farms. Taro growers were included in the survey but not the producers of coffee, macadamia nuts, field corn, and rice.

The amount of cropland was considered to be the most significant and also the most easily obtainable single measure of land. Many Island vegetable and fruit farms include areas which cannot be cultivated because of rough terrain or other unfavorable characteristics. Other land in these farms is potentially cultivable but requires substantial improvements such as clearing or draining before it can be used for crops. The term "cropland" as employed in this survey includes all land that was in cultivated crops at any time during the years 1947 or 1948. There were about 1,800 fruit and vegetable growers in Hawaii at that date who produced for the market. The cropland included in these farms amounted to approximately 11,000 acres.

In order to find the relative importance of enterprises that were family-operated and those that relied mainly on hired labor, growers were separated into two groups: (1) large operators who hired two or more full-time workers or their part-time equivalent, and (2) family farmers who used less hired labor or none at all.

There were 19 large farmers who operated on 960 acres of cropland. This represents 1 percent of all fruit and vegetable growers in Hawaii and 9 percent of their cropland. One-third of the land on these large
farms was used for vegetable production, the remainder for fruit orchards. Large growers thus played a minor role in Hawaii truck crop raising in 1948, operating only about 5 percent of Hawaii's total vegetable acreage. Neither did large farmers dominate the production of any one vegetable crop. They raised 100 acres of a total of 1,000 acres of taro, and 100 of the 850 acres of watermelons. The part they played in the growing of other vegetables was even smaller.

At least half of the large truck crop producers were really family farmers using two or three workers in addition to their family labor. Most of these growers operated a cropland area of from 5 to 14 acres. The remaining large truck crop farms, owned by either individuals or corporations, cultivated mostly from 25 to 34 acres.

During World War II big growers played a more important role in vegetable production than now. Over 2,000 acres were planted to vegetables in 1942 by the sugar and pineapple plantations as an emergency measure. Most of this area was in Irish and sweet potatoes, various kinds of beans, and green corn.

Large farms have frequently become the dominant form of enterprise in Hawaii when a crop industry has greatly expanded and its exports have become important. Examples are the sugar, pineapple, rice, potato, and macadamia nut industries. Large vegetable farms may become more important in the future if exports of vegetables or vegetable products should expand greatly. As such a development is improbable in the immediate future, the remainder of this chapter will deal with vegetable production on family-sized farms.

According to the survey, some 1,780 vegetable and fruit growers operated about 10,000 acres of cropland primarily with family labor. In the following discussion, growers deriving less than half of their income from farming are considered part-time farmers and those deriving more than half are considered full-time farmers. Seventy-five percent of all vegetable and fruit growers were full-time farmers.

The survey showed that distance from or lack of other employment opportunities sometimes resulted in full-time farming. For example, Waipio valley on Hawaii is eleven miles from the nearest town, Honokaa, and about three miles from the nearest automobile road. Employment opportunities in the valley were limited. Consequently, most of the farmers in Waipio valley were full-time operators even though their cropland per farm averaged only three acres.
A small acreage was not always an obstacle to full-time farming. In some areas in or near Honolulu, full-time vegetable producers worked plots of one acre or less. They had an intensive, year-around market-garden type of operation. Many of them sold and delivered their produce directly to retailers or even consumers. Part-time farming was attractive for people receiving pensions and for large, low-income families in which not all members were fully employed in outside jobs.

Of the total of 1,780 small vegetable and fruit farms, 630, or 36 percent were held in fee simple by their operators; the remainder were leased. The proportion of leased and owner-operated farms varied greatly by district and by island. On Oahu, for example, only 11 percent of all small farms were owner-operated, compared with 48 percent on Maui.

The average amount of cropland per family-operated vegetable and fruit farm was 5.7 acres, ranging from 0.1 to 80 acres. Kauai had the lowest average cropland area with 2.2 acres per farm, and Maui had the largest with 8.8 acres.

A Study of Some Typical Vegetable and Fruit Farms

The writer studied the records of 36 fairly typical full-time Island vegetable and fruit farmers for the year 1947. A summary of that investigation is given here; more extensive discussion is included as Appendix C of this book. The sample included farm families from twelve upland and lowland districts on the four largest islands.

The value of assets per farm family averaged $13,100, ranging from $7,500 to $25,500. The average value of the real estate was estimated at $8,100 dollars, or 62 percent of all family assets. There was a car or truck on every farm, and some families owned both. Seventy percent owned tractors and tractor equipment; the others had too little cropland or land that was too rocky and shallow. They were all well equipped with power-driven machinery. Only seven farmers owned horses or mules, and few had livestock other than chickens.

Sales and production for home use averaged $4,000 per farm and ranged from $1,500 to $10,700. Most growers specialized in vegetable production; other agricultural enterprises were of minor importance. Only about one-fourth by value of the food consumed per family was raised on the farm; some growers raised practically nothing for home use.

Costs per farm averaged $2,500, not including charges for family labor. Cost levels varied greatly from farm to farm and district to district, depending primarily on size of output and degree of mechanization. For example, Kona farms were small in size, had a modest output, and were operated mainly with hand tools. Their average costs amounted to $1,000. Kauai farms, of larger size, with a greater output, and tractor-operated, had average costs of $4,300 per farm.
The whole family worked on the farm, putting in on the average labor equivalent to one full-time man and another working seven months of the year. About two-thirds of the work was done by men and one-fourth by women below retirement age. The rest was done by children and aged people.

The yearly net income for a man working full time on these farms averaged $1,100. In comparison, workers in the pineapple and sugar industries averaged from $2,100 to $2,250 per year, or about twice as much.* The size of the grower's net farm income depended on his ability and the resources of the farm, such as soil fertility, location with regard to the market, climate, and availability of irrigation water. The amounts of his sales and his ability to keep the ratio of cost to gross returns low were also reflected in his income. Other important factors which affect farm profit, especially market conditions, were not investigated in this study.

Off-farm income was substantial, amounting to 26 percent of the average family income.

After paying its net income taxes, the average farm family of slightly more than five persons had a net cash income of $2,061. Its living cost was $2,003, leaving average net savings of $58 for the year. This amount of savings does not appear sufficient to enable the grower to make a reasonable annual payment on his debts, to improve his farm and home, and to build up funds for his old age retirement and for special contingencies.

Comparisons of Vegetable Production Costs

The amount of labor required to grow most vegetables in Hawaii is much higher than on the mainland. A study made during World War II showed that Island labor requirements for producing a pound of snap beans, head cabbage, and green corn were about twice as high as on the mainland and for growing a pound of lettuce nearly three times as high.

If Island tomato farmers, for example, should decide to export to the

*Daily earnings of hourly rated Hawaii sugar workers for 1952 averaged 27 percent higher than in 1947. Annual earnings of regular production employees on Hawaiian pineapple plantations increased by about 40 percent over the same six years. The increase in net incomes of Island vegetable farmers was very likely much less during this period.
Vegetables grown in Hawaii during the winter, they would have to compete there with tomatoes grown in Southern California. Winter tomato records collected from Island farms for the years 1947 to 1949 were compared with winter records taken in 1950 in San Diego county, California. Farmers in Hawaii used nearly two and a half times as much labor as the Californians. Damaging diseases and insects were more prevalent in the Islands than in San Diego county. The Hawaii growers spent 17 times as much for fungicides and insecticides as the California farmers. Total costs of producing a pound of tomatoes in Hawaii were almost three times as high as in California. A more detailed comparison of labor requirements and costs of Island and mainland vegetables is included as Appendix D.

Farm Methods and Organization

Vegetable costs and prices have been shown to be higher in Hawaii than on the mainland. Island vegetable farmers must find ways of reducing costs and prices if they want to increase their local and export sales. It has been shown that the incomes of vegetable producers in Hawaii are lower than those of plantation workers. Vegetable growers must increase their income—at the same time they reduce costs—in order to obtain a standard of living equal to that of workers in the major agricultural industries. Since their largest cost is labor, a reduction of labor input per pound of vegetables produced appears to be the most urgent need.

Mechanization. In many cases, better utilization of machinery may be one answer to greater labor efficiency. There has been a substantial increase in the amount of agricultural equipment on Island farms during the last 15 years. The rising trend in the number of mechanized farms shows this development most clearly. In a sample of 277 of the better family-sized farms in 1934, only seven, or 2.5 percent, had tractors. According to the U.S. Census of 1940, out of a total of 4,918 unincorporated farms, 151, or 3.1 percent, had tractors. At the outbreak of World War II a survey was made of the agricultural producers of East Oahu, most of whom were vegetable and fruit growers. Of 341 farmers, 20, or 6 percent, had tractors.

While there appears to have been a slight increase in the use of tractors prior to World War II, the major increase occurred during and after the war. According to the 1948 survey of family-operated vegetable and fruit farms, 690 out of 1,750 farms, or 39 percent, had tractors. (See Table B8.) The same survey showed that in East Oahu 55 percent of all vegetable and fruit growers owned tractors—nine times as many as in 1941.

The amount of agricultural equipment per farm other than tractors
also greatly increased between 1934 and 1948. In 1934, according to F. E. Armstrong, "animal-drawn or tractor-drawn equipment is infrequently found, the most common piece of equipment of this kind, a walking plow, being found on only 20.2 percent of the farms. Slightly more than one farmer in eight has a spike-tooth harrow, while only one out of every 23 has a disc harrow."

In contrast, nearly all of the 26 tractor owners in the previously discussed sample of 36 vegetable growers owned tractor-drawn disc plows, disc harrows, and cultivators. In addition, some sample farmers had other equipment, such as tractor-drawn moldboard plows, planters, ridgers, terracers, post-hole diggers, spray rigs, and trailers. A number of the sample growers who did not own tractors had a horse or mule and horse-drawn equipment.

Lack of credit sources and low incomes had been major factors retarding farm mechanization. This was clearly brought out during an interview with a grower who had successfully mechanized many of his farm operations during the years after World War II. He said: "My neighbors and I wanted to mechanize for a long time, but nowhere could we get cash to buy tractor equipment. During the war we were able for the first time to save enough money to buy these things."

While the number of tractors and the amount of tractor-drawn equipment on farms has increased rapidly, the adaptation of farm operations to tractors and agricultural machinery has frequently been slow. The use of tractors by many growers is largely limited to plowing and harrowing before planting. For example, in the study of winter tomato production, nine farmers prepared their land for planting with a tractor. Only two used tractor-drawn cultivators after planting. In many cases vegetable rows are too close to each other to allow the use of a tractor after the crop is seeded or planted.

Much labor could be saved by finding more uses for machinery already on the farm, as is shown in the following example: Burdock, a root crop, is usually harvested in the Islands by hand digging a trench about 37 inches deep. The average amount harvested daily by this method is approximately 150 to 200 pounds per man. A Kamuela grower attaches a subsoiler to a long shaft; he pulls this with a tractor along both sides of the rows to be harvested. Two men follow the tractor on foot, pulling the loosened plants out of the soil without effort. This crew of three harvests two tons of burdock per day.
Machinery costs are high on many Island vegetable farms because equipment is not used often enough. For example, sometimes tractors are used for not more than 100 or 150 hours per year. A study in 1948 in Hawaii showed the relation between cost per hour of operating a two-plow, rubber-wheeled tractor and the total number of hours per year this tractor was used. It cost $2.00 per hour if the tractor were run 100 hours per year, $1.52 per hour at 150 hours, and 86 cents per hour at 500 hours.* Overhead costs per hour for tractors and other agricultural machinery decline rapidly with increased utilization.

Many Island vegetable growers are overequipped, considering their present crop acreage and production methods. Growers could reduce their equipment overhead in three ways: (1) by having others do some machine jobs for them on a fee basis, (2) by renting equipment, and (3) by cooperatively owning equipment with their neighbors.

In several districts of the Islands there are people who contract to do some farm jobs with agricultural machinery. This is often a satisfactory way for a grower to get equipment for an operation which requires heavy machinery or special equipment such as a soil fumigator. It is also helpful in an emergency. However, for light tractors and frequently needed machinery, such as cultivating and spraying equipment, a farmer needs a close, dependable, and cheap source of supply.

Some growers use their neighbors' equipment. The rent for two-plow wheel tractors in such cases is $1.50 per hour and often more. While this is cheaper for many farmers than owning their own tractor, it is still a rather high rate. Since the owner services the machines, however, this method of getting equipment is convenient for farmers who have had no training in machinery upkeep.

Cooperatively owned agricultural machinery is now used occasionally. Two or more neighbors buy the equipment together and share overhead costs according to the amount of use of the machine by each co-owner. If more than one partner needs the equipment at the same time, previous agreement or the drawing of lots decides who is going to get it first. Cooperative use of machinery works out best if one of the partners assumes responsibility for maintenance.

Many growers are wasteful in the use of their trucks, because they drive with less than full loads to and from town. During World War II a truck pool was organized by the military authorities for transportation of farm commodities between the outlying districts of Oahu and Honolulu. The number of farmer trucks on the road was greatly reduced, and much gasoline, oil, and equipment was saved. However, after the war most Oahu growers returned to individual hauling. Labor could be

* These were minimum cost figures, because a 20-year life of the tractor was assumed. With a 15-year depreciation of the tractor, costs of hourly use were $2.30 for 100 hours, $1.73 for 150 hours, and 92 cents for 500 hours of annual use.
saved and the cost of keeping and operating trucks reduced by more contract trucking or by increasing the cooperative operation of vehicles.

**FARM SIZE.** There is a trend toward larger vegetable acreage per farm in the Islands. The average vegetable area harvested per farm, exclusive of taro and Irish potato land, increased from 2.4 acres in 1929 to 3.2 in 1939 and 4.1 in 1949. The island of Hawaii showed the greatest percentage expansion, from 1.6 acres harvested per farm in 1929 to 4.6 in 1949. Comparable data for 1929 and 1949 were 2.6 and 6.5 acres for the county of Maui, and 2.6 and 3.4 acres for Oahu. On Kauai, the acreage fell from 2.7 in 1929 to 2.4 in 1949. However, the Kauai acreage constituted less than 5 percent of Hawaii’s total.

This trend toward larger vegetable farms and fields is caused primarily by greater mechanization. A grower can produce substantially more with tractor-drawn machinery than with hand tools. The bigger his vegetable output, the smaller is his machinery overhead cost per pound of vegetables raised.

Both the proportion of land required for manipulating equipment and the time during which machinery is used per acre decline with an increase in the size of fields. The same turning space for agricultural implements is needed at the end of a field regardless of its length. With a short furrow, turning takes a larger portion of the total time during which equipment is used than on a long field.

While the average size of vegetable farms in Hawaii has substantially increased, this trend is by no means universal for all farms or all districts. Many small farms in the Islands exist primarily to make use of family labor which otherwise would be largely unemployed. This is the case, for example, for farms that are mainly run by the wife, the children, or old people. Frequently, retired persons produce some vegetables for the market to supplement their pensions. Other small market gardens are operated by persons with part-time employment.

The majority of these growers are located in semi-residential areas, where they have little chance of increasing their acreage. The whole farm is usually less than one acre and often less than half an acre in size. Many of these growers use hand tools almost exclusively in working their plots. A few own garden tractors, and some hire a full-sized tractor for plowing. With labor their major cost, many semi-commercial vegetable producers of this type can be expected to continue to operate in Hawaii, particularly if economic conditions should deteriorate.

In districts such as the Kilauea Volcano area or Kona, the total crop acreage per farm and the size of fields are frequently small because of the lack of available cropland. Only small plots are suitable for vegetable production; the surrounding terrain is too rough, too rocky, or too shallow for cultivated crops. Some of these farms are already marginal
at present produce prices. If the price level for vegetables should decline, these places might have to be abandoned unless they are reorganized along more diversified lines.

**DIVERSIFICATION.** Greater diversification of some of Hawaii's vegetable farms seems desirable for three reasons: (1) it decreases the risk element inherent in specialized vegetable farming; (2) it makes possible a better use of farm resources; and (3) it reduces cash expenditures while at the same time allowing an improvement of the diet of the farm family.

Returns from vegetable production in Hawaii fluctuate greatly. If the weather is favorable, insect and disease damage low, and market prices high, a vegetable producer can make a good profit on a crop. However, if luck is against the grower, his losses may be heavy. Production, in addition to vegetables, of products which bring more stable returns would put his farm business on a sounder foundation.

Waste products of vegetable growing may be used profitably in livestock enterprises. For example, producers of sweet potatoes for baking may expect that as much as one-half or more of their crop will be culls or surplus over market requirements. In the absence of livestock enterprises, this portion of the output would be of little value to the farmer. If either cattle or hogs were kept, both sweet potato vines and tubers could be utilized as feed. Similarly, refuse and culls of other vegetables, such as tomatoes or lettuce, can be fed to hogs or ducks. Furthermore, fertilizer costs could be reduced by the use of livestock manure.

On many vegetable farms only land suitable for vegetable production is being utilized. Rough or rocky areas are lying idle. Rent paid on these portions of the farm is charged to the vegetable enterprise as part of the cost of cultivatable land. If located in areas with suitable climate, macadamia orchards or useful trees could be planted on some of the slopes which are too steep for truck crop production. Other idle land might be utilized as livestock pasture. A dairy calf or two grazing on a truck-crop farm has become more common in Hawaii of late.

Production for home use by Hawaii's growers has been low for many years. In 1934 only one-third of a large sample of farmers not specializing in hog raising had any swine. Only 5 percent of the non-dairy farmers kept dairy cows for subsistence purposes. Other livestock, except poultry and draft animals, was even scarcer. In 1941 more than 40 percent of East Oahu farmers had no home gardens. In 1947 only about one-
fourth of the food eaten by 36 families included in a sample of Island vegetable growers was produced on their farms. An increase in the production for home use, as mentioned earlier, would be an effective way of cutting cash expenses and of improving the diet of the farm family.

However, greater diversification may not be the best way for all vegetable growers in Hawaii to improve their farm business. Many growers prefer to concentrate on a few truck-crop lines. They point to various factors favoring truck-crop specialization in their case, such as: (1) the small amount of land on their farm, (2) their long experience and skill in vegetable growing, (3) the special advantages of their location, and (4) an assured market outlet for their produce.

**CROP-GROWING PRACTICES.** Crop-growing practices need to be improved on many farms. For example, expenses for fertilizers are large. Fertilizer requirements change rapidly on most Hawaii vegetable farms because of climatic conditions and the intensive cropping system practiced. Soils should be tested at frequent intervals so that growers can be sure they apply the right types and amounts of fertilizer and use sufficient lime. However, few producers have their soils tested regularly, even though this service is provided free by the University of Hawaii.

More cover crops, green manure, and mulching are needed. Almost all Island vegetable farms require large amounts of nitrogen fertilizers. Furthermore, in some districts, such as the Volcano area, the organic material in the soil is rapidly being depleted. The planting and plowing under of leguminous cover crops could decrease the amount of nitrogen fertilizer required and could slow down the depletion of organic matter in the soil. Despite these advantages, cover cropping is rarely practiced in Hawaii.

More crop rotation is possible on many Island vegetable farms, even though the small amount of cropland is frequently a limiting factor. Many growers plant the same crops year after year on the same piece of land. As a consequence, insects and diseases become thoroughly established in the field. Labor and material inputs per pound of vegetable increase because of declining yields, more need for pest control, and higher fertilizer requirements.

The effect of good farm practices can be shown by comparing the method of a progressive taro grower in Hanalei valley, Kauai, with those of some East Oahu taro growers. The latter frequently grow several taro crops in succession on the same patch. The land is rested for one week to two months between crops. The patch is usually plowed and harrowed once and the refuse of the preceding crop is left in it. As a result, pythium rot spoils a large portion of the crop, soil fertility has deteriorated, the taro yield has declined, and the percentage of poi which millers get from the taro also has decreased. Because of poor
soil preparation, weeding labor is high, amounting to one-third or more of the total labor on many fields.

In contrast, the Hanalei grower usually rotates taro with rice. He dries the land thoroughly and plows and disks it at least three times over a period of several months, the first two times with a tractor. His losses from rot are low, and taro and poi yields continue high. While his labor inputs during the preparation of the land for planting are somewhat higher than for the Oahu growers, his weeding costs are about two-thirds lower.

**PLANNING.** Island vegetable growers need more and better farm records to help them plan their business and to enable them to get loans. The records kept at present are largely confined to income and expenses for income tax purposes. Very few keep field records on yields, crop conditions, labor, material, and machinery inputs.

More growers are becoming aware of the need of farm budget plans. With the help of these budgets, the family can plan the allocation of its labor and resources to the various farm enterprises during the year. Some farm families help each other during periods of peak labor needs and cooperate in the use of equipment requiring the work of several people. In such cases the neighbors must coordinate their farm plans so that their periods of peak labor requirements will not coincide.

Community planning could frequently be helpful to all growers in a district. For example, common action could reduce the costs of insect and disease control. Farmers could coordinate their spraying, dusting and field sanitation operations for greater effectiveness. They might establish a community warning system to report the outbreak of certain quickly spreading pests. Such a warning system exists on the Eastern seaboard of the United States for late blight of tomatoes. Soil Conservation Districts have been organized in most vegetable areas. Such districts should be established for all agricultural lands where there is a need for them to help solve the local problems of soil and water conservation.

**Marketing**

Some farmers market their produce by selling it directly to retailers or by peddling it to consumers. However, most fresh vegetables and fruits pass also through the hands of at least one wholesaler. Two produce wholesale districts exist now in Honolulu. The older one is located on River Street, near the center of the city. The other was developed after World War II about two miles to the southeast, on Ala Moana, the shoreline boulevard.

Since World War II the number of wholesalers has greatly increased while the market volume has not changed much. Sales volume per
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wholesaler is low and overhead costs per unit of sales are high. A smaller number of wholesalers could probably do the job more efficiently and cheaply.

Cooperatives handle a large part of the fresh vegetables and fruits grown on the outer islands. They usually sell products destined for consumption on the island of origin directly to retailers. Most produce shipped by them to Honolulu is sold to wholesalers. Among Oahu vegetable farmers, the proximity of Honolulu and easy contact with wholesalers and retailers in the city has discouraged the development of strong produce cooperatives.

In recent years great advances have been made on the outside islands in cooperative grading, packing, and marketing of vegetables. Packing houses have been built, and grading and packing in many areas is done there rather than in the field. However, few Island produce cooperatives have yet gained the internal strength which many mainland cooperatives have. Continued education in cooperative principles and practices is necessary.

There are too many small cooperatives, resulting from the numerous farmer factions and groups. By increasing their membership, local cooperatives could use their facilities to capacity. If they had more members they could install more mechanized packing and grading equipment in their packing houses. Some cooperatives might to advantage combine into island-wide and even territory-wide organizations.

Large fluctuations in wholesale prices over short periods of time is one of the major problems of Honolulu's produce market. For example, between mid-April and mid-May of 1952 wholesale prices of snap beans slumped from 18 cents to 5 cents and climbed back to 17 cents per pound. Many vegetable- and fruit-producing areas on the mainland can ship to any one of several markets. Hawaii has no place to market produce that is not consumed here, except for the fraction of 1 percent which is exported. For that reason Honolulu is called a "pocket market."

Practically no vegetables are commercially canned or otherwise processed here. A small excess in market supplies causes sharp price declines and a temporary scarcity brings great price increases. Less fluctuation of prices and a steadier flow of crops to market would reduce the risk of doing business for farmers and dealers. It also would result in lower produce prices to consumers in the long run.

Both farmers and dealers can aid in bringing about more orderly marketing. Many growers still concentrate their plantings during the seasons of the year when they expect highest yields per acre. In their production plans they should give more weight to seasonal market requirements and prices. The market and outlook reports issued periodically by the University of Hawaii Agricultural Extension Service are helpful in making planting decisions.
Closer cooperation between farmers and wholesalers would frequently be of advantage to both parties. Farmers could benefit by consulting their wholesalers in making production plans. Dealers should keep their farmers informed about their needs, and farmers in turn should let the wholesalers know about the condition and progress of their crops. There are now times when a wholesaler does not know what a farmer is growing until the produce is actually delivered to his warehouse.

A strong territory-wide federation of grower cooperatives could be helpful in bringing about a more evenly distributed supply of Island vegetables on the Honolulu market. It could assist agencies now collecting production and market information. It would be in a position to give wholesalers timely warning of approaching scarcities, so that they could order substitute imports from the mainland. In case of oversupply of a commodity, the cooperative federation might declare shipping holidays or establish other types of marketing restrictions until the emergency has passed.

If orderly marketing during periods of overproduction cannot be maintained by voluntary means, it could be brought about by law as a last resort. Marketing agreements approved by a majority of the producers and enforced by law have helped in overcoming temporary market gluts on the mainland.

Many Island growers would like to change present methods of selling local produce on the Honolulu wholesale market. Wholesalers in the city usually handle locally raised produce on a commission basis, or buy it upon delivery in Honolulu. In contrast, they purchase mainland vegetables and fruits f.a.s. West Coast ports, which means that they acquire ownership of the produce when it is delivered alongside ship. They naturally give preference to mainland imports, which they own, over local consignments. They will hesitate to buy competing Island produce until they have sold their mainland holdings.

Hawaiian growers would like to overcome this handicap by selling their vegetables and fruits on an advance-sales basis. However, individual Island farmers are frequently unable to guarantee delivery of certain quantities at set dates, primarily because of weather hazards. A territory-wide cooperative organization might help Hawaii’s farmers, because it would have a broad enough supply base to make advance-sales contracts.

Great progress has been made during the last few years by Island growers and retailers in the quality of fresh produce offered for sale. Before World War II many vegetables and fruits in Hawaii were inferior in quality and appearance to those available on the mainland. During the postwar years grading, packaging, and retail merchandising has been greatly improved. However, some farmers, especially on Oahu, should be more careful in the preparation of produce for market.
Some Island retailers do not give enough attention to good merchandising of fresh produce. They offer for sale in the same containers fruits and vegetables of both good and poor quality. They keep slow-selling produce on their shelves for days without reducing its price, until it becomes unsalable, whereas progressive stores sell poor-grade fruits and vegetables at a discount at the end of the day or on weekends. Better merchandising practices would bring these retailers more satisfied customers and larger sales.

Retailers have an important role to play in overcoming a glutted market. It is their job to quickly translate reduced farm prices into lower consumer prices and thus to increase sales. Island growers frequently complain that many Honolulu retailers are slow in reducing their prices despite sharp cuts in farm and wholesale prices.

A strong advertising campaign could probably increase consumer demand for locally grown vegetables, particularly during a period of overproduction when prices are low. Freshness would be a good argument in favor of Island products.

**Land and Water**

In many districts where vegetables are now grown, scarcity of irrigation water is a severe handicap. For example, farmers on the Kula slope of Haleakala often lose much of their crops during summer and fall when there is little or no irrigation water for 60 days or more.

Water costs in many cases are high. For example, in the spring of 1953 the growers in the Kula district paid 15 cents per 1,000 gallons for the first 10,000 gallons per month and 25 cents for every additional 1,000 gallons. Oahu farmers paid the Suburban Water System 29 cents per 1,000 gallons for the first 25,000 gallons per month and 19 cents per 1,000 gallons thereafter. It is estimated that some produce farmers in the Kailua and Kaneohe districts of Oahu need the equivalent of one irrigation of two acre-inches every 10 days for five months per year or 810,000 gallons per acre, which would cost them $166.00.

Many farmers, such as those who receive their irrigation water from the Oahu Suburban Water System, get a better quality of water than they need. Their irrigation water is pure and delivered to them under high pressure. Their water costs could be materially reduced if non-potable, low-pressure water supplies could be developed.

For years, Island vegetable growers have been seeking both high- and low-level lands on which low-cost irrigation water is available and which is adapted to the use of mechanical equipment. They want to use upland areas for the production of cool-climate vegetables for local consumption. For winter crops—some of which might be exported—they desire low-altitude land with a relatively dry climate.
Most of the lowland areas which meet their requirements are utilized for sugar cane and pineapple production. Suitable lowland and upland areas now used only for grazing lack a dependable, year-around water supply. Some of these lands are so dry that vegetables could not be grown on them at any time of the year without irrigation; others would require irrigation water in periods of low rainfall.

Several irrigation projects of importance to vegetable growers were proposed during the last two decades. A few years before World War II a plan was worked out to irrigate about 12,000 acres in Hoolehua on the island of Molokai. The climate of the district is semi-arid and in most years there is not enough rain for successful vegetable-growing. Anticipated construction costs were high, about five million dollars at the time. The project was recommended by the Territorial Planning Board and originally had the approval of the Army, the Navy, and the Department of the Interior. However, during 1942 the Congress of the United States failed to pass legislation providing for the project.

The Waimea Plain Project on the island of Hawaii called for the irrigation of 1,500 acres, well suited for temperate-climate vegetables. The Commissioner of the U.S. Bureau of Reclamation turned in a favorable report on this project to the Secretary of the Interior in 1948. Costs of construction were estimated at $850,000 for the entire undertaking, or $567 per acre. A resolution in the 1949 territorial legislature to authorize construction of the project did not pass. However, the 1951 territorial legislature appropriated one million dollars for developing a new irrigation project at Waimea.

Other factors affecting the vegetable industry, such as credit, research, education, government services, and legislation, have been discussed in Chapter 2. In connection with land tenure problems, it might be added that Island vegetable farms owned by the operators are usually in better condition than leased farms. Dwellings and other farm improvements are frequently better constructed and maintained. In general, good soil conservation and crop rotation practices are less prevalent on leased farms than on owner-operated farms.

Improvements of the land pay for themselves only over a period of years. The farmer will not invest his labor and money unless he is sure to reap the gain. Landlords could remedy this situation by giving tenants credit for the improvements they make, by lengthening their leases, and by requiring good soil conservation practices.

Some lease contracts, particularly for taro land, stipulate that tenants are not permitted to change the farm layout. Such clauses in rental agreements may prevent making the most profitable use of the land. For example, a farmer might not be able to use mechanized equipment unless he increases the size of fields or taro patches.
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FRUITS • Acreage Trends, 1910 to 1952

Hawaii’s acreage of major fruits other than pineapple has doubled during the last 20 years. It fluctuated between 900 and 1,100 acres in the period 1910 to 1930. (See Table E1.) By 1940 it had increased to 1,700 acres, and by the middle of 1952 it had further expanded to 2,000 acres. The change in area has not been uniform for all fruits during the last four decades.

Papaya orchards increased more than threefold, from less than 100 acres in the years 1910 and 1920 to 320 acres in 1940. This expansion followed the introduction of a new variety of excellent taste, the “solo” papaya. During the war, the importation of mainland fruits was curtailed to save shipping space. On the other hand, Island demand for fresh fruit strengthened with the rapid increase in military personnel and in the civilian population. As a consequence, papaya groves were expanded to 550 acres by 1944. In expectation of papaya exports, growers enlarged their orchards to 870 acres at the end of 1950. Severe rainstorms in the spring of 1951 destroyed many trees in Waimanalo, which was the major production center on Oahu. Total Island plantings declined to 400 acres but rose to 590 by early 1953.

With growing mainland demand, banana plantings increased from 420 acres in 1910 to 690 acres in 1920. Because of declining exports, plantings decreased to 630 acres by 1930. As the Island population increased, banana plantings expanded once more to 705 acres in 1940. Under the stimulus of the war demand they rose to about 1,000 acres, despite the cessation of all exports. Total acreage was still at that level at the beginning of 1953.

In 1910 avocado orchards had expanded to 120 acres in anticipation of the development of an export market on the Pacific Coast. The discovery of the Mediterranean fruit fly in Hawaii in 1910 shattered these hopes. Mainland exports of fresh avocados were prohibited, and by 1920 plantings were reduced to half the 1910 acreage.

During the following 20 years avocados became a popular salad fruit
in the Islands. Some growers expected the development of an export market for avocado products and the early lifting of the ban against fresh shipments to the mainland. As a consequence, plantings expanded to about 400 acres in 1940. However, hopes for large exports did not materialize, and commercial plantings in 1952 amounted to only 160 acres.

Mangos, grown in Hawaii for over a hundred years, have been valued highly as an edible fruit. Nevertheless, they have not been planted in commercial orchards until rather recently. In 1930 the area devoted to cultivated mango trees totalled about 65 acres. Since then several orchards have been planted with newly introduced superior varieties. Commercial plantings of mangos amounted to 160 acres in 1940 and 220 acres in mid-1952.

Early in this century some immigrants, particularly Portuguese, believed that grape growing might have a future in Hawaii. The number of grapevines reported by the U.S. Census in 1910 covered a total area of nearly 300 acres.* However, vineyards were not successful. Climate and soil were not favorable; insects such as the Japanese beetle, and nematodes did great damage to the vines. Only nine acres of vineyards were reported in 1920. In 1952 the area devoted to grape production was so small that it was not listed separately in Hawaii agricultural statistics.

The commercial production of oranges has mainly been carried on by some small growers on the island of Hawaii, where plantings amounted to 24 acres in 1952. Tangerines grow well in the Islands. Commercial orchards increased from 11 acres in 1940 to 22 acres in 1952.

Litchi have been grown in Hawaii home gardens since their introduction from southern China in 1873. The number of trees more than doubled in the decade ending in 1950, with some of the recent plantings

*A. Acreage of Fruits Other than Pineapple, 1930, 1940, and 1952

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
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<tbody>
<tr>
<td>1930</td>
<td>1,100</td>
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<tr>
<td>1940</td>
<td>1,700</td>
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<tr>
<td>1952</td>
<td>2,000</td>
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*However, according to D. L. Crawford, "the area in producing vineyards has at no time reached 100 acres in the Territory."
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on an orchard basis. Total acreage in litchi on farms, both for home use and for sale, amounted to about 70 acres in 1950.

Guavas are growing wild over many thousands of acres in Hawaii. They are not grown commercially, but some of the easily accessible fruit is gathered for making jelly and juice.

Location and Size of Orchards

In 1952 nearly two-thirds of the total fruit acreage in the Islands was located on Oahu, 16 percent on Hawaii, 5 on Molokai, and 1 on Kauai. The production of each major type of fruit is quite localized. Almost two-thirds of all papayas are grown in East Oahu, along its coastal strip, the lower portion of its mountain slopes, and in its small valleys. Another 15 percent is produced in scattered areas throughout West and North Oahu, and 15 percent in Puna and the Hilo area on Hawaii.

Of all eating bananas, 86 percent are produced in East and South Oahu, in places where they are fairly well protected from destructive southern storms. About 80 acres, or 8 percent, are grown on Maui.

The mild climate of Kona is well suited to the production of all kinds of tropical and subtropical fruits. Most of the cooking bananas and more than four-fifths of the commercial avocado crop are raised there. Most of the avocado trees are scattered throughout the coffee orchards of the district. Kona farmers also raise the best-liked oranges in the Islands. Other citrus districts are in Puna and near Hilo, where most of Hawaii's tangerines and oranges are grown.

About three-fifths of the commercial mango acreage is located on Maui and another third on the leeward coast of Molokai. The commercial production of deciduous fruits, primarily plums and some peaches, is limited to the uplands. The Volcano area on Hawaii and the Kula slope of Maui are the main areas where these fruits are grown for sale.

The relative importance of large and small farms in Hawaii's fruit industry was studied by the writer during a survey in December 1948. Of 2,065 acres in fruit orchards, only 530, or about one-fourth, were on farms employing two or more hired workers. Ninety percent of the acreage in cultivated mangos, 35 percent of the avocado plantings, and 15 percent of both papaya and banana orchards were operated by these large fruit growers. The greater portion of commercial litchi plantings were also on large farms. The remaining fruit acreage was managed by farmers hiring less than two men per year. The family farm was, therefore, by far the most common type of operating unit among fruit growers.
Fruits for Island Consumption

In 1951 a total of 43.5 million pounds of fresh fruits and 0.6 million pounds of frozen fruits other than pineapples were available for sale in Island markets. (See Table E2.) Latest figures for canned and dried imports are for 1947, when 6.2 million pounds of canned fruits and 1.3 million pounds of dried fruits were imported. Market supplies of canned and frozen fruit juices, except pineapple, were estimated at 0.4 million gallons for 1951. All dried and frozen fruits, almost all canned fruits and fruit juices, and 69 percent of the fresh fruits were imported.*

There was little competition between imported and home-grown fresh fruits of the same kind. Nearly all deciduous fruits were imported. The main items in this group were 6.3 million pounds of apples, 2.2 million pounds of grapes, 1.4 million pounds of pears, 1.2 million pounds of nectarines and peaches, and 0.9 million pounds of plums and prunes. Plums were the only locally grown deciduous fruit of commercial importance, with a probable 0.1 million pounds or less harvested in 1951.

The entire Island supply of tropical fruits and some subtropical fruits, such as bananas, papayas, mangos, and avocados, was grown in Hawaii. Citrus fruits were the only type of subtropical fruits imported in competition with commercially grown Island fruits. Oranges, with a consumption of 14.4 million pounds, were the most popular fruit in Hawaii. Only 0.25 million pounds of oranges, or less than 2 percent, were locally grown. Of the 0.55 million pounds of tangerines consumed in the Islands, one-half were locally grown. Nearly all of the 3.3 million pounds of grapefruits, lemons, and limes, were imported.

Island fruit growers might be able to substitute their products for some of the fruit imports. A skillful advertising campaign by farmers and dealers could probably increase consumer demand for locally grown fruits. Advertising might emphasize the price differential between imported and home-grown fruits. For example, retail prices of oranges and apples, the two fruits imported in largest volume, averaged 17 and 21 cents a pound respectively between March and May 1952. During the same period papayas and bananas, the two most important Island fruits, sold for 13 cents a pound.

*In 1952 only 24.3 million pounds, or 61 percent, of the fresh fruits were imported.
Other favorable qualities of Island fruits that could be emphasized in promotional work are freshness, high nutritive value, and variety of use. Papayas and guavas, for example, contain more vitamin C than oranges. Bananas are an easily digested carbohydrate food. Both bananas and avocados can be utilized in many different prepared dishes.

Advertising would probably strengthen the demand for some of the Island-grown deciduous fruits, such as plums or peaches. A greater local market could also be developed for the lesser-known subtropical and tropical fruits, particularly in the hotels and restaurants catering to the tourist trade.

Fruits for Export

BANANAS. Chinese (Cavendish) bananas were the only Island fruit other than pineapples that were exported in volume before World War II. (See Table B7.) All banana exports were sent to the West Coast, mainly to San Francisco. Shipments rose from about 6 million pounds annually in the first decade of this century to 15 million pounds in 1915. They ranged from about 10 to 13 million pounds per year during the 1920's, and decreased to around 6 million pounds in the 1930's.

The war interrupted these exports. When the Oriental fruit fly, discovered in Hawaii after the war, was found to attack bananas, shipments to the mainland were forbidden. In 1951 the U.S. Bureau of Entomology and Plant Quarantine again permitted the export of Chinese bananas to the mainland after treatment with ethylene dibromide gas. Trial shipments of bananas from some Hawaii growing districts to the West Coast arrived in good condition; bananas from other districts did not tolerate the treatment and spoiled. The reasons for this differential tolerance to ethylene dibromide have not yet been definitely established. San Francisco wholesalers believe that the prewar demand for Chinese bananas from Hawaii could be revived. They expect the fruit would sell well there during the fall, winter, and spring months. Bananas from test shipments sold for as high as 16 cents a pound wholesale in San Francisco early in 1952. However, sales prospects are poor on the Los Angeles market, where buyers prefer Bluefield bananas.

PAPAYAS. Hawaii's young papaya export industry shows considerable promise. Shipments of this fruit began in 1938, after a treatment against the Mediterranean fruit fly had been perfected. Fresh fruit exports exceeded 300,000 pounds in 1941 but were interrupted by World War II and the subsequent introduction of the Oriental fruit fly. By 1949 the U.S. Bureau of Plant Quarantine had developed a safe method for treating the fruit against the new fly; mainland exports reached 310,000 pounds in 1951 and 380,000 pounds in 1952.

Had it not been for the disastrous storm in 1951 which wiped out
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half of the papaya acreage, the 1951–52 export volume would have been much larger. Mainland demand for papayas was strong. During the winter and spring of 1951–52 fresh papayas sold at wholesale for $3.25 to $4.50 per 10-pound box. Retail prices ranged from 50 to 80 cents apiece for good quality papayas in California.

Market prospects for papayas on the mainland are bright, particularly during the winter season on the West Coast. However, much work lies ahead before a large-scale export industry can be developed. The quality of Hawaii papayas upon arrival in West Coast markets varies greatly. Island shippers have to provide the mainland trade with a stable, high-grade product.

To avoid bruising and injury, the fruit has to be handled with utmost care during harvesting, packing, and shipping. It has to be picked just at the right stage so that it will ripen and color and still be firm on mainland retail stands. The territorial Board of Agriculture and Forestry has established high quality standards for export papayas. Strict enforcement of these grades should prevent any unscrupulous exporter from spoiling the market by exporting cheap and inferior papayas.

In some shipments spoilage caused by anthracnose rot has run as high as 10 percent or more. Research is under way on methods to reduce this loss. Progress with some treatments, in particular a hot water treatment, is encouraging.

With the development of large-scale exports, retail prices of about 30 cents per pound or less on the West Coast might be expected. That would be about half of what papayas sold for on the mainland in 1951. Prices would probably be somewhat higher during the winter and spring and lower during the summer and fall. Shippers believe that they could still export profitably at these prices. They are counting on paying growers from 5 to 8 cents per pound. They estimate their packing, selling, and advertising costs at 7 to 8 cents and transportation costs at 3 cents per pound. They expect mainland wholesale prices to average 19 to 22 cents a pound.

Most growers think that they can operate satisfactorily at the farm prices envisaged by the shippers. According to an Oahu survey in 1950, it cost 33 growers, on the average, an estimated 4.5 cents to produce a pound of papayas. This figure included a charge of $.85 per hour for labor but made no provision for grower profit. Only part of the fruit harvested is of export grade and can be sold at top prices; the remainder has to be sold for less on local markets or to processors.

The selection of mainland receivers was an important decision for Island papaya exporters to make. Most commercial papaya shipments from Hawaii are now sent to a cooperative of avocado farmers, the Calavo Growers of California. Calavo is a national distributor and maintains more than 30 offices throughout the United States. Island shippers
apparently thought that one central organization, experienced in the nation-wide handling of a specialty product, could give them best service in expanding their market.

Some processed papaya products, primarily nectars, were exported from Hawaii previous to World War II. In 1941 Island canners shipped close to 22,000 cases of papaya nectar to the mainland. During the last few years papaya processing has gradually expanded, with an estimated 1.5 million pounds of papayas processed in 1950.

The major export product is still nectar. Another is papaya puree, which is shipped in both canned and frozen form. Papaya puree is a combination of pulp and juice from which other products are manufactured. Also exported in small amounts are canned papaya slices, papaya powder, and mixed jams and marmalades of papayas with other fruits. Research is in progress on other papaya products, such as new juice blends, spiced and brined papaya, and papaya baby-food products.

Papaya products are usually sold at slightly higher prices than comparable mainland products. In the spring of 1952 canned papaya nectar sold in California mostly for 15 cents per 12-ounce can, compared to 11 to 13 cents for the same size can of pear, apricot, or peach nectar. Most of the processed papaya products are still slow sellers but are gradually becoming more widely known.

Hawaii is not the only supplier of fresh papayas and papaya products for United States markets. Southern Florida and the Rio Grande Valley of Texas have small acreages. Puerto Rico has a small area planted and could expand. Cuba is the principal source of foreign imports.

Most producing regions competing with Hawaii are subject to serious crop losses—Florida from hurricanes and frosts, Texas from frosts, and Cuba and Puerto Rico from hurricanes and mosaic. Hawaii is favored by its frost-free climate, its freedom from mosaic and other extremely destructive diseases, and by relatively light damage from windstorms. These advantages are partially offset by higher wage rates, land rentals, and transportation costs.

The quality of Hawaii's fresh solo papayas is valued highly on the mainland. On the Pacific Coast, where nearly all fresh exports from the Islands are now shipped, Island papayas enjoy practically a monopoly.

Cuba will continue to export papaya puree and some fresh fruit, particularly to Atlantic Coast markets. Florida processors are expected to make consumer products, using mainly purees or fresh fruit from Cuba, and market them on a national scale. The Rio Grande Valley and Mexican east coast districts could also compete in fresh fruits and processed products.

Close cooperation between the various industry groups is essential to the development of a large and profitable papaya industry in Hawaii. Seasonal problems will have to be overcome. Papaya sales will probably
slow down during summer and fall, when many different mainland fruits are available at low prices. During this season papaya trees produce most abundantly in Hawaii. In the past few years, papaya processors have been able to use some of the surplus papayas. They should continue to plan for peak operation during the summer and fall and thus provide an outlet for fruit that would otherwise be wasted.

Papayas are as yet little known on the mainland. People in the trade are being informed by Island marketing specialists about the right method of handling, storing, and displaying this tropical product. Consumers are being told about the food value of papayas and taught the best ways of utilizing the fruit. More trade promotion and consumer advertising will be needed to develop a volume market.

Industry cooperation in handling seasonal gluts, balancing expanding plantings and markets, and promotional work might best be brought about by an industry-wide trade organization.

AVOCADOS. Fresh avocado exports to the mainland were prohibited in 1912 because the fruit was a host of the Mediterranean fruit fly. No satisfactory treatment of avocados against fruit flies was developed until 1951. In that year test shipments, fumigated with ethylene dibromide gas, arrived in good condition on the mainland. Since the fall of 1951 regular monthly shipments of one ton or more to the armed services in the Western Pacific have been highly satisfactory.

Scientists and marketing men are now investigating the possibilities of developing a sizeable avocado export industry in Hawaii. Avocado preferences on the mainland are well defined, particularly on the Pacific Coast. Consumers like the fruit to be about 6 to 14 ounces in weight—not too large and not too small. Other important factors affecting sales are good eating quality, high oil content, good color and shape, small seed, and not too thick skin.

A great number of different avocado varieties grow in Hawaii, maturing at various seasons of the year. They are mostly of the Guatemalan and West Indian types, usually weighing one pound or more. Each variety is now being carefully studied for its consumer qualities, season of ripening, tolerance to the ethylene dibromide treatment, optimum storage temperatures, and storage life.

Preliminary test shipments seem to indicate that Island avocados, mainly because of their larger size, may sell below the price paid for Fuerte, the major California variety. They might bring prices comparable to those paid for large West Coast varieties. One such variety, California Nabals, sold for $2.50 to $3.50 per 13-pound box in 1951, which was about $1.00 below prevailing Fuerte prices.

Avocado marketings on the mainland amounted to about 61 million pounds in 1950. Of this total, California produced 68 percent and Florida
18 percent. The remaining 14 percent was imported from Cuba. So far, Hawaii's avocado industry has been geared to Island consumption needs, which amounted to slightly more than one million pounds in 1951. Hawaii, therefore, now produces less than 2 percent of all market supplies in the United States. Island production cannot be expanded very rapidly, since new plantings take three to five years to come into bearing and longer to achieve full production.

The Pacific Coast, because of its proximity to the Islands, is the logical outlet for Hawaii avocados. Avocado sales are increasing faster there than in other regions of the mainland. Pacific Coast residents now consume more than 40 percent of the entire U.S. avocado supply.

In Los Angeles, which is the nearest large market to California's avocado orchards, price competition is more severe than elsewhere. Primarily because of freight, prices in the more northern Pacific Coast cities are higher than in Los Angeles. The difference amounts to about 25 to 50 cents per 13-pound box for San Francisco and to about $1.00 for Seattle. Since Hawaii's ocean freight costs are the same to all major Pacific Coast ports, sales in the northern West Coast markets promise to be more profitable.

California's production is heaviest from December to April and continues to dominate mainland markets in May and June. Its output tapers off to a low from August through November. Cuban avocados are most common on mainland markets in July and August and Florida avocados from September through November.

The best marketing season for Island avocados on the Pacific Coast appears to be from September through November, when California production is at a low point. During these three months in 1951, Florida shipped avocados to the Pacific Coast which brought $4.00 to $4.25 per box. The next best months for Island exports may be July, August, and June, in that order.

Hawaii's opportunities in the mainland market depend principally on the relation between its production and marketing costs and those of other competitive areas. Average production costs in Hawaii are believed to be about the same as in Florida, but lower than in California. Marketing costs on the Pacific Coast for Island avocados are higher than for those grown in California and probably only slightly lower than for their Florida competitors. Island growers and packers expect that they can reduce their costs if Hawaii's avocado industry should expand.

Early in the 1930's some avocado oil for cosmetic purposes was exported from Hawaii. Later, avocado pulp was exported for the manufacture of such products as mayonnaise and ice cream. These exports reached a peak of about 26,000 pounds in 1939. However, no large commercial shipments of avocado products have been made after World War II.
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**MISCELLANEOUS FRUIT PRODUCTS.** The export of some other fruit products is gradually increasing. Among these are jams and jellies of guavas, pohas, and mixed tropical fruits, mango chutney, and guava nectar. The development of a successful method of freezing the juice of passion fruit promises to bring yet another small industry into being. The frozen passion fruit juice or concentrate can be used in many ways. It is an excellent flavoring agent in sherbets, ice creams, and other foods. It may be diluted with water or blended with other juices to make drinks or punches. It provides the fruit acids needed to pep up comparatively bland fruit products like papaya juice.

The yellow-fruited variety of passion fruit, most suitable for juice production, is being grown in back yards for home use. Since it can be cultivated with ease, expansion into commercial production is not expected to present difficulties. Scientists at the Hawaii Agricultural Experiment Station believe that the new passion fruit products will find a good market on the mainland.

**Production Problems and Research**

Agricultural machinery is rarely used on fruit farms other than for preparation for planting and occasionally for cultivating or spraying. However, a few growers have shown that motorized equipment could be employed to advantage in Hawaii’s orchards for many other tasks.

For example, one farmer in East Oahu greatly reduced the labor required in fertilizing his papaya grove by using a tractor. Fertilizing in most groves is still done entirely by hand. This grower pulls a sled heaped with fertilizer slowly through the orchard with his tractor. Two men stand on the sled and throw the fertilizer with a shovel around each tree as they pass by. Because the fertilizer is not covered with earth, a small portion of the nitrogen is lost into the air. This loss, however, is made up many times by the saving in labor cost.

On most fruit farms there is little diversification; many growers have no livestock whatsoever. They could, for example, keep a few pigs to feed their unmarketable fruits. At present, culls are frequently left lying on the ground and serve as breeding places for fruit flies and other damaging pests.

Relatively few fruit plantings are on land owned by the farmers themselves. Most leases are too short to make capital improvements on the land worth while to the renter. The recent experience of papaya growers in Waimanalo, Oahu, provides a typical example of the drawbacks of short leases. The drainage system in that area needed improvement. But, since the land was leased to the papaya growers for only a few years, extensive improvements were not considered profitable. For the same reason few growers planted windbreaks which were adequate for a dis-
strict where strong winds sometime occur. During a storm in March 1951, mentioned earlier, the drainage system proved insufficient. Overflowing water loosened the roots, and the wind, unchecked by windbreaks, blew over many trees. Hundreds of acres of papayas were lost.

Growers have found that replanting papayas in the same field where they have just been raised results in low yields. Investigations are under way to find an answer to this vexing problem.

The search for new fruit varieties and varietal selections continues to be important. The need for choosing good avocado varieties for export has been pointed out before. Horticulturists at the University are testing various strains of passion fruit for suitability in commercial plantings. They are also breeding for export purposes a papaya which is smaller than the solo variety. Many mainland buyers are expected to prefer a smaller fruit.

In view of the large imports of deciduous fruits into the Islands, the commercial possibilities of growing more of these fruits locally is being considered. Some deciduous fruits are being produced successfully in upland areas. For example, the Methley plum bears heavily at higher elevations, producing small, dark-red fruit of satisfactory quality.

Several years ago the most pressing problem in connection with fruit growing in Hawaii was the control of fruit flies, particularly the Oriental fruit fly. In 1947, for example, 50 percent of the crop in a Maui mango orchard was unmarketable because of fly damage. Scientists traveled to many tropical and subtropical countries and sent back parasites of the major fruit flies. Some species of these wasp-like parasites, which develop in the larvae of the flies, have successfully established themselves in Hawaii. As a result the damage done by the Oriental and Mediterranean fruit flies has substantially declined.

MACADAMIA NUTS • Characteristics

Macadamia nut production is today one of the fastest growing and most promising agricultural industries of Hawaii. The smooth-shelled variety of these nuts (Macadamia ternifolia var. integrifolia) was introduced into Hawaii from Australia in the 1880's. The meat of the nut is considered by many people to be superior in flavor to most other edible nuts, including coconuts, almonds, pecans, English walnuts, and cashew nuts. The nuts are ovoid to spherical in shape and about one to one and one-fourth inches in diameter. The shells are extremely hard and vary from one-sixteenth to one-fourth of an inch in thickness, with the heavier shells predominating. Since cracking of the shell by hand is difficult, the nuts are rarely sold to consumers in the shell.

The macadamia makes an excellent salted nut. In 1951 about 75 percent of the total Island output was sold in that form, vacuum-
packed in glass jars of 12, 7, and 3½ ounces. Approximately 20 percent of the production was used for chocolate-coated nut candies. The remaining 5 percent was sold to bakeries and ice cream manufacturers.

Macadamia nut oil is said to compare favorably with the finest grade of edible olive oil and to have some medicinal value. It is thought that the oil could be used to make a high-grade soap and a mild butter. However, none of these secondary products have yet been manufactured, because the supply of nuts has not been sufficient to satisfy the demand for the primary products.

The macadamia tree usually attains a height of 30 feet or more. The first crop of commercial importance appears in the seventh year and full bearing is approached about the fifteenth year. From observations made in Australia, it is believed that the tree will produce nuts for a period of 100 years.

### History

During the first 30 years after the introduction of the nuts into Hawaii, interest in growing them for commercial purposes was small. In 1920 only 27 acres were in macadamias. In 1922 a stock company was formed and sizeable orchards were set out on Oahu and Hawaii. By 1927 there existed 10 plantings of from 1 to 100 acres each, with a total area of about 300 acres, on Hawaii, Maui, Oahu, and Kauai. In that year the territorial legislature exempted all commercial macadamia plantings from taxation for five years to help the infant industry.

Island interest was further stimulated in 1931 when a processing plant was set up in Honolulu where the nuts were cracked, graded, roasted, salted, and packed in consumer-sized containers. By 1938 the total area in macadamia orchards reached a peak of 1,086 acres.

However, profits from many orchards were disappointing. All of the trees planted previous to 1936 were seedlings. Many of these produced low-quality nuts or had poor yields. Grafting better varieties on these trees seemed too expensive to most growers in the depression years. Besides, the costs of processing and marketing the nuts were large because of inadequate machinery and the small volume of the total crop.

During the next few years some plantings were abandoned, and by 1943 the total area in cultivated macadamias had diminished to 667 acres. When prices of nuts in the shell rose from 10 to 14 cents per pound between 1943 and 1944, some mature acreage was reclaimed and brought back into production. Macadamia orchards in 1946 amounted
to 774 acres. In-shell production rose from 380,000 pounds in 1943 to 965,000 pounds in 1952.

Between 1946 and March 1953, macadamia orchards tripled in area from 770 to 2,360 acres. At the latter date about 900 acres were of bearing age and the rest non-bearing. Of the total acreage, 1,670 acres were located on Hawaii, 270 on Maui, 240 on Kauai, and 180 on Oahu. The majority of macadamia plantings so far have been made by corporations or individuals using two or more hired workers. The development of the largest orchard to date was begun in 1948 by a corporation in Keaau near Hilo on the island of Hawaii. The company bought 3,000 acres of virgin forest land on stony lava soil. By March 1953 slightly more than 600 acres had been planted, and by 1954 the area planted will amount to 1,000 acres according to present plans. The second largest orchard is located on the Hamakua coast, also on the island of Hawaii. It totals about 500 acres, of which the greater portion is in bearing. There were about 100 commercial macadamia orchards in all at the end of 1952, of which an estimated 80 or more were on small farms.

Most new plantings were made following the public release of several outstanding varieties by the horticulturists of the Hawaii Agricultural Experiment Station. These men had made their selections from 60,000 seedling trees after 10 years of testing the qualities of both nuts and trees. Nuts from the first five selected varieties averaged 37 percent kernel, and 91 to 97 percent of the kernels were Grade A. In contrast, tests with nuts from seedling orchards gave only 24 percent kernel, with 80 percent Grade A.

Yields from bearing trees now in commercial orchards average about 40 to 50 pound in-shell. Unpublished records of the Experiment Station show an average yield of 60 pounds per tree from 10-year-old trees of the selected varieties. One mature tree at the Kona branch of the Station has produced 150 pounds in-shell per year.
It requires 4 to 4.5 pounds of hulled nuts from seedling trees to produce one pound of kernels, as compared to only 2.7 pounds for large samples of the new varieties. It can be expected that per-acre yields from commercial plantings of the new varieties will amount to at least 3,000 to 4,000 pounds in-shell. Such yields, in terms of shelled nuts, will equal those of walnuts and exceed those of almonds and filberts.

Some macadamias were exported to the mainland before World War II. In 1940 these shipments reached a peak estimated at 110,000 pounds. Exports were not permitted during the war. They were negligible during the first two postwar years but rose to about 23,000 pounds of shelled nuts in 1947. Trade experts estimate that in 1951 about one-fourth of the total production was exported by processors and growers. In addition to these shipments, territorial residents sent an unknown but substantial amount of macadamias by parcel post as gifts to mainland friends.

Potential Production in Hawaii and Other Areas

In Hawaii macadamias grow from sea level to an elevation of 2,200 feet and in some districts possibly at still higher elevations. The trees can adapt themselves to different amounts of precipitation. On Oahu they have done well in areas with 35 to 50 inches of rainfall. However, experiments and observations indicate that a full crop may be expected in semi-arid regions only if plentiful irrigation water is applied. Un-irrigated, macadamias do best in localities with an annual rainfall of from 60 to 150 inches, depending upon the district.

Macadamia orchards require shelter from strong winds. The trees have a weak root system and the branches of most varieties are easily broken. They are adapted to many kinds of soil. Their major requirements are a well-drained soil with a pH of six and preferably of five.

No survey has been made of the land area in Hawaii that could be planted to macadamias without displacing other crops. However, it seems probable that 25,000 to 50,000 acres of land suitable for macadamias but marginal for other cultivated crops could be found without much difficulty, mostly on Hawaii and Maui. Some estimates have been even larger. The limiting factor to additional plantings is more likely to be market demand than available land.

Hawaii is apparently the only place in the world where macadamias are now produced commercially on a significant scale. The nuts are known to have been planted, besides Hawaii and Australia, in California, Texas, Florida, and a number of Mediterranean countries. Formerly, it was believed that macadamias required a strictly tropical climate. However, trees growing in Southern California appeared little damaged by the severe frosts in 1949. Macadamias, being hardier trees than avocados,
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can probably be grown wherever the latter do well, possibly as far north along the California coast as Santa Barbara. California citrus growers, confronted with rising competition from Florida and Texas, may soon be looking for substitute crops. Macadamia nuts might become one of these in some localities.

The climate in southern Texas might be satisfactory for macadamias, and land is available. However, the irrigation water needed for a full crop is scarce. Florida is not believed to be a good place for growing the nuts. Tree losses and limb breakage from hurricanes can be expected to be high. Soil drainage in areas like the Everglades, with their high water table, is poor. Besides, Florida's limestone soils are probably too basic for optimum development of macadamias.

Island nut producers are far ahead of their potential competitors in other production areas, because they possess a selection of good high-yielding varieties well-suited to Hawaiian conditions. It took Hawaii research men and orchardists about 15 years to develop the industry to its present stage. The tree selections which do well in Hawaii may not be suited to other production areas. It can be expected, therefore, that it will take growers in these other areas at least 10 to 15 years to develop their macadamia industry to the point where Hawaii producers are now.

Demand and Prices

In 1952 the demand for macadamia nuts exceeded Island supplies. Particularly, Island growers cannot fill all large orders of mainland processors. The few macadamias that are now shipped to the mainland command top prices among shelled nuts. For the next few years the industry will probably have no difficulty disposing of its output because production will increase slowly. However, Island producers will face a different situation when the recently planted nut orchards, consisting of high-yielding varieties, come into bearing. The local market cannot use many more macadamias at present prices. Foreign exports of a luxury product such as macadamias are difficult to make during the present dollar shortage.

Most of the increased output, therefore, will have to be exported to the mainland. There it must compete both on a quality and a price basis with the shelled product of the major nuts now on the market, such as walnuts, pecans, almonds, filberts, Brazil nuts, and cashews. People acquainted with the American shelled-nut market believe that a large demand can be developed for macadamias because of their superior quality. However, some promotion and aggressive sales effort will be required, because few mainlanders are now familiar with the Island product.

Prices to growers of macadamias have generally been lower than
prices to growers of mainland nuts. Farm prices for macadamias in-shell during the five year period 1936–40 ranged from 8 to 9 cents per pound. They rose gradually to 15 cents in 1945–46. Since 1947 they have been mostly 17 cents per pound.

Prices per pound in-shell to nut growers in the major mainland production areas were as follows in the period 1936–40: improved pecan varieties 12.5 cents, walnuts 10.1, filberts 11.9, and almonds 14.7. During the war and the immediate postwar years, almonds reached an annual peak price of 37.2 cents in 1944, filberts 27.6 cents in 1945, and improved pecans and walnuts 40.1 and 27.7 cents respectively in 1946. Since then mainland nut prices have declined. During the five year period 1947–51, growers averaged 22.7 cents for almonds, 19.6 for walnuts, 20.4 for pecans, and 14.2 for filberts. Thus among major mainland-grown nuts, only the farm prices of filberts averaged lower than those of macadamias during the last few years.

**Farm Costs and Returns**

The writer estimated the cost of producing macadamia nuts on a family-operated farm. Under 1949 conditions it would cost about $535 net per acre to bring an orchard to the point where it would start to bear a small crop at the end of seven years. (See Table E3.) At a land value of $150 per acre the total orchard investment would be $685 per acre. In the calculations a wage of $1.00 per hour for truck and tractor driving and of 80 cents per hour for all other work was used. Labor, equipment, and material costs totaled almost $400, or more than half of all costs. Accrued interest on invested capital amounted to $174, or one-fourth of all costs. The time between the eighth and the fourteenth year after planting is usually considered as a break-even period, during which returns equal costs.

A family can handle about 34 acres of mature macadamia trees, yielding 1.5 tons of nuts in-shell per acre per year. It is assumed that one man spends full time and the rest of the family the equivalent of half a worker's time on the nut enterprise.

At 1949 costs the total investment in a well-equipped nut farm of that size was estimated at about $37,000. (See Table E4.) Thirty-four acres of orchard land and one acre of farmstead were valued at $5,250, or $150 per acre. Investment in buildings and installations amounted to $10,600, including a farm home worth $6,500. The bearing orchard of 34 acres was valued at $18,200, based on the development costs previously discussed. It was assumed that the farmer used modern equipment, whenever possible, and that he owned most of the heavy machinery cooperatively with two other growers. Total investment in equipment on that basis amounted to $2,650.
The present price for in-shell nuts at Island processing plants is usually 17 cents per pound. As mainland exports gain in volume, the price to growers will have to be reduced by additional costs for freight, marketing, and promotional effort. If it is assumed that these additional expenses would amount to about 3 cents per pound, gross returns to growers would be reduced to 14 cents per pound. At the conservative yield estimate of 1.5 tons per acre, gross receipts by growers would be $420 per acre.

In 1949 total costs, except for labor, of producing improved varieties of macadamia nuts on a family farm and delivering them in-shell at dock or processing plant were estimated at $118 per acre. (See Table E5.) The return for management and family labor would be $302 per acre, or $10,300 for a 34-acre orchard.

Growers would get some returns for their labor even if farm prices for macadamia nuts should decline to one-third of their present level. Suppose we take prewar prices of 8.5 cents per pound, less expected future additional transportation and marketing costs of 3 cents. That would bring farm prices down to 5.5 cents per pound. If costs should remain at the present level,* the farmer and his family would receive $1,700 for their year's work in their 34-acre orchard. However, in a period when nut prices decline to such a low level, we may expect farm costs to decrease also, say by one-third. In that case, annual returns to the family for their labor in their 34-acre planting would be $3,000, or 72 cents per hour worked.

Some Factors Affecting Cost

Costs of establishing a macadamia orchard can be reduced by pasturing cattle in it or by growing other crops between the trees. Many orchards are planted on rather steep slopes on which grass is seeded to

* Except, however, for a reduction in the gross income tax, which varies proportionately with gross income. See Table E5, footnote a.
prevent soil erosion. Grazing of young dehorned cattle other than bulls has been successful in at least one large orchard. Other animals, such as bulls, horses, mules, and sheep, are too wild or graze too close.

Cattle should not be let into the orchard until the trees are about four years old and the animals cannot reach the growing tips. Under moist soil conditions very limited grazing should be practiced. Salt must be provided so that the cattle will not chew the bark of the trees, which contains tannic acid. Overgrazing should be avoided. When the trees are about 10 or 11 years old the grass is gradually shaded out. Animals should then be taken out of the orchard to protect the grass cover. The main expenses of keeping cattle in the orchard, other than the purchase price of the animals and possibly some supplementary feed, would be fencing and cattle guards around fill-in trees.

Several methods of interplanting trees are being used by growers. In Kona, macadamias are successfully raised in bearing coffee plantings, being substituted for coffee trees at intervals of about 30 to 35 feet. A large nut producer is planting twice the number of macadamia trees that will ultimately remain in the orchard. When the trees begin to crowd each other, he plans to take out alternate trees. Short-lived fruit trees such as papayas are also occasionally interplanted with macadamias.

Vegetables or flowers can be raised between the young trees during the first six years after planting. However, two large growers who tried this lost money on the project. Vegetables and flowers require continuous attention and much labor. Interplanting of these crops can probably be done more profitably in small orchards.

Macadamia growing is well adapted to family-sized farms. Several acres can easily be developed as a side enterprise. When the orchard comes into bearing, family labor can be used in harvesting the crop. Gathering the nuts from the ground is at present still the most expensive labor operation in producing macadamia nuts. It accounts for about 60 percent of the total labor time. (See Table E5.) Large operators succeeded in greatly reducing the costs of establishing an orchard by using heavy agricultural machinery, but some operations, particularly harvesting, still need to be mechanized.

In seedling orchards nuts on different trees ripen at various times, necessitating some harvesting the year around. With few exceptions, about 90 percent of the crop of a macadamia orchard matures during a period of approximately four months, July through October. There might be a possibility of reducing the ripening spread of trees by certain cultural practices, such as hormone sprays or controlling the time and type of fertilization.

Planting only one variety in an orchard apparently is not advisable. Research is in progress on the advantage of fertilizing the flowers of one variety with pollen from other varieties. Indications are that many
varieties set a greater crop of nuts when cross-pollinated than when self-pollinated. One grower considers cross-pollination so important that he keeps bees in his orchard.

Processing costs now constitute almost 50 percent of the total expense of producing the finished macadamia product. Existing processing plants have a small capacity. Many operations, such as candy making, are still mainly done by hand. As output increases, larger and more highly mechanized plants could be built, reducing greatly the cost per pound of finished nut products.

COCONUTS

With few exceptions, coconut palms are not grown on a commercial scale in Hawaii. The low cost of producing copra in the Philippines and other tropical countries has prevented the development of a coconut industry in the Islands. However, thousands of the picturesque trees are grown throughout Hawaii. Most coconuts do not reach the market but are consumed by the growers.

A small mainland export of coconuts has been developed, amounting to 82,000 nuts in 1952. Some minor products are manufactured in Hawaii from the meat of the nut, such as coconut candy, fresh-frozen shredded coconut, and toasted and salted coconut chips. The shell is used for the manufacture of novelties, such as buttons and buckles.

The statisticians who prepared the 1950 Census of Agriculture for Hawaii did not consider coconut palms sufficiently important economically for separate enumeration. A few farmers use coconuts to feed hogs and cattle. There is no reason to believe that the production of coconuts in Hawaii will increase in the near future.

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COFFEE • History Since Annexation

The price of Hawaiian coffee, and with it the profitability of coffee-growing in the Islands, has fluctuated greatly during the last 50 years. As Hawaiian prices have not been protected by a tariff, they have changed with world market prices. The only exceptions were due to government control during and after World War II and the establishment of a ceiling by the Office of Price Stabilization from 1951 to early 1953.

The prices of green Island coffee dropped from between 35 and 40 cents per pound in the period 1887–98 to 10 to 13 cents in the decade 1902–11. In the short boom after World War I, they reached a high of 26 cents and then declined to 15 cents.

Between 1924 and 1929, Brazil, the world’s largest coffee producer, raised prices by limiting its coffee exports. This “valorization” policy had the effect of raising prices of Island coffee to a level of 23 to 28 cents per pound during that period. With the abandonment of the policy by Brazil, Hawaiian coffee prices dropped to pre-World War I levels. Between 1932 and 1941 they ranged from 10 to 13 cents.

During and after World War II the demand for coffee in the United States increased faster than available imports. Island coffee prices, which stood at 17.5 cents per pound at the end of the war, continued to climb during the postwar period. For the crop year 1951–52, the price for grade “prime” coffee reached the annual average of 51 cents per pound f.o.b. Hawaii mill.

The production of Hawaiian green coffee ranged from 1.2 to 2.7 million pounds between 1900 and 1923. Average output rose to about 4 million pounds during the following decade. While Brazilian valoriza-
tion policy greatly stimulated Hawaiian production, its full effect was not felt until after Brazil had given up its program. In 1933-34, Island production reached a peak of 10.4 million pounds. From then on, output gradually declined to 6.3 million pounds in 1945. During the period 1946-52, it fluctuated between 4.3 and 7.7 million pounds.

The area planted to coffee rose from 3,700 acres in 1909 to 5,700 in 1919. By 1945 the cultivated coffee area had declined to 3,500 acres, at which level it remained until early 1952. Since then it has increased slightly.

Hawaii-grown “Kona coffee” is among the higher priced coffees in the world. Except for World War II, when almost the entire production of the Islands was used locally or sold to the armed forces, most of the Hawaii crop has been exported. During the 1930’s substantial exports, amounting to several million pounds annually, were shipped to the Philippines and to foreign countries. Since World War II most exports have been shipped to the mainland, where Kona coffee is used primarily for blending.

Description of the Coffeegrowing District

Today practically all commercially grown coffee is produced on the Kona coast of Hawaii in a strip 25 miles long and 2 miles wide, some 800 to 2,200 feet above sea level. In this area a cloud bank forms almost daily during the warm summer months, making coffee production possible without shade trees at altitudes as low as 800 feet.

The rainfall distribution is almost ideal for coffeegrowing. A wet period lasting from March or April to September or October is favorable for the blossoming and maturing of the crop. A decrease in rainfall during the subsequent three months, followed by three months of dry weather, facilitates the picking and drying of the coffee. The soil is fertile but shallow and rocky, and the land is rather steep in most of the district.

When prices declined early in the twentieth century, Caucasians who had planted large areas to coffee lost interest and subdivided their plantations. Coffeegrowing became an industry of small-scale farmers, who for many years have been mostly of Japanese ancestry. In recent years some Filipinos have also become coffeegrowers.

In 1952 there were about 700 coffee farms in Kona, most of them averaging from 5 to 8 acres in size. Some were as small as 1 acre and others as large as 40 acres or more. For about three-fourths of all coffee farmers, the crop is their major source of income. In 1950 a little more than one-fifth of the commercial coffee farms were owned in full or in part by their operators. The rest were leased, mainly from large landholders.
Farm Costs, Returns, and Inventory

Incomes of coffee farmers were very low in the middle 1930's. Between 1932 and 1937, economists of the Agricultural Extension Service summarized over a hundred one-year records of Kona coffeegrowers. Their average gross receipts per acre were $167 and their costs, excluding family labor, amounted to $96. Net returns to the farm families for their work were $71 per acre. Growers and their families worked, on the average, 641 hours per acre. Their return for labor was, therefore, only 11 cents per hour. These figures explain why most coffeegrowers were deeply in debt and the cultivated acreage declined during this period.

Conditions were not much better during the first year of World War II. For price-control purposes the costs of production of about 60 Kona coffeegrowers were surveyed in 1942. On a per acre basis the average receipts of the growers were $264, their costs $151 excluding family labor, and their net returns for labor and management $113. They and their families worked 685 hours per acre, thus earning 17 cents per hour. While the earnings of coffee farmers rose somewhat during the following war years, they remained smaller than those of most other farmers and of non-agricultural workers. Consequently, the cultivated coffee acreage continued to decline during the war.

In the postwar period coffee growing became more profitable. The 1947 records of eight full-time Kona coffeegrowers who had received farm-ownership loans from the Farmers Home Administration were analyzed by the writer. The gross receipts per acre for these growers averaged $493, costs $180, and returns for labor and management $313. Their income per hour worked was estimated at 49 cents, or more than four times as much as during the depression period of the 1930's.

The net earnings of the eight coffee growing families averaged $2,630. After deduction of all living costs, net savings amounted to $350 per family. Since 1947 grower returns have risen greatly, with coffee prices in 1952 nearly twice their 1947 level.

Some other observations made during the 1947 study are of interest. The eight coffee farms were small, averaging only seven acres in coffee per farm. Yet hired labor amounted on the average to $300, or 23 percent of total costs.

The need for hired workers on coffee farms arises from the fact that nearly three-fourths of all labor is required during harvesting. The whole family of the coffee grower works long hours during the harvesting season. School vacations are shifted to the time the crop matures in order to free the children for picking. Nevertheless, in most groves hired help is needed during the peak of the harvesting period.

Food raised for home consumption per farm was valued at $220 at retail level. With a retail value of $1,140 of food eaten by the family,
home produced food accounted for only one-fifth of the total food consumption.

Kona coffee farms are highly specialized, according to the 1950 Census of Agriculture. Except for a few chickens and occasionally some pigs, mules, or asses, they have little livestock. Coffee accounted for 97 percent of all their farm sales in 1949; vegetables, fruits, and nuts for 2 percent; and livestock for 1 percent.

Many coffee growers had a car, jeep, or light truck. However, practically none of them had tractors, because of the rocky nature of most of the land and the close, irregular spacing of coffee trees. The average value of land and buildings was $5,600 per farm. The major buildings and structures on a Kona coffee farm include, besides the house, a drying shed for coffee, equipment to remove the pulp from coffee beans, and a water tank.

**Outlook for Coffee Growing in Kona**

Coffee yields per acre in Kona are among the highest in the world. Research is now under way to maintain or increase these yields, at the same time reducing labor costs. This is hoped to be done through wider spacing of trees and adaptation of pruning techniques to the new planting method. It also involves a study of the proper amount, time, and rate of application of fertilizer to the more widely spaced trees.

A substantial reduction in the cost of growing coffee by the increased use of machinery is improbable in Kona. As we have noted, the land is largely unsuited to tractors, and no mechanical device has yet been developed which could be substituted for hand picking, the most labor-consuming task of the coffee grower.

The lack of sufficient drying facilities has been a bottleneck in Kona coffee production. On most farms coffee is dried on platforms in the sun. Overcrowding of these drying platforms, particularly in years with a short ripening season, frequently causes deterioration in quality of some of the coffee. A small artificial dryer has recently been developed which is suited to the family-sized farms of Kona. It can be made for less than a third of the cost of the traditional drying platforms. Better drying may improve the quality of Kona coffee and result in higher prices to growers.

Some observers believe that Kona coffee growers could raise their incomes by forming a processing and marketing cooperative. In particular, they are of the opinion that a cooperative could develop a sizeable mainland market for Kona coffee in uniformly branded consumer packages. The development of a strong coffee cooperative is unlikely during the next few years, however. Kona coffee growers are probably the most individualistic group of farmers in the Islands, re-
luctant to give up their freedom of action. It was this trait more than anything else which made them stay on their coffee farms during the hard times of the 1930's, even though they could have earned better wages elsewhere.

Changes in the land tenure system of Kona would be of advantage to coffeegrowers. At present, coffee leases rarely run for more than 10 or 15 years, many for 5, and some for only 1 year. Few improvements will be made on coffee farms unless growers are given longer leases. Growers have been unsuccessful in attempts to get leases of longer duration by legislative means. They would like changes in their lease contracts which would assure them of reimbursement for their undepreciated investments upon expiration of their leases. They also request that large landowners offer for sale good coffee land in family-sized lots.

The high degree of specialization in coffee has worked out well for Kona farmers during the high level of coffee prices in the last few years. However, if coffee prices should substantially decline, some diversification of their farm business might become profitable. Except for the harvest season, some of the family labor on coffee farms is underemployed. More production for home consumption would probably pay. Other tree crops, such as macadamia nuts and many kinds of subtropical and tropical fruits, do well in Kona. The climate is also favorable for the production of anthuriums, orchids, tropical foliage, and vegetables.

With the increase of coffee prices, values of coffee land in Kona rose greatly in the years after World War II. Farmers who bought coffee orchards for $250 per acre in 1940 were offered up to $2,000 per acre early in 1953.

Despite high coffee prices, the cultivated coffee acreage did not expand until 1952. Since then, new plantings have been increasing in number and more are contemplated. Even newcomers from outside Kona have taken up leases on newly opened-up lands in South Kona. However, the total expansion in coffee acreage so far has been small. In view of the present demand and high prices for coffee and lagging production in foreign countries, a further expansion of the coffee industry in Kona seems justified.

FLORAL PRODUCTS • Recent History

The wholesale value of floral sales of the larger Honolulu florists was estimated at about $160,000 per year in the prewar period 1936–40. This figure did not include marketings by plant nurseries, by sidewalk lei sellers, and by small produce retailers who sold flowers as a sideline. In 1945 the gross sales of the 41 largest Honolulu florists amounted to $530,000 at wholesale prices. The tripling of the sales value over the
The prewar years resulted partly from higher prices and partly from large purchases by servicemen, who sent flowers to their families and friends on the mainland.

Marketings by florists on the outlying islands were much smaller. Only seven stores sold flowers in Hilo in 1945. The sales of the three florists operating on Maui in the same year amounted to $13,000 at wholesale prices.

After the war the production of flowers and decorative foliage expanded faster for several years than that of any other agricultural commodity in the Islands. The growth of exports is shown by the increase in the number of parcels of floral products shipped to the mainland from 62,000 in 1946 to 500,000 in 1950. Since then exports declined from an estimated 470,000 pounds in 1950 to 410,000 pounds in 1952.

The wholesale value of floral products produced commercially in Hawaii was believed to approach 3 million dollars in 1952. (See Table A4.) An estimated 630 Island growers produced flowers and foliage commercially in that year. Of these, 334 were located on Hawaii, 240 on Oahu, 45 on Maui, and 13 on Kauai. Most producers raise flowers on a part-time basis in or near Honolulu and Hilo. For example, there were approximately 325 commercial flower raisers in Hilo and vicinity, only about 20 of whom considered flowers their major source of income.

Production and Marketing for Local Consumption

Flowers are more widely used in Hawaii than on the mainland. In addition to beautifying gardens and homes, they are worn as leis by both sexes and by women as corsages and as ornaments in their hair. Sales through retail florists, excluding plant nurseries, were 2.2 million dollars in 1948. Perhaps another $750,000 should be added for floral sales by lei sellers and others. With sales by retail florists alone of $4.50 per resident, Hawaii outranked all other states in per capita consumption by a wide margin. Nevada had the next highest per capita sales with $3.71, while the average person on the mainland bought only $2.57 worth of flowers.
Most flowers and foliage for local consumption are grown on Oahu, and some in Hilo. Minor production areas, particularly for temperate-climate flowers, are the Kula slope on Maui and the Volcano and Kamuela districts on Hawaii. The total crop acreage of flowers grown for local use on Oahu alone was estimated at over 400 acres in 1952.

Orchids, anthuriums, some other flowers, and tropical foliage, which are raised primarily for export but are also well-liked locally, will be discussed later. The most important flowers produced for local consumption are carnations, gladioli, and roses; most of these are grown on Oahu. In 1952 approximately 30 commercial growers raised 75 acres of carnations on Oahu, nearly all of their output being used for lei-making. Carnations are raised mostly by growers of Korean and Japanese ancestry. Other flowers are produced primarily by growers of Japanese extraction, with a sprinkling of other nationalities. On Oahu gladioli and roses were each raised by about a dozen commercial growers. Total commercial plantings of other cut and lei flowers on Oahu amounted to about 200 crop acres.* No substantial increase in flower production for local use is expected.

Honolulu has no central wholesale market for flowers, in contrast to almost every other metropolitan area in the United States. However, a cooperative of lei-flower growers wholesales the products of its members from its downtown receiving office. Island growers deliver most of their cut flowers and foliage to retail florists, either on an outright sale or on a consignment basis. Frequently they also sell some of their products directly to consumers. Growing and retailing is being combined by many floral enterprises. The same firm may grow flowers and foliage, retail them locally, and ship them to the mainland.

Many growers and retail florists would welcome the development of a central wholesale market in Honolulu. It would save growers time and delivery costs and enable them to sell their merchandise in a ready outlet. For retail florists, such a market would make it easier to compare the quality of products offered for sale. It would open up a wider range of supplies for individual firms. Both buyers and sellers would have the advantage of more clearly defined daily market prices than exist at the present time.

The Export Industry

The wholesale value of floral exports (f.o.b. Hawaii) and sales to tourists was estimated at approximately 1.4 million dollars in 1951. That

* Some other flowers raised frequently for sale in the Islands are asters, gardenias, gingers, birds of paradise, heliconias, calla, Easter and water lilies, watsonias, plumerias, pikakes, gerberas, snapdragons, delphiniums, larkspurs, amaryllis, zinnias, chrysanthemums, tuberoses, statices, and forget-me-nots.
was probably about 1 percent of the total floral sales on the mainland. Some observers believe that a future export value of 4 to 5 percent of mainland sales, or about 6 million dollars wholesale in Hawaii at current prices, is a distinct possibility.

Commercial flower exports have been made possible by the establishment of a low-cost air freight service between Hawaii and the mainland. Airlines set special rates for florist stock to increase their volume of return loads from Hawaii to the continent. In the spring of 1953 it cost 20 cents per pound to send foliage, anthuriums, gingers, heliconias, and birds of paradise by plane from Honolulu to West Coast cities in shipments of 35 pounds or more. The charge for all other flowers, including vanda blossoms and leis, was 30 cents per pound, with a minimum of 25 pounds. In comparison, general commodity rates for air freight were 71 cents per pound for shipments under 100 pounds and 57 cents per pound for bigger cargoes.

More than 25 different floral products were exported to the mainland in commercial quantities in 1952. They fell into four major categories: orchids, cut flowers, foliage, and specialties such as leis.

**ORCHIDS.** Cattleya orchids were frequently sent by soldiers and defense workers to their mainland families during World War II. These exports declined after the war, because Island growers could not compete on a price basis with continental hothouse producers. Besides, cattleyas are easily damaged during transit. However, cattleyas and other types of orchids, such as dendrobiums, cypripediums, and phalaenopsis, are valued highly by Island residents.

The principal orchid for export is the vanda Miss Joaquim, or Princess Aloha, as the variety is sometimes called on the mainland market. It is a small flower about 2½ inches in diameter, first brought to the Islands in 1925. Large-scale exports began after World War II; in 1950 more than 12 million blossoms were exported to the mainland. Vanda shipments represented about 60 percent of the total value of all floral exports in that year.

Vanda prices vary according to the seasonal demand in the continental United States. During the spring and fall of 1948, the Island farm price was 3 cents per blossom, and during the winter it rose to 5 cents. It declined to 1.5 cents during the summer, when many other types of flowers were available on the mainland.

During the last several years vanda prices have greatly declined. In 1948 grower prices averaged about 3 cents per flower. During the summer of 1952 farmers got as little as 0.1 cent per blossom, if they could sell their vandas at all. During the late winter months of 1952–53 prices rose to about 0.5 and 1.0 cent per flower. Some major factors in this decline were unrestricted price cutting by competing shippers, uncertain
quality of blossoms upon arrival on the mainland, and rapid increase in the Island production of vandas.

In 1951 at least three-fourths of all exports to the continental United States were bought for promotional purposes. The orchids were given away free to women at store openings, sales, and at other special occasions by department stores, chain stores, and individual retailers. The quantity of vandas sold through retail florists has declined steadily as "giveaways" have gained in importance. Vanda corsages are being sold in increasing quantities through low-price, high-volume outlets, such as five-and-ten cent stores and drugstores. In 1952 vanda corsages sold for as little as 25 cents retail on the West Coast.

Vandas do best in Hawaii when grown in the open in an evenly warm climate with ample rainfall. The major producing districts in the Islands are Hilo and its surrounding coastal lowlands, and Honolulu and its suburbs.

Vanda raising is at present largely a part-time family undertaking. Only a few of the several hundred growers in the Hilo area had orchid plantings covering more than one acre. One reason for the preponderance of small enterprises is the fact that most growers are not farmers but city dwellers who raise vandas in their yards.

Another reason, where available space isn't the limiting factor, is that the grower works full-time at another job. His orchid plantings are increased only to the point at which the women and children of the family can still handle the routine jobs, such as picking flowers and watering. During his leisure time the man of the household takes care of the jobs requiring heavy labor.

A third reason for the small size of plantings is the large investment needed until the orchids start flowering at about one year. The three major cash expenses in establishing a vanda garden are (1) hapuu, or the trunks of tree ferns on which the orchids grow, (2) vanda planting material, and (3) land. In April 1950, at 20 cents per foot, the ten thousand hapuu required per acre cost $4,500. Vanda slips a foot long averaged about 20 cents each. At the rate of 5 to 6 vanda slips per hapuu, expenditures for planting material amounted to $12,600 per acre. Land, at 10 cents per square foot in Hilo's outskirts, costs $4,400 per acre. These three items alone total $21,000 per acre. To this must be added the cost of fence material, water pipes, manure, insecticides, fungicides, and water. Also not included are the large labor costs of planting the vandas and caring for the non-bearing plants, and the interest on invested capital.

Growers in and around Hilo usually begin commercial vanda production by planting about 1/20 to 1/10 of an acre. The required initial capital is small. If they want to expand, they can raise their own planting material. A grower starting out with 1/10 acre can produce enough
slips for one acre during the next five years.

Vandas bear a heavy crop of flowers in Hilo lowlands. The normal production per plant is about 60 blossoms per year. An average of from 60 to 65 percent of all flowers produced are of export quality. Some of the better rejects are used locally for low-priced vanda leis, but most of them are thrown away. Even at this rate of culling, vanda growing was highly profitable at 1949 prices, and acreage and production rose rapidly. However, low prices since 1951 discouraged producers. Many neglected their plantings. Some offered to sell their stock for as little as 75 cents per hapuu, including the flowering vanda plants.

Between April 1949 and April 1950 vanda shipments to the mainland had to be fumigated, because the orchids were believed to be carriers of the Oriental fruit fly. Research showed that this suspicion was unfounded, and the blossoms can now be exported untreated.

Vandas are shipped to mainland dealers usually in the following five different forms: (1) unprocessed except for wrapping of the stem ends in cotton, (2) "tailored," meaning that wire is added to the stems which are then wrapped in floral tape, (3) in plastic lapel vases, (4) as vanda sprays, and (5) as leis. All flowers are transported to the mainland by air. Most are handled by specialized freight forwarders who reduce costs by combining shipments of several dealers.

Island flower breeders have recently developed a large number of vanda strap-leaf hybrids, or orchids of many different shades and colors. Island growers have hopes that these vanda hybrids will become one of their major export products.

OTHER FLORAL MATERIAL FOR EXPORT. Anthuriums* and tropical foliage require approximately the same climatic conditions as vandas; consequently they are raised in about the same two vanda districts. Most of the output is from small plantings, although several operators each have one acre or more. Anthurium growing is increasing, but for several reasons not at a rate equal to vanda production during its peak expansion period.

Anthuriums are usually grown from suckers, since plants raised from seed may not come true to type and may have flowers of poor quality. Propagation is slow, because a plant produces only a few suckers each year. It takes at least a year and a half for the young plants to begin bearing marketable flowers. Since anthuriums need shade, they are usually grown in lath houses. The investment required per acre of flowering plants in lath houses at 1951 prices ranged from $25,000 to $30,000 or more.

Anthuriums are expensive flowers with a more limited market than

* Scientific name: Anthurium andraeanum.
vandas. In 1948 the grower price was 50 cents each for large blossoms. In 1952 Honolulu prices were 35 cents, 25 cents, and 7 cents for large, medium, and small blossoms, respectively. One plant produces about five blossoms a year.

The leaves of ti plants, crotons, monsteras, dieffenbachias, pothos, and Hawaiian ferns constitute the bulk of the foliage exports of the Islands.* These plants grow easily in the open in Hawaii and do well even on shallow soil. Once planted they need little care except for weeding and occasional fertilizing. Tropical foliage is produced by both small and large growers.

It takes about one year after planting ti before the first leaves can be picked and one and one-half years for croton plants. After that, ti leaves can be harvested at the rate of one leaf every two or three weeks. Prices to growers in 1952 ranged from 0.5 cent each for croton leaves to 1 cent for green ti and slightly more for variegated ti leaves. About 50,000 pounds, or 19 percent, of the tropical foliage and less perishable cut flowers were sent to the mainland by ship, the remainder was transported by air.

Other flowers and plant materials grown for export include gingers, birds of paradise, heliconias, and water lilies. Wood roses are increasing in importance.** They are produced seasonally but are nonperishable and can therefore be stored. Their best market season is in the fall. A small mainland market also exists for flower leis, particularly on the Pacific Coast.

Transportation and marketing costs are high for Hawaiian floral products exported to the mainland. One Hilo shipper reported that his Los Angeles wholesale receiver sold his anthuriums for an average price of $8 per dozen in the spring of 1950. Air transportation charges amounted to 82 cents, or 10 percent of the sales price. Regrading upon arrival reduced the value of the shipment by another 10 percent. The Los Angeles wholesaler got a commission of 20 percent of the sales returns. The Island shipper, who also packed the flowers, received 24 percent of the sales price for his work. Net returns to the grower

Shores in the Return From Sales of Anthuriums in Los Angeles in 1950

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<thead>
<tr>
<th>MAINLAND WHOLESALER</th>
<th>GROWER</th>
<th>PACKER &amp; SHIPPER</th>
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<td>36.7</td>
<td>207.2</td>
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<tr>
<td>24.2</td>
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* Scientific names: Ti plant, Cordyline terminalis; croton, Codiaeum variegatum; monstera, Monstera deliciosa; dieffenbachias, Dieffenbachia picta, D. seguina; pothos, Pothos aureus.

** Scientific names: Red ginger, Alpinia purpurata; shell ginger, Alpinia nutans; torch ginger, Phaeomeria magnifica; bird of paradise, Strelitzia reginae; heliconias, Heliconia humilis, H. elongata, H. longa; water lilies, Nymphaea species; woodrose, Ipomoea tuberosa.
amounted to $2.90, or 36 percent of the mainland wholesale price. Hawaiian foliage producers received 40 percent and vanda growers 24 percent of wholesale prices on the mainland.

Most foliage and flowers other than vandas are marketed either through the normal mainland trade channels for flowers or through retail outlets owned by Hawaii shippers. Prices for Island floral products are usually better in winter than summer. Peak export periods are at Christmas, Easter, and Mother's Day.

**PROBLEMS AND OUTLOOK.** Hawaii has a comparative advantage over mainland areas in production costs of many flowers and foliage. Its mild climate permits year-around production with a smaller investment per plant than is required in most mainland production areas. Under such favorable growing conditions its skilled growers get high yields per acre. Nevertheless, much can still be done to reduce costs of production. For example, many Hilo vanda growers report that they lose 25 percent or more of their flower production because of the vanda nematode and spike rot.

The major problems of Hawaii's floral industry, however, are not so much in production as in distribution and marketing. Among them are questions of quality control, marketing and transportation costs, pricing, orderly marketing, sales promotion, and industry organization.

Mainland receivers frequently complain about the uncertain quality and arrival condition of Island floral products. Losses from regrading and spoilage in 1949 ran an estimated 10 to 20 percent or more in the Los Angeles market. Practices have to be improved at all stages of the marketing process. Growers must harvest their products at the proper state of maturity. Shippers should export only top-quality flowers and foliage to save marketing expenses on items which will be severely down-graded or unsalable upon arrival. Packers should select sufficiently strong containers of adequate size and pack them properly and carefully. Rough handling during loading and unloading and subjecting flowers and greens to excessive heat or cold in transit may also result in poor arrival condition.

With most shipments going by air, Hawaii's floral industry is dependent upon economical and dependable air transportation. Between 1935 and 1947, transpacific air cargo rates greatly declined. Since then rates have been raised for air parcel post and air express. In 1951 rates for air freight on foliage and bulky cut flowers also went up. The level of air cargo rates is an important factor in the competitive struggle for mainland markets between the territory and other areas producing floral products.

In general, an adequate amount of air freight space is available for the movement of floral products. However, during peak periods, such
as just before Christmas or Mother's Day, freight bottlenecks have occasionally developed in the past. Belated delivery of orders undermines the confidence of mainland customers in the ability of Island shippers to fill orders on time. Airlines endeavor to solve the problem by making more planes and cargo space available during critical periods. Shippers try to cooperate by sending their least perishable products a day or two earlier so that the peak load can be distributed over more flights.

Uniform grading of Hawaiian floral products is essential to more efficient marketing, the determination of consumer and trade preferences, and the creation of goodwill in the trade. By pricing according to grades, shippers and producers would soon learn which grades are most desired by their buyers; dealers could order by preferred grades. At present each Island shipper uses his own system of grades, which leads to unnecessary confusion. To be effective, grades for Hawaiian floral products must be approved and accepted by a majority of the members of the floral industry. An impartial body, either an industry or a governmental agency, would have to be responsible for administering and obtaining conformance to the grades.

Severe price cutting within the Hawaiian flower industry, especially among vanda distributors, has been prevalent throughout the mainland. Many sales could have been made at substantially higher prices. Prospective handlers have shied away from Hawaiian floral products because of price instability. The price cuts in most cases were not justified by lower production and marketing costs; these costs have been increasing rather than decreasing.

Keeping a balance between demand and supply for Hawaiian floral products on the various mainland markets is another problem awaiting solution. A survey in mid-1950 revealed that wholesale markets on the Pacific Coast were overstocked with Hawaiian items, and losses from surpluses were heavy. On the other hand, few floral products from the Islands were available in most eastern and southern mainland markets. Furthermore, during periods of heavy overproduction, when all markets are glutted, methods have to be developed to regulate the volume of shipments.

The circumventing of conventional marketing outlets on the mainland may hurt the Hawaiian floral industry in the long run. The vanda Miss Joaquim is rapidly losing popularity with retail florists because of its sale for promotional purposes through non-floral channels. Florists resist these promotion schemes, and many have become hostile to other Hawaiian floral products as well.

Competition for Island flowers and foliage from other producing regions varies by items, location of markets, and seasons of the year. Greenhouse products of various kinds are grown near many large metro-
politan centers. California and Florida provide Hawaii with the greatest present and potential competition. California is a serious competitor in orchids other than vandas, anthuriums, and birds of paradise. The total production of vandas on the mainland is still small compared to that of Hawaii. Florida is by far the largest mainland producer of these orchids. It is also raising anthuriums and birds of paradise in increasing quantities.

Tropical leaves such as those exported from Hawaii are generally not produced for the cut foliage market on the mainland. However, many different types of greens competing with Hawaiian foliage are grown in the Pacific Coast states, Florida, and other areas. Orchids and subtropicals are being imported in increasing amounts into the continental United States, particularly from the Caribbean area, Mexico, and Central and South America.

An industry-wide sales promotion campaign is needed to familiarize people on the mainland with Hawaiian floral products. Dealer education work should stress the handling, storage, display, and use of Hawaiian flowers and foliage. Consumer advertising directed at selected prospects might emphasize the romance and glamour of Hawaii and the exotic forms and colors of Island floral products. It can be pointed out that because they are long-lasting their day-by-day cost is comparable with that of many competing mainland products, despite their high initial prices.

The Hawaiian floral industry needs research to develop new products, improve old ones, and study market potentials. Efforts should be concentrated on lightweight products of high value to permit profitable air shipment or on less perishable items that can be transported by ship. Markets might be developed for additional products. For example, subtropical foliage plants for indoor use have become highly popular on the mainland during the past decade. Hawaii does not yet export subtropical plants or propagating material, but the potential market is worth investigating.

Many of these problems can be solved by united action. An industry-wide organization of growers and shippers in Hawaii should be formed. Such an association could bring about better marketing practices and greater price stability. It could gather market information for shippers, represent the industry before the public, and coordinate promotion and research.

If Hawaii growers and shippers can get together and form a strong organization, they may well be optimistic regarding the future of their industry. With many opportunities yet to be exploited, they might be able to greatly expand their share in the mainland market. However, they must remember that flowers and foliage are perishable luxury products. If transportation should be interrupted in peace or war, they would
face heavy losses. Furthermore, when consumer incomes decline flower and foliage sales and prices can be expected to drop sharply.

MISCELLANEOUS CROPS  •  Rice

In the first decade of the twentieth century, rice growing was the second largest agricultural industry of the Islands. In 1909 the rice area amounted to 9,400 acres and the output reached almost 42 million pounds. That year Hawaii exports, though less than the 13.7 million pounds which they had reached in 1887, still amounted to about 6 million pounds.

Since then Island rice acreage and production have continuously declined. Plantings diminished to 5,800 crop acres in 1919, 500 in 1939, and 160 in 1952. In the latter year rice production had been discontinued on all Islands except Kauai, where 53 farmers still were growing the crop. They produced only about 1 percent of the rice consumed in Hawaii, mainly “mochi,” a glutinous cereal which is popular among people of Japanese ancestry for making rice cakes.

The decline of this Island industry can be attributed to several causes. After the annexation of Hawaii by the United States, sugar producers competed strongly for some of the land and water used by the rice growers. Rents doubled or tripled within a few years. After a long period of continuous rice production on the same land, fertilizer costs rose. Japanese immigrants created a larger market for rice in Hawaii early in the twentieth century, but they preferred the varieties to which they had been accustomed in Japan. Rice produced in Hawaii from Japanese seed apparently lacked certain physical qualities. Japanese were willing to pay $2.00 more per 100 pounds for rice from their own country. Imports from Japan rose from 10.2 million pounds in 1903 to a high point of 43.1 million pounds in 1916. From then on, imports from Japan were replaced more and more by mainland shipments. Since 1950 no shipments have been received from the Orient.

The most important cause of the decline of Hawaii's rice industry was the competition from low-cost producers in California. Mainland
imports, primarily from California, rose from 0.2 million pounds in 1916 to 90 million pounds in the early 1930's. By 1952 they had declined to 63 million pounds.

Production costs for rice are much higher in Hawaii than in California. Agricultural Extension economists compared farm records of rice growers on Kauai in the middle 1930's with those in Butte County, California, during the same years. The yield was 3,600 pounds of cleaned rice per acre in Hawaii and 2,300 pounds on the mainland. Respective costs per acre averaged $144 and $39. Man hours needed to grow and harvest an acre of rice were 488 and 13, respectively.

The Butte County producers operated their large farms, averaging 154 acres, on a highly mechanized basis. They seeded their crop by airplane and harvested it with combines. The Island producers farmed an average area of 10 acres per family. They still used many of the agricultural methods practiced in the Orient for centuries.

Some progress has been made on Kauai rice farms during the past 15 years. However, the crop is still grown in small paddies because of the steepness and narrowness of the valleys in which it is produced. In 1952 the rice acreage per farm ranged from 0.5 to about 20 acres. Many growers use tractors, trucks, and other machinery, but the degree of mechanization feasible on these small plots is limited. According to some Kauai farm records for 1952, the amount of labor needed per acre of rice still ranges from 300 to over 500 hours.

Californians have further streamlined their operations during the past decade. In addition to seeding, they use airplanes for fertilizing, bird control, and weed control. They also handle a large share of their crop in bulk.

Kauai rice growers are now planning to shift from hand harvesting to the use of a rice combine. They are also trying to modernize their present labor-expensive methods of controlling rice birds. There is little hope for any large-scale expansion of this industry in Hawaii. However, if efforts to reduce production costs are successful, rice growing can be expected to continue at present levels or possibly expand slightly.

Field Corn

The area planted to field corn amounted to about 3,200 acres in the decade 1899–1909. During 1919–20 prices were unusually high and corn plantings increased to about 10,000 acres. In those years sugar and pineapples were the only crops that surpassed corn in terms of cropland occupied.

When prices declined at the end of the postwar boom, the acreage diminished greatly, ranging from about 1,500 to 1,900 acres in the 1930's. In the years 1947–52 acreage fluctuated between 350 and 950
acres, and the output of shelled corn between 0.4 and 1 million pounds.

A large portion of the present production is grown in rotation with pastures by Parker Ranch on the northwestern slopes of Mauna Kea on Hawaii. Most of the remainder is produced by family farmers in northern Hawaii and on Maui and Molokai.

Corn may be grown most successfully in the Islands at elevations of about 4,000 feet or above. Moderate yields are harvested also in some areas of lower elevation, such as North Kohala, Hawaii; Kula, Maui; and Hoolehua, Molokai. A major factor limiting production is rainfall. In the high altitudes soil moisture is inadequate about two years out of five. At lower elevations, like Hoolehua, dry spells are even more frequent.

No great expansion in corn production is anticipated except for periods of high market prices or when an emergency cuts off normal feed shipments from the mainland.

**Castor Beans**

Island farmers have made a number of attempts in the past to grow castor beans on a commercial basis but have not found the crop remunerative. Their output had to compete with imported castor beans and oil produced by cheap labor in foreign countries.

Most of the United States imports originate in Brazil and India. Castor oil is in demand for military purposes, mainly for use in lubricating oils. It also has many nonmilitary uses, such as a quick-drying oil in protective coatings. Since 1951 large commercial plantings have been made on the mainland under contract with the federal government to assure supplies of this strategic oil.

Encouraged by high prices for castor oil after the beginning of the Korean war, a few farmers made small plantings in Hawaii. The most expensive operation in castor bean production in Hawaii is harvesting. The varieties now being used in the Islands produce high yields but still have to be harvested by hand. For mainland conditions, new dwarfed varieties have been developed which can be harvested mechanically. Whether or not Island-grown castor beans can compete with imported and mainland-produced beans once prices return to more normal levels still has to be determined.

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DIVERSIFIED AGRICULTURE OF HAWAI"


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BEEF CATTLE  ● Development and Present Status

The number of beef cattle in Hawaii increased by more than 50 percent during the past half century, from 96,000 in 1900 to 128,000 in 1920 and 147,000 in 1952. However, at no time during this period were Island ranchers able to supply all the beef and veal needed in Hawaii. (See Table P1.)

In 1952 about 25.8 million pounds of fresh, chilled, or frozen beef and veal were sold by Island slaughterhouses and importers. Of this, 18.6 million pounds, or 72 percent of the total, were produced locally. The remainder, as well as all canned, pickled, and cured beef, was imported.

Until 1931 most beef and veal imports had come from foreign countries, largely from New Zealand and Australia. In 1928, for example, 4.1 million pounds of chilled and frozen beef were imported, of which all but 4 percent were of foreign origin. In 1952, out of the 7.2 million pounds of chilled and frozen imports, only 2 percent came from foreign countries.

Most of the hides and tallow, the major by-products of Island-raised beef, are exported to the mainland.*

Per capita consumption of fresh, frozen, and chilled beef and veal in Hawaii expanded from 23 pounds in 1920 to 35 pounds in 1928 and 56 pounds in 1952. The increase has probably resulted mainly from greater beef consumption by people of Oriental ancestry, who gradually have adopted American diets. In 1952 the civilian per capita consumption of beef and veal on the mainland was 68 pounds. Island residents are likely to continue eating less beef than mainlander because of their liking of sea foods and because of the warmer climate in Hawaii.

Island beef is not sold on the basis of federal grades in Hawaii. The output of most ranches consists of 2- to 3-year-old grass-fed steers and heifers with a dressed weight of 500 pounds or more. Few Island car-

* Exports in 1947, the last year for which statistics are available, amounted to 161,000 cattle hides and 432,000 pounds of tallow.
casses would grade "prime" according to mainland standards. Most of them would be classified as "choice" and "good."

Island beef prices usually follow the trends of mainland prices but on a slightly higher level, because Hawaii is a beef-importing area. During the five years before World War II, Honolulu prices for dressed Island beef averaged 17 cents per pound. This was 1 cent higher than dressed beef of "choice" grade sold in Chicago. During the war Honolulu prices for Island beef rose to 23 cents per pound, and the spread between the two markets widened to 3 cents per pound.

After the abolition of price controls in 1946 the Honolulu price of dressed Island beef increased rapidly to 45 cents a pound in 1948. However, Chicago prices gained ever faster and were more than 3 cents above Honolulu prices during this period. In 1949-50 a more normal price relationship again prevailed between the two markets, with Honolulu prices about 3 cents above Chicago prices. Just before price ceilings were imposed by the Office of Price Stabilization early in 1957 Chicago prices spurted upwards much faster than Honolulu prices.

Price ceilings held Honolulu prices of dressed Island steers at about 5 cents per pound up to the fall of 1952. That was from 3 to 4 cents below Chicago prices for "choice" beef.

Ranch land is in great demand at present high beef prices. In the spring of 1951, leases for about 100,000 acres of public pasture land were auctioned off on the island of Hawaii. Upset price at this auction averaged 49 cents per acre; average price per acre to the successful bidders was $4.05 per acre. Ranchers bid $8.00 and more per year for land with a carrying capacity of one head of cattle for 5 acres. In contrast, lessors of public pasture leases for land of similar quality paid about 80 cents per acre per year in 1940 and about 90 cents in 1951.

A major reason for the slow increase in the average cost of rentals of public grazing land in the decade previous to 1951 was the fact that few pastures had been up for re-lease during that time. Public pasture leases run for 21 years, with semi-annual payments fixed for the whole period of the contract.

Little pasture land is available for sale in Hawaii. During the last few years some large parcels brought from $40 to $80 or more per acre, the basis of a carrying capacity of one head per 5 acres.
Investment, Cost, and Income for a Small Ranch

No cost and profit studies for Island ranches are available. For this reason a study was made for a hypothetical small ranch which would fully employ an average family. However, because of many different types of ranches in the Islands, not many actual ranches will closely resemble this hypothetical one.

This ranch is assumed to be located in an area with an average precipitation of about 60 inches. The rain is so distributed that pasturing of the land is possible throughout the year. The ranch carries 300 head of cattle, including a breeding herd of 90 cows and 5 bulls. One-sixth of the breeding herd is replaced every year. The average calf crop is 77 percent. Annual mortality is one head in the breeding herd and one 6-month-old calf. Heifers and steers are sold at about 2½ to 3 years of age.

The carrying capacity of the land is 5 acres per head, requiring a total grazing area of 1,500 acres for the 300 head. It is assumed that at the beginning of the lease one-fifth of the pasture land was overgrown with noxious weeds and brush to such an extent that clearing and planting of grass was necessary.

The hypothetical rancher owns a 1½-ton truck. Besides, he owns a medium-sized tractor and tractor equipment cooperatively with two neighbors. Rain is the only source of drinking water for his cattle. Therefore, water installations, such as catching roofs and storage tanks, are required.

Inventory, cost, and returns are estimated for a period in which dressed steers and heifers sell for 40 cents per pound at the ranch. This was the beef price on the outside islands at the end of 1948. In the calculation of investment values and costs, only goods and services bought are included, not family labor or materials produced on the ranch.

The investment in this hypothetical ranch is $64,000. Of this total, the value of livestock accounts for 80 percent, improvements and prepayment of the lease for about 15 percent, and machinery for most of the rest. (See Table F4.) No land value is included in these estimates, because the rancher is assumed to use leased land. If the land were owned, the investment in land would amount to $90,000 at a price of $60 per acre, and the total ranch investment would be $153,000.

The rancher's gross annual receipts would amount to $14,000. Sales of steers and heifers account for about three-fourths of this total, and the sales of cull cows and bulls for the rest. (See Table F2.) Payments by the U.S. Production and Marketing Administration for participation of the rancher in the federal agricultural conservation program are not included in the above figure. If the rancher were to cooperate in this
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program, federal assistance payments might amount to several hundred dollars.

Ranch operating costs per year, excluding a charge for labor, would total $11,400. The land lease and land improvements are the biggest cost items, making up 47 percent of all costs. Interest payments for invested capital account for 28 percent, equipment use for 10 percent, and taxes, supplies, and miscellaneous for 15 percent. (See Table F3.)

The net return per year to the rancher and his family would be $2,600 for labor and management. This figure does not include interest on the investment. If it is assumed that the rancher owns all the investment on the ranch except the land, the interest on that investment can also be considered as part of the ranch income. In that case the total net ranch income would amount to $5,800.

Inventory, costs, and returns were also estimated for this ranch under conditions that would exist when dressed beef sells for 20 cents per pound. (See Tables F2 to F4.) The average wholesale price of Island dressed steers in Honolulu for the decade 1933–42 was 16 cents per pound, and the 1943–45 ceiling price was 23 cents per pound.

At 20 cents per pound for beef, gross ranch sales would amount to $7,000, operating costs to $4,900 and net returns to the ranch family for labor and management to $2,100. The ranch investment would total $32,000 excluding land. If the rancher had bought his land at $60 per acre, his costs, including interest, would exceed his gross returns by $900 per year. Therefore, the rancher could afford to buy his pasture land at the present price of $60 per acre only if beef prices do not decline substantially below 40 cents per pound.

Large-Scale and Small-Scale Ranching

In 1952 about 400 ranchers in Hawaii used 1.5 million acres for beef pasture. Of the total number of 147,000 head of beef cattle on ranches with 20 head or more, 94,000 were on Hawaii, 26,000 on Maui, 14,000
on Kauai and Niihau, 8,000 on Molokai, and 5,000 on Oahu.

Most of Hawaii's beef is produced on large ranches. According to a 1948 survey by the Agricultural Extension Service, 53 ranchers, or 14 percent of the total, were large operators with two or more full-time hired workers. They had 93 percent of the cattle land and 85 percent of the beef cattle on Island ranches. On the average, they pastured 2,300 head per ranch on 33,000 acres.

In addition to these large ranches there were 311 family-operated ranches with less than two full-time hired hands. One-third of these family-sized ranches had less than 25 head, and two-thirds less than 75 head. Only 14 percent of them had herds of more than 200 head. Fifty-five percent had less than 200 acres, 75 percent less than 400 acres, and 92 percent less than 1,500 acres.

Of these small ranchers, 75 gained most of their income from ranching. They averaged 216 head of cattle per ranch. The remaining 236 small ranchers were part-time operators with an average of 48 head of cattle per ranch.

The racial origin of the operators was determined on a sample of 139 ranches. The majority of ranchers were of Caucasian extraction. While people of Portuguese ancestry were the most numerous group on family-sized ranches, Caucasians of non-Portuguese origin predominated among the large farm operators. Nearly one-fourth were Hawaiians and part-Hawaiians and one-seventh were of Oriental ancestry.

Several factors account for the predominance of large-scale ranches in the Islands. Most of these enterprises were organized during the latter part of the last century, and once established they were seldom broken up. If divisions occurred, the successor ranches were usually still big enough to be classified as large enterprises.

In Hawaii excessively dry or wet pastures and ranges of low carrying capacity are most efficiently used in so-called "balanced ranches." Here, several or all of these types of pastures may be included together with some good pasture land. With few exceptions, balanced ranching has so far only been tried on a large-scale basis.

In some cases water distribution systems that required heavy original outlays provide inexpensive drinking water on big ranches. Such installations are not within the reach of individual small cattlemen. Machinery is coming increasingly into use on large ranches. Heavy bulldozers and tractors pulling harrows, heavy cable chains, rakes, and brush cutters are employed in clearing pastures of guava brush, cactus, lantana, and other shrubs or trees. Lighter tractors are used in planting, discing, and mowing. The ownership of heavy equipment is usually uneconomical to individual small cattlemen.

Owners of large-scale ranches can afford to hire skilled managers and to specialize their workers in various ranch jobs, thus increasing labor
efficiency. They are able to maintain a high quality of stock by purchasing good breeding herds and by carrying through an extensive selection and breeding program.

Since ranching requires large amounts of capital, the scarcity of agricultural credit is a handicap for small cattle producers. Credit is generally harder to get in the Islands for small ranchers than for large ranchers.

Methods of leasing public lands were advantageous to big cattle raisers in the past. For certain public leases only one or a few ranchers were in a position to bid. For example, on some parcels not enough drinking water for stock was available; others possessed no free access roads. In such cases the ranchers operating the adjoining lands frequently faced no outside bidders at auctions for these lots. Lately it has been the policy of the Territorial Land Commissioner to acquire, if economically feasible, a right of way for public pasture parcels that are coming up for re-lease.

An important factor favoring large ranches has been the size of public pasture leases. In 1950 parcels under 1,000 acres accounted for 7 percent and larger ones for 93 percent of the cattle land leased by the Territory.

Small ranchers need mostly leases of from 100 to 1,000 acres, depending upon carrying capacity. Of a total of 262 public pasture leases, only 63 were within this size range in 1950. Thirty-four parcels ranged from 1,000 to 9,999 acres and 9 from 10,000 to 124,000 acres; 157 were less than 100 acres in size.

Since 1950 the Territorial Land Commissioner has been increasing the number of pasture leases suitable for small ranches. When large pasture parcels are coming up for re-lease he is subdividing them, wherever possible, into smaller parcels in the needed size range.

For some small ranchers with 50 percent or more Hawaiian blood, the Hawaiian Homes Commission provides land on long-term leases at low cost. In the fall of 1952 it awarded 48 pasture parcels to homeesteaders near Kamuela, Hawaii. These ranches, averaging about 300 acres, are each expected to carry about 100 head of cattle.

Small ranches are suited primarily to districts where year-around grazing is possible, such as the windward areas of Hawaii, Maui, and Kauai, and some leeward sections like Kona. Cattle raising can be handled in these areas either as a full-time or a part-time enterprise. Once the land has been cleared, seeded, and fenced and a watering system has been established, a man can often handle a small ranch on weekends and after working hours.

With some effort small ranchers might be able to avail themselves of some of the methods used by big ranchers. By using noncontiguous pastures in areas of different climatic and rainfall zones, family-sized balanced ranches could be established. Public agencies or cooperatives could develop drinking water systems for cattle. Large ranchers are
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ready to sell the smaller ranchers good breeding stock to improve the quality of their herds.

Mechanical equipment has become indispensable to good ranch management in Hawaii. However, less machinery is being used on small ranches than on large ones. It will ordinarily not pay a family-sized operator to own heavy equipment for use exclusively on his ranch. A few ranchers have purchased mechanical equipment together with one or more neighbors. However, at the present time such cooperative use of machinery is not widespread. Small ranchers find it more convenient to contract for jobs which require heavy machinery.

**Production Problems and Outlook**

Cost levels on most Island ranches probably do not exceed those of mainland ranches. Compared to the systems of raising beef cattle in the temperate zone, ranching in Hawaii requires fewer facilities and operations. Haymaking for winter feeding and substantial storage buildings for feed are not required in the Islands. Other costs, such as pasture clearing and stock watering, are probably higher in Hawaii than in many mainland sections.

Much progress is being made in ranch management in the Islands. Pasture quality on many ranches is being substantially improved. Large portions of good pastures which have become infested with noxious pests and weeds are being reseeded with nutritious grasses and legumes to greatly increase their carrying capacity. Some suggested grasses for planting are Paspalum, Guinea, rye, cocksfoot, Kikuyu, molasses, Rhodes, and Pangola. Among legumes, particularly recommended are several species of clover, pigeon pea, and bird's-foot trefoil; also alfalfa if irrigation is available.*

Continued success in producing high yields of good pasture forage depends largely on how the pasture is managed. Both overgrazing and undergrazing should be avoided. Overgrazing destroys good forage plants. On the other hand, ungrazed plants, resulting from understocking, become unpalatable. Rotation of pastures, periodic mowing, and spreading of manure are all necessary parts of a good pasture management program.

Pasture irrigation is becoming an important practice in Hawaii's cattle industry. Over 1,200 acres were being irrigated in mid-1952. Plans are

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under way for additional irrigated plantings along the dry coastal flats, where sufficient fresh water is available. In their present condition about 10 acres of these dry coastal lands can carry one head in seasonal grazing. When developed, one acre of these lands is expected to carry 2 to 3 head throughout the year.

In ranching the length of time during which stock has to be held is an important profit factor. On most Island ranches beef animals are marketed at 2 to 3 years of age. With irrigated pastures the beef could probably be ready for market within 18 to 20 months. Ranchers in some areas might also improve the quality of their beef by the use of irrigated pastures. Many who have no fattening paddocks sell low-grade beef. If irrigated fattening pastures were developed on their ranches, the animals could be better finished and sold at higher prices. After an irrigated pasture is once established, labor costs are low. One man, with occasional extra help, can irrigate and manage 100 acres. An adequate supply of good and reasonably priced irrigation water will probably be the limiting factor in the expansion of irrigated pastures in Hawaii.

The high cost of watering and fencing-in cattle could probably be reduced in some cases without great difficulty. The water-storage capacity on some ranches is too small. As a result, during dry periods expensive hauling is required to provide water for cattle. Fences sometimes last only 5 years or less. Adequate treatment of posts might lengthen the fence life to 20 years or more.

Most beef cattle in Hawaii are entirely grass-fed. The greater use of sugar-cane molasses as a supplementary feed would increase the carrying capacity of many Island ranches, particularly in areas of light or moderate rainfall. It would probably improve the quality of beef. At present prices of beef and molasses, it would also result in lower costs of production.

Before World War II, when molasses cost cattlemen $5 per ton, some supplied it in their pastures. When its cost reached $40 or more after the war, most ranchers considered it to be too expensive as a cattle feed. In March 1953 its price had declined to $16. When used as a supplementary feed on grass pastures, it had an average feed value of perhaps $27 or more at March 1953 beef prices, depending on pasture conditions.* Therefore, its use should be profitable on ranches easily accessible by truck which are not too far from sugar plantations. However, it has a tendency to act as a laxative and must be used with care when fed to cattle pasturing on succulent forage.

Another good supplementary feed for cattle, when available, is pineapple pulp, which is mostly fed in the form of ensilage. Corn imported

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* Feed value of molasses as a supplement to Hawaii grass pastures averaged almost $10 in the late 1930's when beef sold for 17 cents per pound dressed. Feed value of molasses should be about 2.7 times as high in early 1953 at a beef price of 46 cents per pound.
from the mainland is generally considered too costly for cattle feeding. However, it is sometimes planted as a rotation crop during pasture improvement. This corn is usually fed to cattle, except during periods of high corn prices when it is more profitable to sell it.

The production of feeder cattle in Hawaii is small but gradually increasing. Some ranches are located in areas of heavy rainfall with excellent grass growth. They have a high carrying capacity for raising young beef animals but are not well suited for fattening. On the other hand, there is a demand for feeder cattle on ranches which possess fattening paddocks. More ranchers might find profitable a greater emphasis either on feeder production or fattening if their ranch resources are especially suited to one or the other of these enterprises.

With regard to pasture leases, the inclusion of an escalator clause in lease agreements is considered desirable by many ranchers. They believe it would help stabilize the production methods and income of ranchers on rented land during periods of prosperity and depression. As we have noted, the annual rental in present contracts remains fixed for the duration of the lease. During a period of good beef prices a rancher is often willing to agree to a high rental. But when beef prices decline the lessee might overstock his pasture in order to fulfill his obligation, perhaps permanently damaging the productivity of the land. Or he might lose his lease entirely. An escalator clause would tie the amount of rent to be paid to the price of beef, thus providing for a more flexible cost of cattle raising. Other improvements needed in Hawaii pastures leases were discussed in Chapter I.

Raising beef cattle is now a profitable industry in the Islands. Ranchers believe that a substantial increase in production is possible. In view of beef imports, there does not appear to exist a marketing problem for an additional output of Island beef.

DAIRYING • Development and Present Status

The Hawaii dairy industry greatly expanded during the twentieth century, the number of milk cows and heifers increasing from 4,000 in 1900 to nearly 11,000 in 1940. In January 1953 there were 11,200 mature dairy cows in commercial dairies in the Islands. Milk production increased from 5 million pounds in 1899 to 45 million in 1939 and 80 million in 1952.

Nearly all of Hawaii's milk output is consumed as fluid milk. A small portion is used for coffee cream and, occasionally, for ice cream. Some 50,000 pounds of butter were still produced on the islands outside of Oahu in 1939. During World War II commercial butter making was discontinued and has not been resumed.

Therefore, almost all dairy products other than fresh fluid milk are
being shipped into the Islands. In 1952 imports of butter and butterfat were 3.5 million pounds and cheese 1.6 million pounds. Imports of other dairy products, such as canned, evaporated, or fresh milk and cream, and dried milk or milk solids, amounted to over 19 million pounds in 1947, the last year for which statistics are available.

The milk consumption per capita in the Islands has always been lower than on the mainland. Milk is not a traditional food of Hawaiians or Orientals. However, an intensive program of education has been carried on by the schools, the Agricultural Extension Service, many social agencies, and the dairy industry. All sections of the Island community have now come to appreciate the health value of milk. As a result there has been a great increase in its consumption during the last several decades.

In 1952 the consumption of fresh Island-produced milk and cream amounted to about 175 pounds per person. That was less than half of the mainland per capita consumption of 400 pounds of fluid milk and cream in the same year. Cheese and butter consumption was also much lower in Hawaii than in the continental United States. However, the per capita consumption of dairy products which are used as substitutes for fresh milk were about two-thirds higher in Hawaii than on the mainland. In 1947 about 34 pounds of condensed and evaporated milk and 5 pounds of dried milk and milk solids were consumed per person in the Islands, compared to 20 and 3 pounds, respectively, on the mainland.

The price of Island-produced milk is high. In November 1952 the retail price of home-delivered fresh milk was 31 cents per quart in Honolulu, compared to an average of 25 cents in 56 mainland cities. If the price of locally produced milk would decline, Island consumption would probably increase. Fresh Island milk might also replace some of the imported fresh milk substitutes.

During the last few decades the number of dairymen in Hawaii increased and then declined. However, the size of dairies has steadily increased. Between 1909 and 1929 the number of dairy farmers rose from 108 to 241. In the latter year the average number of milk cows and heifers per farm was about 40. From then on the number of dairies declined, with only 76 remaining in 1952. However, the average number of mature milk cows per commercial producer increased to 142 in 1952.
In that year 4 dairies had more than 800 mature cows, 2 others had more than 300, and 42 had from 50 to 299. Only 28 had small dairies with from 10 to 49 cows.

Annual milk production per cow amounted to 7,400 pounds in 1952. That was substantially above the mainland average of 5,300 pounds per cow in the same year.

Since the middle of the 1930's most dairy animals have been kept on Oahu to satisfy the growing demand of Honolulu residents for fresh milk. In 1952, 83 percent of all fresh milk was produced on Oahu. On the other islands some milk is produced as a sideline on big agricultural enterprises such as sugar plantations and beef ranches.

Many dairies, particularly on Oahu, are operated on a feedlot basis; the land area per farm is usually small. In 1950, of a large sample of 55 dairies, almost one-third had less than 10 acres of land and another third between 10 and 29 acres. The few acres of cultivable land available to dairies are often used to grow forage crops for green cutting. Because of the small size and rough terrain of much of the land used for such crops, the latest field machinery is not widely employed. Consequently, field labor costs are often high.

Some of the green fodder crops, particularly Napier grass, yield a heavy tonnage. But, because they are a low-quality roughage, dairymen have to provide their animals with large amounts of concentrate feed. Some of these supplementary feeds, such as pineapple bran and molasses, are produced locally. Most of them, however, particularly grains and protein feeds, have to be imported from the mainland. An increase in the production of more nutritious types of green forage crops would reduce the amount of feed that has to be purchased from the mainland.

Most replacement cows have so far been brought in from the mainland. About 1,900 dairy cows were imported in 1951 and 1,200 in 1952. This dependence on imported feed and cow replacements makes the Hawaii dairy industry highly vulnerable to any interruption of ocean transportation.

Ways of Reducing Costs of Dairying

Island dairymen are anxious to reduce their costs, lower their prices, and expand the market for their products. During the last few years several have realized that it is cheaper to raise their replacement cows in Hawaii than to import them. Some who have dairies on Oahu have bought or leased pastures on the other islands to raise their heifers. Others have made arrangements with beef ranchers to raise their weaners for them. A few sell their heifer calves to small farmers having some unused pasture areas, with the intention of buying back the mature cows.

Lack of credit is one factor which is slowing up this trend of raising
more dairy animals in Hawaii. On the mainland a large proportion of
the cost of raising cow replacements is financed by agricultural credit
institutions. In the Islands loans are still hard to get for this purpose.

The raising of dairy replacements locally will make possible a herd
improvement program. The amount of milk produced per cow could
be increased by breeding and selecting on the basis of the milk produc-
tion of the dam. Artificial insemination will have to be employed more
widely so that expensive, high-grade bulls can be used more intensively.

Dairy farmers are looking for ways to reduce their feed costs, which
in many cases now amount to half or more of their total costs. At the
present time all mainland feed is still imported in sacks. If this feed
were transported and handled in bulk, the cost of sacks would be
eliminated and substantial labor savings could be made. Dairymen need
the cooperation of shipping companies, feed importers and dealers, and
financial institutions to make bulk transportation of feed to Hawaii
a reality.

There are dairymen who believe that the industry could be put on
a grazing basis to a still greater extent. By shifting from feedlots to
pastures, dairy farmers could reduce their purchases of concentrate feed
and save the labor of cutting forage. Some Oahu producers have shifted
their operations from the vicinity of Honolulu to the more distant rural
districts of the Island. However, even there land is expensive, and farm-
ners have to buy most of their cattle feed.

Pasturing cattle requires several times as much land as growing forage
crops for cutting. Dairies based mainly on pasture would probably be
profitable only on the neighboring islands, where land is cheaper than
on Oahu. Dairymen could use unirrigated pasture land in districts with
sufficient rainfall and irrigated pastures in drier sections. Much land
suitable for dairying is now being used for beef cattle raising on the
outer islands. Dairymen could be expected to compete successfully for
some of these pastures.

In feedlot dairying, economies that arise from large-scale operation
are important and often give the advantage to the bigger operators in
Hawaii. Milk production based on grazing is well adapted to family-
sized enterprises. Small groups of producers could reduce their overhead
costs by cooperating in the use of equipment, machinery, and bulls.

In 1949 the inventory value of a hypothetical, well-equipped dairy
farm with 30 mature milk cows plus replacements was estimated at
$46,000. (See Table F5.) Of this total, 32 percent was for buildings
and installations, 29 percent for livestock, 26 percent for land, and the
remaining 13 percent for miscellaneous items, mostly machinery and
equipment. It was assumed that this farmer would share his field and
transportation equipment with one neighboring dairyman.

The intensive pasture management program described for beef ranches
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is just as essential on dairy farms. In addition to the forage crops recommended for beef pastures, Napier and panicum grass and koa haole are suggested for dairy pastures.*

Transportation of the milk from the outlying islands to Oahu should not provide insurmountable difficulties. Fresh milk has been shipped successfully to Honolulu by barge from Hilo and by plane from Maui. In several mainland areas fluid milk is transported over as great a distance and during as long a period of time as would be necessary in the Islands. The milk could be shipped in bulk and bottled in Honolulu. Production on the outlying islands would have to be large enough to bring down transportation costs to a reasonable level.

SWINE • Development and Present Status

Swine of all ages in Hawaii totaled 8,000 in 1900. By 1940 there were 32,000 head four months old and over. During World War II ample garbage from military establishments and other sources was available at low prices, few live hogs were imported, and the demand for pork was strong. As a result the swine population three months old and over rose to a peak of 60,000 head in 1944. After the war the number of swine above weaning age steadily declined to 39,000 in 1949. Since then the number increased again to 66,000 early in 1953.

There were several reasons for the decrease in the number of Island swine in the immediate postwar period. As garbage supplies from the armed forces became less plentiful, competing bidders greatly raised the price of this feed. Leases to many Honolulu swine farmers were not renewed because the growing population of the city needed the land for houses. It took many swine raisers a long time to find a rural site on Oahu on which they could relocate.

Many Hawaii residents pay a premium price for freshly slaughtered garbage-fed pork, the so-called "hot soft" pork. This is the major reason for imports of live hogs from the continental United States to Hawaii.** These shipments increased from 900 head in 1946 to 15,500 head in 1949. In the latter year, with a Honolulu market supply of 47,500 live hogs, mainland imports accounted for one-third of the total.

A major factor causing an expansion in Island pork production since 1949 was the increased use of the Koko Head area east of Honolulu as a temporary location for swine enterprises. By the spring of 1952 about 130 swine raisers had moved into that district and substantially expanded their operations. Farmers in West and East Oahu and on the outlying

* Scientific names: Napier grass, Pennisetum purpureum; panicum grass, Panicum purpurascens; koa haole, Leucaena glauca.
** Imported live hogs are mostly grain-fed and therefore yield "hard" pork if slaughtered immediately. They are usually fed garbage for a month or more after arrival in the Islands to soften the pork.
islands also greatly increased their production. With increasing Island pork marketings, mainland imports of live hogs declined from 15,500 in 1949 to 1,900 in 1952.

The number of farmers raising swine increased from 625 in 1900 to 1,652 in 1930, then decreased to 1,086 in 1940. In 1949 there were only 481 commercial swine producers in the Islands, but the number rose again to 588 in 1952. Farms with 10 or more hogs of any age were classified as commercial.

**Number of Swine Above Weaning Age in Hawaii, 1944, 1949, and 1952**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Swine Above Weaning Age</th>
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<tbody>
<tr>
<td>1944</td>
<td>(more than 3 months old) 60,000</td>
</tr>
<tr>
<td>1949</td>
<td>(above weaning age) 39,000</td>
</tr>
<tr>
<td>1952</td>
<td>(above weaning age) 66,000</td>
</tr>
</tbody>
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Most swine farms are of family size. Of the total of 588 commercial swine producers in 1952, 17 had more than 500 head of all ages, 228 had from 100 to 499 head, and 343 had between 10 and 99 head. In that year 59 percent of all swine farmers in the Islands, producing 78 percent of all pork marketed, were located on Oahu. Only 1,900 hogs, or 10 percent of all hogs placed on the market on the other islands, were sent to Honolulu. The rest were consumed locally.

About 11.8 million pounds of fresh, chilled, and frozen pork were bought by Island consumers in 1952. Of this total, 6.1 million pounds, or a little more than half, was fresh pork from swine slaughtered in Hawaii.* The remaining 5.7 million pounds of chilled and frozen pork cuts were imported. All pork provisions as well as all smoked and canned pork were also imported.

As previously mentioned, many people of Oriental and Hawaiian ancestry prefer pork that has been slaughtered the same day. They also like the locally produced “soft” pork from garbage-fed swine better than the “hard” grain-fed pork, which is largely imported from the mainland.

It would appear, therefore, that more Island pork could easily be substituted for mainland imports. However, costs of production of Island pork are higher than the landed cost for mainland pork. In April 1952 typical imported frozen pork cuts, such as spareribs, Boston butts,

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*Calculated as follows: Number of head slaughtered (66,900) times estimated average carcass weight (131.4 pounds), converted to retail weight equivalent (65 percent of carcass weight), plus edible offal (3.1 percent of carcass weight).
and pork loins, sold to retail butchers in Honolulu at from 44 cents to 52 cents per pound. Island pork cost the butchers 69 cents per pound on the average, or 20 cents more. To expand the market for Island pork, ways have to be found to reduce its cost of production.

Swine Industry Problems

Finding a suitable permanent location for their farms is a major problem for many Honolulu swine producers. At the end of World War II most Oahu swine producers operated in or near city districts. Many piggeries were in an unsanitary condition and considered health hazards by the territorial Board of Health. Nearly all used leased land, the contracts for which in many cases were due to expire within a few years.

Honolulu swine farmers searched for a rural area with water, a suitable climate and ground conditions for raising swine, and possibly some space for pasturing their animals. They looked for places either for sale or for lease. In the case of leased land they needed a sufficiently long contract to enable them to depreciate their installations over a reasonable period of time. Installations on swine farms are costly, because strict sanitary requirements must be met. There have to be adequate provisions for waste disposal, rat-proofing, and the prevention of fly breeding and noxious odors.

In spite of their sustained efforts, not many swine producers have been able to locate a satisfactory permanent site during the past seven years. Many now operate on land with short-term leases of anywhere from a few months to eight years. For example, the Koko Head leases will expire in 1960. Some of these farmers use makeshift installations, which result in inefficiency and high costs. Others built satisfactory concrete buildings in spite of the short duration of their leases. Their costs, too, are high because of their heavy annual depreciation charges. Both public and private agencies are aware of the problem and are trying to find one or more permanent sites for Oahu's swine producers.

Garbage makes up approximately half of the feed used for pork production in Hawaii. Swine raisers purchase the garbage on a contract basis from installations of the armed forces, public eating places, and food processors and dealers. Besides, they collect it free of charge from residences.

A territorial regulation requires that all garbage be thoroughly cooked before it is fed. Farmers might investigate the possibility of saving labor and equipment by having their garbage cooked in cooperative plants. The garbage obtained from various places could be tested for its quality and mixed accordingly to provide a more uniform feed. Swine raisers might also cooperate in transporting garbage to their farms. In this way they could eliminate duplication of garbage-collection routes.
Mainland concentrates are commonly fed, particularly to breeding animals and young pigs. One group of farmers purchases its concentrate feed cooperatively, with substantial savings. These men now plan to build their own cooperative warehouse and mixing plant. Molasses, at present prices, is one of the cheapest concentrates available. Greater use of this carbohydrate feed would probably be profitable on many farms. A mixture of molasses with pith from bagasse, which is now being fed experimentally to hogs, shows promise as a carbohydrate feed.

Hogs in the Islands are largely raised in confinement—in concrete or wooden pens. A survey in 1947 on Oahu showed that many hog enterprises occupied areas of less than one acre. Producers are becoming more aware of the fact that sows need space to exercise in order to farrow and wean sturdier litters. Consequently the land area per piggery is increasing.

Island swine specialists believe that good pasture can cut grain or garbage requirements by at least 15 or 20 percent. Legumes, such as clover in higher altitudes and alfalfa at low to middle elevations if it can be grown economically, are most valuable as forage. Various herbs and grasses such as pig weed, honohono, Mexican grass, Bermuda grass, and Kikuyu grass, though less nutritious, may also be used.*

Some tree fruits that are palatable to swine can be included in the pasture area. Where these trees and bushes grow wild and low cost labor is available, the fruits can be collected and fed to the animals. Among these fruits are kiawe beans, breadfruit, avocados, mangos, papayas, bananas, coconuts, and guavas.

Swine farming based on pasture can be expected to develop more on the outlying islands than on Oahu, where land is more expensive and less easily obtainable. Some swine raisers on the outer islands might find it profitable to specialize on raising feeder pigs. They could send their weaners to Oahu for finishing on garbage.

Most hog farmers specialize in this one enterprise. Swine production can well be handled as a sideline on vegetable and fruit farms. Swine can utilize surplus or cull fruits and vegetables. Fields can be rotated between crop production and swine pastures. Such a practice is of advantage to both enterprises. However only those grasses ought to be used which can easily be gotten rid of in preparation for vegetable crops.

The amount of labor per pound of pork produced can often be reduced by a better farm layout and greater use of labor-saving devices such as self-feeders and feed trucks. Better breeding stock is needed on

* Following are the scientific names of the herbs and grasses mentioned: pig weed, Portulaca oleracea; honohono, Commelina diffusa; Mexican grass, Isophorus unisetus; Bermuda grass, Cynodon dactylon; and Kikuyu grass, Pennisetum clandestinum.
many Island swine farms. Consumers are demanding pork with less fat, and butchers are asking for a leaner, meat-type animal. Farmers want sows which farrow and wean larger and heavier litters.

Losses from diseases and parasites could be greatly reduced on many Island hog farms. Improved sanitation of pens and pastures and better nutrition would reduce diseases like diarrhea or dysentery. The incidence of external and internal parasites could also be minimized by better sanitation and management practices. Hog cholera, which can be prevented by vaccination, is still a major cause of death. Brucellosis greatly reduces the net profit in affected herds. Nevertheless, only 68 out of 530 Oahu swine producers had done any blood testing for the disease, according to a 1952 survey of the Board of Agriculture and Forestry.

The most common method of swine marketing in Hawaii is rather simple. Farmer and butcher contact each other directly. The buyer pays the producer on an ungraded, liveweight basis, delivered slaughterhouse. The hog is custom-slaughtered for the butcher. About two-thirds of all Oahu swine carcasses are cut up by retail butchers and sold to final consumers. The remaining third is handled by wholesale butchers, who sell cuts to restaurants, peddlers, and some retail markets.

This marketing process could possibly be improved by establishing an assembly yard for market hogs. Producers would bring their butcher hogs to this place and sell them to the highest bidder. Both buyers and sellers would gain by the introduction of grading on a carcass basis. Butchers would pay a premium for the best grade of carcass, and farmers would be encouraged to produce the most desirable animal.

POULTRY • History and Present Status

Climatic conditions in most sections of the Islands are well suited for poultry raising. The number of chickens more than three and four months old, respectively, rose from 32,000 in 1900 to 472,000 in 1950. In 1952 the average annual rate of lay per hen for Hawaii was 156 eggs, somewhat lower than the 1951 mainland average of 175. Egg production rose from 156,000 dozen in 1900 to 2.1 million dozen in 1940 and about 5.3 million dozen in 1952. On a dressed basis, about 3 million pounds of Island meat birds were produced in the latter year.

Imports of poultry products into Hawaii are large. In 1952 about 2.4 million dozen eggs in the shell were imported from the mainland. Substantial amounts of frozen, dried, and otherwise preserved eggs were also imported. The last import figures for these products are for the year 1947 when about 1 million pounds were brought in, the equivalent of approximately 0.8 million dozen shell eggs. Mainland shipments of dressed chickens amounted to 3.6 million pounds in 1952.

The per capita consumption of poultry products in the Islands is only
about half of that on the mainland. For 1952 the annual consumption of chicken was estimated at 14 pounds per capita for civilians in the Islands and at 30 pounds in the continental United States. Price was probably a major factor accounting for the difference. In Honolulu in 1951, fresh young Island chickens sold dressed for 66 cents per pound wholesale; comparable frozen birds imported from the mainland sold for 50 cents per pound. In comparison, young chickens in New York sold for 35 cents per pound wholesale.

Another important reason for low consumption of poultry in Hawaii may be the greater competition of sea foods than on the mainland. The situation may also be influenced by tradition. Many Island people still consider poultry as a holiday or luxury treat rather than as a part of their regular diet.

Estimates of the per capita consumption of eggs in 1952 are about 220 eggs for Island civilians and 407 eggs in the continental United States. There are several reasons for this low egg consumption. Orientals and Hawaiians do not use eggs extensively in their traditional dishes. As they change over to Western diets, their egg consumption will increase. However, even Caucasians eat fewer eggs in the Islands than on the mainland. While this may to some extent be due to the warmer climate in Hawaii, it is primarily a consequence of higher egg prices. In 1951 the average wholesale price in Honolulu of large Grade A eggs in cases was 88 cents per dozen for Island eggs and 74 cents per dozen for mainland eggs. In comparison, a dozen large eggs Grade Extra averaged 56 cents at wholesale in New York in the same year.

The price differential between Island and mainland eggs of the same grade is the result of a strong preference of Island consumers for the Hawaiian product. They like the greater freshness of locally produced eggs and expect them to be of better quality than mainland eggs. In part this preference dates back to before World War II when many mainland eggs, which were transported and stored under unsatisfactory conditions, were definitely inferior to fresh Island eggs. With present methods of transportation and handling, however, this deterioration need no longer occur. All imported eggs, including those shipped from the mainland, have to be stamped with the name or initials of the exporting country. Eggs with processed shells must be so labeled.

The number of commercial poultrymen in the Islands sharply decreased from 750 in 1946 to 378 in 1952. In the same period the average size of laying flocks increased from slightly more than 300 to 1000 layers. Most Island poultry farms are still small and operated only
with family labor. In 1952 only 22 poultrymen had more than 3,000 layers and 49 had between 1,500 and 2,999. In contrast, there were 117 farmers with from 500 to 1,499 layers and 167 with less than 500. Twenty-three operators specialized in meat-bird production. In the same year about half of the commercial poultrymen in Hawaii, who kept about two-thirds of all layers, were located on Oahu.*

Farm Costs and Ways of Reducing Them

Costs of most Island poultrymen greatly exceed those of mainland poultrymen. In 1948 the average costs per hen of a sample of 13 representative Hawaii egg producers were twice as high as those of two groups of producers operating in Alameda and Solano counties in California.** The Island farmers, in spite of higher gross returns from their products, received substantially lower earnings per hour of labor than the mainlanders.†

One of the major reasons for the high production costs in Hawaii is the large labor input per bird. The sample Island farmers averaged 3.9 hours of labor per layer, compared with 2.0 hours for Alameda and 1.5 hours for Solano. On this basis a full-time Hawaii poultryman could keep a flock of only 650 layers and replacements, compared with 1,300 and 1,700 for the Alameda and Solano producers, respectively. Another high-cost factor on Island poultry farms was investment per hen, which was more than twice as much as on the California farms.††

Poultry scientists at the Hawaii Agricultural Experiment Station have indicated several ways in which costs of production could be cut. On the mainland, for example, chicks are mostly brooded on litter on the floor. It is not uncommon there for a single poultryman to care for more than 14,000 chicks at a time. This number could not be cared for by one man in Hawaii, where battery brooders and confinement brooding in raised wire-floor pens were, until two years ago, the almost

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* Farms with 100 or more layers or meat birds were classified as commercial. No statistics on backyard poultry producers with less than 100 layers are available for 1952. The 1950 U. S. Census of Agriculture reported that 3,076 farmers kept 472,183 chickens four months old or over. Of this total, 52,290 chickens were on farms with less than 100 birds.

** The records of 7 Hawaii and 6 Maui producers were compared with those of 18 poultrymen in Alameda county and 8 in Solano county, California. Costs per hen per year were $16.25 for Hawaii compared to $8.36 for Alameda and $6.28 for Solano. Perry F. Philipp, Motoi Ueda, and Masaaki J. Doi, 1948 Poultry Management Efficiency Study in Hawaii, Agr. Ext. Cir. 267, Univ. of Hawaii (Honolulu: 1949), p. 20.

† Average earnings for poultrymen in Hawaii were $1.13 per hour of labor, compared to $1.64 for Alameda and $2.02 for Solano.

†† Investment per hen was $11.33 for Hawaii farms, $5.00 for Alameda, and $4.40 for Solano county.
universally accepted systems of brooding. These methods were used to better control coccidiosis, insects, and parasites.

Recently developed insecticides and drugs against coccidiosis encouraged floor-brooding experiments in Hawaii. The scientists found that about 60 percent less labor was needed in floor-brooding than in battery-brooding. Mortality, growth rate, and feed efficiency were as satisfactory among the floor-brooded chicks as for the battery-brooded chicks. With heat-ray lamps for warming the chicks, the initial investment was smaller than for electric battery brooders, and electricity costs were cut almost in half. Floor brooding is suggested and is becoming popular in Hawaii in areas where rainfall is moderate or light.

Many poultrymen can reduce their costs of rearing chickens. Young birds are commonly raised in Hawaii in developer pens with wide overhanging roofs. Poultry scientists designed a sun-porch developer pen which cost 40 percent less to build than a conventional developer pen with the same floor area. Pullets and cockerels grew as well on the sun porches as in the standard pens, and there were no significant differences in feed consumption and mortality. Chickens raised on the sun porches required on the average 20 percent less labor than those kept in the customary pens. In other words, caring for 12,000 birds in sun-porches would take no more time than 10,000 in standard developer pens.

Under certain conditions it is more profitable to keep laying chickens on litter in confinement rather than in open-air wire-floor pens as is customary in Hawaii. Island scientists showed that chickens maintained on litter had a hen-day egg production of 59 percent during their first year of lay compared to 46 percent for birds on wire floors. Egg production of chickens in wire-floor pens declined during the fall and winter, when they were exposed to strong and gusty winds. In contrast, the birds kept on litter continued to lay well during this period of high egg prices. As a result, returns from litter-housed pullets were from $2.70 to $4.00 per year greater than from pullets kept in open-wire pens.

Litter management is the most prevalent method of keeping laying flocks on the mainland. There one man is able to care for more than 5,000 layers on some farms. By using this system, Island producers can take advantage of the numerous labor-saving devices designed for it on the mainland. However, litter management of laying chickens as well as sun-porch developer pens are so far only recommended for Island areas that are not excessively wet. Many Island poultrymen still feel that the individual laying battery or the modified battery system, wherein 15 or more birds are kept in one pen, are the best housing methods under their conditions.

An all-pullet flock is desirable for commercial egg production. Experiments in Hawaii showed that the annual egg production of pullets ranged from 3 to 30 percent higher than that from hens in their second
year of lay. Nevertheless, in 1951 more than 40 percent of all layers on commercial poultry farms in Hawaii were in their second year of lay.

Many Island farmers buy chicks for replacement only during the spring. As a result of this practice, pullets coming into lay produce only a small supply of large eggs during late summer and fall when prices are high. Besides, buildings and equipment are not fully used during part of the year, because stock lost through culling or death is not promptly replaced. Experiments in Hawaii have indicated that returns from egg production are similar for chickens hatched in any season of the year. It would, therefore, probably pay poultrymen to replace their stock the year around rather than only once a year.

Feed is the largest single expense item on Island poultry farms. It accounted for 61 percent of all production costs on the 13 Hawaii sample farms observed in 1948. Some farmers could save feed by preventing losses from wind, rats, and wild birds. A few could probably profit by mixing their own feed. Others would gain by taking advantage of the cash discounts given by feed dealers. A discount for cash payments of 1 percent on a poultryman's monthly feed bill might amount to as much as 12 percent per year. If he could borrow money at an interest rate of 6 percent to pay for his feed bills in cash, he would still save 6 percent per year. Many Island poultrymen are interested in the possibilities of reducing their feed costs by taking feed delivery in bulk rather than in sacks.

Where feed is as costly as in Hawaii, the conversion rate of feed into poultry products is an important profit factor. Heavy birds need more feed than light ones to maintain their greater body size. Unless the heavier birds also lay more eggs, lighter good-laying hens are usually more profitable for egg production. It is unlikely that the return from the additional carcass weight will pay for the extra feed consumed by each hen during the laying year. For meat production, weight gain per pound of feed is of major importance in selecting a breed. Marketing age is also important. The common practice among commercial broiler producers is to sell their meat birds when they are from 10 to 14 weeks old. When they are kept longer the conversion rate of feed into meat becomes progressively less favorable.

Nearly all feed used by commercial poultrymen in Hawaii is imported from the mainland. During the last few years, chicken raisers sustained heavy losses when feed shipments were interrupted by maritime strikes. Efforts have been made to develop locally produced feeds that could be substituted during such periods of scarcity. Mixtures of low-grade sugar and bagasse pith show great promise as an emergency source of carbohydrates. Investigations are being conducted to determine the practical limitations of this new feedstuff. It has also been found that dried cow manure can be successfully substituted in a standard egg-
laying ration to about 10 percent of the total diet. However, no protein feeds are produced in the Islands other than a little fish and meat meal. A two months' emergency reserve of protein feeds and whole grains, kept by feed dealers, a cooperative of poultry producers, or by a government agency, could greatly reduce the danger of losses from interruptions of maritime transportation.

Sometimes it is argued that Hawaii poultrymen cannot raise meat birds in competition with imports because of the high cost of shipping feed to the Islands. In 1952 it cost approximately 87 cents to import a 100 pound bag of feed from the mainland. Let us assume that it takes about 4.4 pounds of feed to produce one pound of sectioned bird. The cost of shipping that much feed to the territory is 3.8 cents. Importers paid about 3.3 cents per pound to bring in sectioned chicken from the mainland. The difference between the cost of importing the bird and of importing the feed for raising the bird was about 0.5 cent per pound. The price differential in favor of fresh Island poultry will probably always be higher than that amount. In 1951 it averaged 16 cents per pound in Honolulu.

There are other improvements that could result in lower production costs in many poultry enterprises. Among these are an improved layout of the poultry farm, greater use of labor-saving devices and routines, better quality of birds, and more careful culling.

Opportunities for Breeding and Flock Replacement

There is an opportunity to expand poultry breeding in Hawaii. In 1951 about 500,000 chicks and 150,000 dozen hatching eggs were imported into the Islands. At an estimated price of 25 cents per chick and $1.00 per dozen hatching eggs, Islanders paid about a quarter of a million dollars for these mainland imports in that year. Hawaii poultrymen could keep most of that money at home by buying locally produced replacement stock which is better suited to Island conditions.

Poultry scientists compared the performance of one local strain and three imported strains of New Hampshires under identical Island conditions. After about one year of confinement in individual cages, the mortality of the Island strain was less than 6 percent, compared to an average of 21 percent for the mainland strains. Only one of the three imported strains laid as well as the local stock. Up to 17 months of age, the Hawaii pullets produced 196 eggs, compared to 199 for one mainland strain and an average of 162 eggs for the two others.

There is a good possibility that Island poultry breeders can develop an export trade by shipping Hawaii-bred stock to the semitropical and tropical regions of the Western Pacific. Hawaii is located 24 hours closer to these markets than are mainland breeders, an important con-
sideration when shipping hatching eggs and chicks, particularly the latter. Besides, the Island stock would be developed under climatic and management conditions closely approximating those of these potential export areas.

In developing poultry breeding in Hawaii, Island producers must maintain the high standards of breeding now prevailing on the mainland. Otherwise, losses resulting from reduced egg production and economy of growth might offset the disadvantages of importing chicks and hatching eggs.

**Processing and Marketing**

In 1952, 6.1 million dozen shell eggs were sold on the Honolulu market. Of this total, 32 percent was imported from the mainland and 7 percent from foreign countries.* The remaining 61 percent was produced in Hawaii, with Oahu contributing 50 percent and the other islands 11 percent. Of the 5.2 million pounds of dressed chicken sold in Honolulu, 37 percent was produced on Oahu and 63 percent on the mainland. Imports from the outer islands were negligible, and there were no foreign imports.

Most Oahu producers deliver their poultry and eggs directly to retail stores and to consumers. They kill their meat birds at the farm and prepare them for the market. They candle and grade their own eggs and pack them in one-dozen cartons. Most of the outer-island eggs sold in Honolulu are handled on consignment. Some Honolulu wholesalers marketing these eggs candle, certify, and carton them. Others receive their eggs packed in one-dozen cartons and merely distribute them to retail stores.

There are two associations of poultrymen on Oahu with a combined membership in 1952 of approximately 60 percent of all commercial producers on the island. The larger of the two handles no meat birds but helps some of its members find markets for their eggs, particularly during periods of surplus. Its principal functions are to improve the standards of Oahu's poultry industry and to attempt to maintain a uniform price for farmers selling to retailers and consumers. In the latter purpose they are fairly successful by means of publishing prices weekly in newspapers. The other organization is a regular cooperative of egg producers. Its functions include picking up eggs at the farm, storing, and distributing.

A strong cooperative operates in Hilo, which handles some poultry

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*The maritime strike in 1952 probably affected the relative importance of mainland and foreign imports. In 1951, a year without a maritime strike, 42 percent of Honolulu market supplies was imported from the mainland and 1 percent from foreign countries.*
and about 75 percent of the eggs produced on the island of Hawaii. It assembles, packs, stores, and distributes eggs, slaughters and dresses meat birds, and purchases feed and supplies for its members. A poultry cooperative on the island of Kauai also handles both poultry and eggs. The members of a poultry club on Maui ship their eggs together to Honolulu in order to take advantage of lower freight rates for bigger shipments.

Volume and prices of Island eggs show great seasonal fluctuations. Egg production usually reaches a peak in March and April and gradually declines through the summer and early fall. In the four-year period 1946-49 wholesale prices for locally produced large Grade A eggs in Honolulu averaged 83 cents per dozen in March and $1.21 in November. Seasonal price differences, as well as the general price level for Island eggs, have been declining lately. In 1952 prices for Grade A large Island eggs were at a low of 75 cents per dozen in March and a high of $1.00 in January.

A surplus of eggs affects the Honolulu market more than most mainland markets, since there are no other markets to which the Island surplus can be sent. Efforts are being made by many commercial poultrymen in the Islands to equalize their egg production throughout the year. However, some surplus during the spring can be expected to continue, particularly because many backyard producers enter the market to sell their excess eggs during the peak production period.

No large-scale efforts have yet been made to store Island eggs in the peak period for sale later in the year. More, better, and cheaper storage facilities are needed for this purpose. In 1950 only about 27,000 cubic feet of storage space in Honolulu was suitable for eggs. This space could handle adequately less than the average number of eggs consumed per month. In 1952 commercial storage rates for eggs were almost twice as high as West Coast rates.

Lack of credit is another hurdle to the storage of surplus eggs. Farmers require financial help to carry their stored eggs for a period of several months. The risks and costs of such a storage operation ought to be distributed fairly between the several groups of producers and egg handlers. A territory-wide industry organization would probably be helpful for this purpose.

The quality of eggs sold in Honolulu retail stores, although generally satisfactory, could be improved by keeping more Island eggs under refrigeration. Early in 1951 less than one-fourth of all Island eggs were...
displayed under refrigeration in retail stores. An effective territorial inspection service, organized since World War II, makes sure that egg quality at the retail level actually lives up to the grade specified on the cartons. Some Island poultry offered for sale is poorly processed and packaged. A more attractive and higher quality product would probably increase the consumption of locally produced meat birds.

The marketing potential for eviscerated and sectioned Island poultry is probably not yet fully exploited. Many housewives, particularly those having jobs, do not want to dress chickens. In a sample of 200 employees and faculty members of the University of Hawaii, almost 75 percent indicated a preference for either eviscerated or sectioned chickens. At the present time most Island birds are still sold undrawn.

Costs of processing Island birds can probably be reduced. Using the most efficient methods employed locally, a man could slaughter, dress, eviscerate, and package about six chickens per hour. In modern mainland plants, the average number of birds handled per operator during one hour is now several times greater than this figure. It seems, therefore, that Island costs might be cut by utilizing more efficient equipment in cooperative killing and dressing stations, to which individual producers would bring their birds for processing.

There is ample opportunity for an expansion of Hawaii's poultry industry. Per capita consumption of all poultry products is low compared to mainland standards, and a large proportion of both poultry meat and eggs is imported. Surveys showed that Island consumers greatly favor local products over mainland imports; eight out of every ten homemakers prefer Island eggs and chickens.

Advertising and other promotional efforts may increase consumption of poultry products. However, chances are that substantial expansion of output would force down prices. Therefore, increased efficiency and cost reduction in both production and marketing are needed.

**BEEKEEPING**

During the past 50 years Hawaii's beekeeping industry first expanded, then declined, and now has begun another modest expansion. The production of honey amounted to slightly less than 100,000 pounds in 1899. Shipments to the mainland reached a peak of 2.4 million pounds in 1918, according to available statistics. Between that year and 1932 mainland exports continued at an average rate of 1.5 million pounds annually.

Heavy losses from American foul brood, a serious bee disease, and the low prices of the depression brought about a decline of the industry after 1932. Honey production continued low during World War II despite higher prices. Average mainland shipments for 1933–45 amounted
to 0.9 million pounds annually. Production reached a low point of 0.6 million pounds in 1945 and then gradually rose to 0.9 million pounds in 1951. Because of unfavorable flowering conditions, production again dropped to 0.6 million pounds in 1952.

The wholesale honey price declined from 15 cents a pound in 1918 to 3 cents a pound during the depth of the depression. It rose to an average of 16 cents a pound in 1947, following the abolition of World War II price controls. From 1948 to 1952 it ranged between 7 and 10 cents a pound.

Early in the century much of Hawaii's honey was exported to Germany and to England and her possessions. Now most of it is marketed on the mainland, and a small portion is consumed in the Islands.

Beeswax from Hawaii commands top prices on the mainland. It is valued highly by manufacturers of cosmetics because it is easy to bleach. About 13,000 pounds were produced in 1951 and 7,000 pounds in 1952.

The honey yield per colony in Hawaii averaged 88 pounds per year during the three-year period 1949-51 and 49 pounds in 1952. Yields of some Island apiaries are consistently twice as high as the average or higher. The average annual yield was 41 pounds per colony in the whole United States in 1949-50.

Large beekeeping enterprises predominate in Hawaii. In 1952 there were 25 commercial honey producers in the Islands, who cared for 11,900 bee colonies. In 1951 four producers owned over 600 hives each, and together they had more than half of all the colonies in Hawaii. Eight beekeepers, with from 100 to 500 colonies each, accounted for another fifth of all the hives. All others had less than 100 hives each.

Several beekeepers are expanding their operations and are taking the lead in improving management practices in the Islands. They are using better combs and are requeening their colonies regularly and systematically from selected stock. They are improving their extracting equipment and their methods of taking and processing honey and wax in order to reduce costs of production and to improve quality.

They take care not to overcrowd their apiaries but distribute them to make the most of the existing pasture possibilities. They are planning improvements in marketing methods, including the better sampling and grading of honey.

The cost of containers and of transportation to market amounts to approximately 3 cents per pound. Some producers are investigating the
possibilities of reducing these costs by various means, such as the use of fiber shipping containers instead of wooden ones.

The blossoms of kiawe trees are the principle source of honey in the Islands. These trees grow mostly on the flats near the seashore and at low altitudes inland. Kiawe honey, which is very light, is used for blending on the mainland.

At the present time not enough bees are being kept to fully utilize all kiawe groves. In addition, the beekeeping industry could be expanded by a greater use of clover and of ohia lehua, eucalyptus, and Java plum trees.* If all these floral sources were developed to their capacity, the beekeeping industry could expand to its former size and possibly surpass it on some islands.

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* Scientific names: kiawe, _Prosopis chilensis_; ohia lehua, _Metrosideros collina_; eucalyptus, _Eucalyptus spp._; Java plum, _Eugenia cumini._


——— *The Livestock and Meat Situation.* (See 1951–52 issues, especially Nov.–Dec. 1952, p. 9.)

——— *The National Food Situation.* (See Apr.–June 1953, p. 4.)


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As we noted in the Introduction to this book, the Islands are confronted with several serious economic problems. The most serious of these are the unfavorable balance of payments, and the threat of increasing unemployment. Also the economy of the Islands is vulnerable to the effects of changing federal policies, business depressions, labor and management conflicts, and interruptions of transportation between Hawaii and the mainland. After having considered the history and present status of each of Hawaii's diversified agricultural industries, we will now summarize the possibilities of expanding these industries and the effect of such an expansion on the Islands' major economic problems. Also summarized are changes and developments which would strengthen diversified agriculture.

Possibilities of Expanding the Output of Hawaii's Diversified Agriculture

**REPLACEMENT OF IMPORTS BY ISLAND PRODUCTION.** The large proportion of agricultural products now imported can be somewhat reduced by an expansion of Island output. Increases appear feasible mainly in the production of fresh beef and pork, poultry products, milk, and certain fruits and vegetables. More dairy cow replacements could be raised in the Islands instead of importing them. Also, purchases of livestock feed from the mainland could be reduced by increasing the carrying capacity of pastures and by enlarging the local production of nutritious green feeds.

However, many agricultural products will continue to be primarily imported. Only few deciduous and citrus fruits and a small fraction of such food staples as rice, potatoes, and dry onions are now raised in Hawaii. The Islands have never had food processing industries of any importance other than for sugar and pineapples and a few specialties. Therefore, the Islands will continue to import nearly all processed food, such as processed meat, dairy products other than fluid milk and some cream, cereal products, and canned, dried, and frozen fruits and
vegetables. Similarly, most livestock concentrate feeds can be imported more cheaply than they can be produced locally.

**INCREASE OF HAWAII EXPORTS.** In addition to enlarging the output for local consumption, there are possibilities of increasing Island exports of several products of diversified agriculture. Macadamia nut producers are confident that they can develop a large mainland market for their products. The demand for these nuts presently exceeds Island supplies. The expansion of mainland shipments of tropical flowers and foliage was spectacular in the period from World War II to 1950. A renewed growth of floral exports is probable.

Among fruits and fruit products, exports of fresh papayas to the West Coast are rapidly increasing, and market prospects are bright. The prewar demand in San Francisco for Chinese bananas from Hawaii can be revived, in the opinion of produce importers of that city. The possibility of marketing Island avocados on the mainland is now under investigation. Exports of fruit products, such as canned or frozen tropical fruits and fruit juices, jams, and jellies, are gradually expanding.

Prospects are good for exports to the Pacific Coast of some winter vegetables, such as snap beans, cucumbers, and green corn, provided production and marketing costs can be kept low enough. Quick-frozen green lima beans are also a potential export product.

Small amounts of poi are now being shipped to the mainland. It appears that more poi and other taro products could be sold there, particularly for therapeutic and dietary purposes. Mainland exports of Kona coffee in consumer packages could be increased under favorable market conditions. Finally, an increased output of quality Island honey and beeswax could probably be sold without difficulty on the mainland. Hawaii’s total annual production of honey and beeswax amounts now to only a fraction of 1 percent of the consumption of bee products in the United States.

Both the expansion of exports and the reduction of imports of diversified agricultural products would improve Hawaii’s balance of payments.

**Changes Necessary to Reduce Costs**

**INCREASE IN LABOR PRODUCTIVITY.** Expansion of agricultural output for both local consumption and export will depend largely upon lower prices of products. In order to reduce prices, production and marketing costs must be scaled down. A greater output per worker is a major factor in cutting production costs. During the last 15 years there has been a trend toward greater mechanization on diversified Island farms. Continued mechanization, where feasible, and better adaptation of agricultural practices to the use of machinery could greatly
increase the productivity of farm labor. The latter could also be increased in some cases by more labor-saving practices and devices, improved buildings, and a better farm layout.

**BETTER MANAGEMENT AND BUYING PRACTICES.** Better management practices would decrease costs. Crop farmers might include more crop rotation, green-manuring, mulching, and better fertilization based on frequent soil tests. Many livestock and poultry raisers would do well to improve their stock and to follow better feeding practices.

For some cattle ranchers it probably would be profitable to increase the carrying capacity of their pastures while beef prices are at their present high level. Dairymen with sufficient pasture land might find it cheaper to raise their own cow replacements than to import them from the mainland.

To compete successfully with large-scale enterprises, family farmers need to work more closely with each other. By cooperatively owning specialized equipment or costly breeding stock, individual producers can substantially reduce their overhead costs. More cooperative purchasing of farm materials and feed might also lower costs in many cases.

**LARGER FARMS.** In most diversified industries there now exists a trend toward larger diversified farms in terms of output, area, number of animals, and capital investment. Many farmers will probably continue to increase the size of their farms so that they can introduce more mechanical equipment and labor-saving methods and thus raise the productivity of their labor. However, there is no reason to believe that, for maximum efficiency, any diversified agricultural enterprise need be so large that it could not be operated mainly with family labor.

Not all farmers in Hawaii can mechanize more or increase the size of their farms. Topography, land tenure barriers, or location within or adjoining residential areas may make such changes impossible. Some farmers are unwilling to alter their accustomed management practices. Others are part-time farmers with little incentive to enlarge their farms.

**GREATER DIVERSIFICATION OF FARMS.** Most producers in Hawaii's minor agricultural industries are highly specialized. In many cases adding one or more enterprises to the farm would reduce risk, stabilize income, and make better use of farm resources. On most farms an increased output for home consumption would reduce food costs and result in an improved diet for the family.

**MORE FUNCTIONAL SPECIALIZATION.** Output expansion on farms can be expected to result in greater functional specialization.
Growers would then concentrate on the job of producing, letting others do more of the buying, processing, transporting, and marketing.

**NEEDED DEVELOPMENTS IN MARKETING.** An extensive promotional program is required to popularize Hawaii's tropical specialty products on the mainland. Advertising might also increase local sales of some Island agricultural products. Industry-wide trade organizations could probably best undertake this promotional work.

These organizations might also play an important role in handling some of the other marketing problems faced by the diversified agricultural industries. They could bring about greater industry cooperation in balancing production and market expansion and in handling seasonal gluts. They could work for better marketing practices, greater price stability, and better quality of Island products.

In recent years advances have been made in cooperative marketing of some diversified agricultural products in Hawaii. However, few Island cooperatives have yet gained the internal strength of many mainland cooperatives. It can be expected that more farmers in Hawaii will in time become aware that cooperative marketing is advantageous to themselves and to their industries.

**Changes Necessary in Environmental Conditions**

**LAND AND WATER.** Public and private policies on land tenure will have an important influence on the future development of diversified agricultural industries in Hawaii. For example, the sale of more agricultural land by big landholders would encourage diversified farming.

In view of the large amount of leased agricultural land, better leasing practices are needed. Many lease contracts do not provide sufficiently long terms to bring about optimum land utilization. Tenants are discouraged from making improvements on their leaseholds because they do not get credit for the undepreciated portions of such investments when their contracts expire. The breaking up of large leaseholds would promote diversified farming in family-sized units. Greater use of an escalator clause tying the amount of rent paid to the price level of the commodity would help reduce fluctuations of farm income and thereby stabilize production methods.

The development of low-cost irrigation water on arid lands which are adapted to the use of mechanical equipment could greatly aid the expansion of diversified crop and livestock farming. So far almost all irrigation water in Hawaii has been developed with private capital. Publicly financed irrigation projects which appear capable of paying for themselves over a reasonable period of time should be seriously considered.
CREDIT. Diversified farming suffers from a lack of sufficient credit. Private lending institutions might well be able to increase their volume of loans to diversified farmers and their marketing agencies. In addition, the agricultural credit situation could be improved by extending to Hawaii the operations of the lending agencies organized in the Farm Credit Administration.

RESEARCH, EDUCATION, AND GOVERNMENTAL ACTION. Continued emphasis on agricultural research and education is, of course, a prerequisite to a growing diversified agriculture. Laws and governmental regulations should be kept up-to-date to suit changing agricultural and economic conditions.

AGRICULTURAL PLANNING. The optimum development of diversified agriculture will require careful and extensive planning on both a local and territory-wide basis. A Farm Advisory Board was created by the territorial legislature in 1949. Among other things, this board is charged with studying land utilization in Hawaii and making recommendations to farmer groups. The board should become the focal point for all diversified agriculture plans and should have the close cooperation of all public and private groups and agencies concerned.

Effects of the Expansion of Diversified Agriculture

UPON EMPLOYMENT OPPORTUNITIES. An expansion of diversified agriculture would increase farm employment. However, employment would rise at a slower rate than output because of the expected increase in labor productivity.

A larger output on diversified farms would also create more jobs in firms which transport, process, and market diversified agricultural products. Besides, employment would rise in other businesses selling goods and services to farmers. Expenditure of the additional income earned by farmers and the owners and employees of the firms selling to farmers would, in turn, create more jobs. In this way the original rise in employment and income in the diversified agricultural industries would result in a tendency toward a higher level of employment and disbursements throughout Hawaii's economy.

UPON HAWAII'S DEPENDENCE ON FEDERAL POLICIES. Great fluctuations in federal military expenditures have had an adverse effect upon the economic stability of Hawaii during the recent past. A broadening of the Island economy, brought about by an expansion of diversified agriculture, would tend to soften the impact of changing levels of expenditures by the armed forces.
The profitability of Hawaii’s largest agricultural industry, sugar production, is to some extent dependent upon the continuation of favorable federal agricultural policies. An increase in the relative importance of diversified farming would therefore reduce the dependence of Hawaii’s prosperity upon the continuation of federal good will.

**UPON HAWAII’S ABILITY TO WITHSTAND A DEPRESSION.**

It is difficult to assess the over-all effect of expansion and management changes in diversified agriculture upon Hawaii’s ability to withstand a business depression. Additional Island exports of diversified agricultural commodities would be largely limited to high-priced luxury products, such as flowers and foliage, macadamia nuts, winter vegetables, and tropical fruits and their products. During a depression both volume and value of shipments of all these commodities to the mainland would probably decline.

The value of diversified agricultural products for local consumption would also decrease during a depression. However, the quantity produced for Island markets would be expected to remain at least at present levels. Increased farm production of food and feed for use in the home and on the farm would soften the impact of a reduced cash income to farm families.

Many people who were raised on farms expect that in times of business depression they can always return to the farm and make a living there. A more highly mechanized diversified agriculture probably could not absorb many people who became unemployed elsewhere. On the other hand, a depression program of public works designed to improve and develop Hawaii’s agricultural land and water resources would be of lasting benefit.

**UPON LABOR AND MANAGEMENT CONFLICTS.** Hawaii has suffered in the postwar period from recurrent and long-drawn-out labor and management conflicts, particularly in the maritime transport, sugar, and pineapple industries. Labor disputes do not occur on farms operating with family labor exclusively. However, any foreseeable expansion of diversified agricultural industries, in which the family farm is now the major producing unit, would probably be too small to materially affect the impact on the Islands of labor and management conflicts.

**Effect of an Interruption of Mainland Transportation**

**UPON AN EXPANDED DIVERSIFIED AGRICULTURE.** Future interruptions of mainland transportation would hurt most diversified industries and temporarily aid a few others. A suspension of air freight would bring exports of perishable flowers to an almost complete stand-
still. Similarly, even a short break in surface transportation would result in heavy losses of fresh fruits and vegetables grown for export. Shippers of semiperishable commodities, such as macadamia nuts, coffee, honey, and fruit products, would suffer losses resulting from the disturbance of normal marketing. On the other hand, demand and prices for diversified agricultural products which are produced locally and also imported under ordinary conditions would rise as a result of short supplies.

The interruption of imports required for farm production would also result in losses. The amount of these losses would depend on the type of supplies, length of the shipping tie-up, storage practices, and the season of the year. With present feeding and storage methods, a sudden complete break in feed imports for more than one month would be serious for many livestock farmers and poultrymen. Milk and poultry production would also be affected by a lack of cow replacements and chicks from the mainland.

A two months' emergency reserve of protein feeds and whole grain could greatly reduce the danger of shipping-strike losses to livestock farmers and poultrymen. The pasturing of more livestock, the raising of more cow replacements, and the production of more chicks locally would also lessen the impact of a suspension of mainland shipping. Almost all materials used in crop production, such as insecticides and fungicides, packaging containers, gasoline, and machinery, are now imported. Most of these items are not perishable and could be stored if the interruption is foreseen and does not last too long.

If the United States should become involved in another major war, mainland transportation might be disrupted for long periods by enemy action. Because of the need for greater self-sufficiency, there would probably be a strong market for essential crops. Some livestock farmers, such as ranchers, depending primarily on locally produced feed would not have production difficulties. Others, like poultry raisers, might have to reduce their output because of smaller feed supplies. However, industries producing perishable luxury products for export, such as flowers, foliage, fresh tropical fruits, and winter vegetables, might be expected to suffer severely in the event of war.

A Challenge

It is evident that many of Hawaii's diversified agricultural industries show promise for expansion and that such expansion would materially strengthen Hawaii's economy. To bring it about, men are needed with vision, enterprise, venture capital, and capacity for hard work.

The expansion of the diversified agriculture of Hawaii is a challenge to all the people of Hawaii!