Cooperative Extension Service
C/T/A/H/R
College of Tropical Agriculture & Human Resources
University of Hawaii at Manoa

AgriBusiness
Nov. 1999
AB-13

Production Costs of Selected Vegetable Crops in Hawaii
(Cabbage, Cucumber, Green Onion, and Lettuce)

Aaron R. Peterson[1], Khem R. Sharma[1], Stuart T. Nakamoto[2], and PingSun Leung[1]
[1]Department of Biosystems Engineering, [2]Department of Food Science and Human Nutrition

Costs of production were surveyed for Chinese cabbage, head cabbage, cucumber, green onion, baby lettuce, and lettuce with the participation of farmers on Oahu and Maui. The survey was done between fall 1998 and spring 1999.

Why is cost of production important?

Agriculture is a dynamic enterprise, and Hawaii's agriculture is in the midst of change and revitalization. The agricultural component of Hawaii's economy has shifted from sugarcane and pineapple production on large plantations toward a diverse range of crops and farm sizes. Hawaii's agricultural entrepreneurs together face a difficult competitive environment, because most of the agricultural produce sold in Hawaii is imported from areas where costs of production generally are lower. The new diversity in Hawaii's agriculture has also meant more competition among Hawaii's farmers, who are increasingly receptive to new fertilizers, pesticides, machinery, and pest-resistant crop cultivars that come onto the market and promise to make their operations more efficient and productive.

Besides such production-side changes, market-related changes have also occurred. For example, entry of wholesale clubs into the produce market has modified the distribution structure, resulting in smaller margins and greater volumes of lower-priced products. Changes in consumer tastes and preferences have occurred, such as the emphasis on specialty foods in restaurants, and an increase in popularity of produce grown with "organic" methods. Finally, there is greater interest in the nutritional value of foods and in food safety. This concern for the safety of foods and their freedom from chemical and microbial contamination is growing strongly and will have increasing and far-reaching impacts on farm operations and marketing.

In such an environment, it is important to know your cost of production, because that knowledge is essential to maintaining a financially healthy farm. This can be of critical importance to farming in general and farming in Hawaii in particular, because there is often only a fine line between a farm that is making money and one that is going under.

How will analyzing your cost of production benefit you?

Once production cost is known, decisions can be made and actions taken that can save time and money, as illustrated by the following examples.

- Knowing production cost can provide the target (breakeven) prices necessary for setting a price or determining whether an offered price is acceptable.
- Cost of production analysis provides a picture of how the farm business is doing and helps answer questions such as "Where are the dollars going?" and "Is time and money invested in the farm worthwhile?"
- Cost of production analysis can also become "what-if" analysis, an exercise on paper instead of physical trial-and-error. You can test entire production and marketing systems, or evaluate different scales of operation, crops, inputs, equipment, and market factors. For instance, what would be the impact on costs of a change in your fertilizer program that results in a certain increase in crop yield? How would increased time spent in monitoring pests and establishing action thresholds for pest control affect your pesticide program and crop yield?

You can answer these questions only if you know your cost of production.

Published by the College of Tropical Agriculture and Human Resources (CTAHR) and issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. H. Michael Harrington, Interim Director/Dean, Cooperative Extension Service/CTAHR, University of Hawaii at Manoa, Honolulu, Hawaii 96822.

Framework of the study

CTAHR has been conducting cost of production surveys for over 40 years. The selection of crops varied for each study, but data were usually collected for the most commonly grown crops. The study we report here has attempted to (1) devise a systematic data collection and analysis framework for periodic updating of cost of production information and (2) maintain the collected information in a database. This document presents the results of a pilot effort to test this overall concept on selected vegetable crops.

This study was done in cooperation with the Natural Resources Conservation Service (NRCS) and the CTAHR Cooperative Extension Service (CES). NRCS and CES prepared a list of prospective farmers that might be interested in the study, and most of the participants came from this, although a few came through other sources. NRCS and CES agents contacted some of the farmers, and others were contacted directly by the survey staff.

The sample size for this study was much smaller than originally envisioned, due to the lack of broad participation by farmers. Several reasons were given as to why they did not want to participate. Many simply did not have the time. Others were wary of dealing with government agencies, including the university. Some had calculated their cost of production on their own and did not feel they would gain anything from participating. Others did not feel comfortable revealing the financial information required. Several small-scale farmers were concerned about the large-scale farmers using the information revealed in the study to gain a competitive advantage over them. This lack of participation was unfortunate, because the survey staff, although primarily interested in gathering data, produced a detailed cost of production report for each farm surveyed, and those data would have been very useful for many farmers.

A new crop budget analysis program

In the past, CTAHR cost of production studies used either mainframe computer programs or spreadsheet software (such as Lotus™) to input data and calculate results. For the present study, a stand-alone database program was designed for the specific purpose of analyzing crop budgets. This program can be used on a personal computer for entering data, doing calculations, and generating reports. To preserve consistency with previous studies, the new program follows a similar format, but it has added features that allow more flexibility and detailed analysis.

A farmer using the program can enter data for as many farms operated and as many crops grown as needed. The program can be used to analyze the cost of production for various scenarios using different material and production input combinations.

The goal was to develop a program that farmers with some basic knowledge of personal computers could use on their own. The program includes a detailed "help" file explaining each of the program's functions, and the graphical user interface has a simple, clear design. The program and its users' manual are available for free on the Internet at the CTAHR Web site, <http://www2.ctahr.hawaii.edu/biosystems/budget/index.htm>. An IBM-compatible PC with Windows 95 or later is needed to run the program.

The survey

This cost of production survey consisted of 13 farms and 18 crop budgets (some farms had more than one crop surveyed). The survey was originally supposed to cover farms from all islands, but due to lack of participation, only farms on Oahu and Maui are included. The data on lettuce are from seven farms, most of which grew various types of lettuce. We grouped the data from these types because their production is similar, and farmers often grow several types together using the same inputs. Green onions and Chinese cabbage each had three farms surveyed, while baby lettuce, cucumbers, and head cabbage each had two farms surveyed. The baby lettuce farms surveyed also grew several types of lettuce.

Cost of production analysis relies on very detailed information. The data collected were broken down into several components: land and buildings, labor, machinery, variable costs, and fixed costs. The calculations made in the crop budget program are documented in the users' manual. Summary data for each crop surveyed are presented in Table 1 (p. 4–5) and Figure 1 (p. 8).

Acreage, yield, and price

The crop budget program recorded acreage for each crop surveyed, along with yield and price for the respective crops. The average yield and revenue for each crop for the year were recorded, when possible. If a farmer was not able to estimate the average, the latest yield and rev-

enue figures that could be recalled were used. Production was divided into four categories: Grade A, Grade B, Off Grade, and Culls. Most farmers reported selling only Grade A.

Variable costs

Variable costs consisted of machinery (fuel and repair costs), paid labor, family labor, and materials. The variable costs were broken down by the types of activities with which they were associated. The activities were land preparation, planting, weed control, irrigation, fertilizing, pest control, harvesting, marketing, and "other." These costs are summarized in Table 1 and shown in detail for each crop studied in Table 2 (p. 6–7) and Figure 2 (p. 8).

Labor

Labor was broken down in two ways for the analysis. The first was paid labor, which consisted of any employee who was paid a wage by the farmer. The second was family labor, which consisted of the farmer and any others who contributed labor to the farm but were not paid a wage for their labor; they usually (but not always) were family members. Paid labor and family labor were considered variable costs in this study. This distinction must be made between the two types of labor, because many small farms had little if any paid labor. The program assumes a wage rate to estimate the value of family labor.

Machinery

Various data regarding all machinery and equipment used in vegetable production were recorded. These included the type of machinery owned by the farmer, its market value when purchased, the estimated number of hours it is used per year, the life expectancy of the machinery, estimated yearly repair costs, and yearly fuel consumption. These data were then used to estimate an average hourly fixed cost and an average hourly variable cost, which were later multiplied by the use hours for each activity in which the machinery was used. The fuel consumption and repair costs were considered variable costs, while depreciation of machinery was considered a fixed cost.

Fixed costs

Several inputs were considered fixed costs, including depreciation of machinery, buildings, land use, overhead cost, and family overhead cost. Buildings cost consisted of the value of the buildings, along with repairs and improvements, and insurance for the buildings. Land use cost consisted of rent or an allocation of its market value. Overhead cost consisted of utilities, postage, property tax, auto insurance, bookkeeping, lawyer and consultant expenses, and business entertainment and travel expenses. Family overhead cost is an estimated value of the work done by a paid or unpaid family member that does not fall under the typical hourly wage rates described in the labor section. Examples of this are a farmer who pays herself a salary for managing a corporate farm, or a spouse who does the bookkeeping. Most farms had a value of zero for family overhead expense. This item does not affect the overall return, as its value is added back into the return to management and labor during analysis.

Fixed costs were allocated among the farm's crop-acres, and then again among the number of times a crop was grown per year.

Return

The crop budget program is designed to compute four different measures of return. First is *return to management*, which is total revenue minus all fixed and variable costs, including family labor cost. Second is *return to labor and management*, which is return to management plus family labor and family overhead costs. This is important when a farmer uses a lot of family labor. Third is *return to machinery and management*, which is return to management plus the fixed-cost portion of machinery. Fourth is *return to land and management*, which is return to management plus land use cost. This is important when the farmer owns the land outright. The program computed the opportunity cost of owned land, which can be very high given the real estate values in Hawaii. Farmers who owned land claimed that their land was worth anywhere from $40,000 to $100,000 per acre.

Breakeven analysis

The crop budget program also computes a breakeven analysis. Based on the farmer's cost of production, the program estimates a breakeven yield and price based first on total cost and then again on variable cost.

(continued on p. 7)

Table 1. Summary of cost of production data for selected vegetable crops in Hawaii (1998–1999).

	Lettuce		Baby lettuce		Green onions	
	Mean	% of cost	Mean	% of cost	Mean	% of cost
General Information						
Sample size	6		2		3	
Acres	3.12		2.50		4.67	
Crops per year	3.50		4.50		2.67	
Growing period (months)	1.71		1.63		1.83	
Yield (lb/acre)	11,002		1,990		17,500	
Price ($/lb)	0.62		3.58		0.72	
Revenue ($/acre)	6,799		7,114		12,651	
Total cost ($/acre)	5,456	100.0	4,379	100.0	10,508	100.0
Total variable costs ($/acre)	4,292	78.7	3,863	88.2	8,883	84.5
Machinery	463	8.5	276	6.3	856	8.1
Paid labor	1,422	26.1	2,477	56.6	2,328	22.2
Family labor	884	16.2	348	8.0	3,851	36.7
Materials	1,523	27.9	762	17.4	1,847	17.6
Interest on variable costs	49	0.9	46	1.1	74	0.7
Total fixed costs ($/acre)	1,115	20.4	469	10.7	1,551	14.8
Machinery	243	4.5	101	2.3	480	4.6
Buildings	81	1.5	49	1.1	61	0.6
Land use	513	9.4	42	1.0	716	6.8
Overhead cost	222	4.1	121	2.8	294	2.8
Family overhead cost	56	1.0	156	3.6	0	0.0
Return ($/acre)						
to management	1,343		2,736		2,143	
to labor and management	2,283		3,240		5,994	
to machinery and management	1,586		2,837		2,622	
to land and management	1,856		2,778		2,859	
Breakeven*						
(yield [lb/acre] and price [$/lb])						
yield based on total cost	8,601		1,112		14,896	
price based on total cost	0.59		3.54		0.60	
yield based on variable costs	6,829		1,004		12,751	
price based on variable costs	0.45		3.06		0.51	

*Breakeven yields and prices are the averages of the farms surveyed, not the breakeven yields and prices for the average farm.

Cucumbers		Chinese cabbage		Head cabbage	
Mean	% of cost	Mean	% of cost	Mean	% of cost
2		3		2	
1.50		5.43		11.50	
5.00		3.00		2.00	
1.63		1.77		2.75	
31,000		28,048		24,667	
0.54		0.20		0.19	
16,816		5,554		4,691	
8,016	100.0	4,911	100.0	5,431	100.0
7,434	92.7	3,494	71.2	3,942	72.6
420	5.2	535	10.9	752	13.8
3,356	41.9	129	2.6	334	6.1
1,375	17.2	598	12.2	630	11.6
2,283	28.5	2,233	45.5	2,227	41.0
80	1.0	43	0.9	106	2.0
502	6.3	1,374	28.0	1,382	25.4
279	3.5	173	3.5	202	3.7
31	0.4	149	3.0	168	3.1
101	1.3	846	17.2	659	12.1
91	1.1	206	4.2	354	6.5
0	0.0	0	0.0	0	0.0
8,799		643		-741	
10,174		1,241		-111	
9,078		816		-539	
8,900		1,489		-82	
16,259		25,557		32,644	
0.26		0.18		0.28	
15,292		18,154		24,185	
0.24		0.13		0.21	

Table 2. Averages of variable costs for production of selected vegetable crops in Hawaii (1998–1999).

Activity	Machinery	Paid labor	Family labor	Materials	Subtotal	Percent of total variable cost
	($/acre)					(%)
Lettuce						
Land preparation	72	28	24	144	268	6.2
Planting	54	154	19	134	361	8.4
Weed control	12	571	32	237	851	19.8
Irrigation	30	0	24	367	421	9.8
Fertilization	1	38	7	116	161	3.8
Pest control	71	0	37	215	324	7.5
Harvesting	0	617	406	248	1,272	29.6
Marketing	214	0	336	62	611	14.2
Other	9	15	0	0	24	0.5
Total	463	1,422	884	1,523	4,292	100.0
Cucumber						
Land preparation	79	228	100	825	1,233	16.6
Planting	0	767	640	380	1,786	24.0
Weed control	0	249	0	23	272	3.7
Irrigation	0	0	0	128	128	1.7
Fertilization	0	79	0	550	629	8.5
Pest control	66	63	0	128	258	3.5
Harvesting	0	1,601	600	250	2,451	33.0
Marketing	274	106	35	0	415	5.6
Other	0	263	0	0	263	3.5
Total	420	3,356	1,375	2,283	7,434	100.0
Green onion						
Land preparation	24	13	30	83	151	1.7
Planting	0	462	507	456	1,425	16.0
Weed control	0	229	546	401	1,175	13.2
Irrigation	4	0	48	387	439	4.9
Fertilization	0	27	8	78	113	1.3
Pest control	39	0	46	326	411	4.6
Harvesting	0	1,304	2,095	116	3,516	39.6
Marketing	790	293	571	0	1,654	18.6
Other	0	0	0	0	0	0.0
Total	856	2,328	3,851	1,847	8,883	100.0
Chinese cabbage						
Land preparation	102	18	18	220	358	10.2
Planting	55	13	97	51	216	6.2
Weed control	18	40	48	22	129	3.7
Irrigation	51	0	0	280	331	9.5
Fertilization	0	0	0	0	0	0.0
Pest control	228	0	90	401	718	20.6
Harvesting	0	57	269	1,260	1,586	45.4
Marketing	80	0	76	0	157	4.5
Other	0	0	0	0	0	0.0
Total	535	129	598	2,233	3,494	100.0

Table 2 (continued).

Activity	Machinery	Paid labor	Family labor	Materials	Subtotal	Percent of total variable cost
	($/acre)					(%)
Head cabbage						
Land preparation	124	30	18	220	392	9.9
Planting	82	56	92	262	491	12.5
Weed control	26	60	8	10	104	2.6
Irrigation	91	0	0	671	762	19.3
Fertilization	0	0	0	0	0	0.0
Pest control	276	0	115	665	1,055	26.8
Harvesting	0	188	296	400	884	22.4
Marketing	152	0	102	0	254	6.5
Other	0	0	0	0	0	0.0
Total	752	334	630	2,227	3,942	100.0
Baby lettuce						
Land preparation	48	49	21	0	119	3.1
Planting	69	345	75	273	762	19.7
Weed control	0	1,035	0	0	1,035	26.8
Irrigation	19	21	0	166	206	5.3
Fertilization	6	59	11	106	182	4.7
Pest control	0	0	0	0	0	0.0
Harvesting	0	945	0	218	1,162	30.1
Marketing	121	0	241	0	363	9.4
Other	13	22	0	0	35	0.9
Total	276	2,477	348	762	3,863	100.0

Table 3. Summary of cultural practices for the vegetable crops surveyed.

Crop	Fertilizers		Pesticides[z]		Harvesting time[y] (hours)
	Applications	Formulations	Applications	Formulations	
Lettuce	4.2	2.7	10.7	2.5	122.0
Baby lettuce	2.5	2.0	0.0	0.0	127.7
Green onion	3.7	2.7	10.0	2.7	451.0
Cucumber	6.0	3.0	10.5	4.5	145.0
Chinese cabbage	1.1	1.1	19.7	5.0	38.3
Head cabbage	1.7	1.7	32.0	5.5	67.3

[z] Pesticides include herbicides, insecticides, fungicides, and surfactants.
[y] Harvesting includes cutting, washing, grading,[g] and packing.

Cultural practices

Table 3 summarizes the cultural practices (average fertilizer use, pesticide use, and harvesting hours) for the crops surveyed. Each farmer had different techniques and preferences for growing each crop; some were based on agricultural science, some on experience, and some on tradition.

Conclusions

It is very important for farmers to know their cost of production. Farming has become increasingly more competitive, and knowing the cost of production is an important tool in planning, forecasting, and decision-making. The computer program developed for this study puts this tool within reach of Hawaii's farmers.

The cost of production for the crops surveyed varied dramatically from crop to crop. Baby lettuce had the lowest average total cost of production, at $4,379/acre, while green onions had the highest at $10,508/acre. The total variable costs ranged from $3,494/acre for Chinese cabbage to $8,883/acre for green onion. Fixed cost ranged from $459/acre for baby lettuce to $1,551/acre for green onion. Cucumber and green onion cost the most to produce, but they also had high return. Chinese cabbage and head cabbage were cheaper to produce, but they generally had much lower return than cucumber or green onion.

The data summaries in this publication may be used—with caution—as a general guide to current costs of production in 1999. They may also be used—again with caution—to compare with your own data, calculations, and results, either from your own analysis or your use of the study's computer program. The need for caution is because the data summarized are from a small sample of farms on only two islands. Therefore, the data given here and the conclusions based upon them should not be used as a sole basis for business decisions, such as deciding which crops to plant. The market for vegetables in the state of Hawaii is small, and a few more acres of certain crops could easily flood the market, causing prices to drop dramatically.

Reference

Statistics of Hawaiian Agriculture, 1996. Hawaii Agricultural Statistics Service. March, 1998.

Acknowledgments

This research was supported in part by a grant from the Natural Resources Conservation Service, United States Department of Agriculture. We especially thank the farmers who participated in the study. In addition, thanks and appreciation for assistance with the project are extended to Gail Ichikawa (Natural Resources Conservation Service) and CTAHR colleagues Alton Arakaki, Steven Fukuda, Randall Hamasaki, Charlotte Nakamura, Dwight Sato, Robin Shimabuku, and Roy Yamakawa. Editorial assistance from Dale Evans is gratefully acknowledged.

Figure 1. Production costs.

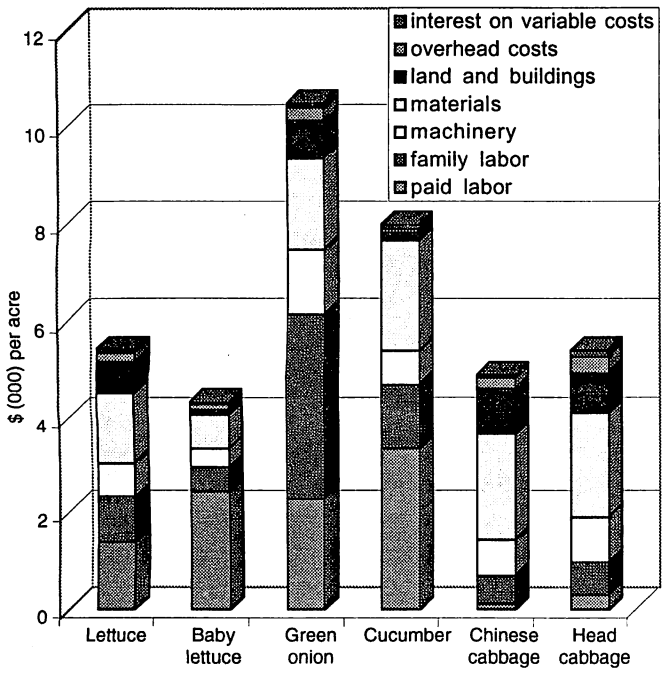

Figure 2. Variable costs by activity.