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The Economics of Commercial Banana Production in Hawaii

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Commercial banana production in Hawaii is primarily organized to supply the Cavendish-type banana, and all banana imports are of the Cavendish-type. The Hawaii banana industry currently supplies about one-half of the Hawaii market, but Hawaii could become self-sufficient with relatively little expansion if banana production were profitable. An economic model of Hawaii banana production is developed from which one can derive estimates of typical and specific economic profitability and consider various production, marketing, and policy scenarios. An analysis of the break-even price and yield and an analysis of the return to productive resources, help one interpret the cost of production results.

Currently about half of the bananas consumed in the state of Hawaii are produced in-state. Many banana varieties are grown throughout the tropical and sub-tropical regions of the world, but for practical purposes the varieties grown commercially in Hawaii can be categorized as either the **Cavendish**-type, which includes: the "Chinese" (syn. "Dwarf Cavendish"), "Williams," "Valery," and "Grand Naim" banana varieties, or the **Brazilian**-type, which includes: "Brazilian" (commonly and erroneously referred to as "Apple") and "Dwarf Brazilian" (syn. "Santa Catarina Prata"). There is significant local demand for the smaller, sweeter Brazilian varieties, and growers usually receive a slightly higher price for them. However, the 10-20% premium usually does not offset the associated post-harvest handling problems or the substantially lower yield.

About 80% of the domestically produced bananas and all of the imported bananas are Cavendish. In short, about 90% of the bananas sold today in the Hawaii retail market are Cavendish. What about the future? While Hawaii's producers have indicated that they intend to expand production to meet the domestic demand, this expansion would most likely produce Cavendish bananas. Therefore, it is unlikely that the mix of varieties will change significantly.

Given Cavendish's dominance of the current and projected market, the focus of this economic analysis is Hawaii's commercial Cavendish banana production. While the *results* generated from this analysis cannot be taken to represent the economic situation for other banana varieties, the analytical *approach* described in the methodology section is (with the appropriate financial data) equally effective for analyzing any banana enterprise.

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Economic Situation

In 1993 the Hawaii Agricultural Statistics Service (HASS) reported that in 1992, 135 farms had a total of 960 acres planted to bananas with 870 acres actually being harvested. Of this total banana acreage, 460 acres (48%) were in Cavendish banana production. Since 390 (85%) of the Cavendish acres are located on the Island of Hawaii, the current study is based on Hawaii Island field research.

The overall statewide average 1992 farmgate price was reported to be 41.0 cents per pound, and the average yield for all banana varieties was 13,793 pounds per acre. (HASS, 1993) The economic value of banana production is based on the **marketed yield,** the amount of bananas actually harvested, cleaned, packed *and* delivered to a ripening facility or shipped to a Honolulu distributor. Since the current study focuses on Cavendish varieties, the Hawaii Island averages of 38.1 cents per pound and 22,250 pounds per acre, are more representative of a"typical" banana farm. Unfortunately, HASS does not record the yield for Cavendish, but we

can assume the Cavendish yield was somewhat higher than the island's average because 1/8 of the Hawaii Island crop consisted of the lower yielding Brazilian-type varieties. The *Banana Industry Analysis No. 4* (Chia *et al.*, 1990) reported that the growers' consensus was that 35,000 lbs./acre was a "normal yield" for Cavendish under reasonably good management practices. Better growers interviewed during the current study reported that they actually market about 30,000 pounds per acre per year, and that their production goal is eventually to market 35,000 pounds. Hawaii's competitors in Costa Rica report marketing this amount. This study calculates economic profit using a conservative, observed marketable yield of 30,000 pounds per acre per year.

Typically, banana farms are small, family-operated farms, with about ten acres in banana production. HASS reported that in 1992 on the Big Island there were 25 banana farms with a total of 445 acres in bananas. Since one large grower accounts for about 200 acres, the remaining 24 farms utilize 245 acres, or about ten acres per farm.

There is an adequate amount of land suitable for increased banana production. However, in spite of the currently limited supply of domestically produced bananas and the substantial demand for bananas, the market price is not high enough to assure that all commercial banana production will necessarily be profitable, that is, will provide an equitable and satisfactory return to a grower. One must calculate the production costs and returns to determine if a particular banana operation could be financially viable. Furthermore, it would take very little extra land to produce enough bananas to replace all imports. With no potential export market, the Hawaii market could easily become saturated, lowering the price for all bananas and therefore the industry's profitability.

Methodology

An economic model of banana production was synthesized based on empirical data. The computerized model has two parts: (a) typical **operating** costs and returns, in cents per pound and in dollars per acre of bananas (Table 1), and (b) typical **ownership** costs and returns, in cents per pound and in dollars per acre, as above, and in dollars per typical farm (Table 2). In these tables, which are the actual computer printouts of the calculations, the italicized figures or text indicate variable data entries; the upright figures and text indicate calculated results or fixed categories.

Production practices in the operating section are typical of better producers, and the operating input costs are *typical* rather than average. A detailed description of the various production practices is beyond the scope of this economic fact sheet. However, it is important to note that bananas are planted and grown in "mats" of four plants per mat, with about 200 mats per acre. We are assuming an average yield of 150 marketable pounds per mat per year or 30,000 pounds per acre. Each plant produces one bunch of bananas, averaging about 50 pounds, but of course some of these bananas will be culls. We are also assuming a 20% annual replacement rate or 40 mats. The computer program calculates the required number of boxes and other harvest costs based on the yield.

The ownership arrangements are also meant to reflect a typical situation. Much of the land in bananas happens to be leased, but the model allows any ownership structure. Banana production is relatively labor intensive, but there is some opportunity for mechanization. The farm portrayed as typical in this study is somewhat mechanized, but the model accommodates the whole range of production possibilities, from no mechanization (all manual labor) to a relatively high level of mechanization.

The "bottom line" for the operations component of the model is *gross margin*, the gross revenue minus all of the operating costs, the amount available to pay for the ownership costs. The ownership "bottom line" is *economic profit*, the gross margin minus the value of all of the ownership resources (i.e., the management, capital and land resources) and an estimate of the riskiness of the enterprise.

Most smaller-scale farmers do not consider the full value of their labor, management and owner equity. They often think of their "profit" simply as the residual of their farming effort, what is left over for family living expenses. However, in calculating the economic profit, we must consider the value of *all* productive resources. The return to the farmer is the value to his labor, management, and owner equity *plus* the economic profit. (Unfortunately, economic profit may also be negative, in which case the return to the farmer would not be as great as the total value of the productive resources.)

Economic profit is the best measure of true farm profitability because it includes *all* costs, not simply cash costs, as does "accounting profit," a more commonly used measure of profitability. In the long run we would expect economic profit to equal zero because all "out-of-pocket" expenses will have been paid and all productive resources, such as land, labor, management, and the owner's capital investment, will have received a return at least equal to their value. We would therefore expect significantly positive economic profitability to attract other producers into the banana industry, and negative economic profitability to encourage producers to exit the industry.

Results

The complete results from part 1 of the program (operating costs) are provided as Table 1. Table 2 presents the detailed results from the second part of the program (ownership costs.) The summaries (Tables 3 and 4) are easier to

TABLE 2. BANANA OWNERSHIP COSTS

Typical 1992 annual gross margin, ownership costs, & economic profit per pound, acre & farm.

WHOLE FARM ASSUMPTIONS:					
Crops per year	*1.00*	Value of mgmt. (% of gross)	*5.0%*	Term debt/asset %	*20.0%*
Productive acres	*10.0*	Opportunity cost of money	*6.0%*	Term interest rate	*10.0%*

GROSS MARGIN, μ	*Lbs./acre/crop:*	*Lbs./acre/year:*	*Lbs./farm/year*	*¢/lb. sold/yr.*	*$/acre/year*	*$/farm/year*	*% of gross:*
Gross Revenue, Σ:	**30,000**	**30,000**	**300,000**	**38.1**	**$11,430.00**	**$114,300**	**100.0%**
Operating costs, Δ:				**26.2**	**$7,851.05**	**$78,510**	**68.7%**
A. Total pre-harvest costs =				11.4	3,413.58	34,136	29.9%
B. Total harvesting costs =				14.8	4,437.47	44,375	38.8%
GROSS MARGIN, μ (Σ - Δ) =				**11.9**	**$3,578.95**	**$35,790**	**31.3%**

OWNERSHIP COSTS, Ω:	*(per farm per year basis)*			*¢/lb. sold/yr.*	*$/acre/year*	*$/farm/year*	*% of gross:*
A. Management resource:				**2.7**	**$800.10**	**$8,001**	**7.0%**
1 Management	$114,300	gross income	5.0%	1.9	571.50	5,715	5.0%
2 Office overhead	$114,300	gross income	*2.0%*	0.8	228.60	2,286	2.0%
3 Other management costs		*Enter farm total under "$/fa*		0.0	0.00	0	0.0%
B. Capital resources:				**6.9**	**$2,069.20**	**$20,692**	**18.1%**
1 Depreciation (est.) on	$154,000	investment					
a. Machinery & equip.	*$40,000*	investment @	*14.3%*	1.9	572.00	5,720	5.0%
b. Bldg. & improve.	*$90,000*	investment @	*5.0%*	1.5	450.00	4,500	3.9%
c. Growing plants	*$24,000*	investment @	*0.0%*	0.0	0.00	0	0.0%
2 Interest expense on	$30,800	loan	10.0%	1.0	308.00	3,080	2.7%
3 Opportunity cost on	$123,200	equity	6.0%	2.5	739.20	7,392	6.5%
C. Land resource:				**1.0**	**$310.00**	**$3,100**	**2.7%**
1 Property taxes	*$85,000*	assessment	*1.00%*	0.3	85.00	850	0.7%
2 Property insurance	*$1,000*	premium		0.3	100.00	1,000	0.9%
3 **Leasehold:**							
a. Purchase of lease	*$0*	cost or mkt val.	*10*	years remaining on lease			
b. Depreciation of lease	*$6,000*	@ rate of	5.0%	0.0	0.00	0	0.0%
c. Interest expense	$0	loan	10.0%	0.0	0.00	0	0.0%
d. Opportunity cost	$0	equity	6.0%	0.0	0.00	0	0.0%
e. Lease rent/prod. acre/y	*$125*	/ac.+ % gross @	*0.0%*	0.4	125.00	1,250	1.1%
4 **Freehold:**							
a. Purchase price	*$0*	cost or mkt value					
b. Interest expense	$0	loan	10.0%	0.0	0.00	0	0.0%
c. Opportunity cost	$0	equity	6.0%	0.0	0.00	0	0.0%
D. Price/yield risk factor:		$114,300	*2.0%*	**0.8**	**$228.60**	**$2,286**	**2.0%**
TOTAL OWNERSHIP COSTS, Ω (A+B+C+D) =				**11.4**	**$3,407.90**	**$34,079**	**29.8%**
TOTAL COST OF PRODUCTION (Δ + Ω) =				**37.5**	**$11,259**	**$112,589**	**98.5%**
ECONOMIC PROFIT, π (μ - Ω) =				**0.6**	**$171.05**	**$1,711**	**1.5%**

BREAK-EVEN ANALYSIS: Gross margin =μ; economic profit = π			*μ /acre/yr.=$0 when:*	*π /acre/yr.=$0 when:*	
In order to cover operating & total costs, μ & π, respectively, must be >= $0:					
given the current ave. yield of	**30,000**	lbs/ac/yr, the break-even ave. PRICE =	**26.2**	**37.5**	¢/pound
given the current ave. price of	**38.1**	¢/lb., the break-even YIELD/acre/year =	**20,606**	**29,551**	lbs/ac/yr

read; however, the detailed results of Tables 1 and 2 have two important uses. First, one may determine exactly how each cost was calculated. And secondly, the detail shows what kinds of data are needed in order to calculate the profitability of a specific banana operation. With the appropriate data, growers can use the economic model, either with an extension agent or on their own, (a) to calculate enterprise profitability and (b) to consider the economic impact of proposed or anticipated production, marketing, or policy changes, in short, to answer "what if?" questions.

Discussion and Conclusions

The gross revenue per pound of bananas is simply the average price of bananas per pound. The gross revenue per acre is this price per pound multiplied times the pounds of bananas actually marketed per acre per crop cycle. The methodology section explained how these particular figures were selected.

Operating costs are the costs for each of the various production and harvest activities. The total cost of production is primarily of interest relative to the gross income from banana sales. The gross margin helps to relate these two figures. The gross margin (*i.e.*, the gross revenue minus the total operating costs) is the amount remaining after paying for all of the operating input costs and for all labor (whether or not this labor was in fact "paid labor.") Therefore, the gross margin can be thought of as the amount left over to pay the ownership costs.

The cost of production can be represented in various ways, but perhaps the most popular expression is in terms of what it costs to grow a pound of bananas. In Table 3, we can see that in 1992 banana farmers typically received about 38.1¢ for a pound of bananas. Valuing pre-harvest labor at $12.00 per hour ($9.00 + 33% for labor "benefits," *e.g.*, self-employment or FICA tax, health insurance, etc.) and harvest labor at $10.00 per hour ($7.50 + 33.3% benefits), it cost 2¢ /lb. to plant replacement mats, a little over 4 1/2¢ /lb. for field maintenance (pruning plants, etc.), about 2 1/2¢ /lb. to fertilize the crop, a little over a half cent per pound for weed control, almost 1¢ /lb. for other pest control, nothing for irrigation (since in this case we have not included an irrigation system), and about 3/4¢ /lb. for interest on the operating costs. The total pre-harvest growing costs amount to about 11 1/2¢ /lb., almost a third of the 38.1¢ received for the pound of bananas. Harvesting, packing and shipping costs add almost 15¢ /lb. more, for a total of a little over 26¢ per pound, about two-thirds of the amount received per pound of bananas. The gross margin is almost 12¢ /lb., about one third of what was received for the bananas. This amount is what remains to pay the ownership costs.

If the ownership costs can be controlled, the farm can be profitable. But since the banana farm typically is small to begin with and since the gross margin is fairly small, we can expect profitability to be relatively sensitive to the size of the operation. Table 4 summarizes the ownership costs in the same "costs per pound" terms in which the operating costs were expressed.

Management is valued at about two cents per pound of bananas sold. The value of the capital resources is almost 7¢ /lb., and the value of the land resource is one cent per pound. There is some risk involved in being an entrepreneur, so a contingency factor is included to compensate for the likely variability in price and/or yield. The estimate used here may be low, and for planning purposes, an individual grower may wish to increase it to reflect personal experience. This entry can be interpreted as saying that the preceding analysis of a typical growing situation is a reasonable estimate, but there is a good chance that the price and/or yield could drop by 2%. The total ownership costs per pound therefore amount to about 11 1/2¢ /lb., consuming nearly the entire gross margin and leaving only a half cent per pound as the economic profit. However, we must remember that an enterprise which generates any economic profit at all is "adequately profitable" in the common sense of "profit." Recall that an economic profit of at least zero means that all cash operating costs have been

TABLE 3. Summary of Operating Costs in ¢/lb. & $/acre (from Table 1)

GROSS REVENUE	Lbs./crop cycle	Price (¢/lb.)	Revenue ($/acre)	% of gross
Typical yield per crop	30,000	**38.1**	**$11,430**	**100.0%**
OPERATING COSTS:		**Cost (¢/lb.)**	**Cost ($/acre)**	**% of gross**
A. Pre-harvest costs: Labor @ $12/hr.				
1 Planting		2.0	600.00	5.2%
2 Maintenance		4.6	1,388.01	12.1%
3 Fertilization		2.6	782.00	6.8%
4 Weed Control		0.6	185.00	1.6%
5 Pest Control		0.9	256.78	2.2%
6 Irrigation		0.0	0.00	0.0%
7 Operating interest @ APR		0.7	201.79	1.8%
Total pre-harvest costs =		*11.4*	*3,413.58*	*29.9%*
B. Harvest costs: Labor @ $10/hr.				
1 Harvesting, grading & packing		9.6	2,872.82	25.1%
2 Shipping		5.2	1,564.65	13.7%
Total harvest costs =		*14.8*	*4,437.47*	*38.8%*
TOTAL OPERATING COSTS		**26.2**	**7,851.05**	**68.7%**
GROSS MARGIN		**11.9**	**3,578.95**	**31.3%**

TABLE 4. Summary of Annual Ownership Costs (from Table 2)

GROSS REVENUE		¢/pound	$/acre/yr.	$/farm/yr.	% of gross
1.00 crops per year	30,000	**38.1**	**$11,430**	**$114,300**	100.0%
10.0 productive acres	Lbs./acre/yr.				
OWNERSHIP COSTS:		**¢/pound**	**$/acre/yr.**	**$/farm/yr.**	**% of gross**
A Management resource		2.7	800	8,001	7.0%
B Capital resources		6.9	2,069	20,692	18.1%
C Land resource		1.0	310	3,100	2.7%
D Price/yield risk factor		0.8	229	2,286	2.0%
Total Ownership costs =		**11.4**	**$3,408**	**$34,079**	**29.8%**
Total Operating costs =		26.2	$7,851	$78,510	68.7%
TOTAL COST OF PRODUCTION =		**37.5**	**$11,259**	**$112,589**	**98.5%**
ECONOMIC PROFIT =		**0.6**	**$171**	**$1,711**	**1.5%**

paid and that all productive resources (including "unpaid" labor) would have received a return equal to their value.

But how profitable is "adequately profitable?" In other words, how much taxable income would an owner-operator of this enterprise of 10 productive banana acres, expect to earn in a year from labor, management, and owner equity? To put labor hours into perspective, a full time industrial worker is assumed to provide 2,000 hours of labor annually. A typical farmer works 2,500 hours per year. The total number of labor hours in our example farm, is 3,470 (from Table 1), or almost one and a half full-time operators, especially when time for management is included. We can estimate the *value* of the owner's labor to be $27,620 ($37,620 minus $10,000 for extra hired harvest labor); the *value* of management is $5,720 (from Table 2), for a total of $33,340. However, the actual total annual income is $42,425: the total *value* of labor and management, $33,340, plus the *value* of the capital equity, $7,392, *plus* the economic profit of $1,693.

If there were a 10% decrease in yield (i.e., down to 27,000 lbs./ac./yr.) and price (34.3¢/lb.), the situation would be quite different. Harvest labor hours would be down because of the lower yield, so the owner would not need to hire as much harvest labor. The value of the owner's labor would be reduced by about $1,000, to $26,618. The value of management would be down to $4,631. The value of the owner's equity would remain the same. Therefore, the total **value** of the labor, management, and capital resources would be $34,010. However, when the negative economic profit (-$13,820) is added in, the **return** to these resources drops to $20,190. In this case, while a 2% decrease in gross income will not have a noticeable effect on net returns, a 20% decrease in price and/or yield results in a 50% decrease in "profitability."

In conclusion, given the assumptions made throughout this study, banana production for better than average managers is reasonably "profitable." The break-even yield is 29,874 pounds per acre and the break-even price is 37.9 ¢/pound. As long as the yield and price are equal or greater than this, the producer will cover all costs of production and generate an adequate return for labor, management and owner equity. However, it must be stressed that the results of this study were not deducted from a survey of all producers, and the input costs are not based on averages. The production model was synthesized from an in-depth analysis of a few selected farms in order (a) to estimate the economic profitability of a typical Cavendish banana farm and (b) to provide a structure for an economic analysis of any banana enterprise.

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The computer model used in the economic analysis was developed with Excel on a Macintosh computer and is freely available to anyone with access to a similar system or who can import an Excel 4 file into their preferred spreadsheet program. To obtain a free copy of the computer program or to comment on this publication, contact the editor directly at UH–Manoa, Kealakekua, HI 96750-0208. *(808) 322-9136.*

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