KAUAI

MOLOKAI

DIVERSIFIED AGRICULTURE OF HAWAII

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PREFACE

The term diversified agriculture as used in Hawaii includes all agricultural industries of the Islands other than sugar and pineapple. It refers to the fact that these industries broaden or diversify Hawaii's narrow agricultural base. At present there is much interest in expanding the diversified agriculture to help stabilize the economy of the Islands.

This book gives in nontechnical language some of the essential economic information about Hawaii's diversified agriculture. It is written for the general public, both farmers and nonfarmers, and is adapted for use in schools. The Introduction presents the major economic problems of Hawaii. Part One discusses the history of farming in Hawaii; and the physical and institutional environment of diversified agriculture; Part Two considers each major diversified agricultural industry in some detail. Appendices give additional information on subject matter discussed in the text. Sources for tables in the appendices are identified by numbers which refer to the numbered sources in Appendix G.

The manuscript for this book was completed in March 1953. Latest available statistics were included, mostly for the year 1952. However, a two-month maritime strike in the summer of 1952 made that year unrepresentative for some purposes. Statistics for 1951 were used in these cases because no shipping strike occurred in that year.

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April 1, 1953

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I NTRODUCTION

Hawaii faces serious economic problems, particularly an unfavorable balance of payments and limited employment opportunities. Its economy is vulnerable to business cycles, changes in federal policies, labor and management conflicts, and interruptions of transportation. Food prices, especially, are generally higher than in the mainland United States.

Some of these difficulties are the result of economic trends which began before World War II and gained momentum during and after the war; others are due to fundamental weaknesses in the Island economy. In view of the present prosperity of the Islands, resulting from the war in Korea and the rearmament program of the United States, a casual observer might easily overlook the long-range trends.

The purpose of this book is to describe the diversified agriculture of Hawaii and to investigate its potential as a strengthening factor in the Island economy.

Balance of Payments

Hawaii has a highly developed trading economy heavily dependent upon the mainland. The Islands possess no mineral resources which are used commercially at present except for some sand, stone, and lime. Therefore it is necessary to import most industrial equipment, fuel, and supplies, construction materials, and many consumer goods. Though Hawaii's economy is based on agriculture, about two-thirds of the food consumed and much livestock feed is imported.

Exports of merchandise, primarily agricultural products and fish, pay for part of these imports. In addition to these visible exports, there are invisible exports such as services rendered and goods sold to the federal government and to tourists. When economists compare exports and imports, both visible and invisible, they use the term balance of payments.

Up to 1940 Hawaii's annual balance of payments was, with few exceptions, favorable. In other words, the people of Hawaii received more money from exports than they spent on imports. Throughout World

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War II, the balance of payments continued strongly in favor of the Islands despite an excess of imports over exports of goods. This was the result of local purchases of materials and services by the armed forces, the U.S.O., the Red Cross and similar agencies, and individual servicemen and war workers.

With the end of the war, federal expenditures were sharply reduced and the number of servicemen and civilians employed by the government declined greatly.

Balance of Payments for 1951

At the same time, merchandise imports continued to exceed in value exports of Hawaiian goods. As a result, Hawaii's postwar balance of payments has been unfavorable. In 1951, despite greater military spending than in the immediate postwar years, imports exceeded exports by about 30 million dollars.*

To maintain its present population and standard of living, Hawaii must find ways of increasing its exports of goods and services or of substituting local production for imports. What are the possibilities of doing this outside of the diversified agricultural industries?

The 1952 export value of sugar and molasses was 134 million dollars. Within one or two years sugar growers hope to increase their output from about one million tons of raw sugar to Hawaii's full annual marketing quota on the mainland and in the Islands of close to 1,100,000 tons. Exports of pineapple products were valued at approximately 92 million dollars in 1952, with little indication at this time of substantial future expansion.

Exports of canned tuna amounted to almost two million dollars in 1952. More than half of the commercial fish catch, valued at 3.6 million dollars for the fiscal year 1951-52 on the basis of payments to fishermen, is consumed in Hawaii. There may be an opportunity to expand fish canning for export if research now in progress is successful.

* However, preliminary estimates indicate that Hawaii's 1952 balance of payments was favorable, mainly because of an increase in federal expenditures and a decrease in imports.

Manufacturing industries in the Islands are relatively unimportant, producing mainly for local consumption or processing waste products of sugar mills and pineapple canneries. One export product is an insulating fiber board, called Canec, made of a by-product of sugar cane milling. Its sales, mostly on the mainland and in foreign countries, amounted to over three million dollars in 1952. Expansion of this industry is possible. The manufacture and export of Island-styled clothing and of Hawaiian handicraft products, such as lauhala weavings and woodenware, could also be increased.

A record number of 60,500 visitors stayed two days or longer in Hawaii during 1952. Direct visitor expenditures in the Islands were estimated at 32.8 million dollars. A further increase in the size of the tourist business appears possible with an expansion of hotel accommodations and recreational facilities, a decrease in transportation costs, and more intensive advertising on the mainland.

The combined payroll of the armed forces, including both servicemen and civilians, was approximately 128 million dollars in 1950. This compares to 33 million in 1940 and 377 million in 1945. The preparedness program brought about a payroll expansion to 195 million in 1952. However, when world tension subsides a reduction in the expenditures of the armed forces in Hawaii can again be expected.

All considered, opportunities exist in Hawaii industries other than diversified agriculture to rectify the usually unfavorable balance of payments. However, success would be more probable if diversified agriculture exports could be increased and imports decreased.

Employment

At the end of World War II there existed 10,000 unfilled job openings in Hawaii. By December 1948 an estimated 13,400 people were unemployed. A record high unemployment of 28,400 was reached in November 1949. By August 1951 the economic impact of the national rearmament program and the war in Korea had reduced the number of jobless to 6,600. However, unemployment is again increasing and amounted to 9,800 in January 1953.

Hawaii's labor force has grown faster than its permanent employment opportunities. The number of persons fourteen years old and over increased from 302,000 in 1940 to 350,000 in 1950. Even assuming a stable population, the age distribution in Hawaii is such that the number of persons of working age will grow rapidly during the next few years.

Civilian employment, excluding domestics, self-employed, and farm workers other than those in sugar and pineapple plantations, increased from 128,000 workers in 1940 to 189,000 in 1943, and declined to 142,000 in 1950. It rose to 155,000 in 1951 as a result of increased expenditures by the armed forces.

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Employment in sugar and pineapple declined during the war and the postwar period. The average working force in the sugar industry dropped from 41,400 in 1940 to 21,500 in 1952, a reduction of 48 percent. Average employment in the pineapple industry decreased by 16 percent from 16,500 in 1940 to 13,900 in 1952.

This reduction in the number of workers in both major industries occurred in spite of a rise in output. It was caused by two factors: first, the scarcity of labor during World War II; and, second, the increasingly high pay of agricultural labor during and after the war. Increased mech-

Employment Opportunities in Postwar Hawaii

anization and more emphasis on labor-saving methods were the necessary consequences. In the sugar industry the dissolution of several companies, the combining of adjoining plantations, and the abandonment of some fields with high labor requirements have contributed to the reduction in the labor force. Leaders in the two industries do not expect employment to decline much below present levels.

In 1949 the armed forces hired slightly more than 20,000 civilian workers, compared to the peak of 63,000 in 1944 and the low of 6,300 in 1939. Since the outbreak of hostilities in Korea this number has increased. Employment in the construction industry has also fluctuated, being influenced by the amount of building contracts let by the armed forces. Employment in other fields, such as local government, civilian federal agencies, manufacturing other than in sugar and pineapple, public utilities, and trade and service industries, gradually expanded over the last decade. This expansion resulted primarily from the rapid growth in population and the considerable rise in the standard of living.

Most of the reduction in unemployment since the outbreak of the war in Korea was due to inductions into the armed forces or to the increased employment of civilian workers in defense activities. Employment opportunities must be expanded to avoid a sharp increase in permanent unemployment if the defense program is cut back.

Vulnerability of the Economy

As previously noted, Hawaii's economy is vulnerable to business cycles, changes in federal policy, interruption of transportation, and strikes or lockouts. The tourist trade and the pineapple business appear to be especially sensitive to business cycles. Arrivals of visitors in Hawaii shrank from 22,200 in 1929 to 10,100 in 1933 during the low point of the depression. With money more plentiful, 31,800 visitors arrived in the Islands in 1941, and 60,500 stayed for two days or longer in 1952. The value of the pineapple pack reached a high point of 50.1 million dollars in 1930, but dwindled to 9.6 million dollars two years later. This was followed by a marked recovery of mainland shipments to 59.5 million dollars in 1937.

The sugar industry of Hawaii is particularly dependent upon favorable federal policies. Since 1876 sugar production has been continuously supported by such policies. At the present time the Sugar Act of 1948, amended in 1951, limits the total supply of sugar reaching the American market and allocates a production quota to the Islands. It also provides for grower subsidies financed by a tax on sugar manufactured in the United States and by a compensating tax on imported refined sugar. Without favorable federal policies, the sugar industry in Hawaii would have to reduce its output greatly.

Needless to say, the size of the armed forces in Hawaii is affected by changes in federal policy. Fluctuations over the past decade have already been discussed.

Tourist Arrivals in Hawaii, 1929, 1933, 1952

Hawaii has suffered in the postwar period from recurrent and long-drawn-out labor-management conflicts, particularly in the maritime transport, sugar, and pineapple industries. Management had been in a dominant position in Hawaii ever since the rise of the sugar industry because of close ownership and management ties between many of the Islands' important enterprises. Labor unions, relatively unimportant before World War II, transformed the Islands between 1944 and 1946

into one of the most strongly unionized areas of the United States; even agricultural workers in the sugar and pineapple industries are highly organized.

Because of its geographical location and the specialization of its economy, Hawaii is vulnerable to any interruption or even threatened tie-up of transportation to and from the mainland. Disputes in the sugar and pineapple industries have serious repercussions among the lesser Island industries.

Prices of Locally Produced Food

Most food prices average higher in Hawaii than on the mainland. On November 15, 1952, the cost of a typical market basket of food was \$46.90 in Hawaii as compared to \$41.91 on the mainland, or 12 percent more. (Retail prices used for the mainland were those paid on the average in 56 cities, according to the U. S. Bureau of Labor Statistics. Honolulu retail food prices were collected by the Territorial Bureau of Labor Statistics.)

For goods imported from the mainland, the higher prices are due somewhat to greater shipping and handling costs. The prices of many locally produced items such as milk, pork, eggs, and some vegetables and fruits are higher because of higher production costs.

In the preceding pages, the major economic difficulties confronting the Islands have been discussed. It has been noted that once the economic stimulus of the present mobilization program weakens, changes in Hawaii's economy outside of diversified agriculture may not be sufficient to solve these problems. To what extent the diversified agricultural industries can be of assistance in putting Hawaii's economy on a sounder basis can only be determined after an analysis of these industries.

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part **ONE**

chapter 1 LAND AND PEOPLE

Before we discuss each of Hawaii's diversified agricultural industries, it might be well to orient ourselves with regard to the land, people, and institutions insofar as they affect these industries. The Island reader, although familiar with many of the facts, may want to refresh his memory. However, the reader in the mainland United States or abroad will need to study the first chapters more carefully for a better understanding of the entire book.

Physical Characteristics of the Islands

The Hawaiian Islands lie near the center of the North Pacific Ocean. San Francisco, the mainland port nearest to Honolulu is 2,100 nautical miles away; Los Angeles and Vancouver are slightly farther. The distance from Honolulu to Yokohama is 3,400 miles; to Auckland, New Zealand, 3,800; to Sydney, Australia, 4,400; to the Panama Canal, 4,700; and to Manila, 4,800.

The eight main islands, a group about 375 miles long, are located entirely within the tropics. The total land area of these eight islands is 6,406 square miles, divided as follows: Hawaii, 4,021; Maui, 728; Oahu, 589; Kauai, 551; Molokai, 259; Lanai, 141; Niihau, 72; and Kahoolawe, 45.

The Islands are great volcanic mountains rising from the ocean floor. The two highest peaks, Mauna Kea and Mauna Loa, both located on Hawaii, are close to 14,000 feet above sea level. Haleakala on Maui is 10,000 feet. The mountains on the other islands are lower, ranging from about 5,000 feet on Kauai and Molokai, and 4,000 feet on Oahu, to 1,300 feet on Niihau. One-fourth of the Islands is estimated to lie below 650 feet elevation, one-half below 1,950 feet, and three-fourths below 4,500 feet. About 90 percent of the population lives below 650 feet.

Large parts of the interior of most islands consist of rugged, mountainous terrain dissected by numerous deep gullies. Between the mountains of some islands are plains or plateaus, with flat areas stretching along the coast. These plateaus, plains, and the lower mountain slopes,

although a comparatively small part of the total area, are the most important agricultural lands in the Islands.

The climate of Hawaii is mild and the temperature changes little from day to day and between summer and winter. The northeasterly trade winds, blowing most of the time from cool ocean currents, keep temperatures generally below those in similar latitudes elsewhere. Because of these prevailing winds the people of Hawaii refer to the windward and leeward sides of an island.

As an illustration of the evenness of temperatures, in downtown Honolulu, on the leeward side of Oahu, the mean monthly temperature for August, the warmest month, is 78° F, and for January, the coldest month, 71° F. The average daily range of temperature is 9° F, or slightly more than the difference between the average summer and winter temperature. It has never been warmer than 88° F or cooler than 56° F in Honolulu. There is a decrease of about one degree for each 300-foot rise in elevation. Frost and snow very rarely occur below 4,000 feet, but in winter are common above 6,000 feet.

Rainfall varies remarkably within short distances, due mainly to topographic influences. For example, the normal annual rainfall for 5,000-foot-high Mount Waialeale on Kauai is more than 500 inches, compared to less than 20 inches at sea level about 15 miles to the leeward.

The maximum rainfall occurs at approximately 3,000 feet on the windward side of the highest mountains on Hawaii and Maui and near the crest of the lower mountains on all the islands. The lowlands on the windward side receive moderate and at some places heavy rainfall. On the upper reaches of the highest mountains, precipitation is scant. The lower leeward slopes and plains are, with few exceptions, arid or semi-arid. The latter districts get much of their precipitation during the infrequent southerly or Kona storms. Rainfall in dry areas is greatest in winter. In wet areas there are three maximum rainfall periods, namely, March-April, August, and November-December.

Annual and monthly variations in rainfall are great in all parts of the Islands. For example, the precipitation at Honolulu totalled 11 inches in 1926, nearly 44 inches in 1927, and 15 inches in 1928. Precipitation in any one month may also vary greatly from one year to the next. Places with an annual rainfall average of 100 inches or more may at times have a dry month with one inch or less. Conversely, dry sections with an annual average of 20 to 30 inches may record 20 or more inches during a single wet month. For some stations on Oahu with over 30 years of rainfall records, each month has ranked first in rainfall during at least one year.

Occasional strong winds may damage trees, crops, and buildings. In some districts with strong prevailing winds, some type of windbreak is necessary for successful crop production.

The climate is such that crops can be grown the year around in present agricultural areas. At times farmers harvest as many as four or five vegetable crops a year from the same field. However, the mild, moist climate is also favorable for insect pests and plant diseases. Control measures are possible in many cases, but involve higher costs than paid by competing farmers on the West Coast.

Hawaii soils in dry and hot areas are usually neutral or alkaline in reaction. They contain little organic matter and nitrogen but have a high content of available minerals. Soils formed under heavy precipitation in the cool sections of the Islands contain much organic matter and nitrogen, which, however, may soon become exhausted by steady cropping. In wet locations soils are low in available minerals, which have been leached out by rains. Most soils in Hawaii are porous, which allows for rapid drainage, good aeration, and easy development of roots. Earth particles eroding from the mountains have accumulated on some of the lower slopes, plateaus, and plains, forming fertile and deep soils.

Systems of irrigation, which are valued at over 45 million dollars, bring water many miles to once arid lands. Additional water resources are available, but their development would require considerable investment.

Utilization of Agricultural Land

The total area of the Islands amounts to 4,100,000 acres. (See Table A1.) Of this, about 1,210,000 acres, or 29.5 percent, were territorial forest reserves in 1951. These reserves have been created primarily to prevent runoff and soil loss following rain.

The armed forces occupied 58,000 acres, or 1.4 percent of the total, in 1951. Some 213,000 acres, or 5.2 percent, were used for national parks. Waste land, cities, towns, camp sites, roads, and land not otherwise specified, except agricultural land, accounted for 912,000 acres, or 22.2 percent.

About 1,706,000 acres, or 41.6 percent of all land in the Islands, were used for agricultural purposes. (See Table A2.) Pasture land amounted to 1,397,000 acres and land in crops to 309,000 acres. Of the total cropland, 295,000 acres were in sugar and pineapples. Diversified crops other than flowers occupied 14,000 acres, or slightly less than 5 percent of all cropland. About 5,600 acres were used for vegetables and taro, 3,500 acres for coffee, 1,900 acres for tree fruits, 2,200 acres for macadamia nuts, and 800 acres for miscellaneous field crops. No exact data were available for the land area on which flowers and foliage were produced. It was estimated that about 600 acres were used for this purpose.

According to the United States Census of 1950, about 117,000 acres

were irrigated in that year. Sugar was grown on all except a small portion of the irrigated land. The remainder was devoted mainly to taro, rice, vegetables, and fruits.

The island of Hawaii, largest and most southerly of the group, is made up of four mountains, Mauna Kea in the northeast, Mauna Loa in the south, Hualalai in the northwest, and the Kohala mountains at the northern end.

The land area of the island is 2,573,000 acres, of which 716,000 acres were territorial forest reserves and 196,000 acres were national parks in 1951. Approximately 560,000 acres were occupied by cities, camp sites, roads, military establishments and wasteland, mainly lava flows.

The total cultivated land amounted to 109,000 acres, or 4 percent of the total land area. Of this, 101,000 acres were devoted to sugar cane, and the rest to minor agricultural crops. About 990,000 acres, or more than one third of the total land area of the island, were used for grazing.

The Kau district, covering the broad southern slopes of Mauna Loa, is traversed by many lava flows of various ages. The soil cover is thin in many places and consists chiefly of volcanic ash. The amount of annual and monthly rainfall is highly irregular. Annual rainfall ranges from less than 20 inches near the coast to over 100 inches at 3,500 feet elevation. The best agricultural land between 500 and 2,000 feet was used by two sugar plantations in 1951.

The Puna district, to the southeast of Mauna Loa, has a high annual rainfall averaging from 80 to 200 inches in the various agricultural areas. The soil is generally shallow with frequent rock outcroppings. Some sugar is produced in the lower windward districts. Near Kilauea Volcano, at an altitude of 4,000 feet, there is a cool-climate vegetable district. Farmers in the vicinity of the road from the Volcano to Hilo and near the southeastern tip of the island also produce vegetables and fruits. Extensive macadamia nut orchards are being developed in the area.

The Hilo and Hamakua districts on the windward side of Mauna Kea, with few exceptions, get from about 80 to more than 200 inches of rain

per year. The mountain slope is cut by many precipitous ravines, but lands in between are arable and productive. Sugar cane is grown in a nearly continuous belt along the coast from south of Hilo to the cliffs of Waipio valley in the north. Some truck crop farms are scattered throughout the districts. In Waipio valley, accessible by land only over a mule trail, taro is the principal crop. Bearing macadamia nut orchards are largely limited to the northern portion of Hamakua, but plantings have been made recently in other parts of these districts. The Hilo area is the center of flower growing and poultry and swine raising on the island.

Sugar is the main crop on the lower windward slopes of the Kohala mountains on the northern tip of the island. A few farms produce field corn, vegetables, and macadamia nuts. In the important cool-vegetable district of Kamuela, on the plateau between the Kohala mountains and Mauna Kea, farmers produce temperate zone crops such as lettuce, cabbage, and celery.

The Kona district on the western slopes of Hualalei and Mauna Loa is the only area in the Islands with more summer than winter rainfall. Kona's annual precipitation in the major agricultural areas, at elevations of about 800 to 2,200 feet, is high for a leeward district. It ranges from 50 to 100 inches per year. Coffee, grown on about 3,500 acres, is the major product of the district. This crop is favored by an excellent climate, freedom from storms during most periods of the year, and by well-drained though shallow soil. Kona is now the main district where taro is grown without irrigation. Other crops produced commercially are avocados, bananas, and other fruits, macadamia nuts, and vegetables.

Cattle are grazed on the upper slopes of the mountains of the island, above the areas used for crop production, as well as in lowlands located mostly on the leeward side. The carrying capacities of ranges vary widely. The island has some of the poorest pasture lands of the territory. Most of these are located in dry and arid areas or in semi-waste lands covered by partly decomposed lava flows; others are in districts with excessive rainfall. On the other hand, several of the best ranges in the Islands can be found on the northern slopes of Mauna Kea, the leeward slopes of the Kohala mountains, and in Kona. A portion of the arid saddle land between Mauna Kea and Mauna Loa is used for sheep grazing.

The island of Maui, to the north of Hawaii, is 466,000 acres. In 1951, 177,000 acres were forest reserves and parks and 81,000 acres were used for other nonagricultural purposes or were waste land. Close to 54,000 acres, or 12 percent of the total area of the island, were under cultivation.

On the northeastern side of the extinct volcano of Haleakala, the topography is too rough and the soils are too poor for most crops. At present wetland taro grown on the Wailua and Keanae coastal flats is the only cultivated crop of commercial importance produced here.

Precipitation in the Wailuku plain between Haleakala and the West Maui mountains is low, but soils there are of high quality. About 29,500 acres of sugar cane were grown there under irrigation in 1951. Pineapples are produced above the sugar plantations on the northwestern slopes of Haleakala.

The largest vegetable-growing area on the island is located on the Kula slope, stretching along the western and northwestern side of Haleakala at elevations of from 500 to more than 3,000 feet. Cabbage, tomatoes, and onions are the major crops, but many other vegetables also do well in the deep, fertile soils of these districts.

On the arid leeward side of the West Maui mountains is another irrigated area of sugar cane of about 9,500 acres. Pineapples are grown in the zone of somewhat greater rainfall on the northwestern tip of the island.

Vegetable and taro farmers are located on both the windward and leeward coasts of West Maui and near the larger towns of the Wailuku plain. Some fruit is grown near Lahaina and in the Kula area, and macadamia nuts are grown near Haiku. A little less than one-third of the island, ranging from the dry leeward coastal areas to the wet windward slopes of Haleakala, is used as cattle pasture.

The island of Kahoolawe, formerly a cattle range, is now uninhabited, unused, and severely wind-eroded. In 1951 all crop land on the island of Lanai, about 15,000 acres, was in pineapples.

Of Molokai's total area of 166,000 acres, a mountainous windward area of 47,000 acres was territorial forest reserve in 1951. Pineapples on about 17,000 acres were the island's major crop. They were being grown on plateaus in the central and western parts of the island.

Only about 300 acres were in minor agricultural crops, primarily corn, taro, vegetables, and mangoes. These crops were grown mostly on the Hoolehua plateau in the center of the island, on the lower leeward slopes, and in small valleys. Lack of irrigation water in the arable areas was the primary reason for the low acreage of minor agricultural crops. Cattle ranches occupied 93,000 acres.

Only about 90,000 of Oahu's 377,000 acres were used for agriculture in 1951. Forest reserves included 120,000 acres, mostly the higher portions of the mountains.

On the leeward side of the island in and around Honolulu are located many of Oahu's poultry and swine enterprises, nearly one-half of its dairies, and many flower farms and vegetable market gardens.

A fertile plateau, gently sloping toward the ocean at both ends, extends through the middle of the island, flanked by the Waianae and Koolau mountain ranges. Some 32,000 acres of sugar cane were grown by irrigation on its lower portions in 1951. On its higher part, where rainfall is slightly greater, about 22,000 acres were in pineapples.

Vegetables and some fruit were produced under irrigation in the dry Waianae district on the leeward side of the Waianae mountains.

In the windward district of Koolauloa were another 4,000 acres of sugar cane, nearly all of them irrigated. In 1951 over 400 acres of wetland taro were under cultivation in the lower areas of the many valleys on the windward side of the Koolau mountains. Other crops grown in this section were vegetables, about 400 acres of papayas, and 700 acres of bananas. The latter were raised primarily in the upper, wind-protected portions of the valleys.

About 30,000 acres were used for pasture. Oahu was the only island on which less land was used for grazing than for cultivated crops. The pastures on the slopes of the Waianae range were used mainly for beef cattle. Dairies operated on the grazing lands in the southeastern part of the island.

Practically the whole island of Niihau, consisting of 46,000 acres, was used for beef and sheep grazing.

On Kauai the territorial forest reserve covering the mountainous interior amounted to almost half of the island's 350,000 acres. About 53,000 acres were cultivated.

Sugar cane was grown on about 46,000 acres, from Kilauea in the north with few interruptions around the island to Mana in the west. All but approximately 5,000 acres of sugar-cane land on the island were under irrigation. About 7,000 acres of pineapples were produced in several areas, from the vicinity of Anahola in the northeast to Kalaheo in the south.

Approximately 170 acres each of taro and rice were grown from Hanalei valley in the north to Waimea and Hanapepe valleys in the southwest. About 250 acres were planted to vegetables on farms scattered from Hanalei to Waimea, with the largest acreage in the vicinity of Kapaa and Wailua. Approximately 260 acres of macadamia nut trees were growing in the southern portion of the island. Cattle ranchers used about 90,000 acres for grazing.

Land Tenure

The present land tenure pattern in Hawaii is to a great extent the result of the land division in the 1840's called the *Great Mabele*, the development of large-scale agricultural enterprises, and the largely unsuccessful policy of homesteading a part of the public domain. In 1948 public land amounted to about 1,760,000 acres, or 43 percent of all land in the Islands, and private land to approximately 2,360,000 acres, or 57 percent. Of the government-owned land, 227,000 acres were used by federal agencies, 1,356,000 acres were territorial, 4,000 acres county, and 169,000 acres Hawaiian Homes Commission land. The latter was

set aside by the Hawaiian Homes Commission Act of 1920 for home-steading by people of Hawaiian ancestry.

Plantations and individual farmers owned about half of the cropland which they farmed in 1945. They leased the rest. Similarly, ranchers owned approximately half of their grazing lands. (See Table A3.)

Much of the territorial public land is poor, according to a statement by the territorial Commissioner of Public Lands during the 1946 congressional hearings on statehood for Hawaii. Cropland is usually much

more valuable than pasture land. Of all leased agricultural lands, most of the cropland was leased from private owners and the greater part of the pasture land was leased from the Territory. About 167,000 acres of cropland were leased in 1945, of which 24 percent was public land and 76 percent was privately owned.

Of the 680,000 acres of leased grazing land, 75 percent was public land and 25 percent was privately owned.

On all islands most of the land not owned by the government is held by a relatively few corporations, trusts, and individuals. In 1951 the largest private landholder, the Bernice P. Bishop Estate, owned 370,000 acres, or 15 percent, of all private holdings in the Islands. The inventory of this estate listed 30,000 acres of farm land and 218,000 acres of grazing land. In the same year, the ten largest private property owners accounted for about 50 percent of the private land. In 1948 about 69 percent of all private land in the Islands belonged to the 50 largest owners.

At present agricultural land available for fee simple purchase in the Islands is scarce while the demand for it is great. High land prices are the result. For example, in 1952 pasture land on the outside islands with a carrying and fattening capacity of one head of cattle per five acres cost \$40 to \$80 or more per acre. Small parcels for diversified crops on Oahu sold for as high as \$2,000 or more per acre.

The natural scarcity of all agricultural land in Hawaii is one reason for its short supply on the market. Another is the policy of many large landholders not to give up their holdings.

In view of the large amount of leased agricultural land, good leasing practices are essential. The Committee on Pasture Land Leases, appointed by the Commissioner of Public Lands in 1948, stated that "land leasing practices in . . . Hawaii . . . are neither productive nor progressive as judged by similar practices in England and its Commonwealths and in the Scandinavian countries."

A revision of the length and form of some agricultural leases appears

necessary. The leases of public land are in written form and are, with some exceptions, for sufficiently long terms. Public leases are for 15 years for cropland and 21 years for pasture land.

Private leases for large areas, particularly for lands used for grazing, sugar cane, and pineapples, are also adequate in length and form in most cases. The most common length of large private grazing leases is about 20 years, and up to 30 years for undeveloped grazing tracts. Sugar leases for large areas run frequently for 20 years or more. Pineapple lands are leased for the length of one or more growing cycles of a pineapple planting, with many leases of 8 to 10 years.

Small farmers in the diversified agricultural industries often have to be content with oral leases for one year or less. That holds true even for crops like taro that require more than one year to mature. Five- and 10-year leases for vegetable land are not frequent. Land for long-term tree crops such as coffee and avocados is rarely leased for more than 15 years. There is, therefore, need for long-term written contracts for these farmers.

In most cases lessees of both private and public agricultural lands do not get any credit for the improvements they make on the leased property. Neither can they remove these improvements when their contracts expire. The above-mentioned Committee on Pasture Land Leases recommended that the outgoing lessee should receive a cash payment for the undepreciated value of his investment in permanent buildings, water developments, and permanent heavy fencing on the land at the end of his tenure. The committee pointed out that these proposals would "stimulate the physical improvement of the property, . . . guard against the rapid depreciation of buildings and fences as the lease nears its expiration and . . . keep the area in high production at all times."

Even though the committee did not mention it, credit should also be given for temporary buildings and improvements, service roads, fertilizer which has been applied but not completely used up, and for clearing the land of noxious pests and weeds.

The committee suggested that lessees be required to follow modern methods of soil conservation and "to participate in the programs for land conservation . . . within any Soil Conservation District created in the area concerned." In present lease contracts, stipulations regarding soil conservation, if included at all, are usually vague and ineffective.

In some industries, for example sugar and coffee, the amount of rent to be paid is frequently tied to the price level for the commodity produced. The use of such an "escalator clause" appears desirable in other agricultural industries in which the annual rentals are now fixed for the whole period of the lease. This is especially true in those branches of agriculture in which rent is an important item of cost, such as cattle ranching.

Until recently, many leases of agricultural land, both public and private, were for so large an area that bidding by all but a few large operators was discouraged. The committee proposed the subdivision of certain large public pasture leases into smaller ones ranging mostly from about 200 to 600 acres. The Commissioner of Public Lands followed some of these suggestions, giving the smaller ranchers a chance to compete for these land resources.

The ownership of water rights in Hawaii presents a complex pattern which appears to be unique in the United States. Surface water is held in fee simple title by individuals, trusts, and by the territorial government. Like land, the control of water resources is highly concentrated. On the larger islands, except for a few public water departments and some other owners, irrigation water is controlled by sugar plantations or private water companies closely connected with sugar-growing interests. Irrigation water developments in Hawaii have almost all been made with private capital. In contrast, many irrigation projects in the western United States are federal projects.

Agricultural Planning

Before World War II a Territorial Planning Board was charged with the duty of preparing a master plan for the physical development of the Islands. This agency was discontinued during the war. The 1949 territorial legislature created the Farm Advisory Board, which is less broad in scope than the prewar agency. The board is to study the maximum utilization of the public and private lands of the Islands and to make recommendations regarding the further development of lands suitable for farming. The members of the board were appointed early in 1952, but no money had been appropriated for their use by the 1951 legislature. The optimum development of diversified agriculture will require careful and extensive planning on both a local and territory-wide basis. The new Farm Advisory Board should become the focal point for this work and have the close cooperation of all public and private agencies concerned.

Population

The population of the Islands is estimated to have been about 300,000 at the time of Captain James Cook's arrival in 1778. (See Table A6.) As a result of their long isolation from the rest of the world, the natives had little resistance to the diseases that white men brought with them. By 1872 the population was only 57,000, of whom about 50,000 were native Hawaiians. The remainder were mainly Americans, British, and Chinese.

As the expanding sugar industry created a demand for labor, plantations imported large numbers of workers. Up to 1878 most contract labor came from China. Beginning in that year Portuguese were imported in increasing numbers, and after 1885 Japanese were brought in. Most of the agricultural laborers since 1908 have come from the Philippines. Since 1931 immigration from the Orient has been negligible. One exception was the year 1945, in which 6,000 Filipino men and some dependents were brought in because of scarcity of plantation laborers.

Civilian Population in Hawaii, 1778, 1872, 1940, and 1952

Smaller groups of immigrants had come from many other countries, such as Korea, Puerto Rico, Spain, and Germany. In addition, there was a slow but steady immigration from the mainland United States, which increased greatly just before and during World War II.

Of Hawaii's 500,000 residents, including military personnel, in 1950, about 185,000 were of Japanese extraction, 74,000 of part-Hawaiian, 115,000 of Caucasian, 61,000 of Filipino, 32,000 of Chinese, and 21,000 mainly of Korean and Puerto Rican extraction. Less than 13,000 were full-blooded Hawaiians. (See Table A7.) In 1952 approximately 14 percent of the population, or 65,000 people, were aliens, mostly Japanese and Filipinos.

The population of the Islands rose from the low point of 57,000 in 1872 to 154,000 in 1900, nearly 370,000 in 1930, and a peak of 491,000 in July 1948. (See Table A6.) As a result of depressed economic conditions and later the effects of the Korean War, emigration exceeded immigration by 65,000 during the following four years. However, with an annual excess of more than 11,000 births over deaths in the Islands during the last five years, another population increase can be expected.

The population increase during the past half-century was greatest on Oahu, particularly in the city of Honolulu. From some 20,000 in 1890, Honolulu's population rose to 138,000 in 1930 and to 233,000 by 1952.*

* Figure for 1930 includes military personnel stationed in Honolulu. Figure for 1952 includes civilians only.

In contrast, the population on the outlying islands declined by 16 percent between 1930 and 1952. (See Table A8.)

Other urban areas which have developed are of minor importance compared to Honolulu. The second largest city in the Islands, Hilo, on the island of Hawaii, had a population of 26,000 in 1952. A preliminary report of the 1950 U.S. Census lists only five other cities in the Islands with more than 6,000 population: Wahiawa, Kailua-Lanikai, and Waipahu on Oahu, and Wailuku and Kahului on Maui. The largest towns on the islands of Kauai, Lanai, and Molokai were, in the order named, Lihue with about 4,000, Lanai City with about 3,000, and Kau-nakakai with about 1,000.

In 1952 the population of Oahu was 326,000, or 70 percent of the total for the Islands. Hawaii ranked second with 64,000, followed by Maui with 38,000, and Kauai with 29,000. Only 8,000, or less than 2 percent of the total population, lived on Molokai, Lanai, and Niihau. The population density averaged 73 people per square mile in the territory as a whole, 553 on Oahu, and 24 on the outlying islands. (See Table A8.)

The numerical importance of the several races represented in Hawaii varies greatly from one agricultural industry to the other. It depends upon the time of their arrival in the Islands and their experience and traditions in their countries of origin.

According to a sample survey in 1947, about one-half of all adult men employed on the sugar plantations and nearly three-fourths of those working on the pineapple plantations were Filipinos. They now constitute most of the hired labor force of Kona's coffee industry, and some work as laborers in the dairy and cattle industries. They are also beginning to establish themselves as small sugar growers and as coffee and vegetable tenant farmers.

After the Filipinos, the Japanese are the largest racial group among plantation workers. Most of the small-scale growers and the great majority of small farmers in the minor agricultural industries are of Japanese ancestry. They produce nearly all the coffee, vegetables, rice, and fruits other than pineapples, much of the taro, flowers and honey, and some macadamia nuts. Farmers of Japanese or Okinawan ancestry dominate the poultry and swine industries. They are of lesser importance in the dairy industry, and are seldom beef cattle ranchers.

Caucasians hold most of the higher managerial positions on plantations. They also own and manage a major proportion of the large enterprises in the diversified agricultural industries, particularly in cattle raising, dairying, and macadamia nut growing. The Portuguese are mainly ranchers or dairymen; they rarely produce crops as a major enterprise.

Some Hawaiians and part-Hawaiians, who make up the largest portion

of subsistence farmers, produce crops for sale, particularly taro, and some work on ranches. Chinese, who once constituted the largest group of plantation workers and farmers, particularly rice growers, have with few exceptions left agriculture.

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chapter 2 INFLUENCING FACTORS

Research and Education

Agricultural research and education in Hawaii compare well with similar activities on the mainland. The experiment station of the Hawaiian Sugar Planters' Association and the Pineapple Research Institute, both privately financed, concentrate nearly all of their research on the two major agricultural industries. However, some of their research results are applicable to other agricultural fields.

Most of the research for the diversified agricultural industries is being done by the University of Hawaii Agricultural Experiment Station. Diseases and pests of plants and animals are studied and methods developed for their control. Improved crop varieties and livestock strains are introduced and new agricultural methods are adapted to the requirements of the Islands. Problems of human nutrition, food processing, and marketing are investigated.

Research on fruit flies, a major agricultural problem of Hawaii, is handled cooperatively by the U.S. Bureau of Entomology and Plant Quarantine, the territorial Board of Agriculture and Forestry, the Hawaiian Sugar Planters' Experiment Station, the Pineapple Research Institute, and the Hawaii and California Agricultural Experiment Stations.

The Board of Agriculture and Forestry, in addition to its fruit fly work, is engaged in other agricultural research, mainly in the marketing field. However, it is primarily a regulatory agency.

In 1949 the territorial legislature created the Industrial Research Advisory Council to sponsor and finance studies which contribute to the development of the Hawaiian economy. Most of its research projects to date have been in the field of diversified agriculture.

The Federal-Hawaii Cooperative Agricultural Extension Service was established in 1928 as an integral part of the University of Hawaii. Together with other educational agencies, it has played a prominent part in the progress which Hawaii's agricultural population has made during the past two decades. The Agricultural Extension Service acquaints farmers with new developments and demonstrates better practices in crop and livestock production, pasture management, and soil

conservation. In its home demonstration clubs it trains women to make better homes for their families and to become more useful members of their communities. It publishes agricultural statistics, price reports, and production forecasts. It makes studies of efficiency and costs of farm production and demonstrates good marketing methods. Its 4-H clubs train farm youth in agriculture, homemaking, leadership, and citizenship.

Hawaii's public school system is outstanding in that children living in rural districts have the same educational opportunities as city children. Since 1937 the age limit of compulsory school attendance has been 16 years. In 1948, 30 percent of all public school pupils were attending high school. The corresponding figure for the continental United States in 1948 was 23 percent.

Hawaii's public schools are administered as one educational unit by the territorial Department of Public Instruction. Training opportunities for all boys are provided in vocational agriculture and shop, including classroom instruction and field practice. Evening classes in agricultural subjects are held for interested adults. The Future Farmers of America, a nation-wide agricultural youth organization, is sponsored by the DPI. In cooperation with the U.S. Veterans Administration, it also provides special agricultural training for veterans of World War II.

The University of Hawaii offers undergraduate and graduate courses leading to bachelor's and master's degrees in agriculture and Ph.D. degrees in soil science, entomology, and genetics.

Before World War II a large proportion of farmers in Hawaii were aliens, many of them educated and trained in farming in foreign countries. The older generation largely adhered to their accustomed agricultural practices and progress was relatively slow.

This situation has fundamentally changed in postwar Hawaii. Many of the present farmers were born in the Islands and have gone through the public school system. As soldiers during the war, a good many saw mainland or foreign agriculture at close range. They also gained experience in handling motorized equipment in the armed forces. Even on farms where the father still works, the son now often decides how the farm is to be run. As a result, production and marketing practices have greatly improved during recent years. Today the farmers in Hawaii closely cooperate with research and educational institutions and are quick to make use of new agricultural developments.

Farmer Organizations

Since World War II, Hawaii's farmers have become increasingly aware of the value of farmer organizations. Two farmer federations have been created: the Territorial Young Farmers Association, sponsored by the DPI, and the Hawaii Farm Bureau Federation, which is close to the Agricultural Extension Service. In addition, farmers in several diversified

industries have formed associations, for example, the territory-wide Hawaii Poultrymen's Council, the Hawaiian Dairy Farmers Association, and the cattlemen's associations on several islands.

These associations have economic, educational, and political aims which are similar to those of corresponding farmer organizations on the mainland. They are used to promote activities and legislation designed to help their industry. Meetings give the members an opportunity to get together socially and to learn about changes in their field.

An increased development of cooperatives in the diversified agricultural industries was brought about by World War II and continued in the postwar period. About twenty active farmers' cooperatives were registered in Hawaii early in 1953. Of these, only two had existed before the war. They served the producers of fruits, vegetables, flowers, eggs, poultry, and livestock. Although most of them marketed farm products and bought supplies for their members, marketing was the more important side of their business. Approximately 15 percent of all farmers in the Islands belonged to one or more farmer cooperatives.

Hawaii's farmers before World War II were little used to cooperative action. The development of cooperatives during the war was stimulated by the necessity for united action in assembling shipments, making equitable distribution, and purchasing supplies. After the war the majority of co-op members decided to continue and expand their cooperative marketing and purchasing activities. Fruit and vegetable growers in particular saw the need for orderly marketing. They feared a cutthroat struggle for the Honolulu market among growers on the various islands and mainland shippers. However, an attempt to form a central cooperative organization with the local island cooperatives as members, failed.

The territorial cooperative law, until 1949, was not conducive to cooperative development. For example, it hindered the formation of a central cooperative organization of fruit and vegetable locals because it contained no provision for unequal voting rights by member locals. Furthermore, the territorial attorney general had ruled "that a cooperative was not exempt from the general excise tax if it had accumulated a surplus, nor to the extent to which it traded with non-members."

In 1949 an amended territorial cooperative law was passed which was closely patterned after the Uniform Agricultural Cooperative Association Act used on the mainland. By remedying the major defects of the old territorial statute, the new law opened the way for an increased development of agricultural cooperatives for production, financing, purchasing, and marketing.

Labor

Most farms in the diversified agricultural industries of Hawaii use farm family labor almost exclusively. If outsiders are hired on the small

vegetable, fruit, swine, or poultry farms, they may or may not receive housing. In 1952 on Oahu their cash wages ranged mostly from \$5.00 to \$7.00 per eight-hour day.

In the coffee-producing area of Kona, seasonal laborers are hired during the harvest, which normally is at its peak from October to January. Many of these workers are unmarried Filipinos. Coffee-growers

give these workers a place to live and some occasional jobs during the off-season to hold them on the farms until the following harvest season.

Before World War II the prospect of a change from plantation life induced Filipino laborers from sugar plantations to come to Kona for the coffee-picking season. Now, with plantation jobs less plentiful, they fear giving up a permanent position

Pay for Picking One Bag of Coffee

for a temporary one. The pay for coffee picking has so far been too low and the season too short to attract many persons from the cities, even the unemployed. Children's work is so important in Kona that school vacations are shifted to coincide with part of the coffee-picking season.

Wage scales in Hawaii increased greatly for all types of work during and after World War II. Farm employers in the diversified agricultural industries were compelled to raise their wage rates in order to hold their labor supply. For example, the rate paid for picking a bag of coffee during the peak of the season rose from \$0.65 in 1939, to \$1.65 in 1945, and to \$3.00 in the 1952-53 season. A worker does well when he picks three bags a day. Even in remote Hanalei valley on Kauai, daily cash wages paid by taro-growers amounted to \$5.00 or more in 1951 compared to \$1.75 to \$2.50 a day in 1942.

Most of the hired labor in the diversified agricultural industries is used on the large cattle ranches and dairy farms, where union labor is not common. Ranches in many cases still continue the perquisite system now abandoned by the plantations. These perquisites may include some or all of the following: housing, medical care, farm products for family use, and laundry service. In 1952 cash payments to ranch labor, excluding perquisites, usually varied from \$125 to \$200 per month, with salaries in more responsible positions up to \$300 per month. Monthly earnings for workers on Oahu dairy farms ranged from \$200 to \$300, including housing.

Transportation

Nearly all the freight between Hawaii and the United States mainland is transported by ships. The number of overseas vessels using the port

of Honolulu during the fiscal year ending June 1951 was 941. Formerly, most of the freight from the mainland destined for delivery on islands other than Oahu was unloaded in Honolulu and trans-shipped by inter-island carriers. However, as each major island now has at least one good overseas shipping port, more and more freight is going directly to and from Hilo on Hawaii, Kahului on Maui, and Port Allen and Nawiliwili on Kauai.

By far the largest portion of the freight moving between the United States mainland and the Islands is carried by vessels of the Matson Navigation Company. The remainder is shared mainly by the Isthmian Steamship Company, the American Pioneer, American President, Waterman, and Pacific Transport Lines, and occasionally by barges. Matson's freighters leave for Hawaii weekly from both Los Angeles and San Francisco, and approximately bi-weekly from Seattle, Tacoma, and Portland. A joint service by Matson and Isthmian provides for weekly to 10-day sailings from the North Atlantic seaboard with regular calls at Gulf ports. Fast, modern C-3 type freighters sail from Honolulu to California and Pacific Northwest ports in five and a half days and to North Atlantic ports in about 18 days.

Matson's C-3 freighters on the Hawaii-California run average approximately 56,000 cubic feet of refrigerated space each, and the vessels to the Pacific Northwest about 41,000 cubic feet. The passenger liner *Lurline*, operating on the Honolulu-California run, has 51,000 cubic feet of refrigerated space. The entire Matson fleet now has about three times as much refrigerated space as in prewar days. The cold-storage space on the C-3 freighters is subdivided into 20 refrigerated compartments of various sizes so that cargo can be segregated according to temperature requirements, type of product, and destination.

Incoming overseas freight of Island ports, excluding petroleum products shipped by tankers, was approximately the same as outgoing freight in 1951, with each amounting to about two million tons. This made full loads possible on both the incoming and outgoing trips, which is a basic requirement for low tariff rates. Water freight rates on most agricultural products between the West Coast and the Islands were from about \$16.70 to \$17.50 per revenue ton of non-refrigerated cargo and 3.2 cents per pound of refrigerated cargo early in 1953.

Honolulu is a regular port of call for some freighters traveling from the mainland to Japan, China, and elsewhere in the Orient. Some steamers sailing from North America to New Zealand and Australia also stop at Honolulu.

Air shipment of agricultural products between Hawaii and the mainland is largely restricted to high-value and low-weight perishables such as flowers, foliage, and day-old chicks. Honolulu airport is a stopover for transpacific flights from North America to New Zealand, Australia,

and the Orient. However, airfreight of agricultural commodities to and from foreign countries other than Canada is insignificant.

Scheduled barges now transport most of the interisland freight. Before World War II, when four steamers served the interisland trade, passenger service provided a sizeable portion of steamship revenue. Nearly all

**Incoming and Outgoing Overseas Freight of Island Ports for Fiscal Year 1951
(Excluding Petroleum Products)**

travel between the islands is now by air. In 1952 the only remaining ship which carried freight regularly between Honolulu and the island of Hawaii discontinued operation.

In addition to the previously mentioned major overseas shipping ports, the Islands have a number of minor harbors, piers, and landings. The more important among the latter for diversified agricultural products are the ports at Kawaihae in South Kohala and Kailua in Kona on the island of Hawaii, and the pier at Kaunakakai on Molokai. With the improvement of highways, the tendency has been more and more to ship through one or two main ports on each island.

Interisland rates in 1952 were \$6.00 per revenue ton between Honolulu and Kahului, Nawiliwili, and Port Allen; \$6.50 between Honolulu and Hilo; and \$7.00 between Honolulu and Kawaihae, Mahukona, and Kailua, Hawaii. Some refrigerated space was available on interisland ships and barges at 1.5 cents per pound. The longest scheduled sailings between the outside islands and Honolulu take about 24 hours.

Air shipment of diversified agricultural products is more important in Hawaii than in the continental United States where trucks provide a flexible and fast way of transporting perishable commodities over short distances. With good airports on all major islands, the airplane takes the place of the truck in Hawaii, at least for high-priced, perishable agricultural products. For example, 16 percent of all fruits and vegetables transported from the outside islands to Honolulu were sent by air in 1952.

Airfreight rates for shipments of half a ton or more in February 1953 were 2.5 cents per pound from the island of Hawaii to Honolulu and 2 cents per pound from all other islands.

The surfaced highways connecting farm districts with cities, harbors,

and airports are generally adequate. However, unsurfaced side roads to some farms or groups of farms may occasionally become impassable for cars and trucks during heavy rains. The two small railroads in the Islands, the Oahu Railway and the Kahului Railroad on Maui, are of little importance to the diversified agricultural industries.

Agricultural Credit

The diversified agricultural industries in Hawaii suffer from a lack of sufficient credit. Commercial banks are an important source of credit for large-scale agricultural enterprises, particularly sugar and pineapple plantations. They also furnish production credit for small independent cane producers. However, they give few loans to small producers of diversified agricultural products. Such loans are mainly restricted to installment loans of up to three years duration to dairy, beef cattle, and poultry farms. Cattle loans are usually secured by a chattel mortgage on the livestock. Loans by commercial banks to producers of vegetables and tree fruits are rare.

Lenders are reluctant to make farm loans under the G.I. Bill of Rights. Since the beginning of the loan guarantee program in 1946, only one veteran got such a loan up to early in 1952, although many made inquiries. In contrast to some mainland areas, insurance companies make no mortgage loans in Hawaii to farmers producing diversified agricultural commodities.

Wholesale and retail dealers played a major role in financing farmers in the past. In his book *Paradox in Hawaii*, D. L. Crawford showed how this type of credit became a heavy burden to the farmer during the thirties in the coffeegrowing district of Kona. He wrote: "The store sells food and necessary goods on credit, taking in coffee when the harvest is done. If there is not sufficient crop to pay off the debt, the balance is carried forward to the next year. So it piles up, to be finally cleared off in some good year which comes perhaps once or twice in a decade. Meanwhile there is a high interest rate adding to the burden and the man is helpless because the debtor is always at the mercy of his creditor.

"To make matters still worse, the storekeeper has a good deal of authority in fixing the price which he will allow on the debtor's coffee when it is finally harvested." Upon delivery, the coffee "has not been graded and its ultimate value can only be guessed at. It is human nature that the storekeeper, who has waited long for his money, will scale the price down to a point where he feels that he is well protected against loss."

At present, dealer credit is of less importance to farmers than before World War II. Many farmers paid off their debts to merchants during the prosperous World War II and the first postwar years. Coffee buyers

still advance credit at times. Some produce wholesalers give production loans, and feed dealers often deliver feed on credit. Machinery and equipment can be bought on time payment plans. In addition, many farmers carry accounts with farm supply and grocery stores.

The main sources of capital to the small farmer are his own savings and those of his family and friends. Oriental families, particularly Japanese, are closely knit. Because of this and the lack of other sources of credit, the farmer of Oriental ancestry turns to his family first when in need of capital.

The Kona Community Federal Credit Union, organized a few years ago, has satisfied the minor production and consumption credit needs of many farmers in the district. Recently a credit union was formed on Molokai which may become of importance in serving farmers producing diversified agricultural products.

Share cropping, a common practice of agricultural financing on the mainland in the South, is not extensively used in the Islands. However, some land, particularly on Oahu, has recently been leased to fruit and vegetable growers on a share basis.

Among governmental credit organizations, the Farmers Home Administration is by far the most important. The FHA was the successor in 1946 to the Farm Security Administration (FSA). It makes four types of loans, farm ownership, operating, farm housing, and disaster loans. Farm ownership loans are repayable in forty years, operating loans in from one to seven years, and farm housing loans in from five to thirty-three years. Disaster loans can be either short-term or long-term loans, depending on the purpose, with a maximum of twenty years. Operating loans were first made in Hawaii in 1938, ownership loans in 1939, housing loans in 1950, and disaster loans in 1951. In the beginning the FSA restricted itself to the island of Hawaii, but in 1940 it began operations on other islands as well.

Nearly all ownership loans are of the "tenant purchase" type. With a loan of this type, the FHA buys the land and finances the establishment of the farm as well. There have been very few "development loans," where the farmer already owns the land and needs capital for its development or the enlargement of the farm.

By March 1, 1952, about 345 Island farmers had received 2.1 million dollars in ownership loans. As of the same date, 839 operating loans amounting to over 1.1 million dollars had been made. In addition 78 housing loans amounting to \$640,000 and 55 disaster loans for a total of \$78,000 had been approved.*

* These figures do not include \$95,000 worth of emergency crop and feed loans. The first of these loans had been made by the Farm Credit Administration in the early 1930's. The program had been taken over by the FSA and had been discontinued in 1946.

The record of the FSA and FHA program in Hawaii so far has been good. Up to March 1952 no financial losses occurred among the ownership, housing, and disaster loans. Losses in operating loans totalled only \$200. Of a total of 2.0 million dollars in ownership loans, 1.1 million dollars of principal was repaid by March 31, 1951. By that date 143 of the 285 ownership borrowers had completely repaid their loans.

Observers attribute the success of the FSA and FHA in Hawaii primarily to the careful selection of borrowers and the supervised loan program. Loans other than housing loans are granted only after a farm and home plan has been made by the farmer in cooperation with the FHA. Trained agriculturists of the FHA supervise the carrying out of these plans and help with advice if needed.

The record of FHA borrowers in Hawaii is better than on the mainland. On March 31, 1951, Island ownership borrowers had repaid 55 percent of their loans, compared to a 48 percent average for the mainland. Extra repayments of principal, in addition to required minimum payments, were about 50 percent higher in the Islands than the mainland average. In making these comparisons, it must be remembered, however, that operations of the FSA on the mainland began several years earlier than in Hawaii. These early years, largely falling into a period of agricultural economic depression, are included in the above mainland figures.

Furthermore, to become a client of the FHA a farmer must show that he cannot obtain credit from a bank or other lending agency at a reasonable rate of interest and on terms to meet his needs. As possibilities of getting farm credit are much scarcer in Hawaii than on the mainland, most Island clients of the FHA can be expected to belong to a better class of farmers than in the continental United States. A sample survey of 52 FHA-financed farms in the Islands indicated that the FHA farmers were, in general, better-than-average farmers.

FHA farm ownership loans in Hawaii are at present limited to \$18,000 per farm, with loans exceeding \$12,000 requiring regional or national office approval. Operating loans are limited to \$7,000 per loan. The ownership loan ceiling confines the farm ownership financing of the FHA largely to agricultural industries requiring relatively little capital. For example, ownership loans to full-time beef cattle ranchers and dairymen have been rare.

Several other FHA requirements limit the type and number of clients applying for loans in the Islands. For loans other than disaster loans, farmers must be American citizens. Except for a farm housing loan, a borrower has to devote a major portion of his time to his farm, and receive a major portion of his income from it. To receive these loans, farmers must have security of farm tenure. Despite these limitations, eligible applicants for housing and operating loans have far exceeded the funds available to the FHA during the last few years.

The only major territorial agricultural credit agency, the Farm Loan Board of the Territory of Hawaii, which was created in 1919, has not been successful. Up to 1941 a total of about \$330,000 had been loaned by the agency. In that year delinquent loans and interest payments amounting to \$243,000 were reduced to \$134,000 under the terms of the so-called Reamortization Act. No new farm loans have been made directly by the board since 1942; outstanding farm loans amounted to \$15,000 in 1952.

The failure of this lending institution appears to have been caused by poor administration and by some of the stipulations in the law under which it was established. The upper limit for loans was \$5,000. Loans granted for the purchase of land had to be repaid within ten years, development loans within five years. Experience has shown that this loan ceiling was too low and the repayment periods too short. The restriction of all loans to fee simple property greatly limited the number of potential borrowers. The lack of a supervised loan program and poor selection of borrowers were other causes for the failure of the board.

Since 1949 the board has made available to the FHA its revolving fund of about half a million dollars. By March 1952 the FHA had used about \$230,000 of this in its insured mortgage farm ownership program.

The Hawaiian Homes Commission can make loans up to \$12,000 to its agricultural homesteaders. Only persons with at least 50 percent Hawaiian blood are eligible for the program of this agency. Few of these homesteaders have so far been successful as commercial farmers.

The fact that the agricultural borrowers of the Hawaiian Homes Commission and the Farm Loan Board have failed to prosper is sometimes cited as evidence that diversified agricultural industries and small farming cannot be successful in Hawaii. In view of the satisfactory record of the great majority of FHA farmers producing diversified agricultural products, such a conclusion does not appear to be warranted.

Private lending institutions might well be able to enlarge their volume of loans to diversified farmers and their marketing agencies. Lately the two principal commercial banks in the Islands have shown an increasing interest in the financial needs of non-plantation agriculture. More credit would become available to Island farmers if they would keep better farm records. At the present time many agricultural producers are unable to furnish financial statements that are satisfactory to lending institutions. Marketing agencies could encourage the granting of credit to farmers by using mainland-type practices such as crop or livestock product assignments, which protect the interests of creditors. Landowners could greatly aid farmers in getting loans by selling them land or by granting them longer and more secure leases.

The agricultural credit situation in Hawaii could probably be improved greatly by extending to Hawaii the operations of the lending

agencies organized in the Farm Credit Administration. Farmers on the mainland form credit cooperatives, the so-called National Farm Loan Associations. These obtain long-term credit from the Federal Land Banks, which are part of the Farm Credit Administration. For the purpose of getting short-term production loans from the FCA, mainland farmers establish cooperative Production Credit Associations. The Bank of Cooperatives, also a part of the FCA system, extends credit to mainland farmer cooperatives.

In 1951 two representatives of the FCA investigated the possibility of establishing a Production Credit Association in Hawaii. They recommended against such an undertaking at that time. However, they indicated that a PCA might operate successfully within a few years with continued improvement in Island agriculture and with further growth of farmer cooperatives. Several agricultural leaders in Hawaii feel that the volume of business among farmers would justify a PCA immediately.

Island farmers are being paid for part of the costs of certain conservation practices by the U.S. Production and Marketing Administration. The maximum annual payment under this agricultural conservation program to any one farmer or rancher is limited to \$2,500 in 1953. It is the policy of PMA to approve only those practices which are most conducive to better soil conservation and increased agricultural production.

Laws, Regulations, and Taxes

Island farmers operate within an extensive system of laws and governmental regulations. Regulating authorities include federal, territorial, county, and district agencies.

In 1903 the Territory started a plant and animal inspection and quarantine service to protect its crop and livestock industries. At present territorial and federal services cooperate in the enforcement of quarantine regulations on shipments to and from Hawaii.* Certain plants and animals moving in interisland trade are also inspected by the territorial agency. Despite the quarantine, several serious plant pests and livestock diseases have been introduced in recent years, such as the Oriental fruit fly and the Newcastle disease of poultry.

Many progressive acts and ordinances passed during the last few years have enhanced the development of the diversified agricultural industries. A marketing act passed in 1945 greatly improved the marketing of farm produce. It provides for the adoption of grades for fresh fruits and vegetables and a territorial inspection service for agricultural products. On its authority the Board of Agriculture and Forestry has

* These agencies are the Division of Foreign Plant Quarantine of the Bureau of Entomology and Plant Quarantine, USDA, and the Division of Entomology, Territorial Board of Agriculture and Forestry.

promulgated regulations governing grading, packing, standard containers, and labeling.

The portion of the marketing act which regulated dealers in farm produce was expanded by the 1949 and 1951 territorial legislatures. In 1949 legislation was passed providing for the establishment of grades and compulsory inspection service for fruits, vegetables, and nuts that are exported. Laws now in effect controlling the quality of seeds, economic poisons, and mixed feeds protect the farmer as a buyer. Agricultural production is safeguarded by legislation such as the law controlling the use of 2,4-D and similar plant hormone preparations.

The mild climate of Hawaii makes strict sanitary regulations necessary. Some of these ordinances, such as those regarding adequate rodent and fly control for livestock and poultry, require expensive procedures.

Meat slaughtered for sale is inspected for evidence of disease by territorial authorities in the same manner as under federal regulations. (One slaughterhouse is federally inspected.)

The territorial legislature in 1947 passed a law providing for the creation of Soil Conservation Districts to protect the land against waste and erosion and to conserve water. By the middle of 1953, twelve districts had been established on the islands of Hawaii, Oahu, Kauai, Maui, and Molokai. Both the U.S. Soil Conservation Service and the Agricultural Extension Service assist in the formation of the districts and cooperate with the district directors in their operation.

Hawaii has a wage-and-hour law more inclusive than that of many states—extending even to agricultural labor. However, this law does not apply to agricultural enterprises employing less than 20 persons. The Hawaii Employment Relations Act, a "little Wagner Act," gives the right of organization and collective bargaining to agricultural workers in enterprises employing eight or more persons except those engaged directly in the milking or feeding of dairy cows. The child labor law regulates the conditions under which minors work, but children working on farms of their parents or guardians are exempt from most of the provisions of this act.

Most taxes which are levied on Island farmers are similar to those paid by farmers on the mainland, such as real property tax, fuel tax, federal net income tax, and territorial net income tax. Because of low net incomes, only a fraction of the family farmers in the diversified agricultural industries pay net income taxes. In a sample of 52 small farmers in 1947, 11 paid federal and 9 territorial net income taxes. The average payment per sample farm was \$28.00 federal and \$4.00 territorial net income tax.*

* This sample included only small family farms employing very little hired labor. A sample including a representative share of the larger diversified farms would have shown higher average income tax payments per farm.

In contrast to farmers in most mainland states, farmers in Hawaii have to pay a territorial gross income (general excise) tax. The rate is 1.5 percent of gross receipts from sales by agricultural producers to dealers. Wholesalers pay a 1 percent and retailers a 2.5 percent tax on their gross receipts. Farmers who sell directly to consumers pay a tax of 2.5 percent.

The gross income tax is among the heaviest tax burdens on farmers in Hawaii, except for those with high incomes. In contrast to net income

Gross Income Tax Rates (Percent of Gross Receipts)

taxes, its rate stays the same regardless of the amount sold. At present tax rates, general excise tax payments of the above-mentioned sample farmers would have averaged 2.2 percent of their total farm costs including interest.*

The effect of the tax is similar to that of a retail sales tax; both tend to reduce the volume of sales. In some states, such as California, food is exempt from retail sales taxes. This exemption gives food products a relative advantage over other commodities in these states. Hawaii's farmers and food dealers do not have this tax advantage, because they are taxed the same as other businessmen.

The general excise tax puts Island food producers at a disadvantage in competing with mainland growers. For example, a wholesaler importing farm products from California buys from farmers not subject to a gross income tax. Island farmers selling to the same wholesaler have to pay a 1.5 percent gross income tax. In the case of agricultural exports from Hawaii, the general excise tax is a cost which growers in most competing areas do not have.

Another effect of the territorial gross income tax is to increase the prices of goods purchased. The amount by which prices are raised by the tax depends largely on the degree to which it can be shifted by

* Actual gross income tax payments of these farmers constituted a smaller percentage of their farm costs because the rate on sales by agricultural producers to dealers was 0.25 percent for the first six months of 1947. The rate was raised to the present level of 1.5 percent on July 1, 1947.

wholesalers and retailers to consumers. For products with nation-wide fixed sales prices, dealers may have to absorb the tax, with no price rise to consumers. However, producers and dealers usually base their markup on their cost, including the tax. Most agricultural products are sold at least three times—by the producer, a wholesaler, and a retailer. In these cases, the price rise to the consumer above what he would have had to pay without the tax is estimated at about 5 percent.

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chapter 3 HAWAII AGRICULTURE TO 1900

Prediscovery Hawaii

Before the coming of the white men, the Hawaiians had been economically self-sufficient for many centuries. They practiced an intensive form of agriculture which sustained an estimated population of 300,000 at the time of Captain Cook's discovery in 1778.

Their main staff of life was *poi*, prepared from the cooked corm of the taro plant. Most of the wetland taro was grown partially under water in rich bottom lands and on irrigated terraces. Wetland taro patches were level beds, perhaps 20 to 50 feet square, surrounded by earthen dikes. The so-called dryland taro was produced without irrigation in some of the moist upland areas. Sweet potatoes were also cultivated but were less exacting in their water requirements.

Other food crops were grown, such as breadfruit, bananas, plantain, coconuts, sugar cane, awa root, and gourds, although nothing much was done by the natives except to plant them. The paper mulberry tree, from which the Hawaiians made their cloth, or *tapa*, was cultivated along with these food plants.

Hawaiians developed much skill in the growing of some crops. They brought irrigation water to their taro fields from streams which were often far away. It required ingenious engineering to make these irrigation systems function effectively. An efficient system was developed for the distribution of water, and the adjustment of disputes.

The Hawaiians learned how to conserve and build up the fertility of the soil. They developed simple hand implements for tillage, such as a wooden spade of simple design. They had practically no iron or other malleable metals and no work animals.

Fish was the most important source of protein in the diet of the Hawaiians. Of primary importance among animals raised for meat were breeds of short-legged and large-bodied dogs. These were kept in yards, fed on vegetables and refuse, and eaten at an early age. A small, razor-back type of hog was also commonly raised. Its flesh was preserved by boning it, rubbing it well with salt, and drying it. Chickens were the only other livestock.

All land belonged to the king, who distributed it to his principal chiefs on a feudal basis. They in turn allotted the land to lesser chiefs, who subdivided it among the common people.

The functional agricultural unit was the individual tenant's holding, or *kuleana*. In the uplands, *kuleanas* were from about seven to nine acres in size. Each tenant cultivated two or three acres during a given year, then would let this land lie fallow for two or three years. *Kuleanas* used for wetland taro in the fertile bottom lands were smaller.

The tenants could be ejected at will by their chiefs. However, in contrast to European feudalism in the Middle Ages, the farmers were not serfs. They could leave one chief if his burdens proved too heavy, and seek a *kuleana* from another. The commoners retained only one-third of the fruits of their labor for their own use. The remaining two-thirds were paid in one form of tax or another to the various orders of chiefs and priests.

Considerable commerce existed between islands and between different areas on the same island. For example, on the island of Hawaii the people of Kona bartered dried fish for vegetable produce from the fertile Hamakua coast. The inhabitants of Niihau, a rather dry island, sent yams to the island of Kauai in exchange for wood to build their canoes.

Before Cook's visit, exchange had developed to the point that regular market fairs were held on the island of Hawaii where peddlers from all parts of the island came together to barter their products. Market inspectors were at hand to assure orderly trading and to arbitrate disputes. The natives possessed no medium of exchange or money. No legal protection was given to lenders; apparently willingness to lend implied willingness to bear the risk of the debtor's default.

Farming, like all other activities in ancient Hawaii, was tightly regulated by a strict religious ritual. Under this so-called *kapu* system, much extra labor was required and violators were severely punished.

Discovery to Middle of 19th Century

As foreign vessels began to visit the Islands the number of imported cultivated plants and domesticated animals increased rapidly. It is known that Captain Cook introduced melons, pumpkins, and onions. The orange was brought to Hawaii in 1792, the grape in 1796, the Irish potato about 1820, and the mango tree in 1824. By 1825, cabbages, Indian corn, limes, and pineapples were exchanged at the regular market then functioning in Honolulu. A great number of other fruits and vegetables from both temperate and tropical zones have since been introduced from all parts of the world. There probably exists now a wider range of cultivated crops in Hawaii than in any other place of comparable size.

New species of animals were imported at a rapid rate. Captain Cook brought goats, which roamed wild in the mountains and have since become forest pests. Cattle and sheep were brought to Hawaii in 1793 and horses in 1803. By about 1825 turkeys, ducks, donkeys, mules, and European varieties of chickens, pigs, and dogs had been introduced.

As a result of the king's strict *kapu* on cattle, the interior plains and mountains were full of them by 1830. Removal of the *kapu* started ranching and the hunting of the wild cattle on horseback on Hawaii and the other islands. Government and king jointly owned the wild, unmarked herds and sold or leased slaughtering rights to private parties. The wild cattle amounted to 25,000 head in 1846. Though meat and tallow were sold, wild cattle were hunted primarily for their hides and eventually became very scarce. Ranching developed into a highly profitable enterprise in the middle of the nineteenth century.

During the 1840's the interests of cattlemen frequently collided with those of farmers. The cattle destroyed the *hala* trees and vegetable patches of the Hawaiians, who were not in the habit of fencing their land. In at least two areas, in Waimea on Hawaii and in Kahuku on Oahu, farmers were actually driven away from their homes by the depredations of cattle. Laws were passed against trespassing cattle but not enforced. As time went on the evil was mitigated by fence building.

Provisioning of ships gave the first foreign stimulus to Hawaiian agriculture. Ships stopping at the Islands during the four decades following discovery were mainly engaged in fur and sandalwood trade between the Pacific Northwest, China, and Hawaii. Beginning about 1820 whaling ships made the Islands their principal field base of operations and stayed in port for weeks and months in the spring and fall. Whaling in the Pacific reached a peak between 1840 and 1860, and rapidly declined thereafter.

At first the foodstuffs which the natives had to offer for sale to the sailors were limited to pigs, poultry, yams, and a few fruits and vegetables. During the latter part of the whaling period the most important provisions bought by the whalers were beef, sweet potatoes, and Irish potatoes. Also bought were chickens, turkeys, hogs, pumpkins, melons, onions, yams, coconuts, limes, oranges, bananas, pineapples, molasses, sugar, and coffee. As late as 1844 most of the trade was barter. Near the ports the natives learned to use money, but in the outlying districts it was not yet generally the medium of exchange.

Agricultural exports had been insignificant before the 1830's. Beginning in that decade, modest exports of sugar, molasses, cattle hides, and tallow appeared rather regularly in the export statistics. In the 1840's coffee became another permanent export item.

The California gold rush brought a brief but spectacular boom to Hawaii's agriculture. Production of Irish and sweet potatoes was stim-

ulated more than that of any other crop. Some Irish potatoes had been exported in 1847, but the strong demand and high prices began in the fall of 1849. Exports rose from 900 barrels in 1849 to 52,000 in 1850 and 43,000 in 1851. By the fall of 1851, the boom was over. Total shipments of Irish potatoes amounted to only 8,200 barrels in 1852 and had practically ceased by 1855. Competition from the Oregon country had pushed Hawaii out of the California market. In addition, the Californians began to raise potatoes themselves. To make things worse, the potatoes from Hawaii had acquired a bad reputation on the West Coast since Island growers had shipped many potatoes of inferior quality to San Francisco.

Exports of some other agricultural products also reached a peak early in the 1850's but continued at a modest level for a number of years more. Shipments of sweet potatoes, for example, rose from only a few barrels in 1848 to 56,700 in 1851. Though they declined to 6,100 barrels in 1852, nearly 2,000 barrels were shipped as late as 1859. Banana exports began in 1851, reached 1,700 bunches in 1853, and then continued at lower levels during the following years. Cattle ranchers sent 25 tons of fresh and salted beef to California in 1853 and were still exporting nearly that much in 1860. Other agricultural products exported to California during the gold rush were chickens, turkeys, swine, dried pork, cattle, mules, eggs, onions, pumpkins, melons, cabbage, yams, oranges, pineapples, coconuts, coffee, sugar, molasses, flour, and hay.

With the exception of beef and some sugar and coffee, most of the agricultural crops during the gold rush period were produced on *kuleanas*. Active steps were taken by the government to encourage family farming. For example, most of the potatoes exported were grown in Kula on the slopes of Haleakala, Maui. Public land there was subdivided into lots of from one to ten acres and offered for sale to the natives at \$3.00 per acre.

Agricultural techniques had not changed greatly by the middle of the nineteenth century. Ax and knife were now used generally by the natives, but no heavier or specialized tools. S. E. Bishop reports that in his youth in Kona he never saw a plow, scythe, sickle, or as far as he remembered, a metal spade or shovel.

In the late 1830's some carts and oxen came into use in the less backward communities. Horses became more common, and animals were used in the grinding of sugar.

American missionaries, the first of whom arrived in 1820, were a major influence in spreading Western methods of agriculture. Among other things, they taught the natives how to yoke oxen, to plow and harrow, and to fertilize their crops.

Great Mahele and Aftermath

During the fifth decade of the 19th century, the landholding system changed from a feudal to an alodial basis in the so-called *Great Mahele*. The king divided the land among himself, the government, the chiefs, and the common people. The king's own property, or "crown land," amounted to approximately 984,000 acres, the government land to 1,495,000 acres, the chiefs' to 1,619,000 acres, and the common people's to 28,600 acres.

Not all native tenant farmers applied for the title to a *kuleana*. Some felt that the cost of acquiring a title exceeded its value. Others believed that the *kuleanas* offered to them were too small to sustain their families. During the land division, some surveyors included in a *kuleana* only the land actually under cultivation. In many areas, such as in the uplands, a *kuleana* had to be three times as large as the area actually cultivated.

It must also be realized that the farms given to the common people consisted primarily of irrigated taro lands in the valleys. These lands were regarded as by far the most valuable at that time.

Many *kuleanas* passed rapidly out of the hands of the commoners into the possession of non-Hawaiian operators of sugar and rice plantations and cattle ranchers. The natives were slow in grasping the full significance of land titles. Returns from lease or sale of their land were high and life in the port towns tempting.

Large portions of the areas granted to the king, the government, and the chiefs were mountainous, arid, or forest lands. With the increasing importance of crops other than taro, the growth of livestock industries, and the development of irrigation, many of these latter lands became of great agricultural value.

Much of the land of the chiefs and the government also passed into the hands of white people by sale, lease, or marriage. In 1856 only 209 of the 15,514 land claims registered with the government had belonged to foreigners or their descendants. By 1896, 57 percent of the taxable land was in their hands. Title to all government and crown land was conveyed to the United States by the Treaty of Annexation.

Sugar Industry Until Annexation

Up to 1835 few foreigners were engaged in farming. Uncertain land tenure, lack of near markets, and the possibility of making money more easily by trading with the whalers kept them out of agriculture. However, during the next 25 years they began to turn their attention to this field. Their change of attitude was brought about primarily by three developments: (1) the change in the landholding system, (2) the rapidly increasing export market on the West Coast of the United States, and (3) the decline of the whaling trade.

Among the many crops they tried, sugar was destined to become Hawaii's major industry. It has been reported that as early as 1802 attempts were made to produce sugar commercially in the Islands. The first permanent plantation, the forerunner of the present system of corporation agriculture, was established on a large leasehold at Koloa, Kauai, in 1835. Other sugar producers and mills soon began operating, and the first sugar exports were reported in 1837.

For the next 20 years the young industry struggled against heavy odds. It was handicapped by the lack of or uncertainty of markets, low prices, labor scarcity, and drought. Other factors were the planters' lack of experience, equipment, and capital. Until the *Great Mabele* many difficulties arose from the feudal land system.

By 1857 the surviving plantations were primarily those which were large and centralized, combining the growing and processing of sugar cane in one enterprise. They had proved better suited to the Hawaiian conditions of that time than a system of central mills to which sugar cane is brought by individual cultivators. Mill machinery and cultivation practices steadily improved. In 1872 it was stated that "no country can boast of finer mills or plantations."

Up to 1856 sugar was produced without irrigation. When irrigating of sugar proved profitable in that year, a large number of small-scale irrigation projects were undertaken.

With the increasing complexity of sugar production, many planters had little time left for marketing, purchasing, and financial matters. Therefore, they affiliated with Honolulu merchants who handled on a commission basis all their business except the growing and milling of sugar cane. From such a modest beginning some of these merchants, who were called factors, grew to their present dominating position in the sugar industry.

Boom prices during the Civil War in the United States furnished a major stimulus to Hawaii's sugar industry. Sugar exports expanded from 572 to 8,865 tons during the war and continued to increase thereafter. The Treaty of Reciprocity between the United States and Hawaii, concluded in 1875, provided for free entry of Hawaiian sugar and molasses

into the United States. The sugar industry became "as profitable as gold mines were only hoped to be" and it expanded rapidly. About 20,000 additional acres were brought under cultivation in six years, and old sugar land was farmed more intensively. Twenty plantations were in operation in 1875; five years later there were 63.

Large-scale irrigation developments were undertaken under the stimulus of the treaty. The first of these, the Hamakua Ditch, was 17 miles long and able to deliver 40 million gallons of water daily to the fertile sunny plains near Paia, Maui. Later on, still larger ditches were built. The Spreckels Ditch was 30 miles long and the Koolau Ditch had a capacity of 80 million gallons daily. In addition, subterranean water resources were developed by large-scale pumping.

Hawaii Sugar Production in 1875 and 1898

Sugar planters and factors loosely organized in 1882 in the Planters' Labor and Supply Company, which

founded a sugar experiment station early in 1895. Later that year the more strongly integrated Hawaiian Sugar Planters' Association superseded the first organization and took over the newly established experiment station.

The successful development of the sugar industry following the conclusion of the Treaty of Reciprocity of 1875 is best shown by the increase in sugar production. It rose from 12,500 tons in 1875 to 229,400 tons in 1898, when the Islands were annexed by the United States. Sugar had become king in Hawaii.

Coffee Industry Until 1900

Coffee was first grown in Hawaii in 1817 on the island of Oahu. The first large coffee plantations were established in the late 1830's and early 1840's on Kauai; others followed on Maui and near Hilo and in Kona on Hawaii. The Kona district was found to be especially well suited to its growth.

Some coffee was consumed locally and a good deal sold to the visiting whalers. Exports began in 1845. For a short period coffee became the second largest agricultural industry in the Islands, and some believed it was destined to become the major industry of Hawaii.

Coffee planters soon ran into trouble, however. Coffee and sugar began to compete for land and labor during and after the California gold rush. Land rents went up; many coffeegrowers could not pay high enough wages and lost their workers to the sugar planters; a destructive

plant blight struck the industry. The sharp rise in sugar prices during the Civil War in the United States was the final blow to coffee plantations. In many cases, coffee planters uprooted their trees and planted sugar instead.

However, coffeegrowing continued in small units on a family basis. Most of the producers were natives who lived some distances from cane fields. They were not greatly attracted by employment on sugar plantations because of their training and habits. They planted either coffee slips or seed and let the trees grow without attention until it was time to pick the berries. Husks were removed by primitive methods, often resulting in coffee with an unclean appearance or poor flavor, which reduced its price.

With tariff protection of the local market, home consumption in the early 1870's was estimated at about 200,000 pounds. Exports fluctuated greatly; they amounted to 415,000 pounds in 1870 and to only 39,000 pounds two years later. Most exports went to Pacific ports of the United States and some to British Columbia and Germany.

The Reciprocity Treaty of 1875 harmed Island coffeegrowers. It removed the Hawaiian tariff on coffee imports from the United States, and American shippers flooded the Hawaiian market with cheap grades. In the 1880's coffee exports declined to their lowest level since they were first listed in the export statistics.

About 1887 the world market for coffee began to rise substantially. Prospects for the crop seemed excellent and large sums of money were spent to develop new coffee plantations in the Islands. Exports increased rapidly and in 1899 amounted to 825,000 pounds.

Hawaii Coffee Exports, 1870,
Average 1880's, and 1899

Rice Industry Until 1900

Rice growing became an important Island industry in the early 1860's. A ready market for rice had existed for some time; in the 1850's \$10,000 to \$12,000 worth was imported annually from China. The number of Chinese immigrants, who were large rice consumers, rapidly increased both in the Islands and in California.

In 1860 an experimental planting in Hawaii proved successful. Agricultural resources suitable for rice growing were available and unused. With the decline in the native population, the demand for *poi* had also declined, and many taro patches had been abandoned. The existing

earthen banks and irrigation channels could quickly be made ready for growing rice. To help the industry get on its feet, a protective tariff was imposed of 1 cent a pound for rice in the husk and 1.5 cents for cleaned rice. A speculative rice fever began, and the cultivation of the crop spread quickly. However, after the first enthusiasm natives and Caucasians found the returns from rice growing disappointing. They leased their lands to the Chinese, who completely took over the industry.

Rice exports increased rapidly from about 670,000 pounds hulled in 1862 to 1,960,000 pounds in 1875. The industry was greatly stimulated by the Reciprocity Treaty of 1875, under which rice was admitted free of charge to the United States. Chinese growers extended plantings to all remaining unused taro lands and then reclaimed swamp and marsh land. During the peak of the rice era, they brought previously unirrigated land under cultivation and irrigated it from newly dug wells.

In 1880 the home market was made more secure by an increase in import duties to 1.5 cents a pound on paddy and 2.5 cents on hulled rice. In 1887 rice exports reached a peak of 13,680,000 pounds and then gradually declined. In 1899 production amounted to 33,440,000 pounds valued at \$1,560,000. At that time, slightly more than 9,000 acres were used for rice. The major portion of this acreage was on Oahu (with two-thirds of the output) and on Kauai.

There were three types of rice producers: (1) independent family farmers, (2) cooperative groups, and (3) plantations. The great majority of farmers raised from one to five acres each. To finance their operations the small growers commonly borrowed from grocery stores. Such loans ordinarily were not secured by a lien on the crop or even a note but were made merely on the basis of confidence.

There were two types of group farming, the *fun kung* and the *hop pun*. In the *fun kung* system the owner or lessee of the real estate furnished the land, agricultural equipment, and work animals. The laborers bound themselves by contract to the plantation and supplied their own rations. At the end of the season, the capitalist and the workers divided the crop, or the money from the sale of it, on the basis of their mutual contract or agreement. In the case of the *hop pun*, or small partnership, two or three farmers jointly leased a piece of land, raised a crop, and divided the proceeds.

Companies were formed by both Chinese and Americans to promote and finance rice plantations. Some of these finance companies were also rice dealers or millers. The largest company, Sing Chong, had 4,000 acres under cultivation and at its peak produced half the Oahu output. Most of the large plantations ranged from 100 to 300 acres. They were usually operated for the companies by a salaried manager.

Most of the rice growers did not own the land they cultivated. In 1900 cash tenants operated 393 of the 504 rice farming units, share

tenants 40, and managers 24. Only 33 operators owned their farms in full and 14 were part owners.

The Chinese produced rice in Hawaii by the same methods their forefathers had used for centuries in their homeland. They introduced water buffalos with which to prepare the soil. Horses were used for threshing. Most other work was done by hand. Permanent plantation

Land Tenure of Rice Growers in 1900

workers received about \$12.00 a month besides housing and board. At planting and harvesting times extra laborers were recruited from the major towns.

On the windward side of the Islands one rice crop was raised per year, yielding an average of 3,000 pounds per acre. Two crops a year were grown on the leeward side, totalling about 5,000 pounds per acre.

Miscellaneous Crops Until 1900

Bananas were the only fruits regularly exported throughout the second half of the nineteenth century. The Hawaii-grown Cavendish bananas became popular in California, particularly among the Chinese. Annual shipments increased to more than 10,000 bunches in 1875 and more than 60,000 bunches in 1885. By 1889 exports exceeded 100,000 bunches and, with some fluctuations, remained at about that figure until annexation.

Orange exports from Hawaii to California began about 1840 on a limited scale and continued for about 30 years. By the end of the century the tables were turned, however, and Hawaii was importing oranges from California. Other crops, such as potatoes and cabbage, suffered the same fate. During the gold rush period Hawaii shipped these produce items to California, but later California began sending them to Hawaii. As a consequence, commercial production of some crops in Hawaii was negligible for many years. However, the variety of fruits and vegetables grown for home use in many Island backyards greatly increased during the second half of the nineteenth century.

Other potential export crops were tried, but none proved permanently successful. The earliest efforts to grow cotton in Hawaii date back to the first years of the nineteenth century. Production on a commercial scale began with the outbreak of the American Civil War when northern cotton consumers, cut off from their normal suppliers in the South, turned to the Islands as a possible source of the fiber. Exports expanded from 600 pounds in 1862 to a maximum of 22,300 pounds in 1866. Shipments to the mainland declined after that date and ceased entirely

Hawaii Banana Exports in 1875
and Average 1890's

in 1875. The postwar competition of the southern states and the increasing opportunities in sugar were too much for the Hawaiian cotton grower.

A serious effort to produce silk on Kauai between 1836 and 1844 was a failure. Drought, wind, and insects damaged the mulberry trees, the leaves of which were used to feed the silkworms. When the project turned out to be less profitable than sugar and coffee, it was abandoned.

A little wheat was raised in the Islands before 1840. By 1852 about 140 acres were grown near Makawao, Maui, and some 1,200 acres the next year in the same locality. A power mill was erected in Honolulu and about 5,000 barrels of flour were manufactured. For a few years production was sufficient to fill domestic requirements and to make a few small export shipments.

However, Hawaii growers could not compete with California farmers who began at that time to produce low-cost wheat on a large scale. In the spring of 1857 sales were made at \$11.00 and \$13.00 a barrel in San Francisco, compared to \$17.00 in Honolulu. With a profitable sugar industry competing for capital and labor, commercial wheat growing passed completely out of the picture in the late 1860's.

Among staples grown for home consumption, taro production decreased with the decline in native population. However, *poi* remained the mainstay in the diet of the Hawaiians, who did not easily substitute other foods for it. Whenever the supply of taro dwindled—such as in 1861, the first year of commercial rice production—prices rose to bring production quickly back into line with demand. Growing of the taro crop gradually passed out of the hands of the Hawaiians and was taken over by the Chinese. By the end of the century, the Chinese raised half of the taro and milled 80 percent of the *poi*.

Corn was not valued as food by the Hawaiians. In the 1850's plantings in the cooler uplands were successful. About 1900 several thousand

acres were grown for feed in the Kula district of Maui and the upper portions of the Parker Ranch on Hawaii.

Livestock Industries from 1850 to 1900

Cattle ranching steadily expanded during the second half of the nineteenth century. In 1846, out of a total of 35,000 head of cattle in the Islands, about 10,000 were estimated to have been domesticated. U.S. Census returns in 1900 gave the number of cattle one year old or over as 103,000. Modern English breeds, which were brought to Hawaii about 1850, had largely replaced the original longhorns by 1900.

The *Great Mabele* provided a sound foundation for the development of large-scale ranching. Caucasians as well as Hawaiians—including the nobility and even the king—were in the ranching business. Beef cattle were raised on both private and government land. Numerous small ranches were absorbed by larger ones through lease or sale, and in many instances several small ranches were combined under single ownership. By the time of annexation, many of the present large ranches were already in existence.

As late as 1875 hides and tallow were reported to have been of greater value than beef. The number of hides exported rose from 6,000 in 1836 to an annual average of 21,000 in the period 1870–80. Around 1900 exports reached 30,000 hides per year. At first they were largely sent to South America. When California became an important population center, most hides were shipped there.

Dairies developed much more slowly than beef cattle ranches. Cow's milk was a new food for the Hawaiians and most Orientals, and both races were slow in adopting it as a regular article of diet. The demand for milk and other dairy products came largely from Caucasians. Dairy cattle were introduced into Hawaii about the middle of the nineteenth century. One commercial dairy was reported in operation in Honolulu in 1869 and five by 1880.

Number of Cattle in Hawaii
in 1846 and 1900

Previous to annexation, when beef prices were low, some of the large ranches found it profitable to keep dairy cows. They made butter and shipped it to Honolulu. In 1900 there were about 4,000 cows two years old and over in Hawaii which were kept primarily for milk production.

In the 1850's the Royal Hawaiian Agricultural Society pointed out the great potentialities of the Islands for wool production. Sheep ranches were soon established on the Waimea plains of Hawaii and on Molokai,

Lanai, and Niihau. In 1875 wool exports reached 565,000 pounds valued at \$70,000. The sheep industry apparently reached its peak in 1884, with 122,000 head of sheep in the Islands, and from then on it gradually declined. About 100,000 sheep were reported in Hawaii in 1900.

The raising of horses and mules became an important enterprise on many ranches. Mules were the favored draft animals on the plantations, particularly in the latter part of the nineteenth century. Horses were used for work with cattle and by overseers in getting about the sugar plantations.

Horse racing became popular in the Islands about 1870. Hawaiian breeders produced excellent race horses and polo horses, some of which were exported to the United States. In 1900 there were 13,000 horses and 6,500 mules in the Islands.

Swine raising, mostly on small farms, was a minor industry during the last half of the century. About 1855 some new breeding stock was imported. A few beef cattle ranches and sugar plantations took up swine raising as a side enterprise about the time of annexation. By 1900 the total swine population numbered only 8,000.

Turkeys were raised in a semi-wild state on some of the big livestock ranches late in the last century. However, production was insufficient to satisfy the demand of the Island market.

Before 1900 chickens were kept only in backyard flocks; no commercial egg producers operated in Hawaii. At times the local stock was improved by imported American and European breeds. However, chickens in Hawaii were still poor egg producers in 1900. According to the U.S. Census for that year, 32,000 chickens produced only 155,000 dozen eggs.

The first swarm of bees was brought to the Islands in 1857. Until 1895 beekeeping was carried on as a household activity. In that year the first commercial venture in the production of honey and beeswax for export was begun. In 1899 the honey industry was still small. The U.S. Census reported only 1,400 bee colonies for that year.

Transportation and Wages, Mid-century to 1900

The few Hawaiian agricultural exports in the first half of the nineteenth century were usually carried as additional cargo by whalers or other ships visiting the Islands. With the growth of agricultural exports, particularly of sugar, a line of clipper barks began operation between San Francisco and Honolulu in the 1850's. Permanent steamer service between the two ports was established in 1867. Soon thereafter sugar interests started their own shipping lines, which by 1901 included about 15 sailing ships. Most Hawaiian agricultural export commodities of that period were not highly perishable. Therefore, sailing ships, though

slower than steamers, were the most economical means of transport to the Pacific Coast.

With the development of specialized agricultural industries, inter-island and intercoastal trade expanded and improved. Freight of sugar from the outer islands to Honolulu and of fertilizer and general merchandise from Honolulu to the outer islands represented a large part of total interisland tonnage. Rice was shipped from distant places on Oahu to Honolulu. Sailing vessels, averaging 60 tons, had largely replaced canoes by 1850. In 1860 a 400-ton steamer began interisland operation on a permanent basis.

**Agricultural Cash Wages in the
1840's and in 1890**

The mountainous interior of each island discouraged road building for a long time. A passable cart road existed in 1853 on the leeward side of Oahu, but there were only horse trails between Honolulu and the windward sides of the island. A carriage road had been built around Oahu by 1875, but the other islands

had just a few short stretches of road at that date. However, the increased economic development following the passage of the Reciprocity Treaty brought rapid improvement in overland transportation. New roads were constructed and narrow-gauge railways were soon in operation on Oahu, Maui, and Hawaii.

By 1850 money had been generally accepted as a medium of exchange and a measure of value. Nevertheless, barter continued, with imported merchandise exchanging for beef, pork, poultry, *poi*, vegetables, and the like. The first permanent bank was established in 1858, and another was opened in 1885.

Agricultural wage levels rose steadily. In the late 1840's the average wage was 15.5 cents a day; in addition, the employer supplied the workers with grass houses, taro patches, and an outlay of 6 to 10 cents per working day for food. By 1856 total labor costs, including food, were about 33 cents a day, or \$9.00 a month. This wage compared favorably with the cost of keeping slaves in the South at that time. It was estimated that a slave cost 37.5 cents a day, plus depreciation and interest on the invested capital.

In 1863 wages of \$8.00 to \$10.00 per month excluding food were considered reasonable. By 1890, under the stimulus of the Reciprocity Treaty, contract labor received from \$15.60 to \$19.50 per month. Wages for free labor ranged from \$17.50 to \$22.25. In addition, the employer in both cases had to pay board and quarters, and importation costs in the case of contract workers.

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chapter 4 HAWAII AGRICULTURE SINCE 1900

Sugar Industry, Annexation to Present

The annexation of the Islands by the United States in 1898 assured the Hawaiian sugar industry of access to a large protected market. Many new sugar plantations were established. Firms that could secure additional land and water rapidly expanded as much as possible.

The harvested sugar cane area increased from 60,300 acres in 1899 to 90,300 acres in 1903. (Harvested acreage in Hawaii is lower than the total acreage in sugar cane; it takes sugar cane from 18 to 24 months to mature.) In the same period, annual sugar production rose from 283,000 tons to 458,000 tons. In 1917 production reached a high of 654,000 tons, and in 1918 the total area in sugar cane was at the all-time peak of 277,000 acres.

Production fell off during the last year of World War I and the years immediately following because of a shortage of ships, fuel, fertilizer, and labor. During the 1920's and early 1930's sugar plantations found it once more profitable in terms of labor, fertilizer, and irrigation, to intensify cultivation and to extend acreage to areas less suited to sugar growing. By 1933, at the then prevailing wage rates and production costs, the intensive and extensive margins for sugar production were reached. In that year raw sugar output amounted to 1,064,000 tons. Although the total acreage in cane was slightly below the record levels of World War I, the area harvested was at the all-time high of 145,000 acres.

The rise in wages between 1933 and 1940, the wartime labor and equipment shortage, the further sharp rise in wages since 1944, and the increase in other production costs have forced the industry to make many changes. The plantations are combating higher labor costs with more mechanization, laborsaving practices, and efforts to increase yields per acre. Fields which cannot be worked with mechanized equipment have largely been abandoned. More scientific and efficient agricultural methods have been developed and the handling of sugar in bulk rather than in sacks has become more and more common.

Overhead costs per ton of sugar have been reduced by increasing the size of plantations and by merging adjoining companies. Small isolated plantations have been liquidated. The number of sugar plantations decreased from 42 in 1932 to 28 in 1952. In the latter year, the area planted to sugar cane per plantation averaged 7,900 acres, ranging from 600 to 25,000 acres. The total area in cane amounted to 222,000 acres.

Raw Sugar Production in Hawaii, Selected Years, 1899 to 1952

In 1952 approximately 1,500 small sugar growers had under cultivation about 24,000 acres, or about 11 percent of the total sugar cane acreage. All but 12 of these family-sized farms were located on the island of Hawaii. (See Table A5.)

The small sugar growers have two types of agreements with the plantations: as adherent planters or as independent growers. Under the adherent planter arrangement, plantations have the right to make many basic decisions in the operation of the small cane farms, such as the timing of planting and harvesting. They also furnish fertilizer, weed killers, seed cane, and other supplies at a charge approximating cost, and finance the farming operations of the adherent planters. The planters usually care for the crop from planting until harvesting.

In 1951 the plantations offered the small growers so-called independent grower contracts which give the small growers greater independence in the management of their farms. In most instances, they are being financed by commercial banks. Early in 1953 almost 80 percent of the small sugar planters were operating under the new arrangement. This constitutes the first break in the long trend of centralization and integration in the Hawaiian sugar industry.

As an aftermath of World War II and a crippling strike in the industry, raw sugar production dropped to 680,000 tons in 1946. With improved cane varieties, more economical growing and harvesting methods, and better labor relations, the 1952 crop reached 1,020,000 tons.

A substantial decline of sugar prices would force a reduction in the Hawaiian output, unless accompanied by a corresponding decrease in

cost. Hawaiian sugar growers are concerned about the future level of sugar prices in view of the recent expansion of world sugar production. They hope, however, that the U.S. sugar quota system would continue to mitigate the effects on domestic growers of declining world sugar prices. It is one of the primary purposes of federal sugar policy to insure reasonable returns to domestic producers.

Hawaiian sugar cane growers, like other domestic cane and beet producers, receive so-called "conditional payments" from the U.S. Production and Marketing Administration. These subsidies have averaged about \$9.50 per ton of sugar, or \$9,600,000 per year for all Island cane farmers in 1951 and 1952. The future level of these payments will also affect the amount of Hawaii's sugar output.

Under the assumption that sugar prices and federal subsidies remain at present levels, the leaders of the Hawaiian sugar industry expect to raise production within a year or two to about 1.1 million tons of raw sugar. In the 1951 amendment of the Sugar Act of 1948, Hawaii's quota for the continental United States was continued at 1,052,000 tons of raw sugar. An additional quantity of refined sugar is annually allowed to Island producers for sale in Hawaii, amounting to 42,000 tons in 1952.

Development of Pineapple Industry

Pineapple growing and canning became Hawaii's second major industry within a few decades after the turn of the century. The young pineapple industry was at first opposed by most of the sugar planters in the Islands. They feared that pineapple growers would compete for their land and labor supplies and that this competition would raise the cost of production to more than sugar could afford.

However, pineapple growers generally use land not suitable for sugar cane production. Growing of cane is confined to lowland areas which can be irrigated or in which rainfall is high. Pineapple plantations frequently use semi-arid lands for which no irrigation water is now available. The labor requirements of the pineapple industry did not make serious inroads on sugar labor or greatly affect the wage level of sugar workers.

Although the pineapple had been a familiar fruit in Hawaii for many years, its commercial possibilities were only recognized in the 1880's when new varieties were introduced. Among them was the "Smooth Cayenne," which is now grown almost exclusively.

In the 1890's fresh fruit was exported occasionally, and a small cannery operated for a few years. In 1900 homesteaders on the Wahiawa plateau of Oahu began raising the new crop. At first they shipped fresh fruit to San Francisco despite heavy spoilage losses. When one of the homesteaders built a cannery, practically the whole crop was canned and fresh shipments nearly ceased.

Soon a small plantation was under way. The territorial legislature tried to encourage small-scale production by exempting from real and personal property taxes the first 40 acres of pineapples per farm. Nevertheless, large-scale production of pineapple soon became dominant. In 1909 the two largest corporations each accounted for more than 1,000 acres out of a total of 5,400 acres in pineapples.

The area owned or leased for growing the fruit increased to 47,000 acres by 1920. Of this total, 33,000 acres were on Oahu, 6,000 each on Hawaii and Maui, and 2,000 on Kauai. By 1937 pineapple growing had been tried in many new districts and a substantial shift in the importance of production areas had occurred. Plantations had been established on

Area Used for Pineapple Growing in Hawaii, 1909, 1937, and 1952

Lanai and Molokai, and acreage on Maui and Kauai had been increased. Plantings had been cut to less than half the 1920 acreage on Oahu and had been completely discontinued on the island of Hawaii. Despite these changes, total acreage had increased little since 1920.

By 1952 the area in pineapples had increased to 73,500 acres. Production had been expanded on all islands that raised the fruit in 1937. (See Table A2.) Further expansion of planted acreage is not expected at this time.*

A minor portion of the 1952 pineapple crop was raised on about 110 small, non-plantation farms, most of which had contracts with canneries. The others sold their fresh fruit in Island and West Coast markets. Mainland shipments of fresh pineapples amounted to almost 1,300 tons in 1952 and are expanding.

Canned pineapples were generally unknown to the average consumer the world over at the turn of the century. Demand for the canned fruit expanded less rapidly than the supply. In February 1909 the Hawaiian

* Test plantings of several hundred acres made in the Kohala district of Hawaii produced high yields of good quality pineapple. However, commercial plantings there were discontinued in the fall of 1952 because of the then existing slow market for pineapple products.

industry found itself with about three-fourths of its entire output of the previous year on hand. The growers organized and broke the marketing bottleneck by launching an extensive advertising campaign.

The first million-case pack was shipped in 1912. Production continued to grow and reached a pre-World War II peak of 22.3 million cases in the crop year ending May 31, 1940. The canned pack declined during the war to about 18.1 million cases in the crop year 1944-45. In the postwar period it rose to the record volume of 26.1 million cases in the crop year 1950-51. Largely because of a strike on one plantation, the sale declined to 23.6 million cases in the crop year 1951-52.

The value of the pineapple output has greatly fluctuated from year to year. Insect pests and plant diseases have made repeated inroads, and climatic factors, particularly variable rainfall, affect quantity and quality of production at times. Market forces have been the major cause of the industry's instability in recent years. Price fluctuations of competing canned fruits and juices, such as canned peaches and grapefruit juice, and lately of concentrated frozen orange juice, are important. Another reason for unstable marketings is the fact that pineapples are a luxury food item. Sales, therefore, are severely reduced by declines of consumer purchasing power during business recessions.

The depression of the 1930's hit the industry particularly hard. It forced the competing growers into a territory-wide organization, the Pineapple Producers Cooperative Association. In the ensuing arrangement all firms agreed to limit production under a quota system and to sell their pineapple pack through a marketing committee. With improved market conditions during World War II, the agreement was allowed to lapse and it has not been renewed since.

After years of research a satisfactory canned pineapple juice was developed. Quantity shipments began in 1934, and pineapple juice has since become highly popular. In 1945 it even exceeded the quantity, though not the value, of canned pineapple fruit. In the postwar period several frozen pineapple products have been developed. Fresh frozen pineapple chunks have been shipped to the mainland for several years. In 1952 a new product, frozen pineapple juice concentrate, reached the market.

Processors utilize practically all parts of the fruit. Some of the by-products are pineapple pulp and bran, citric acid, alcohol, sugar syrup, and natural sugar.

Many complex production and processing problems had to be overcome during the short history of the industry. In 1913 a device for the peeling and coring of pineapples, the Ginaca machine, was patented. Insect pests and plant diseases, such as the mealy bug and wilt, were brought under control by extensive scientific work. In 1916 researchers found that spraying with solutions of iron sulfate prevented the chlo-

rosis of pineapple plants. This discovery made possible the production of pineapples on lands well adapted to the crop but where the soils were high in manganese, such as in parts of the Wahiawa plateau on Oahu.

In recent years plantation engineers have highly mechanized pineapple production. Powerful crawler tractors pull heavy-duty plows across the fields. Large spraying rigs have almost completely replaced hand spraying. Harvesting machines equipped with conveyor belts extending over several plant rows have reduced picking labor and improved crop quality. Double-bin truck trailers transport the fruit from the field to the canneries.

Most of the Island pineapple pack is being consumed within the United States; only a small portion is exported. Hawaii now produces about 85 percent of the mainland consumption of canned pineapple products. The Island industry may expect more competition on the mainland, mainly from the Philippines, Cuba, Mexico, and Puerto Rico.

Connection Between Major and Diversified Agricultural Industries

Some of the 28 sugar and 14 pineapple plantations now operating in Hawaii engage in one or more diversified agricultural enterprises. Several sugar plantations hold large tracts which they use for beef cattle. Others operate dairies, and at least one raises swine.

Occasionally, plantations produce crops other than sugar and pineapples. For example, the Honokaa Sugar Company had in 1952 the second largest macadamia nut orchard in the Islands, with about 500 acres. Baldwin Packers, Ltd., a pineapple corporation, had in 1951 a mango orchard of about 80 acres, 50 acres of watermelons, and approximately 1,000 litchi trees. During World War II sugar and pineapple companies produced several thousand acres of vegetables and field crops. After the war all plantations except Baldwin Packers gave up the growing of these crops.

Some of the factors, the business agents of the sugar companies, engage directly in a few agricultural enterprises other than sugar and pineapple production. For example, Theo. H. Davies and Co., Ltd., operate a cattle ranch on the Hamakua slopes of Mauna Kea on Hawaii; Castle and Cooke, Ltd., have ventured into the growing of macadamia nuts.

The small farmers who contract to grow sugar cane or pineapples usually devote most of their cultivable acreage to these crops. Both products assure the growers of a comparatively safe though sometimes modest income per acre. However, some of these farmers also raise diversified products. In some areas they use the space between the rows

of recently planted or harvested cane to raise such vegetable crops as cucumbers or tomatoes.

Sugar and pineapple plantation workers grow vegetables in their backyards or in community gardens. They also keep some poultry and livestock. Most of this diversified production is for family subsistence and little reaches the market.

Sugar and several by-products of sugar and pineapple processing are of importance to diversified agriculture. Sugar is used in the canning of fruits and juices, in the preparation of jams, jellies, and fruit and nut candies.

Much of the livestock and poultry feed used in Hawaii has to be imported. Blackstrap molasses, a sugar by-product, is a valuable carbohydrate feed for beef and dairy cattle and hogs. Mixtures of low-grade sugar and the pith of bagasse, a by-product of sugar milling, show great promise as an emergency source of carbohydrates for poultry. Investigations are now being conducted to determine the practical limitations of this new feedstuff. Another potential livestock feed being tested is a mixture of molasses and bagasse pith. Efforts are now being made in a pilot plant at the Oahu Sugar Company to develop a process of separating the pith and fiber of bagasse economically on a large scale. The fiber may be used to manufacture paper products.

Some of the by-products of pineapple canning are highly valued by livestock producers, especially dairymen. The skin and core of pineapples, the so-called pineapple pulp, is sometimes fed to cattle unprocessed or as ensilage. More frequently, the pulp is dried before feeding.

Many subsidiary enterprises serve both the major and diversified agricultural industries. Among these are firms which import insecticides, fungicides, agricultural machinery, and packaging material. Iron works, can factories, and fertilizer mixing plants manufacture goods used in agricultural production. Finally there are the firms engaged in transportation, marketing, and the rendering of various services. The existence side by side of sugar, pineapple, and diversified agricultural industries in Hawaii provides a sufficiently large volume of business for these subsidiary enterprises to provide good service at reasonable cost.

Some agricultural research is equally useful to both major and diversified industries. Climatic and soil investigations are cases in point. A study of the utilization of agricultural wastes and by-products such as molasses or pineapple pulp has been valuable to both major and diversified agricultural industries. Practices developed in the major industries can frequently be applied or adapted to diversified agriculture or vice versa.

Training and experience given to workers in one sector of Hawaii's agriculture may frequently be useful in the development of other agri-

cultural industries. For example, mechanization in the sugar and pineapple fields began well before the outbreak of World War II. During and since the war, agricultural machinery has increasingly come into use in diversified agriculture. Experience with mechanical equipment in former plantation jobs now is useful to many newly established independent farmers.

Diversified Agriculture, 1900 to Present

The industries constituting the diversified agriculture of Hawaii have shown great divergence in their development since 1900. Among field crops, rice declined from more than 9,000 acres in the first decade of this century to a mere 160 crop acres in 1952. The competition of low-cost, mechanized rice growers in California has been the major reason for the decline of this Island industry. In 1952 only about 1 percent of the rice consumed in Hawaii was locally grown.

Field corn plantings rose from 3,200 acres in 1900 to about 10,000 acres in 1920, a year of high corn prices. The area planted to this crop rapidly declined after that and was down to 360 acres in 1952. Local growers now supply only a small fraction of Island requirements.

Taro patches decreased from 1,300 acres in 1900 to about 770 in 1930 because of plant diseases and the competition of cheaper starchy foods. At the beginning of 1953 the area in taro amounted to 840 acres. Potato plantings were enlarged to 1,600 acres as part of a drive for greater self-sufficiency during World War II; by 1952 they had declined to 120 acres.

Fresh vegetable growing has expanded with Hawaii's rapidly increasing population. The harvested area, excluding taro and potatoes, rose from about 1,200 acres in 1910 to 4,700 acres in 1952. About 35 percent of Hawaii's fresh vegetable market supplies for civilians was imported in the latter year.

The size of coffee plantings and production has fluctuated with the price. The area decreased from 14,000 acres in 1898 to 3,700 acres in 1910. During the 1920's it increased to about 6,000 acres, but subsequently declined to the 1952 level of 3,500 acres. Most of the crop is exported to the mainland.

Major tree fruit plantings expanded from 1,100 acres in 1910 to 2,000 acres in 1952. Banana and papaya orchards made up almost 80 percent of all fruit plantings in the latter year. Avocados and mangos accounted for most of the remainder. About 61 percent of the fresh fruit bought by Hawaii's civilian population was imported in 1952.

Two young agricultural industries, macadamia nuts and flowers, show great promise. Sizeable macadamia orchards were first planted commercially in 1922. As in any new industry, macadamia nut growers

had to overcome many production difficulties. During the last few years trees of good varieties have been highly profitable and the acreage is expanding rapidly. In February 1953 about 2,400 acres were planted to macadamia nuts.

Large-scale floricultural exports became possible with special air freight rates in the years since World War II. Vanda orchids, anthuriums, and tropical foliage are some of the major products of this industry. Between 1946 and 1951 the number of floral packages shipped annually to the mainland increased more than eightfold.

Many other crops have been tried in Hawaii since 1900. Most of them were abandoned as economically unsound. Among these were

Number of Horses, Mules, and Donkeys in Hawaii in 1920 and 1950

rubber and sisal, the producers of which could not compete with the cheap labor of the Orient and other areas. Tobacco was tried for many years but never became commercially successful. Other crops, such as cotton, cassava, and grapes, are grown only on a few acres.

Most livestock industries have been greatly expanded since 1900. Beef cattle increased from about 96,000 head in 1900 to 147,000 in 1952 as a result of better herd and pasture management and higher beef prices. The swine population increased from 8,000 head in 1900 to 32,000 in 1940 and to 84,000 early in 1953. Sheep decreased steadily in number from 102,000 in 1900 to 14,000 in 1952. Hawaii imported about one third of its fresh, chilled, and frozen civilian meat supplies other than poultry in 1952.

The raising of horses, mules, and donkeys expanded during the first two decades of this century. In 1920 there were almost 16,000 horses and 9,500 mules and donkeys on Hawaii's farms. With the coming of the tractor and automobile, the number of draft, pack, and riding animals sharply declined. By 1950 only 1,900 mules and donkeys were left. Horses are still being raised for use on cattle ranches; their number amounted to 7,600 in 1950.

Island milk production increased from about 2 million quarts in 1900

to 37 million in 1952. In spite of this expansion, fresh milk consumption in Hawaii is low compared with mainland standards. Practically all processed dairy products are being imported.

The total number of chickens more than three and four months old, respectively, rose from about 30,000 in 1900 to more than 470,000 in 1950. Island poultrymen produced 5.3 million dozen eggs and nearly 800,000 meat birds in 1952. Despite this increase in poultry flocks, 31 percent of the supplies of shell eggs and 55 percent of the poultry meat, excluding turkeys, consumed in Hawaii was imported in 1952.

Honey exports gradually expanded to reach an average annual export volume of 1.5 million pounds in the 1920's. Output declined after that because of bee diseases and low prices. Honey production in 1951 was about 900,000 pounds, most of which was exported to the mainland.

A few commercial rabbit producers are operating in the Islands. Other livestock and poultry raised during the last fifty years, such as goats, ducks, pigeons, geese, and turkeys, are not now of major commercial importance.

Significant 1952 Statistics

The 1952 wholesale value of agricultural marketings in Hawaii was estimated at about 278 million dollars. (See Table A4.) Of this total,

Number of Commercial Agricultural Enterprises in 1952

the value of products of the sugar and pineapple industries, including Sugar Act payments to sugar cane producers, accounted for 238.9 million dollars.

The output of diversified agriculture was estimated at 39.2 million dollars, or 14 percent of all agricultural production. Livestock products alone amounted to 25.8 million dollars. Cattle products accounted for 9.3 million dollars, milk for 7.3 million, poultry products for 5.1 million, and pork for 4.0 million. Marketings of sheep and bee products together were about \$130,000.

The wholesale value of diversified crops and flowers was estimated at 13.5 million dollars. Of this, fresh vegetables and taro accounted for 5.1 million dollars, flowers for 3.0 million, coffee for 3.9 million, fruits and macadamia nuts for 1.3 million. Rice and corn together were worth \$160,000.

About 5,200 full-time or part-time farmers operated in Hawaii in 1952. (See Table A5.) Approximately 3,600 of these were diversified farmers, flower growers, or ranchers, and the remainder raised sugar cane and pineapples. Of a total of 3,580 diversified crop and flower enterprises, vegetables, rice, and taro were raised on 1,800, coffee on 710, flowers on 630, and fruits and nuts, on 440. About 1,480 farms or ranches had commercial livestock enterprises. Hogs were raised on 590 farms and poultry on 380. There were 400 cattle ranches, 3 sheep ranches, 76 dairies, and 25 apiaries.

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part **TWO**

chapter 5 VEGETABLES

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

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

**Hawaii Exports of New Potatoes
in 1938 and 1941**

1938
4.9 MILLION LBS.

1941
1.3 MILLION LBS.

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.

Island Vegetable Output, 1941, 1944, and 1952

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

Oahu and Outer Island Vegetable
Production in 1951

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.

Number of Owner- and Renter-Operated Vegetable Farms in 1948

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.

**Net Income of Vegetable Farmers and
Plantation Workers in 1947**

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.

mainland 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,

Percentage of All Vegetable and Fruit
Farmers in East Oahu Owning Tractors
in 1941 and 1948

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

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 23 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-portable, 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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chapter 6 FRUITS AND NUTS

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 or-

Acreage of Fruits Other than Pineapple, 1930, 1940, and 1952

chards 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

* However, according to D. L. Crawford, "the area in producing vineyards has at no time reached 100 acres in the Territory."

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, 12 on Maui, 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 13 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.

Origin of Hawaii Market Supplies
of Fresh Fruit in 1952

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

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.

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-

tract 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

Uses of Macadamia Nuts in 1951

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

Macadamia Nut Acreage in Hawaii, 1943, 1946, and 1953

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. Unirrigated, 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,

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

Cost Per Acre of Eight-Year-Old Macadamia Nut Orchard

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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chapter 7 COFFEE, FLOWERS, AND MISCELLANEOUS CROPS

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.

Average Price of One Pound of Green Kona Coffee, 1932-41 and 1951-52

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 coffeegrowing 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 coffeegrowing 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 coffeegrower 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 coffeegrowers 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 Coffeegrowing 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 coffeegrower.

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 coffeegrowers 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 coffeegrowers 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

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 com-

Number of Parcels of Hawaiian Floral Products Shipped to U. S. Mainland,
1946, 1950, and 1952

modity 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 *lei*s 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, statice, 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, cyripediums, 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 *bapuu*, 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, monstera, 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 weed-

ing 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

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

* 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

Hawaii Rice Acreage in 1909 and 1952

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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chapter 8 LIVESTOCK, POULTRY, AND BEES

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 F1.)

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 mainlanders 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.

Annual Lease Cost Per Acre of Public
Pasture Land in Hawaii Carrying 1 Head
Per 5 Acres, 1940, 1948, and 1951

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 1951

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 1948.

A major reason for the slow increase in the average cost of rentals for 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 on 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

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.

Annual Lease Cost Per Acre of Public
Pasture Land in Hawaii Carrying 1 Head
Per 5 Acres, 1940, 1948, and 1951

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 even 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 1951,

Chicago prices spurted upwards much faster than Honolulu prices. Price ceilings held Honolulu prices of dressed Island steers at about 52 cents per pound up to the fall of 1952. That was from 3 to 4 cents below Chicago prices for "choice" beef.

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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.)

Distribution of Operating Costs of a Hypothetical Ranch in Hawaii

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, where-ever 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 homesteaders 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

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

* Scientific names for grasses: *Paspalum* grass, *Paspalum dilatatum*; Guinea grass, *Panicum maximum*; rye grass, *Lolium perenne*; cocksfoot, *Dactylis glomerata*; Kikuyu, *Pennisetum clandestinum*; molasses grass, *Melinis minutiflora*; Rhodes grass, *Chloris gayana*; Pangola grass, *Digitaria decumbens*. Scientific names for legumes: Kaimi clover, *Desmodium canum*; Spanish clover, *Desmodium uncinatum*; white clover, *Trifolium repens*; black medic clover, *Medicago lupulina*; bird's-foot trefoil, *Lotus corniculata*; pigeon pea, *Cajanus cajan*; alfalfa, *Medicago sativa*.

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

* 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.

Per Capita Consumption of Fresh Milk
and Cream in Hawaii and on the
U. S. Mainland in 1952

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 production 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 farmers 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

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

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,

* 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 (5.1 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, *Ixophorus 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.

**Per Capita Consumption of Chicken in
Hawaii and on the U. S. Mainland in 1952**

HAWAII
14 LBS.

U.S. MAINLAND
30 LBS.

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

* 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

* 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

Origin of Eggs Marketed in Honolulu
in 1952

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.

Honey Yield Per Colony in Hawaii and on the U. S. Mainland, 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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chapter 9 SUMMARY

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!

appendix

GENERAL TABLES

Table A1.—Land Utilization in Hawaii, by Islands and for the Territory, 1951.

Item	Territory		Hawaii		Maui and Kahoolawe		Lanai and Molokai		Oahu		Kauai and Niihau	
	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent	Acres	Per-cent
Agricultural land	1,706,000	41.6	1,100,000	42.7	204,000	41.3	125,000	48.7	90,000	23.9	187,000	46.9
Forest reserve	1,210,155	29.5	716,250	27.8	160,055	32.4	52,805	20.6	120,425	31.9	160,620	40.3
Army, Navy, and Air Force land	58,367	1.4	727	(a)	1,341	0.3	24	(a)	54,195	14.4	2,080	0.5
National parks	213,409 ^b	5.2	196,273 ^b	7.6	17,130	3.5	0		0		0	
Other land ^c	911,915	22.2	560,190	21.8	111,554 ^d	22.6	78,811	30.7	112,340	29.8	49,020	12.3
Total land area	4,099,840	100.0	2,573,440	100.0	494,080	100.0	256,640	100.0	376,960	100.0	398,720	100.0

a. Less than 0.1 percent.

b. Of this total 48,652 acres were authorized by Congress but have not yet been officially turned over by the Territory to the national parks.

c. Cities, towns, campsites, roads, wasteland, and land not otherwise specified.

d. Includes the whole area of Kahoolawe of 28,800 acres.

Sources: Ref. 24,* pp. 8, 9, for agricultural land, forest reserve, total land area; Surveyor of the Territory for land used by Army, Navy, Air Force, and national parks.

*Reference numbers refer to Appendix G.

Table A2.—Utilization of Agricultural Land in Hawaii, by Islands and for the Territory, 1951.

Item	Territory		Hawaii		Maui		Molokai and Lanai		Oahu		Kauai and Niihau	
	Acres	Per- cent ^a	Acres	Per- cent ^a	Acres	Per- cent ^a	Acres	Per- cent ^a	Acres	Per- cent ^a	Acres	Per- cent ^a
Plantation crops												
Sugar cane	221,215	13.0	101,380	9.2	38,925	19.1	0		35,230	39.2	45,680	24.4
Pineapples ^c	72,600	4.3	400	0	12,600	6.2			21,800	24.2	6,700	3.6
Total plantation crops ^d	294,810	17.3	101,780	9.2	51,520	25.3	32,100	25.7	57,030	63.4	52,380	28.0
Diversified crops ^e												
Coffee	3,500		3,500		0		0		0		0	
Corn, field ^g	625		312		218		80		0		15	
Fruits, tree ^h	1,932		294		228		92		1,292		26	
Nuts, macadamia ^h	2,197		1,476		276		2		180		263	
Rice ^g	166		0		0		0		0		166	
Taro ^g	871		153		95		50		411		162	
Vegetables ^g	4,703		1,323		1,484		56		1,595		245	
Total diversified crops ^e	14,000	0.8	7,060	0.6	2,300	1.1	280	0.2	3,480	3.9	880	0.5
Total land in crops ^d	308,810	18.1	108,840	9.9	53,820	26.4	32,380	25.8	60,510	67.2	53,260	28.5
Pasture land ^d	1,397,000	81.9	991,000	90.1	1,500,000	73.5	93,000	74.4	29,000	32.3	134,000	71.5
Total agricultural land ^d	1,706,000	100.0	1,100,000	100.0	2,040,000	100.0	125,000	100.0	90,000	100.0	187,000	100.0

a. Percentage of total agricultural land.

b. Acreage at end of 1951, rounded.

c. Acreage at end of 1951, including fallow land, campsites, and roads, rounded.

d. Figures rounded.

e. Commercial acreage only; acreage of flowers and a few unimportant crops such as cotton and grapes not included.

f. Average acreage during 1951.

g. Plantings for 1951 harvest.

h. Acreage at end of 1951.

Sources: Ref. 24, pp. 8, 9; ref. 15, December 1951, for mango acreage, included in tree fruit acreage.

Table A3.—Approximate Tenure and Utilization of Agricultural Lands in the Territory of Hawaii, December 31, 1945.

Tenure and utilization	Acres
Public agricultural lands:	
Crop land leases	
Sugar cane	34,390
Pineapple	3,200
Other	2,500
Total public crop land leases	40,090
Pasture leases	510,780
Total public agricultural leases	550,870
Private agricultural lands:	
Crop land	
Sugar cane	
Owned by plantations	130,250
Leased from others	71,715
Total sugar cane	201,965
Pineapple	
Owned by plantations	21,060
Leased from others	40,140
Total pineapple	61,200
Other	25,000
Total private crop land	288,165
Pasture land	
Owned by ranchers	671,240
Leased from others	168,970
Total private pasture land	840,210
Total private agricultural lands	1,128,375
Total agricultural land in Territory	1,679,245

Source: Ref. 41, p. 745.

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Table A4.—Wholesale Value and Volume of Agricultural Products
Produced Commercially in the Territory of Hawaii, 1952.^a

Item	Unit	Volume	Value
			1,000 dollars
Sugar, raw	tons	1,020,450	138,860 ^b
Molasses	tons	250,000	
Pineapples: ^c canned fruit	1,000 cases	13,905	100,000 ^d
canned juice	1,000 cases	9,650	
Total plantation crops			238,860
Fruits, fresh (except pineapples)	1,000 pounds	15,700	1,125
Vegetables, fresh	1,000 pounds	47,080	4,582
Taro (for manufacture)	1,000 pounds	12,180	542
Coffee, green ^e	1,000 pounds	7,700	3,900
Corn, field: shelled	1,000 pounds	380	22
Macademia nuts, unshelled	1,000 pounds	965	165
Rice, milled	1,000 pounds	845	136
Flowers			3,000
Total diversified crops			13,472
Beef cattle	head	34,200	8,662
Dairy products: cows and calves	head	2,620	655
milk	1,000 quarts	37,442	7,301
Sheep products: mutton	head	2,460	40
wool	1,000 pounds	55	35
Swine	head	66,900	3,951
Poultry products: eggs	1,000 dozens	4,753	3,722
meathirds	number	793,000	1,345
Bee products: honey, extracted	1,000 pounds	584	56
beeswax	1,000 pounds	7	3
Total livestock, poultry and bee products			25,770
Total livestock and diversified crops			39,242
Total Agricultural Marketings			278,102

a. All data are for calendar year 1952, unless otherwise indicated. Value is wholesale value on island of origin. By wholesale value is meant value when sold to Island retailers or value fob ship in Hawaiian ports, if if exported.

b. Approximate value of raw sugar, molasses, and Sugar Act Conditional Payments to Hawaiian sugar cane producers.

c. Pineapple data for fiscal year ended May 31, 1952.

d. Approximate value of total pack.

e. Estimates for crop year ended June 30, 1952.

Sources: Hawaiian Sugar Planters' Association for sugar industry data; Pineapple Research Institute of Hawaii for pineapple industry data; Edward L. Rada for estimate of value of flowers; ref. 25, pp. 8, 9, 35, 37, 38, 41, for other data.

Table A5.—Number of Commercial Agricultural Enterprises and Number of Farms, by Islands and for the Territory of Hawaii, 1952.

Enterprise	Territory	Hawaii	MauI	Molokai and Lanai	Oahu	Kauai and Niihau
Beef cattle ^a	405	226	90	21	20	48
Sheep ^a	3	2	0	0	0	1
Dairy ^b	76	20	6	2	44	4
Hogs ^b	588	96	71	37	344	40
Poultry ^b	378	132	33	5	184	24
Bees ^a	25	3	12	3	5	2
Total livestock	1,475	479	212	68	597	119
Taro	280	92	87	11	33	57
Other vegetables	1,465	308	360	48	659	90
Fruits	343	104	81	8	144	6
Coffee	706	705	1	0	0	0
Macadamia nuts	99	63	9	3	4	20
Rice	53	0	0	0	0	53
Flowers	632	334	45	0	240	13
Total diversified crops ^a	3,578	1,606	583	70	1,080	239
Total commercial diversified enterprises ^c	5,053	2,085	795	138	1,677	358
Total diversified farms ^d	3,642	1,396	583	83	1,325	255
Sugar						
Plantations	28	13	3	0	4	8
Small planters	1,501	1,489	0	0	0	12
Pineapple						
Plantations	15	1	3	4	3	4
Small growers	111	0	74	0	1	36
Total sugar and pineapple ^a	1,655	1,503	80	4	8	60
Total commercial enterprises ^c	6,708	3,588	875	142	1,685	418
Total farms ^d	5,249	2,883	638	87	1,333	308

a. December 31, 1952.

b. August 31, 1952.

c. Some farms have more than one enterprise.

d. In this estimate, each farm is listed only once regardless of number of enterprises.

Sources: U.S. Dept. of Agr., Production and Marketing Administration, for number of sugar growers; Pineapple Research Institute of Hawaii for number of pineapple growers; ref. 25, pp. 4, 7, for all other enterprises.

Table A6.—Population of the Hawaiian Islands for Specified Years, 1778-1952.

Year	Population	Year	Population	Year	Population
1778 ^a	300,000	1872	56,897	1910 ^b	191,909
1832	130,313	1878	57,985	1920 ^b	255,912
1836	108,579	1884	80,578	1930 ^b	368,336
1853	73,138	1890	89,990	1940 ^b	423,330
1860	69,800	1896	109,020	1948 ^c	491,146
1866	62,959	1900 ^b	154,001	1952 ^c	465,325

a. Estimates for 1778 range from 250,000 to 400,000 people.

b. Figures include Army and Navy personnel stationed in Hawaii.

c. Civilian population only.

Sources: Ref. 1 for 1778; ref. 9, for 1832-96; ref. 26, p. ccxvii, for 1900; ref. 27, p. 571, for 1910; ref. 28, p. 373, for 1920; ref. 29, p. 44, for 1930; ref. 32, p. 1210, for 1940; ref. 10 for 1948, 1952.

Table A7.—Population of the Hawaiian Islands, by Racial Antecedents, 1900, 1910, 1940, and 1950.

Race	1900 ^a	1910 ^a	1940 ^a	1950 ^a
	<u>Number of persons</u>			
Hawaiian	29,799	26,041	14,375	12,206
Part Hawaiian	7,857	12,506	49,935	73,885
Puerto Rican	(b)	4,890	(c)	9,551
Caucasian	28,819	39,158	103,791	114,793
Chinese	25,767	21,674	28,774	32,376
Japanese	61,111	79,675	157,905	184,611
Korean	(c)	4,533	(c)	7,030
Filipino	(c)	2,361	52,569	61,071
All others	648	1,071	15,981	4,271
Total	154,001	191,909	423,330	499,794

a. Figures include Army and Navy personnel whose posts of duty were in the Hawaiian Islands.

b. Puerto Ricans included under Caucasians.

c. Included under "all others."

Sources: Ref. 26, p. ccxvii, for 1900; ref. 27, p. 571, for 1910; U. S. Census for 1940 and 1950.

Table A8.—Population of the Hawaiian Islands in 1900, 1930, and 1952, and Population Density in 1952, by Islands and for the Territory.

Island	1900	1930	1952	Land area	Number of persons per square mile, 1952
	<u>Number of persons</u>			<u>Square miles</u>	
Oahu	58,504	202,887	325,797	589	553.1
Hawaii	46,843	73,325	64,004	4,021	15.9
Mau	25,416 ^a	48,756	38,170	728	52.4
Kauai	20,562	35,806	29,081	551	52.8
Molokai	2,504	5,032	5,219	259	20.2
Lanai	(a)	2,356	2,847	141	20.2
Miihau	172	136	207	72	2.9
Total	154,001	368,300 ^b	465,325	6,406 ^c	72.6

a. Census of 1900 gives only one figure for combined populations of Maui and Lanai. Census for 1910 shows a population of 131 on Lanai.

b. Includes two inhabitants on Kahoolawe, but excludes 36 inhabitants on Midway.

c. Includes 45 square miles for uninhabited island of Kahoolawe.

Sources: Ref. 26, p. ccxvii, for population in 1900; ref. 29, p. 44, for population in 1930; ref. 10 for population in 1952; ref. 31, p. 330, for land areas.

appendix **B** VEGETABLE TABLES

Table H1.—Production and Imports of Important Fresh and Processed Vegetables, Territory of Hawaii, 1951.^a

Commodity	Territorial production ^b	Imports ^c		
		Fresh	Frozen	Canned ^d
		1,000 pounds		
Artichokes	(e)	65	0	
Asparagus	(e)	34	16	800
Beans, green lima	(e)	0	94	181
Beans, snap	1,820	0	98	548
Beets	110	1	0	
Broccoli	220	212	80	
Cabbage, head	8,700	309	0	
Cabbage, oriental	3,090	46	0	
Carrots	1,395	2,489	3	
Cauliflower	250	398	29	
Celery	365	2,797	0	
Corn, green	890	0	81	1,409
Cucumbers	3,855	10		
Daikon	4,280	0	0	
Garlic	0	220	0	
Lettuce	3,355	1,825	5	
Melons other than watermelons	(e)	1,400	0	
Onions, dry	595	7,195	0	
Peas, green	(e)	10	237	2,329
Peppers, sweet	505	441	0	
Potatoes	630	20,376	15	
Pumpkins	445	4	0	
Spinach	(e)	42	82	135
Squash, various	405	186	12	
Sweetpotatoes	1,000	516	0	
Taro	11,830	0	0	
Tomatoes	5,090	2,118	0	1,002
Tomato juice and paste	0	0	0	3,343
Watermelons	4,240	1,378	0	
Misc. vegetables and vegetable juices	4,550	298	191	2,714
Total	57,620	42,370	943	12,461

a. Direct imports by the armed forces are not included. Some produce produced locally or imported through civilian channels and sold to the armed forces by Honolulu wholesalers are included.

b. Production for export not included.

c. All imports were from the mainland United States except for 47,000 pounds of ginger root and 6,000 pounds of miscellaneous vegetables from foreign countries. Small imports of canned vegetables from foreign sources are not included.

d. Import data are for year 1947. Data for 1951 not available but imports were probably not much different from those in 1947.

e. Data not available; production small.

Sources: Ref. 24, pp. 29, 30, for territorial production; ref. 18, pp. 5, 6, 9, 10, for fresh and frozen imports; ref. 34, p. 5, for canned mainland imports.

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Table B2.—Production for Market of Important Vegetables,
Territory of Hawaii. Quantity for Selected Years 1937-51, Value for 1951.

Commodity	Quantity					Value 1951
	July 1936 to June 1937	1941 ^a	1944	1947	1951	
		1,000 pounds				1,000 dollars
Asparagus	110	80	55	(b)	(b)	(b)
Beans, snap	1,558	2,041	3,512	2,275	1,820	299
Beets	18 ^c	334	611	195	110	6
Broccoli	123	270	374	275	220	45
Burdock	411	460	273	545	745	156
Cabbage, head	9,047	11,195	9,584	9,165	8,700	319
Cabbage, oriental	1,967	2,734	2,915	2,665	3,090	371
Carrots	500 ^d	1,823	3,555	2,520	1,395	75
Cauliflower	(b)	(b)	481	530	250	38
Celery	(b)	(b)	2,323	900	365	38
Corn, green	379	1,224	3,593	1,290	890	68
Cucumbers	1,354	2,278	3,934	3,125	3,855	466
Daikon	(b)	(2,000)	2,971	3,080	4,280	229
Dasheens	(b)	(340)	293	565	400	74
Eggplant	1,043	1,137	1,149	705	675	81
Ginger root	(b)	(380)	277	870	390	195
Lettuce	387 ^e	1,083	4,885	2,785	3,355	420
Lotus root	237	631	323	385	405	103
Onions, dry	243	211	768	560	595	43
Onions, green	(b)	(500)	1,536	890	520	83
Peas, all types	(b)	(75)	183	100	(b)	(b)
Peppers, sweet	102	332	512	470	505	131
Potatoes	11,274	6,787	7,831	440	630	28
Pumpkins	784	256	525	425	445	34
Squash, summer and Italian	87	(70)	822	265	225	36
Squash, misc.	(b)	(145)	399	350	180	15
Sweetpotatoes	1,268	2,349	2,000	1,855	1,000	70
Taro	11,631	18,126	15,435	12,615	11,830	687
Tomatoes	3,485	5,172	11,020	4,950	5,090	702
Watercress	(b)	(1,005)	1,696	1,400	1,405	138
Watermelons	2,059	2,598	2,339	4,195	4,240	355
Yam bean root	(b)	(100)	190	240	185	25
Other vegetables	(b)	500	856	90	(b)	(b)
Total	55,000 ^f	66,236	87,225	60,720	57,795	5,330

a. Numbers in parentheses are approximations.

b. Data not available.

c. In addition, 193,000 bunches were produced.

d. In addition, 714,000 bunches were produced.

e. Number of 1,000 heads of "Iceberg" type lettuce.

f. Total estimated by author.

Sources: Ref. 13, p. 41, for fiscal year 1936-37; ref. 41, p. 689, for 1941;
ref. 19, pp. 8, 9, for 1944; ref. 22, pp. 27, 28, for 1947; ref.
24, pp. 29, 30, for 1951.

Table B3.—Unloads of Specified Fresh Vegetables at Honolulu from the Mainland United States, 1939, 1941, 1944, 1947, and 1951.

Commodity	1939 ^a	1941 ^a	1944 ^b	1947 ^c	1951 ^c
	1,000 pounds				
Artichokes	57	41	-	112	65
Asparagus	61	67	-	65	34
Beets	16	137	-	15	1
Broccoli	31	100	-	123	212
Brussels sprouts	87	73	-	23	11
Cabbage, head	147	1,383	-	696	309
Carrots	954	2,641	1,508	1,858	2,489
Cauliflower	709	1,175	131	666	398
Celery	1,722	3,354	419	2,887	2,797
Cucumbers	60	203	-	149	10
Garlic	115	156	199	162	216
Lettuce	1,495	3,820	-	2,603	1,825
Melons:					
Cantaloups	354	676	-	984	815
Watermelons	17	25	-	1,138	1,378
Other	482	995	242	802	585
Onions, dry	7,021	6,556	4,315	6,789	7,195
Parsnips	66	216	-	27	(d)
Peas, green	106	96	-	27	10
Peppers, sweet	170	462	-	565	441
Potatoes	20,119	33,088	15,315	15,164	20,376
Pumpkins	2	15	-	11	4
Rhubarb	47	79	-	5	3
Spinach	20	28	-	15	42
Squash, various	286	828	-	212	186
Sweetpotatoes	219	1,005	-	471	516
Tomatoes	1,207	3,055	-	2,914	2,118
Turnips	191	654	-	85	57
Total	35,761	60,928	22,129	38,568	42,093

a. Including large quantities for the armed forces.

b. Including very small quantities for the armed forces. Data not available where dash is used, but unloads, if any, were negligible.

c. Including some quantities for the armed forces (quantities imported by wholesalers and resold to the services).

d. Data not available.

Sources: Ref. 40, pp. 61, 62, data for 1939-47; ref. 18, pp. 6, 9, for 1951.

Table B4.—Fresh Vegetable Market Supplies, Territory of Hawaii, 1951. (Grouped according to percentage which was Island-grown.)

Commodity	Imports	Territorial production	Total market supplies
<u>1,000 pounds</u>			
Less than 10 percent Island-grown:			
Staple vegetables:			
Onions, dry	7,195	595	7,790
Potatoes	20,376	630	21,006
Garlic	218	0	218
Total staples	27,789	1,225	29,014
Truck crops:			
Artichokes	65	(a)	65
Asparagus	34	(a)	34
Brussels sprouts	11	(a)	11
Melons other than watermelons	1,400	(a)	1,400
Spinach	42	(a)	42
Total truck crops	1,552		1,552
Total less than 10 percent Island-grown	29,341	1,225	30,566
From 10 to 90 percent Island-grown:			
Broccoli	212	220	432
Carrots	2,489	1,395	3,884
Cauliflower	398	250	648
Celery	2,797	365	3,162
Ginger root	47	390	437
Lettuce	1,825	3,555	5,380
Peppers, sweet	441	505	946
Squash, various	186	405	591
Sweetpotatoes	516	1,000	1,516
Tomatoes	2,118	5,090	7,208
Watermelons	1,378	4,240	5,618
Total 10 to 90 percent Island-grown	12,407	17,415	29,822

Commodity	Imports	Territorial production	Total market supplies
<u>1,000 pounds</u>			
More than 90 percent Island-grown:			
Western vegetables:			
Beans, snap	0	1,820	1,820
Beets	1	110	111
Cabbage, head	309	8,700	9,009
Cabbage, oriental	46	3,090	3,136
Corn, green	0	890	890
Cucumbers	10	3,855	3,865
Eggplant	0	675	675
Onions, green	25	520	545
Pumpkins	4	445	449
Total Western vegetables	395	20,105	20,500
Oriental and Hawaiian vegetables:			
Burdock	0	745	745
Daikon	0	4,280	4,280
Dasheens	0	400	400
Lotus root	0	405	405
Taro	0	11,830	11,830
Watercress	0	1,405	1,405
Yam bean root	0	185	185
Total Oriental and Hawaiian vegetables	0	19,250	19,250
Total more than 90 percent Island-grown	395	39,355	39,750
Grand total	42,143	57,995	100,138

a. Data not available; territorial production negligible.

Sources: Summarized from Tables B1 and B2.

Table B5.--Average Honolulu Wholesale Prices of Island-Grown Vegetables and Fruits for the Period 1938 to 1941, and the Years 1943, 1945, 1947, and 1951.^a

Commodity	Average 1938-1941	1943	1945	1947	1951
	Cents per pound				
Fruits					
Avocados	4.8	12.5	13.0	12.9	12.8
Bananas	2.5	5.5	6.0	7.4	8.1
Mangos, cultivated	(b)	(b)	23.0	23.0	(b)
Oranges	4.0	(b)	5.0 ^d	5.0 ^d	5.0 ^d
Papayas	2.7	3.4	4.0	6.3	5.6
Tangerines	(b)	(b)	15.0	14.8	13.5 ^d
Vegetables					
Beans, snap	7.3	11.1	13.0	17.1	17.8
Beets	2.4	5.0	5.5	4.8	5.5
Broccoli	9.0	12.0	16.0	16.4	21.7
Burdock	5.3	15.0	18.0	35.2	21.0 ^d
Cabbage, head	2.1	4.5	5.0	6.0	5.2
Cabbage, oriental	4.2	7.0	6.0	10.0	13.1
Carrots, topped	2.8	4.2	7.5	7.3	7.5
Cauliflower	8.1	(b)	16.0	14.5	15.0 ^e
Celery	5.3	19.6	16.0	13.0	12.5
Corn, green	2.5	5.7	7.5	7.9	8.1
Cucumbers	6.4	11.0	11.0	15.5	14.2
Daikon	1.4	4.0	3.8	5.3	6.2
Dasheens	4.7	6.0	6.0	14.8	22.1
Eggplant, long	4.4	7.0	6.0	9.4	12.4 ^e
Eggplant, round	3.0	5.0	5.0	6.2	
Ginger root	8.0	8.0	15.0	21.6	50.0 ^d
Lettuce	5.4	15.1	15.0	11.9	13.6
Lotus root	6.4	(b)	14.0	29.6	25.5
Onions, dry	2.5	7.0	7.0	6.4	7.3 ^e
Onions, green	(b)	(b)	11.0	14.0	16.2
Peas, Chinese	33.6	(b)	50.0	50.0	73.6
Peppers, sweet	11.2	17.0	17.0	26.6	27.1
Potatoes	2.6	4.0	5.0	5.0 ^e	4.5 ^d
Pumpkins	3.0	5.0	5.0	6.5	9.0
Rhubarb	4.0	10.0	8.0 ^d	8.0 ^d	(b)
Squash, summer and Italian	6.4	10.0	10.0	15.0	16.0 ^d
Squash, misc.	(b)	5.0	5.0	6.4	8.0
Sweetpotatoes	1.7	4.2	6.0	6.0	8.0
Taro (for manufacture)	2.2	3.8	3.6	6.3	5.7
Tomatoes	5.4	10.0	12.0	12.0	16.2
Watercress	(b)	(b)	8.0	12.5	10.0
Watermelons	7.0	10.0	8.0	18.1	9.4
Yam bean root	(b)	5.0	7.0	11.9	14.4

a. Prices are those charged retailers by wholesalers and producers. Annual prices are unweighted averages of monthly prices which are weighted for percentage of various qualities marketed. When Honolulu prices were not available, prices on outside islands were quoted as indicated. Previous stock was field run; present practice is to grade.

b. Data not available.

c. Price on island of Maui.

d. Price on island of Hawaii.

e. Average price for long and round eggplant.

Sources: Unpublished material in Hawaii Agr. Ext. Serv. files for average 1938-41 prices of burdock, cauliflower, daikon, dasheens, ginger root, lotus root, dry onions, peas, rhubarb, squash, and watermelons; ref. 12, pp. 133-138, for all other average 1938-41 prices; ref. 40, pp. 71, 72, for 1943 prices; ref. 12, pp. 133-138, for 1943 taro prices; ref. 19, pp. 13, 14, for 1945 prices; ref. 40, pp. 71, 72, for 1945, for prices of tangerines, dry onions, and summer and Italian squash; ref. 21, pp. 23, 24, for 1947 prices; ref. 18, pp. 54, 55, and ref. 24, pp. 27, 28, for 1951 prices.

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Table B6.—Acreage of Important Vegetable Crops, Territory of Hawaii, Selected Years 1909-51.

Commodity	Acreage harvested for market during year							
	1909 ^a	1919 ^a	1929 ^a	1939 ^a	1941 ^b	1944	1947	1951
	Acres							
Asparagus	-	-	-	72	93	54	(c)	(c)
Beans, snap	-	-	139	301	407	700	300	237
Beets	-	-	-	48	42	66	16	12
Broccoli	-	-	-	74	90	95	64	49
Burdock	-	-	-	34	23	12	47	51
Cabbage, head	-	-	594	553	1,400	904	736	612
Cabbage, oriental	-	-	-	285	273	254	286	361
Carrots	-	-	93	149	228	463	227	159
Cauliflower	-	-	-	-	(c)	87	76	31
Celery	-	-	-	-	(c)	57	22	14
Corn, green	-	-	-	129	308	822	329	224
Cucumbers	-	-	94	158	285	545	431	384
Daikon	-	-	-	-	(150)	188	223	310
Dasheens	-	-	-	-	(25)	17	62	36
Eggplant	-	-	53	91	114	68	56	51
Ginger root	-	-	-	-	(12)	10	29	14
Lettuce	-	-	-	121	110	653	313	342
Lotus root	-	-	18	32	62	40	43	61
Onions, dry	-	-	89	26	21	105	72	78
Onions, green	-	-	-	-	(35)	82	62	46
Peas, all types	-	-	-	-	(25)	70	40	(c)
Peppers, sweet	-	-	26	19	66	91	76	71
Potatoes	353	405	214	487	680	1,289	73	135
Pumpkins	-	-	-	45	25	72	53	45
Squash, summer and Italian	-	-	86	26	21	81	24	18
Squash, misc.	-	-	-	-	(18)	23	36	15
Sweetpotatoes	270	232	336	180	155	294	319	139
Taro ^d	-	-	772	622	920	910	930	871
Tomatoes	-	-	309	449	531	1,243	486	519
Watercress	-	-	-	-	25	26	26	27
Watermelons	-	-	520	204	325	285	703	652
Yam bean root	-	-	-	-	10	10	18	10
Misc. vegetables	1,913	1,718	232	323	51	101	6	(c)
Total	2,536	2,355	3,578	4,428	6,530	9,717	6,184	5,574

a. Dash indicates data not available.

b. Numbers in parentheses are approximations.

c. Commercially unimportant acreage.

d. Acreage in 1941 and later years is average acreage planted during the year.

Sources: Ref. 27, pp. 599, 600, for 1909; ref. 28, p. 379, for 1919; ref. 29, pp. 11, 12, for 1929; ref. 30, pp. 30, 31, for 1939; ref. 41, p. 689, for 1941; ref. 20, pp. 15, 16, for 1944; ref. 22, pp. 27-30, for 1947; ref. 24, pp. 29, 30, for 1951.

Table B7.—Exports of Fresh Vegetables and Tree Fruits from Hawaii to the Mainland United States, Selected Years 1909-51.^a

Commodity	1909	1918	1929	1931	1940	1947	1951
	<u>1,000 pounds</u>						
Vegetables	8 ^f	89	840	399 ^b	2,815 ^c	230 ^d	174
Fruits ^e	5,500	6,680	11,000	6,997	7,024	0	313

a. Exports to foreign countries were negligible.

b. Commodity breakdown as follows (1,000 pounds): Dasheens, 68; ginger root, 63; and lotus root, 268.

c. Commodity breakdown as follows (1,000 pounds): Asparagus, 22; swamp cabbage, 11; green corn, 15; cucumbers, 5; dasheens, 55; ginger root, 75; lotus root, 357; Irish potatoes, 2,260; yam bean root, 2; yams, 3; and miscellaneous vegetables, 1.

d. Commodity breakdown as follows (1,000 pounds): Dasheens, 51; ginger root, 92; lotus root, 47; and miscellaneous vegetables, 40.

e. Bananas were the only tree fruit exported in volume from 1909 through 1931. In 1940, 206,000 pounds of papayas and 6,818,000 pounds of bananas were exported. In 1951, only 313,000 pounds of papayas were exported. Original data for bananas in bunches converted to pounds at 55 pounds a bunch.

f. Export value in 1,000 dollars; volume not available.

Sources: Ref. 38, p. 673, for vegetables 1909; ref. 4, p. 53, for fruits 1909; ref. 36, December 1919, p. 86, for vegetables 1918; ref. 2 for fruits 1918; ref. 36, December 1929, p. 114, for vegetables 1929; ref. 11, p. 96, for fruits 1929; ref. 7, table I, for 1931; ref. 8, table I, for 1940; ref. 16, p. 45, for 1947; ref. 18, p. 53, for 1951.

Table B8.—Number of Family-Sized Vegetable and Fruit Farms, Their Land Ownership Pattern, and Number Owning Tractors, Territory of Hawaii, by Islands and for the Territory, December 31, 1948.

Island	Part-time	Full-time	All	Owned by operator	Leased by operator	Owning tractor
	<u>Number</u>					
Hawaii	90	303	393	301	92	106
Maui	120	208	328	158	170	120
Molokai	39	23	62	7	55	4
Oahu	127	694	821	94	727	392
Kauai	76	104	180	74	106	64
Territory	452	1,332	1,784	634	1,150	686

Sources: Survey made by county agents of the Hawaii Agr. Ext. Serv. in cooperation with the author.

Table B9.—Number and Crop Acreage of Family-Sized and Large Vegetable and Fruit Farms, Territory of Hawaii, by Islands and for the Territory, December 31, 1948.

Island	Family-sized farms				Large farms				All farms	
	Number	Crop land			Number	Crop land			Number	Total crop land
		Total	Per farm			Total	Per farm			
			Average	Range			Average	Range		
		Acres				Acres				Acres
Hawaii	393	2,421	6.2	0.1-80.0	5	105	22	3- 30	398	2,524
Mau <i>i</i>	328	2,885	8.8	0.3-50.0	3	280	93	50-195	331	3,165
Molokai	62	237	3.8	1.0-15.0	1	95	-	-	63	332
O <i>h</i> eu	821	4,230	5.2	0.2-40.0	10	480	48	5-150	831	4,710
Kauai	180	397	2.2	0.5-20.0	-	-	-	-	180	397
Territory	1,784	10,170	5.7	0.1-80.0	19	960	50	3-195	1,803	11,130

Source: Survey made by county agents of the Hawaii Agr. Ext. Serv. in cooperation with the author.

appendix C STUDY OF VEGETABLE AND FRUIT FARMS

This appendix presents a detailed discussion of economic conditions on a sample of 36 Hawaii fruit and vegetable farms in 1947. From among the growers who had farm ownership loans with Farmers Home Administration in 1947 were selected those who derived more than 50 percent of their total family income from their farms and who had kept apparently reliable and complete records. The sample included about 2 percent of all vegetable and fruit growers in the territory.

REPRESENTATIVENESS OF THE SAMPLE

Since this sample was not selected by any formal sampling procedure, how representative it is of Hawaii's full-time farms should be explained. Many vegetable-growing districts with widely different characteristics were represented. Farms in three

upland districts were included: nine at Volcano-Glenwood and one at Kamuela on Hawaii, and four at Olinda on Maui. The other farms were located at lower elevations: four at Mountain View, three at Kona, and one each at Naalehu, Pahoa, and northern Hamakua on Hawaii; two at Omaopio and one at Haiku on Maui; six at Kaneohe and Kahaluu on Oahu; and three in Wailua Homesteads on Kauai. The principal vegetable-growing areas not adequately represented in the sample were those on the leeward sides of the Islands.

Because of the paucity of available records, some of the districts and islands were not weighted in the sample in accordance with the distribution of all vegetable and fruit farms in the territory. For example, while the proportion of Maui and Kauai farms in the sample was approximately the same as in the total territorial farm population, the percentage of Hawaii farms was too large, and that of Oahu farms too small.

An effort was made to evaluate the representativeness of the sample with regard to farm quality. FHA supervisors graded soil fertility and depth, topography, climate, and market distance of all sampled enterprises. The farms in the different districts varied greatly, as is shown in Table 01.

In the upland districts: The Volcano-Glenwood growers had the disadvantage of shallow soil and poor climate. The Olinda growers had good land resources, but a short growing season for high-value crops. The Kamuela growers had deep, fertile soil, level land, and good climate.

At lower elevations: The Mountain View growers had land of less than average quality, and a wet climate. The Kona growers had shallow soil, but the climate made vegetable raising possible during periods of high prices. The grower at Pahoa had shallow soil, the one at Hamakua had a wet winter, and the one in Naalehu was remote from the nearest shipping point; otherwise the farm resources of these three growers were about average. The growers at Omaopio had a better than average soil and climate but they were short of irrigation water. The Haiku grower had fair land, but a wet climate. Oahu and Kauai growers had better than average land and climate for vegetable production. In addition, Oahu growers were favored by their proximity to the Honolulu market.

On the whole, the soil depth on the majority of sample farms was below average and the topography

just about average for Hawaii's vegetable and fruit farms. Soil fertility and climate were rated above average for most farms. The distance of the sample farms to the principal market, Honolulu, was greater than average for all Island vegetable and fruit farms because the sample was overweighted with farms located on the outside islands.

Thirty-four of the 36 sample farmers operated their own property exclusively, and two leased a portion of their land from others. This sample, therefore, was only representative of owner-operated farms for all matters in which type of ownership was a factor.

The acreage of the majority of sample farms was significantly larger than that of most vegetable farms in the territory. The average total area of the 36 farms was 36 acres. The crop acreage, a more significant figure, was 10 acres (Table C3). Fourteen sample growers had 10 or more acres of cropland, thirteen had between 5 and 10 acres, and nine had less than 5 acres. In comparison, the average crop area of family-operated vegetable and fruit farms in the territory was only 5.7 acres in 1948 (Table B9).

In comparing the average crop acreage on the sample farms with that of all vegetable and fruit farms in the Islands, it must be remembered that one-fourth of all growers were part-time farmers, whereas the sample growers were full-time farmers. There was also a slight difference in the definition of "cropland" in the sample and in the territorial survey, which somewhat favored the former. In the sample, cropland included all land that could be used for crop production without major clearing and drainage operations. In the survey the term was given to all land that had been used for crop growing during 1947 or 1948. However, even if this difference in definition is taken into account, the sample growers had considerably more cropland than the average farmer in the survey.

An attempt was made to compare the characteristics and qualities of the sample growers with those of the average vegetable and fruit producers in the territory. Because of the shortage of agricultural credit in Hawaii, the FHA had been able to select the best among many applicants for loans. All sample growers were born and raised in the Islands or in the mainland United States, while many non-FHA farmers were foreign born and educated. The sample growers were also substantially younger than the majority of all Island vegetable

producers; their average age was 37 years. No data were available for the average age of all territorial vegetable and fruit farmers in 1947, but in 1950 it averaged 47 years, according to the United States Census. (See ref. 33, p. 14.) Thus, on the basis of upbringing and age, the sample growers can be expected to be more progressive in their production methods than the majority of Island farmers.

The sample growers had, with one or two exceptions, adequate agricultural experience. Twenty-seven of the 35 men for which information was available, or 77 percent, had been on their present farms when the United States entered World War II. Four had begun operating their farms in 1942, two in 1943, and one each in 1945 and 1946. In comparison, all fruit and vegetable growers in the territory had occupied their present farms on the average for 11 years in 1950. (See ref. 33, p. 14.)

The fact that the sample farmers kept better records than almost all other Hawaiian growers indicated, on the basis of mainland experience, that they were better-than-average farmers. On the other hand, some of the best FHA borrowers had repaid their debts out of their high war-time profits and, therefore, were not included in the sample.

Independently of each other, FHA supervisors and the county agents of the Agricultural Extension Service graded every sample grower for his farming ability. Their evaluations agreed in nearly all cases. The majority of sample farmers were rated as better-than-average fruit and vegetable producers (Table C1).

The lack of representativeness of the sample may be summarized as follows: (1) the sample was not weighted according to territorial farm distribution; (2) the farms were of larger than average size; (3) the ability of most growers was above average; and (4) the sample represented owner-operators only.

INVENTORY OF THE SAMPLE FARMS

The book value of total assets per sample farm family averaged \$10,300, ranging from \$6,200 for the farms in Kona to \$14,100 for those in Olinda (Table C2). Substituting the 1947 market values

of real estate would bring the average value of assets per sample family up to \$13,100. The book value of land averaged \$3,160 per farm, or \$88 per acre, and ranged from \$1,550 in Mountain View to \$5,600 in Olinda, or \$30 to \$186 per acre. Non-cropland remained largely unused on the sample farms. The total land investment per farm divided by the crop acreage was therefore a fair approximation of land costs per crop acre.

The investment per crop acre depended upon the value per acre of all land on the farm, and, more important, on the proportion of cropland per farm. For example, on the Kauai farms 70 percent of the total area was cropland. The investment in all farm land was \$118 per acre, or \$30 above the sample average. Nevertheless, the investment per crop acre was \$168, the lowest for all districts. In contrast, cropland of the Mountain View sample enterprises amounted to only 5 percent of total farm land. Despite the low investment of \$30 per farm acre, the investment per crop acre there was \$620, the highest for all sample districts. The average investment per crop acre on all sample farms was \$312.

The book value of land on the sample farms was the purchase price. All but two farms had been bought before World War II or during the first war years when prices were low. Therefore, the supervisors of the FHA were requested to estimate the 1947 market value of the land for each sample farm. According to their conservative opinion, the average market value of land was \$4,590 per sample farm, or 54 percent more than the book value (Table C3). Differences between book and market value ranged from 31 percent at Omaopio to 84 percent at Mountain View. Using the same method of computing farm investment per crop acre as before, Mountain View farms had the highest market value with \$1,140 per acre, Oahu farms second highest with \$721, and Kauai farms lowest with \$252 per acre.

At the rate of 5 percent, the annual interest charges per crop acre in several sample districts were higher than rents paid for leased cropland. For example, the average interest charge per crop acre at Mountain View was \$57, while rents for vegetable and fruit land in that area were half that amount or less.

The value of farm improvements other than the dwelling, such as farm buildings, fences, and irrigation systems were low, averaging \$440 per sample farm. The values ranged from \$80 on the farms in

Kona to \$890 on those in Omaopio (Table C3).

A mainland farmer would be astonished at the small number of animals kept by the sample growers. Only seven of the 36 farmers owned horses or mules. Twenty-five raised chickens. Of these, sixteen had less than 20 birds of all ages, eight had between 21 and 80, and one had a flock of 1,000. Seven farmers kept ducks, and five had cattle. Of the six who raised hogs, three had only one each. The average value of livestock per sample farm was \$254 (Table C4). Though small, the number of animals owned by the sample growers was probably larger than that owned by most vegetable and fruit producers in the territory, because the FHA supervisors had stressed to their clients the need for more livestock enterprises.

For their size the sample farms were well equipped with cars, trucks, and farming equipment. All except one grower had either a car or a truck, but he, too, bought a truck in 1948. There were 11 cars and 31 trucks on the 36 farms. Five families owned both a car and a truck, and one grower owned three trucks of various sizes. Average investment for cars and trucks was \$850 per sample farm (Table C5).

Twenty-five growers, or 70 percent of the sample, owned tractors and tractor equipment. In addition, one producer owned a tractor cooperatively with another. The Kona growers had no tractors, because their land was too rocky and shallow. The other farms without a tractor had too little cropland under cultivation to warrant the investment. Most tractors were the wheel type of 15 to 20 horsepower. The depreciated book value of tractors and implements on farms owning a tractor averaged \$1,430 and ranged from \$340 to \$3,180.

Tools and miscellaneous equipment other than cars, trucks, tractors, and implements averaged \$280 per sample farm (Table C5). Major items used by all sample growers were sprayers (both power-driven and hand-operated), hand dusters, and weed burners. Many farmers had horse-drawn implements, engines, pumps, and portable irrigation equipment. Garden and hand tools and shop equipment were valued anywhere from twenty-five to several hundred dollars per farm.

After World War II when war surplus machinery could be bought cheaply in Hawaii, many growers, particularly veterans, took advantage of the opportunity to buy jeeps, cars, trucks, trailers, and other equipment.

The average depreciated investment in farm equipment per sample grower was \$1,850. It ranged from \$700 per farm in Kona to \$3,200 in Olinda (Table C2). The value of supplies, growing crops, and farm cash on hand was estimated at about \$1,000 per sample producer (Table C2).

Assets other than real estate used for the farm business averaged \$3,100 per sample grower, ranging from \$1,780 on the nonmechanized small farms of Kona to \$4,220 on the larger mechanized farms of Olinda. These figures indicated the major capital requirements of a vegetable producer who leased his land. In addition, a tenant needed funds for prepaying his lease and for taking care of his family until his crops were harvested.

The book value of all assets used in the farm business per sample farm ranged from \$3,800 on the Kona farms to \$10,200 on the Olinda farms, averaging \$6,700. Based on the 1947 market value of farm real estate, this figure increased to \$8,200 (Table C2).

Non-farm business assets of the family included the dwelling, household assets, cash on hand other than an operating minimum needed for the farm, and various types of savings. The average book value per house was \$1,660 (Table C6). Many houses were constructed before World War II, when building costs were low. Their average 1947 market value was estimated at \$3,000 by FHA supervisors, or 80 percent above their book value. The houses ranged from an old shack worth barely \$600 to a large, well-built home appraised conservatively at \$6,300.

Household assets were valued at \$800 on the average per sample farm. Securities, bank savings, life insurance, receivables, and cash on hand averaged \$1,000 per grower. Four families had less than \$100, 12 from \$100 to \$500, 13 from \$501 to \$1,500, and seven from \$1,501 to \$4,600 of such savings. The average book value of all non-farm assets per grower was \$3,600 (Table C2). If the 1947 market value of the house were substituted for its book value, the total figure for non-farm assets would come up to \$4,900.

Average debts per sample farmer were \$4,700, which was 46 percent of the book value and 36 percent of the market value of total assets (Table C7).

FARM RETURNS ON THE SAMPLE FARMS

Gross farm returns were defined as the sum of farm sales and inventory changes, farm production

for home use, and soil conservation payments by the federal government. The mean gross farm return per sample grower was \$3,990 (Table C10). Twelve producers had gross farm returns between \$1,500 and \$2,499, 22 between \$2,500 and \$9,700, and two between \$9,701 and \$10,699. There was a correlation between crop acreage and gross farm returns. The producers in the two districts with the largest crop acreage per farm had the highest gross farm returns; the growers in the four districts with the smallest crop acreage, the lowest.

Crop sales and inventory changes constituted by far the largest portion of gross farm returns. They averaged \$3,470 per sample grower, or 87 percent of gross farm returns. The share of crop sales in gross farm returns ranged from 81 percent for Mountain View to 93 percent for Kauai.

The sample farmers were specialized as to the type of crops raised. Of the total crop marketings, 84 percent were vegetable, 6 percent tree crop, 8 percent pineapple, and 2 percent flower sales (Table C9). Only eight out of the 36 growers sold more than \$800 worth of crops other than vegetables. Of these, five sold tree fruits, two pineapples, and one flowers. One of these eight farmers specialized in fruits only. In the case of the remaining seven producers, marketings of crops other than vegetables amounted to anywhere from one-third to two-thirds of all crop sales. The growers producing both fruits and vegetables usually raised only one type of fruit. Farmers producing vegetables exclusively frequently concentrated on few kinds.

A glance at the sales of livestock and miscellaneous products makes the lack of enterprise diversification on the sample farms even more apparent. Total sales and inventory changes of livestock averaged \$135 per sample grower, or 3 percent of gross farm returns (Tables C8 and C10).

Sales of other than crop and livestock products averaged \$120 per sample grower, or 3 percent of gross farm returns. Seven farmers made sales of this type, ranging from \$80 to \$1,200. Six of them, in the Volcano-Glenwood and Mountain View districts of Hawaii, marketed fern stumps and firewood, by-products of their land clearing operations. They also sold fern sprouts, which are used in the preparation of oriental dishes. One Oahu farmer and his family sold guavas and mountain apples which grew wild in the area.

Soil conservation payments amounted to only \$6 per sample farm. Six growers had become eligible for such payments, four on Maui and two on Kauai. The amount per grower who received payments averaged \$36, ranging from \$20 to \$68.

Farm production for home use was small and consisted mainly of food. Its value ranged from \$50 to \$720, averaging \$260 per sample grower, or 6.5 percent of total gross farm returns (Table C10). Firewood production accounted for about \$60 on the farms on the island of Hawaii, and was mostly negligible on the other islands. Some growers raised practically nothing for home use.

Food produced for home use on the farm averaged 26 percent of the total value of food consumed per farm family and ranged from 5 to 65 percent (Table C11). To arrive at the retail value of home-produced food, the farm value was increased by one-third. On this basis, the mean retail value of home-grown food was \$310 per farm. Food bought amounted to \$890. The retail value of all food consumed by the average sample family of 5.4 people was \$1,200.

FARM COSTS OF THE SAMPLE FARMS

Total farm costs were broken down into the following major groups: (1) crops, (2) livestock, (3) equipment, (4) hired labor, (5) miscellaneous, and (6) interest. Crop costs included cash expenses for fertilizer and lime, insecticides, fungicides, herbicides, packaging materials, and transportation and marketing. They amounted to 38 percent of all farm costs per sample farm. Because of larger transportation and marketing costs, this proportion was higher for growers on the outside islands than for those located on Oahu. It amounted to 50 percent on Maui, compared to 27 percent on Oahu (Table C12). Crop costs varied directly with the level of output per farm. Feed and other livestock costs amounted to \$177, or 7 percent of all farm costs.

Equipment costs included expenses for car, truck, tractor, other machinery, and tools. Interest on equipment was not included here but with interest on all farm assets. Cars and trucks were depreciated at the rate of 10 percent per year. However, only part of this depreciation was considered as a cost of the farm business. A varying portion was charged to off-farm business or family living, depending upon the

percentage of car or truck use for these purposes. Tractors were depreciated at the rate of 10 percent per annum. The rate of depreciation of other machinery and tools varied from 8 to 25 percent per year depending upon the item.

Average annual car and truck costs were \$411 per sample grower. For four farmers, car and truck costs ranged from \$20 to \$199, for 22 from \$200 to \$420, and for 10 from \$421 to as high as \$1,361. Average tractor costs per grower owning a tractor were \$311. Three farmers had tractor costs of from \$100 to \$199, eighteen from \$200 to \$365, and three from \$366 to \$526. Costs of other machinery and tool replacement were \$75 per operator, ranging from \$15 on a nonmechanized farm to \$214 on a highly mechanized enterprise.

Total equipment costs were \$704 per grower, or 29 percent of total farm costs (Table C12). A Kona farmer who did not own a tractor had the lowest equipment costs--\$228. The vegetable grower at Naalehu had equipment costs amounting to \$1,900. He was located far away from his nearest shipping point, Hilo, and his trucking costs were high.

Only eight of the sample growers used any hired labor. Three paid wages of \$155 or less, two paid between \$400 and \$700, and three who used full-time hired help paid from \$900 to \$1,300. Average hired labor costs were \$121 per sample grower, or 5 percent of all farm costs (Table C12).

The major items included under miscellaneous costs were depreciation and upkeep of improvements, taxes, water, utilities, fire insurance, and rent. As these growers had few farm buildings and other improvements, their depreciation cost and upkeep averaged only \$37.

In 1947 Island farmers paid three kinds of direct taxes other than net income taxes, namely, personal property, real property, and gross income taxes. The personal property tax, which averaged \$22 per sample grower, was abolished at the end of 1947. Real property taxes averaged \$42 per sample producer and ranged from \$6 for a grower in Mountain View to \$130 for one on Oahu.

The gross income tax on sales by farmers to wholesalers, 0.25 percent in the first half of 1947, was raised to 1.5 percent beginning July 1. The average gross income tax paid per grower was \$37 and ranged from \$13 to \$100, depending upon volume and season of sales. The tax rate of 1.5 percent is still in effect. The amount of gross income taxes which

farmers would now have to pay on a sales value equal to that in 1947 would be about 70 percent higher.

Expenditures for irrigation water varied greatly. In the more humid districts irrigation was either not necessary or was required only during short periods. In these areas water was usually cheap, and costs for irrigation water ranged from zero to about \$20 per year. In sections with pronounced dry spells and where water was expensive, such as Kula, Maui, expenses for irrigation water ranged from \$100 to \$200 per farm. Average tax and water expenses per grower were \$128, or 5 percent of all farm costs.

Other items, such as rent in the case of two producers, the farm share of utilities and fire insurance, and contributions to farmer organizations, amounted to \$25 per farm. Total miscellaneous costs were \$190, or 8 percent of all farm costs.

Interest, computed at the rate of 5 percent on all assets used in the farm business, was \$334 per grower, or 13 percent of all farm costs (Table C12). It ranged from \$130 for a producer in Mountain View to \$640 for one in Olinda.

Total costs per grower, including interest but excluding a charge for family labor, averaged \$2,470 (Table C13). They varied greatly from farm to farm and district to district, depending primarily on size of output and degree of mechanization. Kona farms were small in size, had a modest output, and were operated mainly with hand tools. Their average costs were \$1,000. Kauai farms, of larger size, with a greater output, and tractor-operated, had average costs of \$4,300 per farm.

FARM INCOME ON THE SAMPLE FARMS

Farm income values were calculated by subtracting farm costs from gross farm returns. Depending on how interest was treated, several income measures were obtained. In calculating "net farm income," interest was not considered a cost, but rather an income. Farm costs in this case included all cash expenses as well as depreciation of buildings and equipment. Net farm income per sample family averaged \$1,860 and ranged from \$1,500 in Volcano-Glenwood to \$3,100 on Kauai.

In the case of "labor and management income," interest was considered a cost. At an interest rate of 5 percent on all farm assets, the average

labor and management income per sample family was \$1,520 and ranged from \$1,190 for farmers in Omaopio to \$2,780 for the Kauai growers (Table C13).

If interest at the same rate were charged only on the actual debts of the growers in 1947, the average labor and management income per family would be \$1,690, or about half way between the two income measures just discussed. Actually, the producers in the sample were all financed by FHA and paid only 3 percent on their loans.* The actual labor and management income for these families averaged, therefore, \$1,760 per farm and ranged from \$1,390 in Omaopio to \$3,010 on Kauai.

The yearly net income earned per man working full time on these farms is a significant income measure comparable to wage returns in the major agricultural industries. This net income per work year was calculated by dividing the actual labor and management income per farm by total man years worked. It averaged \$1,112, ranging from \$850 in the Volcano-Glenwood district to \$1,600 on Kauai (Table C14).

In February 1947 the mean hourly wage for about 6,000 sugar plantation laborers was 94 cents. The modal third of these sugar workers received 84 cents per hour. (See ref. 14, p. 56.) If it is assumed that these employees worked at least 2,400 hours during the year at these wages, the mean annual earnings per worker would have been \$2,250 and the modal income \$2,000.

Average cash earnings for 1,056 pineapple plantation workers, not including managerial, supervisory, and professional employees, amounted to \$1,929 in 1946. All of these workers were on the payroll throughout the year. However, because of the seasonal character of the industry, not all of them worked regularly during the year. Perquisites valued at 15 cents per hour for men and 10 cents per hour for women were not included in the earning figure for the months January through September. (See ref. 14, pp. 87, 89, and 90.)

Earnings of full-time wage workers in the sugar and pineapple industries thus were about twice as

* All these farms had received their farm ownership loans before 1946 when the interest rate charged by the FHA was 3 percent. Farmers that received farm ownership loans from the FHA after 1948 pay an interest rate of 4 percent.

high as the labor and management income of the fruit and vegetable sample farmers.

The effect of the following four factors on the net farm income per worker on the sample farms was studied: (1) gross farm returns per worker, (2) ratio of non-labor costs to gross farm returns, (3) farmer ability, and (4) farm quality. The gross farm return per Kauai grower was about 50 percent above the sample average of \$2,525. The Kauai producers were rated above average in ability and their farms at least average in quality. Their costs amounted to 57 percent of gross farm returns, 1 percent above the average for the entire sample. They had the highest net income per worker for all sample subgroups (Table C14).

The Kona growers had a gross farm return of \$2,450 per worker, which was below the sample average. However, they were considered good farmers and the climate of their district enabled them to market their crops during the season of high prices. They did not use tractors and, partly because of this, their costs amounted to only 37 percent of their gross farm returns, which was less than for any other sample subgroup. They had the second highest income per worker among the sample districts.

The six Oahu growers were rated as above average in ability, and their farms were considered to be fairly good. Their location on Oahu, close to the Honolulu market, was one reason why their cost percentage of gross farm returns was low, 48 percent. Their gross return per farm worker was slightly above average. They ranked third highest in net annual income per worker among the subgroups.

Olinda growers had a gross farm return of \$3,000 per worker, or about 25 percent above the sample average. They were rated as better than average farmers and operated the largest crop acreages in all sample districts. However, the climate limited their production mainly to low-value crops, such as cabbage. Their cost percentage of 60 percent of gross farm returns was high. They had the fourth highest net income per worker.

The records of the two Omaopio producers show the limiting effect on net farm income of just one component of farm quality, namely, availability of irrigation water. These growers planted a large crop in the spring but no rain fell for several months during the summer. Available irrigation water was insufficient, and part of the crop dried

up. The gross farm return per worker of \$2,900, though above average, was far below expectations. Another consequence of the drought was the increase in the cost percentage to 66 percent of gross farm returns, the highest for all districts. The growers were of average ability and the natural resources, other than availability of irrigation water, were of high quality. Nevertheless, the Omaopio operators were in sixth place in annual income per worker among the eight major sample districts.

The Volcano-Glenwood district ranked lowest in farm quality. Its soil was shallow and its fertility had been depleted on some of the farms. The crop acreage per farm was small, and the climate limited the range of crops. The growers in this district were judged as being below average in ability. They had the smallest gross farm returns per worker and the second highest cost percentage of gross farm returns. Their district had the lowest farm income per worker of all sample areas.

OFF-FARM INCOME ON THE SAMPLE FARMS

Off-farm income was substantial for some of the sample families. For ten of them it ranged from \$800 to \$3,600, constituting anywhere from 17 to 49 percent of their total income.* Eight more families had from \$100 to \$700 off-farm income, which in all but one case amounted to less than 15 percent of their total income. Of the remaining 18 families, the off-farm income was less than \$100. Off-farm income per sample farm averaged \$597, or 26 percent of the average total family income of \$2,238 (Table C15).

Sometimes the outside work of the grower had some relation to his farm. For example, one vegetable grower trucked the produce of others to market with his own. Another, who received low prices on the wholesale market, began selling his truck crops to neighbors at retail. Eventually he bought additional vegetables from other producers and expanded his operations. A few growers used their tractors, bulldozers, and other equipment on neighboring farms.

* Families who received less than 50 percent of their total family income from the farm were not included in the sample.

In some cases the off-farm work had no relation to the farm but consisted in running stores or working for a wage in town or on plantations.

Occasionally, grown-up children, parents, or relatives living on the farm had outside jobs, but also contributed directly or indirectly to the farm labor force. The women worked in the house after returning from their outside jobs, freeing the grower's wife or mother for work in the fields. Similarly, the men who worked off the farm helped in doing the chores and farm labor on week-ends.

SAVINGS ON THE SAMPLE FARMS

Net savings were calculated to indicate the financial stability of the sample families at their 1947 standards of living. The term net savings as used here means the difference between living costs of the family and cash income after net income taxes. To determine net savings, farm production for home use and federal and territorial net income taxes were deducted from family income.

Only four growers paid any federal, and six any territorial net income taxes. The average federal net income tax paid per sample family was \$26, and the average territorial net income tax was \$5. As mentioned earlier, production for home use averaged \$260 per farm. By subtracting these taxes and production for home use from the average family income of \$2,288, an average family cash income after taxes of \$1,997 was obtained.

Living costs as used here include all family cash expenses, the cost of using the car for family purposes, as well as interest, depreciation, and upkeep on the dwelling, home furniture, and equipment. Since the book value of the houses was too low to be taken as a basis for calculating interest and depreciation, the 1947 sales value of each house was estimated, and the average of book value and sales value used in calculating interest and depreciation.

On the average the sample families spent \$34 more than they earned (Table C15). Eleven households overspent their cash income by \$400 to \$1,500 and eight by \$100 to \$399. Eleven families saved between \$100 and \$300 and six from \$400 to \$1,500.

In this calculation of net savings, an interest charge of 5 percent on farm and home debts was included as a cost rather than the 3 percent interest

that these FHA clients actually paid. This was done to make the sample results more representative of territorial vegetable and fruit farmers in general. Interest rates on loans to Island growers are rarely less than 5 percent. It could be argued that the sample producers might have reduced their living standards somewhat if they had paid an interest rate of 5 rather than 3 percent. Net family cash income after taxes and family living costs were, therefore, recalculated on the basis of a 3 percent interest rate on farm and home debts.

This recalculation raised family cash income after net income taxes from \$1,997 to \$2,061 and decreased living costs from \$2,031 to \$2,003. As a result, average savings per sample farm rose to \$58. Nineteen families in the sample still earned less than they spent, though the distribution was somewhat more favorable. Nine families spent from \$400 to \$1,300 and 10 from \$100 to \$399 more than their income during the year. Six families saved up to \$399, and 11 from \$400 to \$1,500.

To encourage a grower to continue operating his farm, sufficient savings should remain above his family living costs to enable him to make a reasonable annual payment on his debts and to improve his farm and home. Besides, the grower needs to build up funds for his old age retirement and for special contingencies. Savings of \$58 per year are not sufficient to provide for these needs.

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Table C1.—Grower Ability, Farm Quality, and Amount of Farm Labor per Farm on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Farms	Farmer ability	Natural resources of farm				Farm labor				
			Crop land			Climate	Adults other than aged people		Children	Aged people	Total
			Soil fertility	Soil depth	Topography		Male	Female			
	Number	Ability units ^b	Quality units ^b				Man labor years				
Hawaii											
Volcano and Glenwood	9	-0.1	0	-1.0	0	-0.3	1.18	0.37	0.11	0	1.66
Mountain View	4	0.5	0	0	-0.3	0	1.00	0.33	0	0.12	1.45
Kona	3	0.7	0	-0.7	0	1.0	0.92	0.08	0	0	1.00
Maui											
Olinda	4	0.5	1.0	1.0	0.2	0	1.08	0.48	0.09	0.14	1.79
Omaopio	2	0	1.0	0.5	0	0	0.85	0.50	0.05	0	1.40
Oahu	6	0.7	0.5	0.5	0.5	0.3	0.83	0.38	0.08	0.02	1.31
Kauai	3	0.7	0.3	0	0.3	0.7	1.33	0.47	0.08	0	1.88
Misc. districts ^c	5	0.5	0.2	0	0.2	0.2	1.24	0.40	0.23	0.05	1.92
All farms	36	0.4	0.3	-0.1	0.1	0.4	1.07	0.38	0.09	0.04	1.59

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Farmer ability and natural resources of farm were graded 1 for good, 0 for average, and -1 for poor.

c. One farmer each in Naelehu, Pahoa, northern Hamakua and Kamuela, Hawaii; and one in Haiku, Maui.

Sources: Supervisors of the FHA and county agents of the Hawaii Agr. Ext. Serv.

Table C2.—Summary of Assets, Debts, and Net Worth per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Book value									1947 market value ^b		
	Real estate except house	Live-stock	Supplies, farm cash and growing crops	Farm equipment	Total farm assets	Non-farm assets	Total assets	Debts	Net worth	Total farm assets	Non-farm assets	Total assets
	Dollars									Dollars		
Hawaii												
Volcano and Glenwood	2745	23	921	1798	5489	2897	8384	5009	3375	6430	4454	10884
Mountain View	1893	48	877	1767	4585	3848	8433	4347	4086	5949	5673	11622
Kona	2013	143	935	707	3797	2445	6242	3207	3035	5117	2886	8003
Maui												
Olinda	6004	354	646	3216	10220	3916	14136	7966	6170	11726	5421	17147
Omaopio	4697	118	958	1504	7277	5251	12528	7309	5219	8568	7050	15618
Oahu	4967	408	1034	2113	8522	3807	12329	3048	9281	11363	4454	15817
Kauai	3672	124	1271	1530	6597	3416	10013	4408	5605	7980	5180	13160
Misc. districts	3395	775	1268	1616	7054	4116	11170	3692	7478	8389	5373	13762
All farms	3598	255	984	1850	6686	3573	10259	4682	5577	8196	4899	13095

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Only real estate values are 1947 estimates; values for all other assets are book values.

Sources: Records of borrowers of the FHA and value estimates by supervisors of the FHA.

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Table C3.—Real Estate Investment per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Acreage		Book value					1947 market value ^b				
	Crop	Total	Land	Improvements except house	Total real estate except house	House	Total real estate	Land	Improvements except house	Total real estate except house	House	Total real estate
	<u>Acres</u>		<u>Dollars</u>					<u>Dollars</u>				
Hawaii												
Volcano and Glenwood	5.2	27.1	2461	284	2745	1659	4404	3217	371	3688	3216	6904
Mountain View	2.5	52.5	1550	343	1893	1975	3868	2850	407	3257	3800	7057
Kona	6.3	35.1	1933	79	2013	959	2972	3267	66	3333	1400	4733
Mau												
Olinda	24.0	43.9	5624	380	6004	1820	7824	7117	393	7510	3325	10835
Omaopio	12.5	20.5	3807	890	4697	1851	6548	4975	1013	5988	3650	9638
Oahu	9.6	35.0	4304	663	4967	1819	6786	6917	891	7808	2466	10274
Kauai	17.7	25.3	2977	695	3672	1236	4908	4458	597	5055	3000	8055
Misc. districts	11.0	46.2	2920	475	3395	1703	5098	4170	560	4730	2960	7690
All farms	10.1	35.9	3156	442	3598	1662	5260	4589	519	5108	2988	8096

a: Arithmetic means shown for eight sample districts and for the whole sample.

b: Based on estimates made by supervisors of U.S. Farmers' Home Administration.

Sources: Records of borrowers of the FHA and value estimates by supervisors of the FHA.

Table C4.—Livestock Inventory per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Chickens		Ducks		Hogs		Cattle		Horses, mules, and asses		Other animals	Total livestock
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars	Dollars	Dollars
Hawaii												
Volcano and Glenwood	8	21	0.3	1	0	0	0	0	0	0	1 ^b	23
Mountain View	1	3	7.5	22	0	0	0	0	0	0	23 ^c	48
Kona	19	34	6	17	0	0	0.7	42	0.7	50	0	143
Mau												
Olinda	12	27	4	8	0.3	6	2.5	225	0.7	88	0	354
Omaopio	34	118	0	0	0	0	0	0	0	0	0	118
Oahu	31	101	2	3	6.7	211	1.2	93	0	0	0	408
Kauai	15	44	0	0	0.3	13	0	0	1.3	67	0	124
Misc. districts	223	560	0	0	4	150	0.6	35	0.4	30	0	775
All farms	44	116	2.1	5	1.7	57	0.6	49	0.3	24	2.7	254

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. One farm had one goat and one had two rabbits.

c. One farm had 15 turkeys.

Sources: Records of borrowers of the FHA.

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Table C1.—Grower Ability, Farm Quality, and Amount of Farm Labor per Farm on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Farms	Farmer ability	Natural resources of farm				Farm labor				
			Crop land			Climate	Adults other than aged people		Children	Aged people	Total
			Soil fertility	Soil depth	Topography		Male	Female			
	Number	Ability units ^b	Quality units ^b				Man labor years				
Hawaii											
Volcano and Glenwood	9	-0.1	0	-1.0	0	-0.3	1.18	0.37	0.11	0	1.66
Mountain View	4	0.5	0	0	-0.3	0	1.00	0.33	0	0.12	1.45
Kona	3	0.7	0	-0.7	0	1.0	0.92	0.08	0	0	1.00
Mau											
Olinda	4	0.5	1.0	1.0	0.2	0	1.08	0.48	0.09	0.14	1.79
Omaopio	2	0	1.0	0.5	0	0	0.85	0.50	0.05	0	1.40
Oahu	6	0.7	0.5	0.5	0.5	0.3	0.83	0.38	0.08	0.02	1.31
Kauai	3	0.7	0.3	0	0.3	0.7	1.33	0.47	0.08	0	1.88
Misc. districts ^c	5	0.5	0.2	0	0.2	0.2	1.24	0.40	0.23	0.05	1.92
All farms	36	0.4	0.3	-0.1	0.1	0.4	1.07	0.38	0.09	0.04	1.58

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Farmer ability and natural resources of farm were graded 1 for good, 0 for average, and -1 for poor.

c. One farmer each in Naelehu, Pahoa, northern Hamakua and Kamuela, Hawaii; and one in Haiku, Maui.

Sources: Supervisors of the FHA and county agents of the Hawaii Agr. Ext. Serv.

Table C2.—Summary of Assets, Debts, and Net Worth per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Book value									1947 market value ^b		
	Real estate except house	Live-stock	Supplies, farm cash and growing crops	Farm equipment	Total farm assets	Non-farm assets	Total assets	Debts	Net worth	Total farm assets	Non-farm assets	Total assets
	Dollars									Dollars		
Hawaii												
Volcano and Glenwood	2745	23	921	1798	5489	2897	8384	5009	3375	6430	4454	10884
Mountain View	1893	48	877	1767	4585	3848	8433	4347	4086	5949	5673	11622
Kona	2013	143	935	707	3797	2445	6242	3207	3035	5117	2886	8003
Mau												
Olinda	6004	354	646	3216	10220	3916	14136	7966	6170	11726	5421	17147
Omaopio	4697	118	938	1504	7277	5251	12528	7309	5219	8568	7050	15618
Oahu	4967	408	1034	2113	8522	3807	12329	3048	9281	11363	4454	15817
Kauai	3672	124	1271	1530	6997	3416	10413	4408	5605	7980	5180	13160
Misc. districts	3395	775	1268	1616	7054	4116	11170	3692	7478	8389	5373	13762
All farms	3598	255	984	1850	6686	3573	10259	4682	5577	8196	4899	13095

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Only real estate values are 1947 estimates; values for all other assets are book values.

Sources: Records of borrowers of the FHA and value estimates by supervisors of the FHA.

Table C3.—Real Estate Investment per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Acreage		Book value					1947 market value ^b				
	Crop	Total	Land	Improvements except house	Total real estate except house	House	Total real estate	Land	Improvements except house	Total real estate except house	House	Total real estate
	<u>Acres</u>		<u>Dollars</u>					<u>Dollars</u>				
Hawaii												
Volcano and Glenwood	5.2	27.1	2461	284	2745	1659	4404	3317	371	3688	3216	6904
Mountain View	2.5	52.5	1550	343	1893	1975	3868	2850	407	3257	3800	7057
Kona	6.3	35.1	1933	79	2013	959	2972	3267	66	3333	1400	4733
MauI												
Olinda	24.0	43.9	5624	380	6004	1820	7824	7117	393	7510	3325	10835
Omaopio	12.5	20.5	3807	890	4697	1851	6548	4975	1013	5988	3650	9638
Oahu	9.6	35.0	4304	663	4967	1819	6786	6917	891	7808	2466	10274
Kauai	17.7	25.3	2977	695	3672	1236	4908	4458	597	5055	3000	8055
Misc. districts	11.0	46.2	2920	475	3395	1703	5098	4170	560	4730	2960	7690
All farms	10.1	35.9	3156	442	3598	1662	5260	4589	519	5108	2988	8096

a: Arithmetic means shown for eight sample districts and for the whole sample.

b: Based on estimates made by supervisors of U.S. Farmers' Home Administration.

Sources: Records of borrowers of the FHA and value estimates by supervisors of the FHA.

Table C4.—Livestock Inventory per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Chickens		Ducks		Hogs		Cattle		Horses, mules, and asses		Other animals	Total livestock
	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars	Number	Dollars	Dollars	Dollars
Hawaii												
Volcano and Glenwood	8	21	0.3	1	0	0	0	0	0	0	1 ^b	23
Mountain View	1	3	7.5	22	0	0	0	0	0	0	23 ^c	48
Kona	19	34	6	17	0	0	0.7	42	0.7	50	0	143
MauI												
Olinda	12	27	4	8	0.3	6	2.5	225	0.7	88	0	354
Omaopio	34	118	0	0	0	0	0	0	0	0	0	118
Oahu	31	101	2	3	6.7	211	1.2	93	0	0	0	408
Kauai	15	44	0	0	0.3	13	0	0	1.3	67	0	124
Misc. districts	223	560	0	0	4	150	0.6	35	0.4	30	0	775
All farms	44	116	2.1	5	1.7	57	0.6	49	0.3	24	2.7	254

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. One farm had one goat and one had two rabbits.

c. One farm had 15 turkeys.

Sources: Records of borrowers of the FHA.

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Table C5.—Farm Equipment, Machinery, and Tools per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Car ^b		Truck ^b		Tractor and tractor equipment		Other equipment and tools	Total farm equipment ^b
	Number	Dollars	Number	Dollars	Number	Dollars	Dollars	Dollars
Hawaii								
Volcano and Glenwood	0	0	1.1	805	0.6	905	227	1798
Mountain View	0	0	1	363	0.8	1383	136	1767
Kona	1	590	0	0	0	0	210	707
Maui								
Olinda	0.2	68	1	1188	1	1735	347	3216
Omaopio	0	0	1	138	1	1274	121	1504
Oahu	0.5	276	0.8	1215	0.8	700	588	2113
Kauai	0.7	211	0.7	400	1	913	205	1530
Misc. districts	0.4	500	0.8	325	0.6	1130	159	1616
All farms	0.3	184	0.9	662	0.7	993	278	1850

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. In columns "car" and "truck" total book value of vehicle is given. In column "total farm equipment" only farm share of vehicle is included. See also Table C6, footnote c.

Sources: Records of borrowers of the FHA.

Table C6.—Non-Farm Assets per Family on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Cash, receivables, insurance, securities				Non-farm assets			
	Cash on hand ^b	Receivables	Insurance and securities	Total cash receivables, insurance and securities	Non-farm share in car and truck ^c	Household assets	House	Total
	<u>Dollars</u>				<u>Dollars</u>			
Hawaii								
Volcano and Glenwood	251	22	135	408	139	837	1659	2635
Mountain View	89	0	429	518	115	1329	1975	3419
Kona	600	0	285	885	93	625	959	1677
Maui								
Olinda	876	0	533	1409	122	752	1820	2694
Omaopio	1857	0	1052	2909	29	662	1851	2542
Oahu	596	0	283	879	666	643	1819	3128
Kauai	1422	166	100	1688	199	443	1236	1878
Misc. districts	547	190	551	1288	498	817	1703	3018
All farms	617	45	355	1017	267	787	1662	2716

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Cash up to \$200 (\$300 in one case) was included in farm assets.

c. Part of value of vehicles, varying with amount of non-farm use on each farm, was considered a non-farm asset.

Sources: Records of borrowers of the FHA.

Table C7.—Debts per Farm on 36 Vegetable and Fruit Farms in Hawaii, January 1, 1947.^a

Location	Land Debts	Other Debts	Total Debts
	<u>Dollars</u>		
Hawaii			
Volcano and Glenwood	3823	1186	5009
Mountain View	3293	1054	4347
Kona	2072	1135	3207
Maui			
Olinda	7083	883	7966
Omaopio	6226	1083	7309
Oahu	2761	287	3048
Kauai	3524	884	4408
Misc. districts	2854	838	3692
All farms	3778	904	4682

Table C8.—Livestock Sales and Inventory Changes per Farm on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Poultry	Hogs	Beef	Other stock	Total
	<u>Dollars</u>				
Hawaii					
Volcano and Glenwood	61	0	0	0	61
Mountain View	19	0	50	0	69
Kona	- 4	0	0	0	- 4
Maui					
Olinda	- 7	6	140	-25	114
Omaopio	80	0	0	0	80
Oahu	- 9	143	26	0	160
Kauai	1	60	0	0	61
Misc. districts	428	0	29	0	457
All farms	79	29	30	- 3	135

a. Arithmetic means shown for eight sample districts and for the whole sample.

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

Sources: Records of borrowers of the FHA.

Table C9.—Crop Sales and Inventory Changes per Farm on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Sales					Inventory changes of growing crops	Total crop sales and inventory changes
	Vegetables	Tree crops other than coffee	Coffee	Pineapples	Flowers		
	<u>Dollars</u>					<u>Dollars</u>	
Hawaii							
Volcano and Glenwood	3110	0	0	0	44	-67	3088
Mountain View	2300	0	0	0	44	467	2511
Kona	1926	40	36	0	0	173	2175
Maui							
Olinda	4319	0	0	0	472	62	4854
Omaopio	4042	0	0	0	0	-287	3754
Oahu	1735	1074	0	0	0	6	2815
Kauai	3003	0	0	3160	0	421	6584
Misc. districts	3157	148	0	0	8	80	3393
All farms	2876	203	3	263	70	54	3469

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

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Table C10.—Farm Returns per Farm on 36
Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Farms	Farm sales and inventory changes				Soil con- servation payments	Farm pro- duction for home use	Total gross farm return
		Crops	Live- stock	Other Products	Total			
	<u>Number</u>	<u>Dollars</u>				<u>Dollars</u>		
Hawaii								
Volcano and Glenwood	9	3088	61	180	3329	0	213	3542
Mountain View	4	2511	69	362	2942	0	160	3102
Kona	3	2175	- 4	0	2171	0	285	2455
MauI								
Olinda	4	4854	114	0	4968	35	381	5384
Omaopio	2	3754	80	0	3834	15	243	4092
Oahu	6	2815	160	208	3182	0	194	3376
Kauai	3	6584	61	0	6645	15	392	7052
Misc. districts ^b	5	3393	457	0	3850	0	324	4174
All farms	36	3469	135	120	3724	6	260	3990

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

Table C11.—Data on Home Produced Food per Farm for 36
Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Home produced food		Purchased food	Retail value of all food consumed	Home produced food as per- centage of food consumed
	Farm value	Retail value			
	<u>Dollars</u>		<u>Dollars</u>	<u>Dollars</u>	<u>Percent</u>
Hawaii					
Volcano and Glenwood	164	219	889	1108	20
Mountain View	104	139	859	998	14
Kona	227	302	714	1016	30
MauI					
Olinda	368	490	1408	1898	20
Omaopio	242	323	898	1222	26
Oahu	194	258	938	1196	22
Kauai	392	522	683	1205	43
Misc. districts	241	321	675	996	32
All farms	232	309	887	1196	26

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

Table C12.—Costs per Farm on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Crop costs	Livestock costs		Equipment costs			Hired labor costs	Miscellaneous costs			Interest ^b	Total costs
		Feed	Other	Car and truck	Tractor	Other machinery and tools		Improvement, depreciation and upkeep	Taxes and water	Rent, utilities, insurance, etc.		
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Hawaii												
Volcano and Glenwood	988	63	28	445	179	71	115	21	103	22	274	2309
Mountain View	555	121	10	375	175	60	0	33	68	17	229	1643
Kona	419	54	1	249	0	37	17	15	59	0	190	1040
Maui												
Gilinda	1762	93	7	475	330	125	0	26	155	68	510	3551
Onaopio	1437	144	0	352	259	56	0	62	229	1	364	2904
Oahu	526	124	65	271	203	79	6	47	184	52	426	1982
Kauai	1904	192	18	419	454	94	643	58	152	15	329	4278
Misc. districts	550	464	23	612	222	72	260	53	117	3	353	2729
All farms	942	153	24	411	218	75	121	37	128	25	334	2468

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Computed at a rate of 5 percent on all assets used in the farm business.

Sources: Records of borrowers of the FHA.

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Table C13.—Farm Income at Four Levels of Interest on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Gross farm return	Interest not included as cost		Interest at 5 percent on all farm assets		Interest on actual farm debts			
						At 5 percent		At 3 percent	
		Cost	Net farm income	Cost	Labor and management income	Cost	Labor and management income	Cost	Labor and management income
	<u>Dollars</u>	<u>Dollars</u>		<u>Dollars</u>		<u>Dollars</u>			
Hawaii									
Volcano and Glenwood	3542	2035	1507	2309	1233	2206	1336	2138	1404
Mountain View	3102	1414	1559	1643	1458	1540	1562	1489	1613
Kona	2455	850	1605	1040	1415	961	1494	917	1538
Maui									
Olinda	5384	3041	2343	3551	1833	3352	2032	3228	2156
Omaopio	4092	2540	1552	2904	1188	2811	1281	2703	1389
Oahu	3376	1556	1820	1982	1394	1666	1710	1622	1754
Kauai	7052	3948	3104	4278	2775	4110	2942	4045	3007
Misc. districts	4174	2376	1798	2729	1445	2503	1671	2452	1722
All farms	3990	2134	1856	2468	1522	2299	1691	2233	1757

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

Table C14.—Gross Farm Return and Labor Income per Man on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Gross farm returns	Labor income
	<u>Dollars</u>	
Hawaii		
Volcano and Glenwood	2134	846
Mountain View	2139	1112
Kona	2455	1538
Maui		
Olinda	3008	1204
Omaopio	2923	992
Oahu	2577	1339
Kauai	3747	1599
Misc. districts	2174	897
All farms	2525	1112

a. Arithmetic means shown for eight sample districts and for the whole sample.

Sources: Records of borrowers of the FHA.

Table C15.—Family Income, Living Costs, and Savings per Farm, on 36 Vegetable and Fruit Farms in Hawaii, 1947.^a

Location	Off-farm income	Interest on actual farm and home debts at 5 percent								Interest on actual farm and home debts at 3 percent		
		Farm income	Family income	Family cash income before taxes	Federal income tax	Terr. net income tax	Family cash income after taxes	Family living costs ^b	Net savings	Family cash income after taxes	Family living costs ^b	Family net savings
	Dollars	Dollars								Dollars		
Hawaii												
Volcano and Glenwood	361	1336	1697	1485	0	1	1484	1934	-450	1552	1902	-350
Mountain View	700	1562	2262	2101	0	1	2100	1890	210	2150	1853	297
Kona	284	1494	1778	1493	0	0	1493	1398	95	1538	1379	159
Maul												
Olinda	1204	2032	3236	2855	12	0	2843	3073	-230	2961	3038	- 78
Omaopio	404	1281	1685	1442	0	0	1442	2284	-842	1550	2245	-695
Oahu	1063	1710	2773	2579	141	14	2424	1997	428	2465	1980	485
Kauai	10	2942	2951	2599	28	10	2521	2148	373	2582	2125	458
Misc. districts	510	1671	2181	1856	0	0	1856	1735	121	1907	1711	196
All farms	597	1691	2288	2028	27	4	1997	2031	- 34	2061	2003	58

a. Arithmetic means shown for eight sample districts and for the whole sample.

b. Includes all cash living expenses, cost of using car or truck for non-business purposes, depreciation and upkeep of dwelling and household assets, and interest on portion of total indebtedness charged to non-farm assets.

Sources: Records of borrowers of the FHA.

appendix **D** VEGETABLE LABOR NEEDS, COSTS, AND RETURNS

The amount of labor used to produce most vegetables in the territory is much higher than in the mainland United States. In 1943 and 1944 labor requirements per acre for four important vegetables were greater in Hawaii than on the mainland by the following percentages: 119 percent for head cabbage, 136 percent for snap beans, 200 percent for green corn, and 325 percent for lettuce (Table D1).

The difference between Island and mainland labor requirements was less pronounced per pound of vegetables produced. It amounted to 81 percent for beans, 110 percent for head cabbage, 125 percent for green corn, and 186 percent for lettuce. However, per acre yields under the intensive cultivation methods of the territory are generally higher than those on the mainland. (See ref. 6, p. 2.)

This explains the better showing of Hawaiian growers on a per pound basis than on a per acre basis.

A study of costs and returns of growing winter tomatoes was made on 10 plantings in the seasons 1946-47 to 1948-49. The average labor employed on all sample fields was 497 man hours per acre.

In contrast to this high labor input, the amount of tractor use was low. The average number of hours of tractor work was 17.5 per acre. One farmer did not use a tractor at all, while another operated his at the rate of 27 hours per acre. Tractors were primarily employed for plowing the soil before planting. All growers but one used a tractor for that operation. Only four farmers did any machine cultivating.

All tomato plantings were small in size. Five of the 10 plantings were on 0.25 acres, three on 0.75 acres, one on 1 acre, and one on 1.75 acres.

Grower returns and costs were on an f.o.b. roadside basis, picked but not packed. Gross farm returns per average acre yielding 12,400 pounds of marketable tomatoes were \$1,828. Total costs including a charge of \$397 for family labor at the rate of \$.80 per hour, were \$681. The difference between gross farm returns and costs, the farm management income, was \$1,147 per acre. The farm management income plus the charge made for labor averaged \$1,544 per acre. (See ref. 3, pp. 6, 10, 15, and 22.)

Labor was by far the largest cost item--58 percent of all costs (Table D2). Insecticides and fungicides constituted the second most important expense, or 18 percent of total costs. Fertilizers amounted to 10 percent, and all other costs including equipment use, water, rent, and interest, to 14 percent of the total.

These Hawaiian winter tomato records were compared with 10 unpublished winter tomato records for the 1949-50 season collected in San Diego county, California. If Island tomato growers should decide to export to the mainland during the winter, they would have to compete directly with these California farmers.

The tomato plantings of the San Diego farmers were much larger than those of the Hawaiian growers. They ranged from 2 to 20 acres per farm, averaging about 9 acres. Average yield per acre was 52,200 pounds, or more than four times as high as that of Island farms.

Total cost per pound of tomatoes averaged 7.23

cents for the territorial farmers, or nearly three times the cost of 2.53 cents for the San Diego growers. Island costs were substantially higher than California costs in every one of four sub-groups. Labor costs of 3.90 cents per pound were nearly two and a half times as high as the 1.60 cents on the mainland. San Diego labor costs were computed at the rate of \$1.00 per hour for skilled labor and \$.60 per hour for unskilled labor. They averaged about \$.80 per hour of hired labor, or the same as the wage rates charged in the Hawaiian study.

Damaging insects and diseases were more prevalent in the Islands than in San Diego. The territorial growers spent 1.37 cents per pound of tomatoes for insecticides and fungicides, or 17 times as much as the San Diego farmers, who bought only .08 cents worth of such materials per pound. The Hawaiian plantings also apparently required more fertilizer than those in California. Fertilizer costs per pound of Island tomatoes were .72 cents compared with .24 cents, or three times as much. All other costs combined were twice as high in Hawaii as in California.

Gross returns per pound of tomatoes, picked but unpacked in the field, were about 6 cents for the San Diego producers. With costs of 2.5 cents per pound, these growers had a profit margin of 3.5 cents per pound in 1949. The gross return per pound for the Hawaii farmers averaged 14.7 cents and their costs 7.2 cents. Their profit margin of 7.5 cents was thus more than twice as much per pound as that of the San Diego farmers.

Table D1.—Comparison of Labor Required to Produce Four Vegetables in the Mainland United States and in Hawaii, 1943 and 1944.

Crop	Location	Labor input per acre		Yield per acre	Labor input per pound	
		Man hours	Territorial as percentage of Mainland		Man hours	Territorial as percentage of Mainland
				<u>1000 pounds</u>		
Beans, snap	Mainland Oahu	300	236	6.7	.057	181
		895		8.7	.103	
Cabbage, head	Mainland Territory	113	219	11.6	.010	210
		248		11.6	.021	
Corn, green	Mainland Oahu	57	300	4.6	.012	225
		171		6.3	.027	
Lettuce	Mainland Oahu	117	425	8.5	.014	286
		497		12.5	.040	

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Table D2.—Average Costs of Producing Tomatoes on 10 Hawaiian and 10 San Diego County Farms.^a

Cost item	Hawaii		Costs per pound		
	Costs per acre	Percentage of total costs	Hawaii	San Diego County	Hawaiian costs as percentage of San Diego costs
	<u>Dollars</u>		<u>Cents</u>		
Labor	397	58.2	3.90	1.60	244
Insecticides and fungicides	121	17.8	1.37	.08	1713
Fertilizer	69	10.1	.72	.24	300
Tractor	23	3.4			
Other equipment	15	2.2			
Water	20	2.9			
Miscellaneous	37	5.4			
Total other costs	95	13.9	1.24	.61	203
Total costs	682	100.0	7.23	2.53	286

a. Hawaiian costs for 1946-47 to 1948-49 seasons; San Diego costs for 1949-50 season.

Sources: Ref. 3, pp. 15, 20, 23, 25, for Hawaiian costs; Wallace Sullivan, Agr. Ext. Serv., Univ. of California, Berkeley, made available cost records from San Diego County, California.

appendix **F** FRUIT AND NUT TABLES

Table E1.—Acreage of Important Fruit Crops (other than Pineapple), Territory of Hawaii, Selected Years, 1910 to 1952.

Fruit crop	1910 ^a	1920 ^a	1930 ^a	1940 ^a	1944	1947	1952
	<u>Acres</u>						
Avocados	124	57	157	425	279	266	159
Bananas	420	690	730	705	958	1,008	1,013
Grapes	295 ^b	9	8	8	19	(c)	(c)
Mangos	47	49	65	160	84	231	220
Oranges	97	50	35	65	24	25	24
Papayas	99	84	221	321	546	441	576
Tangerines	(c)	(c)	(c)	11	15	18	22
Total	1,082	939	1,116	1,694	1,931	1,989	2,014

a. U.S. Census reports in the period 1910 to 1940 include data only on the number of trees. The following figures were used in calculating the area in each crop: avocados, 70 trees per acre; bananas, 800; grapes, 300 vines; mangos, 58 trees per acre until 1930, and 48 in 1940; oranges and tangerines, 108; papayas, 435.

b. However, according to D. L. Crawford (Hawaii's Crop Parade, p. 134), there was at no time an area of as much as 100 acres in producing vineyards.

c. Data not available.

Sources: Ref. 27, p. 600, for 1910; ref. 28, p. 379, for 1920; ref. 29, p. 12, for 1930; ref. 30, pp. 32-33, for 1940; ref. 20, p. 15, for 1944; ref. 22, p. 27, for 1947; ref. 15, July 1952, p. 6, for 1952.

Table E3, continued.

- a. In calculation, a wage rate of \$1.00 per hour for drivers of trucks and tractors and \$0.80 per hour for all other labor was used.
- b. Interest, depreciation, and repairs.
- c. Working capital \$500 per orchard or \$14.71 per acre. Interest on working capital \$0.74 per acre annually; share of truck insurance, \$25.00 per farmer or \$0.24 per acre; other incidentals, \$0.30 per acre, total incidentals \$1.30 per acre.
- d. 150 pounds and 250 pounds of husked nuts harvested in 6th and 7th year respectively. Total labor cost of harvesting these nuts at \$0.80 per hour amounts to \$10.52; other expenses to \$2.00; gross return at \$0.17 per pound to \$68.00, and net return to \$55.48.
- e. Interest compounded annually.

Sources: Ref. 5, p. 21, for labor and machine inputs, material inputs, field machinery and sheds, contract operations, and tax; other figures estimated by author.

Table E4.—Estimated Investment on a Family-Type Macadamia Farm of 34 Bearing Acres under 1949 Conditions.^a

Item	Price per unit	Farm investment
		<u>Dollars</u>
Land:		
Orchard land, 34 acres	\$150 per acre	5,100
Homestead, 1 acre	\$150 per acre	150
Total land		5,250
Buildings and installations:		
Farm house	Contract	6,500
1 combination garage, machine shop and storage shed, 20' x 25'	\$2 1/8 per sq. ft.	1,062
1 storage and processing warehouse, 20' x 40'	\$3 per sq. ft.	2,400
1 10,000-gal. tank and foundation materials		670
Total buildings and installations		10,632
Macadamia nut trees ^b		18,204
Equipment and tools:		
Hulling equipment		500
Small equipment and tools		200
One-third share in the following: (equipment owned cooperatively with two other growers)		
1 truck, 1-1/2 tons, stake body	New \$3,000	1,000
1 wheel tractor, 16 HP at drawbar, rubber tires	New \$1,600	533
1 disc plow, double discs, 26"	New \$ 306	102
1 disc harrow, 5' cut	New \$ 285	95
1 spike barrow	New \$ 65	22
1 mower attachment	New \$ 300	100
1 trailer and misc. tractor equipment	New \$ 300	100
Total equipment and tools		2,652
Supplies		400
Cash		300
Total investment		37,438

a. Investment value at the beginning of 15th year. All buildings and equipment valued as new. Trees undepreciated.

b. All common labor was valued at \$.80 per hour; tractor and truck labor at \$1.00 per hour; and interest on expenses including labor, at 5 percent.

Source: Estimate by author.

Table E5.—Estimated Costs and Returns per Acre of Producing Unshelled Macadamia Nuts for Export on a Family Farm in 1949.

Item	Cost other than labor	Labor
	Dollars	Hours
Care of orchard:		
Fertilizing	28.47	3
Weed control	1.00	4
Mowing grass	1.07	4
Pruning, brush and trash removal	1.33	8
Pest and rat control	10.46	4
Miscellaneous	1.84	2
Total orchard care	44.17	25
Harvesting, processing, dock delivery:		
Gathering nuts	-	76
Hauling nuts to huller	1.00	2
Hulling	1.00	10
Bagging and warehousing	12.00	4
Hauling to port	1.00	2
Total harvesting, processing, dock delivery	15.00	94
General costs:		
Office expense	1.20	3
Depreciation of machinery and structures	15.80	
Depreciation of trees	10.71	
Interest on investment	21.14	
Taxes	9.30	
Miscellaneous	1.00	
Total general costs	59.15	3
Total costs ^a	118.32	122
	Return	
Gross receipts per acre for 1.5 tons at 14 cents per pound.	420.00	
Return for labor and management per acre for 1.5 tons at 14 cents per pound. ^a	301.68	
Return for labor and management on a 34-acre farm at 14 cents per pound. ^a	10,257.12	

a. When macadamia nuts sell for 5.5 cents per pound, gross receipts would amount to \$165.00 per acre. Gross income taxes would be \$2.48 compared with \$6.30 at 14 cents per pound. If it is assumed that all other costs would remain the same at 5.5 cents per pound as they were at 14 cents per pound, total costs would be \$114.50 per acre. Return for labor and management would be \$50.50 per acre and \$1,717 for a 34-acre orchard. If it is assumed that, at 5.5 cents per pound of macadamias, costs other than gross income taxes would decline by one-third from their levels at 14 cents per pound, total costs per acre would decrease to \$77.16 per acre. Return for labor and management would be \$87.84 per acre and \$2,987 for a 34-acre orchard.

Source: Estimate by author.

appendix F LIVESTOCK TABLES

Table F1.—Territorial Production and Imports of Beef and Veal, Selected Years, 1910-1952.

Year	Fresh, frozen and chilled beef and veal		Canned beef		Pickled or cured beef and veal		
	Territorial production ^a	Imports		Imports		Imports	
		Mainland	Foreign countries	Mainland	Foreign countries	Mainland	Foreign countries
	1,000 pounds		1,000 pounds		1,000 pounds		
1910	(b)	231	(c)	328	(c)	(c)	
1920	(b)	472	2,247	388	331 ^d	82	
1928	(b)	164	3,941	982	768 ^e	37	
1939	13,000 ^f	7,888	459	2,082	492	15	
1947	17,728	10,608	(g)	1,836	(g)	315	
1952	18,596	7,092	127	(b)	(b)	(b)	

a. Dressed weight. b. Data not available. c. Not listed in source.

d. Includes all prepared and preserved meat products; beef not listed separately in source.

e. Figure includes all canned meat, beef not listed separately in source.

f. Calculated from 16th U.S. Census by adding number of cattle butchered on farms and cattle sold from farms in 1939 and subtracting number of cattle bought by farmers in 1939; resulting total multiplied by assumed dressed weight of 475 pounds per head. Number of calves calculated in same manner; dressed weight of 60 pounds per head was used.

g. Data not available; however, amount known to have been small.

Sources: Ref. 38, p. 963, for 1910 mainland imports; ref. 39, p. 463, for 1910 imports from foreign countries; ref. 37, December 1920, p. 90, for 1920 mainland imports; ref. 35, calendar year 1920, p. 139, for 1920 imports from foreign countries; ref. 37, December 1928, p. 104, for 1928 mainland imports; ref. 35, calendar year 1928, pp. 380, 381, for 1928 imports from foreign countries; ref. 30, p. 29, for 1939 territorial production; ref. 34, p. 4, for 1947 mainland imports; ref. 25, pp. 34, 37, for 1952 territorial production, and p. 24 for 1952 total imports; ref. 17, p. 23, for 1952 imports from foreign countries.

Table F2.—Annual Gross Sales on a Hypothetical 1,500-Acre Cattle Ranch Stocked with 300 Head at \$.40 and \$.20 per Pound Dressed Beef F.O.B. Ranch.

Sales	Beef \$.40 per pound, dressed		Beef \$.20 per pound, dressed	
	Price per unit	Total returns	Price per unit	Total returns
		<u>Dollars</u>		<u>Dollars</u>
52 2 to 3-year old steers and heifers weighing 520 lbs. dressed, per head	\$.40 per lb. or \$208 per head	10,816	\$.20 per lb. or \$104 per head	5,408
14 Cull cows, 600 lbs. dressed, per head ^a	\$.35 lb. or \$210 per head	2,940	\$.17.5 per lb. or \$105 per head	1,470
1 Cull bull, 900 lbs., dressed	\$.20 per lb.	261	\$.14.5 per lb.	130
Total gross sales		14,017		7,008

a. It is assumed that 1/6 of all breeding cows, or 15 head, are replaced each year. One cow is assumed to die per year.

Sources: Estimate by author.

Table F3.—Annual Operating Cost of a Hypothetical 1,500-Acre Cattle Ranch Stocked with 300 Head under Economic Conditions Existing when Dressed Beef Sells at \$.40 and at \$.20 per Pound, F.O.B. Ranch.^a

Item	Beef at \$.40 per pound	Beef at \$.20 per pound
	Total cost	Total cost ^b
	<u>Dollars</u>	<u>Dollars</u>
Land lease and land clearing		
Lease of 1500 acres of pasture land at \$3.00 per acre	4,500	1,500
Annual depreciation of clearing and planting 300 acres; cost of \$25 per acre depreciated over 21-year lease	357	179
Total land lease and land clearing	4,857	1,679
Buildings, installations and fences		
11.5 miles of fence wire, valued new at \$21.59, depreciation and repair figured at 10% per annum	216	108
Water installations, valued new at \$6350, depreciation and repair figured at about 5% per annum	320	160
Total buildings, installations and fences	536	268
Equipment and tools		
Truck, 4000 miles at \$.14 per mile	560	280
Tractor, 200 hrs. at \$1.76 per hour ^c	352	176
Tractor equipment, valued new at \$4100, rancher's share 1/3 of depreciation and repair figured at 10% per annum	137	68
Depreciation on equip. and tools, 8.3% on \$800	67	34
Total equipment and tools	1,116	558
Supplies		
Salt and minerals	150	75
Seed	150	75
Herbicides	50	25
Insecticides	200	100
Medicine	50	25
Fertilizer	150	75
Total supplies	750	375
Taxes ^d		
Real property tax (tax evaluation of land \$22,500 at \$15 per acre. Tax rate \$19.88 per \$1000 valuation)	447	223
Territorial gross income tax, 1½% of sales value	204	102
Total taxes	651	325
Miscellaneous	300	150
Interest on investment at 5% per annum ^e	3,186	1,584
Total operating cost	11,396	4,939

a. Conditions at 40 cents resemble those that existed in Hawaii in 1948.

b. It was assumed that at \$.20 per pound of beef, all costs would be half of what they would be when beef sells for \$.40 per pound except for cost of lease and interest on investment. Lease was assumed to be \$1.00 per acre per year. Interest was based on investment value calculated in Table F4.

c. Tractor and tractor equipment owned cooperatively with two other ranchers. Total annual use of tractor on the three ranches was assumed to be 600 hours, or 200 hours per ranch.

d. Net income taxes not included.

e. Does not include interest on truck and tractor which is included in the mile and hour rates above.

Source: Estimate by author.

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Table F4.—Investment on a Hypothetical 1,500-Acre Cattle Ranch Stocked with 300 Head under Economic Conditions Existing when Dressed Beef Sells at \$.40 and at \$.20 per Pound F.O.B. Ranch.^a

Item	Beef at \$.40 per pound		Beef at \$.20 per pound
	Price per unit	Average investment value ^b	Average investment value ^{bc}
	<u>Dollars</u>		<u>Dollars</u>
Land clearing and land lease			
300 acres cleared and planted	\$25 per acre	3,750	1,875
3 months prepayment for 1500-acre land lease	\$.75 per acre	1,125	375
Total land clearing and land lease		4,875	2,250
Buildings, fences, and installations			
Fence wire, 11.5 miles		1,180	590
Water installations, animal, tool and equipment sheds		3,175	1,588
Total buildings, fences, and installations		4,355	2,178
Equipment and tools			
Truck, 1½ tons	New \$3,000	1,500	750
Share of tractor, 42 HP Diesel, crawler type, owned cooperatively with 2 other ranchers	New \$5,300, total value	883	441
Share of tractor equipment owned cooperatively with 2 other ranchers	New \$4,100, total value	683	342
Other equipment and tools		400	200
Total equipment and tools		3,466	1,733
Livestock			
90 breeding cows, 600 lbs. per head dressed weight	\$210 per head	18,900	9,450
5 breeding bulls	\$500 per head	2,500	1,250
69 calves, 1/2 yr. old, 210 lbs. per head dressed weight	\$.40 per lbs. or \$84 per head	5,796	2,898
68 long yearlings, 1½ yrs. old, 330 lbs. dressed weight	\$.40 per lb. or \$132 per head	8,976	4,488
68 steers and heifers, 2½ yrs. old, 500 lbs. dressed weight	\$.40 per lb. or \$200 per head	13,600	6,800
Total cattle		49,772	24,826
5 horses	\$150 per head	750	375
Total livestock		50,522	25,261
Supplies and miscellaneous		200	100
Cash		300	150
Total investment		63,718	31,672

a. Conditions at 40 cents beef resemble those that existed in Hawaii in 1948.

b. Replacement value, 50 percent depreciated is used except for livestock, supplies and cash which are evaluated at full replacement value. When beef sells for 40 cents per pound, annual rental of land was assumed to be \$3.00 per acre.

c. It was assumed that at 20 cents per pound of beef the value of all items is half of what it would be when beef sells for 40 cents per pound, except for prepayment on lease of land which was based on an annual rental of \$1.00 per acre.

Sources: Estimate by author.

Table F5.—Inventory of a Hypothetical Family-Type 100-Acre Dairy Farm in Hawaii, 1949.^a

Item	Price per unit	Farm investment Dollars
Land, 100 acres	\$120 per acre	12,000
<u>Buildings and installations</u>		
1 farmhouse, about 1,000 sq. ft., iron roof, house floor 8 ft. above ground	Contract	6,500
1 walk-through type of barn for 8 cows, processing room, and feed storage room, all under one roof	Contract	3,600
1 combination garage, machine and storage shed, 20' x 40'	\$2 1/8 per sq. ft. Contract	1,700
Lean-to shelters for calves, bull and cows		300
<u>Fences:</u> 10,000 ft. of 48" woven wire and 1 strand barbed wire 860 posts (including materials for gates)	\$03.7 per running ft. \$1.50 per post	370 430
Total fences		2,000
1 10,000 gallon reduced water tank and foundation materials		670
Total buildings and installations		14,770
<u>Dairy and feed equipment</u>		
Milking machine, 2 cow unit and 1/2 HP electric motor, installed		600
Farm cooler, 60 gal./hr. and compressor, installed		600
Small water heater and steam generator, installed		450
Galvanized steel sink		50
Sterilizer		100
Portable farm scale		75
Ensilage cutter		500
Miscellaneous equipment		500
Total dairy and feed equipment		2,915

		17,685
Item	Price per unit	Farm investment Dollars
<u>Field and transportation equipment</u> (1/2 share in the following equipment owned cooperatively with one other dairymen)		
1 1/2 ton truck	\$2000 new	1,000
1 wheel tractor, 16 drawbar HP, rubber tires	\$1600 new	800
1 disc plow, double discs, 28"	\$ 306 new	153
1 disc harrow, 5' cut	\$ 285 new	142
1 mower attachment	\$ 300 new	150
Trailer and miscellaneous tractor equipment	\$ 300 new	150
Total field and transportation equipment		2,395
<u>Livestock</u>		
30 mature milk cows	\$350 per head	10,500
3 bred heifers, 2 to 2 1/2 years old	\$260 per head	780
3 bred heifers, 1 1/2 to 2 years old	\$200 per head	600
3 heifers, 1 to 1 1/2 years old	\$150 per head	450
3 heifer calves, 6 mos. to 1 yr. old	\$ 90 per head	270
4 calves, 0 to 6 mos. old	\$ 45 per head	180
1 bull	\$600 per head	600
Total livestock		13,380
<u>Supplies</u>		400
Cash		400
Total investment		46,260

^a. The value of buildings, installations, equipment is the new,
undepreciated value of these items.

Source: Estimate by author.

appendix G SOURCES FOR TABLES IN APPENDICES

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