

# Analysis of Daikon Production on the Island of Hawaii



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#### **COVER PHOTO**

A farmer cultivating a field of daikon which is about 3 weeks old, in Puukapu, Waimea (Kamuela), island of Hawaii. The photo is courtesy of Parimal Choudhury.

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# ANALYSIS OF DAIKON PRODUCTION ON THE ISLAND OF HAWAII

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## INTRODUCTION

During the summer of 1965, a survey of vegetable farmers was carried out on the island of Hawaii. Six of the interviewed farmers grew daikon. This included all but two of the known growers and approximately 80 percent of the daikon acreage on the island. Since the island of Hawaii produced 84 percent (1965) of this crop in the State, the production of these six interviewed growers represents about 67 percent of the State's acreage. Daikon is the fourth largest vegetable crop by total acreage in the State, and is second on this island.

The analysis of practices and costs is based on the six farm interviews and is supplemented by published research materials and the experience of resource people in the Hawaii Agricultural Experiment Station and the Hawaii Cooperative Extension Service. Some information was gathered about the two growers who were unavailable at the time of the survey from other sources and has been included in the following description of conditions.

## DESCRIPTION OF THE FARMS

Most of the daikon produced in Hawaii is grown in the Kamuela (Waimea) area on the island of Hawaii, a cool, relatively dry plateau between the Mauna Kea and Kohala mountains. There are two locations: Puukapu, which is several miles east of the Post Office on State Highway 19; and Lalamilo, a State irrigation project, which is located a few miles southwest of the Post Office on State Highway 19. Besides this, there are a few acres of daikon grown near Honokaa.

The number of acres of land owned and rented by all eight (six interviewed, two not interviewed) of the known growers was 356 acres; therefore, the average farm size was  $44\frac{1}{2}$  acres, which includes unused land. Only one farmer leased all of his land (Hawaiian Homes Commission land). One other farmer rented about 60 percent of his land. Some farmers owned land in both Puukapu and Lalamilo, while others only owned land in one place or the other.

Of the eight known producers, seven depended on daikon as a major source of farm income. The average acreage of vegetables grown in a normal year by a producer in this group was 50 acres; this includes 36 acres of daikon. Throughout the year more than one crop can be produced on any specific parcel of land, which accounts for the discrepancy between the average farm size and the average acreage of crops. Three growers specialized in daikon production and were also the only ones who processed their crop.

The other farmers in the group produced two or three other crops, though daikon still made up 65 percent of their total vegetable acreage. Usually, these other crops were celery, lettuce or head cabbage.

### PRODUCTION PRACTICES OF THE INTERVIEWED FARMERS

Farmers producing daikon in the Kamuela area try to plant about one acre of the crop per week throughout the year. They all plant by seeding directly in the field.

In the summer the average length of the growing season is 62 days, while in the winter it is 71 days.

Field Preparation--Harvested fields are first disked to chop up the remaining plants and refuse. Next, these fields are deep plowed and/or subsoiled and redisked. Deep plowing or subsoiling is necessary because of the length of the daikon roots (15 to 24 inches).

Planting--One-half of the growers used a tractor and seeder to plant their seed. The others planted by hand.

Fertilizing--Every farmer applied a chemical fertilizer before or during the planting operation. None of them applied a sidedressing.

Irrigating--None of the growers irrigated their daikon, either in the summer or winter. The other crops grown by these farmers were irrigated.

Spraying--Only one farmer sprayed his field and this was just one time. The others did not use any insecticides or fungicides.

Weeding--One-half of the interviewed growers weeded or cultivated their fields.

Thinning--Three growers thinned out their seedlings.

Harvesting--Usually, the farmers pulled the daikon two times per planting. This operation required about 76 percent of the total labor required by the crop (see Table 1).

Processing--Three of the farmers processed their daikon.



Figure 1. A field of daikon which is 1 to 2 weeks old, illustrating the type of farms in Puukapu, Waimea (Kamuela), island of Hawaii.



Figure 2. A 5- to 6-week-old daikon plant. The daikon will be ready to dig up in 3 to 4 weeks.

### CALENDAR OF OPERATIONS

Table 1 summarizes labor requirements for the various operations in daikon production as reported in the survey. Harvesting is the major labor using activity and accounted for over 76 percent of the total hours. To show the distribution of labor requirements, a calendar of operations is presented in Table 2. This illustrates the labor requirements for one planting, by weeks, and also provides an effective tool for planning. Knowing the labor demand of his crop or crops per week or month, the farmer is in a position to organize his planting schedule to effectively employ labor and other resources. As previously indicated, farmers try to plant this crop once a week. This permits a weekly schedule of planting, harvesting different plantings, and maintaining immature plantings.

Table 1. Labor use per acre of daikon, Kamuela area, island of Hawaii, Hawaii vegetable crop survey, summer, 1965

Labor-using activity	Average hours used	Percent of total labor used
Establishing the stand <sup>a/</sup>	8.4	5.9
Cultural operations	(24.6)	(17.1)
Fertilizing	2.3	1.6
Cultivating	18.1	12.6
Spraying	1.4	1.0
Thinning	3.5	2.4
Harvesting	109.8	76.5
Average total hours of labor	143.5	100.0

<sup>a/</sup> Includes field preparation and planting operations.

Table 2. Calendar of farm operations for a representative farm producing 11,000 pounds of daikon per acre, Kamuela area, island of Hawaii

Week	Operation	Man-hours per acre	Number of men	Acres	Power-hours per acre	Type of power and equipment	Materials and notes
1	Subsoiling (1X)	1.0	1	1	1.0	Tractor and subsoiler	Several farmers plowed first then disked  6½ bags (80#) of 5-10-10 5 pounds of seed per acre
	Disking (3X)	3.4	1	1	3.4	Tractor and disk harrow	
	Preplant fertilizing (1X)	2.4	1	1	2.4	Tractor	
	Planting (1X)	3.4	1	1	3.4	Tractor and seeder	
Total hours - first week		10.2			10.2		
2	--	--	-	-	--	--	
Total hours - second week		0.0			0.0		
3	Cultivating (1X)	1.0	1	1	1.0	Tractor and cultivator	
Total hours - third week		1.0			1.0		
4	Thinning (1X)	7.0	2	1	--	By hand	
Total hours - fourth week		7.0			0.0		
5	--	--	-	-	--	--	
Total hours - fifth week		0.0			0.0		
6	Weeding (1X)	20.0	2	1	--	By hand	Optional
Total hours - sixth week		20.0			0.0		
7	--	--	-	-	--	--	
Total hours - seventh week		0.0			0.0		
8	--	--	-	-	--	--	
Total hours - eighth week		0.0			0.0		
9	Harvesting (2X)	109.8	4	1	0.0		
	Processing	128.6	3	1	0.0		
Total hours - ninth week		238.4			0.0		
Total hours - production		148.0			11.2		
Total hours - processing and production		276.6			11.2		



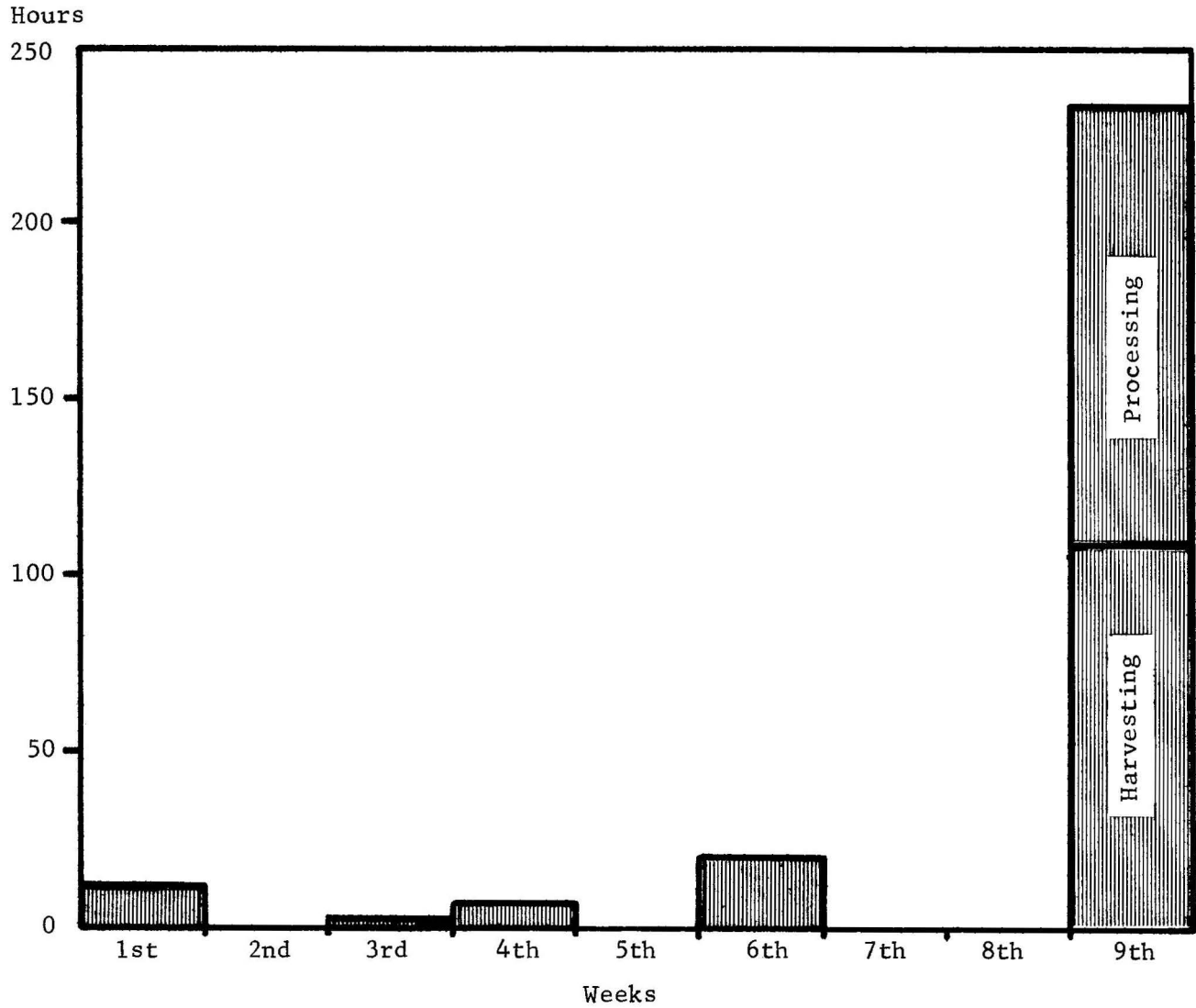


Figure 3. Typical schedule for labor use per acre per week for daikon production Kamuela area, island of Hawaii.

The distribution of labor use is summarized in Figure 1.

### COSTS OF PRODUCING DAIKON

The costs of production of daikon in this report are representative of the costs reported in the Kamuela area on the island of Hawaii for a normal year. If there are severe changes in the weather conditions, level of managerial ability, and/or insect and disease infestation, the amount of materials, techniques of production, yields, and cost items must be adjusted to the altered conditions.

When the farmers were interviewed, they were asked about their usual or normal practices. Summer and winter requirements were considered separately, although in this particular study, the difference between the seasons was very small. In this way, an attempt was made to avoid overemphasis on practices used for a single planting just prior to the interview.

The data obtained from the interviewed farmers were used as guidelines for selecting an appropriate set of production practices and ascertaining their level of use. Labor requirements and machinery use were estimated on the basis of these production activities and combined with the appropriate prices to obtain representative costs to the farmer. None of this information reveals the costs and practices of any one of the farmers who were interviewed.

#### Direct and indirect costs

The costs of producing daikon are separated into direct and indirect costs (see Table 4). In this way the costs that vary with production and those that remain fixed are identified. Direct costs of production are related to the actual growing and harvesting of the crop. Mainly this includes labor and materials. Indirect costs are related to the entire farm operation and do not change with levels of production. Examples are the depreciation costs of machinery and buildings, rent, etc. These are shown in Table 3. Since some farmers produce other crops besides daikon, this cost has been divided among all the crops on the basis of usage. The average amount of equipment use for producing daikon was 65 percent, which varied from 25 percent to 100 percent. The last column of Table 3 presents the average per acre cost of the machinery and buildings to the daikon enterprise. More specifically, this is the indirect cost of producing one acre of daikon.

A representative farmer who produces daikon in the Waimea area would have the following equipment and buildings:

- 1 - Disk Harrow
- 1 - Plow
- 1 - Cultivator
- 2 - Seeders
- 1 - Knapsack Sprayer

- 1 - Tractor, 1953, crawler type
- 1 - Tractor, 1957, wheel type
- 1 - Pickup Truck, 1955, ½ ton
- 1 - Fertilizer Applicator
- 1 - Farm Building, 1,250 square feet

Table 3. Machinery and buildings investment, average daikon grower, island of Hawaii, Hawaii vegetable crop survey, 1965

Item	Average value of investment <u>a/</u> (1965)	Average depreciation per year <u>b/</u>	Average per acre cost to daikon enterprise <u>c/</u>
	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Implements	859.10	161.55	2.94
Sprayers	188.76	35.22	.27
Tractors	3,072.33	358.75	7.25
Trucks and Pickups	1,060.45	208.87	7.43
Buildings	2,600.00	166.11	2.24
Total	7,780.64	930.50	20.13

a/ Value of investment was calculated by first depreciating the original price of each piece of equipment in order to determine the 1965 value. Next these values for each category were summed and divided by the number of interviewed farmers.

b/ Depreciation per year was determined by dividing the purchase price of each piece of equipment by the number of years it could be used (based on farmer's estimate of years of use). Then these amounts were summed for each category and divided by the number of interviewed farmers.

c/ Cost to the daikon enterprise was calculated by summing the depreciation per year and reducing this to a per acre basis. This was multiplied by the percentage of use of each piece on the representative daikon crop.

Table 4. Costs and returns per acre for producing daikon in the Kamuela area on the island of Hawaii

Item	Cost per acre	
	Dollars	Cents per pound
Direct Costs:		
Labor (143.5 hrs. @ \$1.25/hr ) <sup>a/</sup>	179.38	1.6
Materials:		
Seed.....	\$13.34	
Fertilizer.....	34.16	
Spray materials..	7.84	
Bags.....	17.81	
Gas and oil.....	17.36	
Others.....	3.14	
Total materials	93.65	.9
Gross income tax <sup>b/</sup>	2.15	--
Total direct costs	275.18	2.5
Indirect costs:		
Machinery and buildings	20.13	.2
Rent	13.38	.1
Total indirect costs	33.51	.3
Total cost	308.69	2.8
Total gross return (11,000 lbs. @ 3.9¢) <sup>c/</sup>	429.00	3.9
Net farm earnings	120.31	1.1
Interest on investment <sup>d/</sup>	9.32	.1
Net return to management	110.99	1.0

<sup>a/</sup> The prevailing wage in the Kamuela area was \$1.25 per hour for hired labor. This cost does not include the labor hours for processing.

<sup>b/</sup> This is based on one-half of one percent of the farmers' gross sales.

<sup>c/</sup> Price for fresh daikon.

<sup>d/</sup> Interest was set at 6 percent per year of the average investment.

**Total cost**

The total cost for producing an acre of daikon is estimated at \$308.69 (Table 4). This does not include trucking costs, shipping charges, and wholesaler expenses, rather it is the cost at the farm level.

The average yield for daikon in the Waimea area was reported to be 11,000 pounds per acre. According to the interviewed farmers, this does not vary much between the summer and winter seasons. At this level of production, cost per pound would be 2.8¢. If a price of 3.9¢ per pound is paid to the farmers for fresh daikon, the gross return to an average grower is \$429.00 per acre.<sup>1/</sup> Therefore, the net return to management is \$110.99 per acre or one cent per pound (see Table 4).

Direct costs make up 89 percent of the total cost. Of this amount, labor comprises 65 percent of direct costs and 58 percent of total costs. This may not be a meaningful picture of the cash expenses or working capital requirements for growing daikon inasmuch as all the labor including operator and other family labor has been charged \$1.25 per hour. Family labor is an integral part of the operations surveyed and does not require the weekly outlay that hired labor does. Furthermore, there are very few job opportunities outside the farm for most of the family.

**LABOR AND MANAGEMENT EARNINGS**

A representative farmer who grows daikon in the Waimea area has available the following workers:

Operator.....	67 hrs/wk	
Wife.....	40 hrs/wk	
Son.....	45 hrs/wk (summer)	-- 25 hrs/wk (winter)
Son.....	30 hrs/wk (summer)	-- 20 hrs/wk (winter)
Daughter.....	17 hrs/wk (summer)	-- 5 hrs/wk (winter)
Hired worker.....	56 hrs/wk	

Of course, some farmers depend more heavily on their family labor to produce daikon than others. Although the average for the survey was 17 percent (Table 5) for hired labor, actual use varied from 0 percent to 41 percent.

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<sup>1/</sup> The price of 3.9¢ per pound was estimated by the Hawaii Crop and Livestock Reporting Service in Statistics of Hawaiian Agriculture, 1965, U. S. Department of Agriculture and Hawaii State Department of Agriculture, 1966, p. 42. The average price reported by the farmers was 3.4¢ per pound. However, farmers were uncertain about average prices at the farm level and estimates varied widely. For this reason the Statistical Reporting Service's estimate was used in computing returns in this study.

Table 5. Labor used in producing daikon, Kamuela area, island of Hawaii, Hawaii vegetable crop survey<sup>a/</sup>

Type	Hours per acre	Percent of total
Hired labor	24.4	17
Family labor <sup>b/</sup>	119.1	83
Total	143.5	100

<sup>a/</sup> This labor excludes the amount required for processing.

<sup>b/</sup> Family labor includes the father (operator), wife, children, and sometimes the operator's or wife's parents and in-laws.

Assuming that 83 percent of the labor used (Table 5) is supplied by the farmer's family, this 119.1 hours when added to net farm earnings at the rate of \$1.25 per hour would increase the earnings of the farmer and his family from an acre of daikon to \$269.19 per acre.

If the lowest and highest percent (59% and 100%) of family labor use of the interviewed farmers is used instead of the average (83%), the income to the family varies from \$226.15 to \$299.69 per acre (Table 6).

Table 6. The range and average percentages of family labor and hired labor and how they affect the family income per acre of daikon, Kamuela area, island of Hawaii, Hawaii vegetable crop survey

Range and average percentage of family labor	Range and average percentage of hired labor	Income to family per acre of daikon
59% (lowest)	41% (highest)	\$226.15
83% (average)	17% (average)	\$269.19
100% (highest)	0% (lowest)	\$299.69



Changes in the income to the families will also occur with price changes. In this report the price is assumed constant at 3.9 cents per pound for fresh daikon. A change of one-half cent per pound of daikon would raise or lower net farm income by \$55.00 per acre, other things remaining the same.

## PROCESSING DAIKON

One-half of the interviewed farmers processed their daikon. The others sold it fresh, either in Honolulu or Hilo. There are three possible methods of processing.

First, the daikon is washed, trimmed, and salted by the farmers. Once this is finished, it is shipped by air to plants in Honolulu or by truck to locations in Hilo for further processing.

Second, the farmers make takuwan. Each farmer has his own secret process. A typical method of preparation is: The daikon is first salted. Then it is weighted by putting the daikon in a press and squeezing out the liquid portion. Cooked seasoning (sugar, vinegar, water, coloring, and salt) is added. This mixture is soaked in a tub for approximately 5 days to allow the flavoring to penetrate into the daikon. After the soaking is completed, the finished product is either put into bottles or plastic bags for distribution.

Third, the daikon is used to make sanbaizuke. First, the daikon is diced and salted. Next, the daikon is compressed in order to remove the liquid portion. Sometimes other vegetables (i.e., lotus root, egg plant, and cucumbers) are diced and salted, and then added. This mixture with the additional vegetables is again compressed to remove any moisture. A cooked seasoning (soy sauce, sugar, vinegar, pepper) is put into the mixture. Finally, the sanbaizuke is packaged for sale. This is another secret process that each farmer has developed independently.

Processing a one-acre crop requires an average of 129 hours of labor (see Table 2). Usually, this involves three to four people. They do this each week throughout the year. Both Table 2 and Figure 1 illustrate the relative amount of labor required by this additional operation.

No attempt has been made to evaluate the profitability of processing the daikon. This section is included only to indicate that some farmers go one step beyond growing the crop.



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