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COSTS AND BENEFITS ASSESSMENT OF HATILLO ENERGY CANE

PLANT AND FIRST-CONSERVATION CROPS; 1982-1983

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ABSTRACT

Energy cane yields and costs from a 25-acre study at Hatillo are reviewed for both intensive and conservation production scenarios. Maximum yield from intensive production was 125 tons whole cane/acre year, at a cost of $9.82/ton. Maximum yield from conservation agriculture was 53 tons/acre year, at a cost of $7.47/ton. The potential value of energy cane is presented in the context of a multiple-products commodity vs a traditional sugar and molasses commodity. Conservation culture, though economical, is limited by the need for intensive inputs every second year, and a greater commitment of land area to produce a given quantity of cane.

THE HATILLO STUDY

An assessment of production costs and potential benefits has been prepared for two sugarcane crops managed as energy commodities. Termed "energy cane", this material has been under investigation since 1980 at a 25-acre farm near Hatillo on the semi-humid north coast. Two crops were produced: (a) An intensively-managed plant crop, and (b), a "conservation" (or minimum tillage) crop, designed to measure the carry-over effects of the previous year's intensive inputs.

Two "generations" of energy cane were propagated. The first generation was represented by a standard commercial cane variety ordinarily planted for sugar (var. PR 980); the second generation, variety US 67-22-2, was specifically selected for its biomass energy and sugar attributes.

Two control plantings were made, simulating both conventional cane management ("Sugar Corporation" control) and minimum-tillage cane receiving no inputs after initial establishment.

The study was performed by CEER-UPR Biomass Division personnel based at Lajas and Río Piedras. The farm itself (Santa Rosa) was made available by its owner, Mr. José B. De Castro, retired, currently residing at Río Piedras. The PR Sugar Corporation collaborated with certain production and harvest equipment and with milling facilities at Coloso near Aguadilla.

RESULTS

1. Yields And Costs; 1st And 2nd Generations

(a) First Generation: The 25-acre farm yielded 93 short tons of cane managed as an energy crop, ie, with emphasis on final tonnage rather than sugar (Table 1). This was the first-generation variety PR 980, an interspecific *Saccharum* hybrid normally planted for sugar. It ordinarilly yields 25 to 30 short tons as a sugar commodity. The cost of this cane was in the order of $1,018 per acre, or $10.95 per ton (Table 1).

The most expensive cost factors were fertilizer ($180.00/acre) and harvest/delivery operations ($465.00/acre). The same two factors will figure prominently in any energy cane enterprise based on intensive management. The principal means of lowering costs/ton under these circumstances is by increasing the productivity of each dollar input, that is, by increasing the tonnage of harvested cane.

An alternative way to lower costs is via "conservation agriculture". By this means the variable inputs such as fertilizer, irrigation, and pesticides are reduced or eliminated altogether, leaving only fixed costs such as land rental and harvest/delivery operations to be borne by the energy planter. The "conservation" approach was taken for the first-ratoon crop (Table 1). Both yield and cost figures were dramatically reduced (to 31 tons per acre, at a cost of $256.00 per acre). Because yield declined less than expenditures, the cost per ton was further lowered to only $8.26 (Table 1).

By way of reference, a typical yield of conventional sugarcane is 25 to 27 tons/acre, with costs ranging from $25.00 to $30.00/ton, or approximately $700.00/acre. The two energy cane crops at Hatillo materially lowered their costs, on a per ton basis, by vastly increasing yields relative to dollars expended.

(b) Second Generation: Production costs were further lowered with the second-generation variety (US 67-22-2, an interspecific (*S. spontaneum*) hybrid (Table 2). This again was a direct result of increased yields from essentially constant production expenditures. The plant crop, harvested in 1982, produced 125 tons whole cane/acre at a cost of $9.82/ton. The first conservation crop yielded 53 tons/acre at a cost of $7.47/ton. This is the optimal cost figure obtained to date for energy cane.

It must be emphasized that such cost reductions are predicated first on the exceptional growth capability of *Saccharum* species, and second, on the outstanding growth characteristics of the variety US 67-22-2, specifically selected for its high tonnage attributes rather than sugar.

2. Energy Cane Sugar And Fuel Values

(a) Energy Cane As A Fuel Source: The energy cane harvested at Hatillo was sold as conventional sugarcane and milled at Central Coloso. There is so biomass-processing facility in Puerto Rico, that is, no dewatering plant operating in conjunction with a drying and size-reduction enterprise to produce boiler fuel of higher quality than bagasse. Because of this, much of the energy value of energy cane is not credited when processed by a standard sugar mill. In the latter facility bagasse is esentially a waste byproduct to be disposed as a low-grade fuel for low-pressure boilers that were not designed to function efficiently as energy-recovery systems. About the last thing that sugar mill engineers want to have lying around is excessive bagasse. This would not be the case in an energy cane processing plant in which biomass fuels are the primary product and sugar a byproduct.

The bagasse emerging from sugar mill tandems in Puerto Rico today contains about 52% moisture. It burns with some difficulty, requiring excess air and 2 to 4 gallons of oil/ton to effect complete combustion. Dried to ambient moisture (15-18%), this material would be an excellent substitute for fossil fuels in a boiler system designed to accept biomass. Pegged to the current value of no. 6 fuel oil ($29.00/bbl), each pound of dried bagasse has a potential value of 3.5 cents (Table 3). On a per acre basis this would be in the order of $1,300 for intensively-managed energy cane (Table 3, item 3(a). Added to this is the value of "trash" exceeding $1,600/acre (Table 3, item 3(b). Added to this is the value of "trash exceeding $1,600/acre (Table 3, item 3(b).

From these approximate figures it evident that the value of energy cane utilized as an energy crop at 125 tons/acre is nearly double its worth as a sugar crop; moreover, its value as an energy crop is more than three times that of conventional sugarcane (yielding only 26 tons cane/acre). In essence, the data from Hatillo show that cane products exceeding $6,000 per acre can be grown, harvested, and delivered for slightly more than $1,200/acre (Table 3).

(b) <u>Energy Cane As A Sugar Source</u>: Although propagated for fuel, the sugar yield of energy cane is appreciable. Over 5 tons sugar/acre were recovered from the Hatillo cane (plant crop), which compares quite favorably to the 2.0 to 2.2 tons sugar/acre recovered from conventional sugarcane in Puerto Rico. Again, the high sugar yields are a function of the higher tonnage of energy cane harvested per acre. It can be seen that energy cane is a better sugar source than sugarcane.

When pointed out to various audiences, the sugar value of energy cane is sometimes questioned on the grounds that "so much more tonnage" of raw whole cane must be milled to obtain this sugar. Such logic, though understandable in the context of conventional sugar planting, is invalid when applied to energy cane. The mill does not grind and sort through a greater amount of relatively useless fiber to obtain a given quantity of sugar; rather, a relatively greater amount of valuable fuel is ground and sugar is recovered incidentally to the fuels dewatering process. Again, whether thinking in terms of fuels or fermentable solids as the salable products, it is utterly critical that a future cane industry be oriented to the highest possible tonnage of total biomass yield per dollar expended rather than the traditional yield of sugar per dollar expended.

Although the economics of conservation agriculture for second-generation energy cane appear attractive, two factors must be borne in mind for any future energy-planting scenario: (a) The relatively high yields obtained (53 short tons per acre year) are predicated upon intensive inputs being administered every second year, and (b), a greater land area must be committed to attain a given feedstock supply for an energy cane processing plant. Cane that has been allowed to grow essentially "wild" on a continuous basis produces in the order of 12 to 16 tons per acre year. Managed as energy cane with minimal inputs every second year, the land area needed to attain the feedstock goal would be roughly 1.4 times greater than needed under a continuous intensive production scenario.

BACKGROUND REFERENCES

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Table 1

PRODUCTION COSTS FOR FIRST GENERATION ENERGY CANE

(Hatillo Project; Plant and 1st Ratoon Crops)

ITEM No.	INPUT	COST ($US/ACRE), FOR CROP 1/	
		PLANT (1980)	1st RATOON (1982)
1.	LAND RENTAL	50	50
2.	SEEDBED PREPARATION	45	0
3.	WATER	60	0
4.	WATER APPLICATION	48	0
5.	SEED	45	0
6.	FERTILIZER	180	0
7.	PESTICIDES	27	0
8.	DAY LABOR 3/	30	0
9.	HARVEST & DELIVERY	465	171
10.	CULTIVATION	5	0
11.	LAND RENOVATION	0	0
12.	SECURITY	0	35
13.	SUBTOTAL	925	256
14.	MANAGEMENT (10% Of #13)	93	0
15.	TOTAL COST/ACRE	1,018	256
16.	YIELD (TONS/ACRE) 2/	93	31
17.	COST/TON ($US)	10.95	8.26

1/ "First generation" = variety PR 980.

2/ Whole cane; includes stems, tops, and attached leaves but not detached leaves ("trash").

3/ Labor not included in other cost items.

Table 2

PRODUCTION COSTS FOR SECOND GENERATION ENERGY CANE

(Hatillo Project; Plant and 1st Ratoon Crops)

ITEM No.	INPUT	COST ($US/ACRE), FOR CROP — PLANT (1980)	1st RATOON (1982)
1.	LAND RENTAL	50	50
2.	SEEDBED PREPARATION	45	0
3.	WATER	60	0
4.	WATER APPLICATION	48	0
5.	SEED	45	0
6.	FERTILIZER	180	0
7.	PESTICIDES	27	0
8.	DAY LABOR	30	0
9.	HARVEST & DELIVERY	625	292
10.	CULTIVATION	5	0
11.	LAND RENOVATION	0	0
12.	SECURITY	0	18
13.	SUBTOTAL	1,115	360
14.	MANAGEMENT (10% OF #13)	112	36
15.	TOTAL COST/ACRE	1,227	396
16.	YIELD (TONS/ACRE)	125	53
17.	COST/TON ($US)	9.82	7.47

1/ "Second generation" = variety US 67-22-2.

2/ Whole cane; includes stems, tops, and attached leaves but not detached leaves ("trash").

3/ Labor not included in other cost items.

Table 3

SUGAR AND FUEL VALUES FOR 2ND GENERATION ENERGY CANE

(Hatillo Project; Variety US 67-22-2)

ITEM	COMPONENT	CROP	TONS/ACRE	VALUE ($US/ACRE) 1/
1.	SUGAR	PLANT	5.63 2/	2,522 1/
		1st RATOON	2.61 3/	1,169
2.	MOLASSES (BSM)	PLANT	1.41	987 4/
		1st RATOON	0.65	455
3.	COMBUSTIBLE DM 5/			
	(a) Bagasse	PLANT	18.8	1,316 6/
		1st RATOON	8.0	560
	(b) Trash	PLANT	23.3	1,631 6/
		1st RATOON	5.5	385

TOTAL VALUE/ACRE:

- o As Sugarcane (Items 1 + 2) — Plant Crop .... 3,509; 1st Ratoon 1,624
- o Energy Cane (Items 1 + 2 + 3) — Plant Crop .... 6,456; 1st Ratoon 2,569

1/ At 22.4 cents/lb.; N.Y. Coffee & Sugar Exchange, April 9, 1983.

2/ Rendiment = 4.50

3/ Rendiment = 4.92.

4/ At 35.0 cents/lb. BSM (Blackstrap Molasses).

5/ Air dry basis (15%, moisture), 6,500 BTUs/lb. (approx.).

6/ Assumes 6,500 BTUs/lb., pegged to no. 6 oil at $29.00/bbl.

Table 4

POTENTIAL INPUT AND BENEFIT VALUES FOR ENERGY CANE

(Intensive Vs Low-Tillage Management Scenarios)

ITEM NO.	CROP	INPUT LEVEL	VALUE ($US/ACRE) 1/ INPUTS	BENEFITS	DIFFERENCE
1.	PLANT	INTENSIVE	1,227	6,456	5,229
2.	1st RATOON	LOW-TILL	396	2,569	2,173
% Decline With Low Tillage			-67.7	-60.2	-58.4

1/ Based on cost and yield data from Hatillo project (1980-1983), and current (1983) values of sugar and fuel oil.