

**COMPARING COSTS AND RETURNS FOR SUGARCANE PRODUCTION  
ON SAND AND MUCK SOILS OF SOUTHERN FLORIDA, 2008-2009**

**Fritz M. Roka<sup>1\*</sup>, Leslie E. Baucum<sup>2</sup>, Ronald W. Rice<sup>3</sup>, and Jose Alvarez<sup>4</sup>**

<sup>1</sup>Southwest Research and Education Center, University of Florida, 2685 SR 29N Immokalee, FL 34142

<sup>2</sup>Hendry County Cooperative Extension, University of Florida, 1085 W Pratt St. LaBelle, FL 33975

<sup>3</sup>Palm Beach County Cooperative Extension, University of Florida, 559 N Military Trail, W Palm Beach, FL 33415

<sup>4</sup>Everglades Research and Education Center, University of Florida, 3200 E Palm Beach Rd, Belle Glade, FL 33430

\*Corresponding author: fmroka@ufl.edu

**ABSTRACT**

Sugarcane production in Florida is concentrated south and west of Lake Okeechobee and is grown on both muck and sand soils. During the 2008-2009 season, more than 12 million metric tons of sugarcane was harvested and supported important sugarcane milling and sugar refining operations located in southern Florida. Farms on muck soils account for 80% of Florida's annual sugarcane crop, while farms on sand soils account for the remaining 20%. This paper compares revenues, production costs and net annual returns from two equally sized sugarcane farms (2,000 hectare) representing typical growing conditions on sand and muck soils. Sugarcane growers on muck soils enjoy two distinct advantages over their counterparts farming sugarcane on sand soils. First, total farm revenues are higher because of greater yields and a higher percentage of land that can be grown for commercial harvest. Second, unit costs of production are lower due to the inherent organic matter in muck soils, allowing growers to apply substantially less quantities of fertilizers. Annual net returns to land, management and risk from growing sugarcane on muck soils are estimated to be \$400/ha, more than five times higher than estimated net returns from growing sugarcane on sand soils (\$70/ha). While sugarcane production on sand soils is less profitable relative to muck soils, economic returns from sugarcane on sand soils are higher than from cattle operations, offer less risk than presently associated with citrus production, and occupy land area far beyond the capacity of the vegetable industry to absorb.

Keywords: representative farm, enterprise budget, sugar price, yields

**INTRODUCTION**

The Florida sugarcane industry is a major contributor to the state's agricultural economy. The 2008-2009 sugarcane harvest season produced 1.40 million metric tons of raw sugar from approximately 12.15 million metric tons of sugarcane (Eiland 2009). Sugarcane was harvested on 157,138 hectares, which represented a 1.7% increase from the previous year (Rice et al. 2009). Sugar is a basic industry in Florida because it channels dollars from outside the state and

generates direct, indirect and induced impacts on the regional and state economies. The annual farm gate value of raw sugar and molasses between 2004 and 2008 averaged more than \$440 million (USDA-NASS 2009). The revenue generated by the sugar industry, which includes sugarcane farming, milling and sugar refining, along with resulting byproducts, has a significant impact on south Florida and the state's economy. The vertically integrated industry generates more than \$2.2 billion of annual output. When the economic multiplier takes into account the indirect as well as the direct economic impacts, the Florida sugar industry contributes more than \$4.5 billion to the state's economy and provides for more than 47,000 jobs (Hodges et al. 2004).

Sugarcane production in Florida is concentrated in areas south and west of Lake Okeechobee. Palm Beach, Hendry and Glades are south Florida counties where sugarcane production is especially important. Growers in Palm Beach County produce sugarcane primarily on "muck" or organic soils. Growers in Hendry and Glades counties produce sugarcane primarily on "sand" or mineral soils. Harvested sugarcane area in 2008-2009 was divided between 125,312 hectares (80%) on organic soils, and 31,826 hectares (20%) on mineral soils (Rice et al. 2009).

The purpose of this paper is to compare the estimated annual costs and returns from growing sugarcane on organic and mineral soils in South Florida, hereafter referred to as muck and sand soils, respectively. Cost and return information is important to sugarcane producers and processors, as well as to researchers, lending institutions, government agencies, public officials, private consultants, and other interested parties. More specifically, estimating differences in costs and returns from the main sugarcane production areas should highlight differences in sugarcane profitability and potential impacts on the economic base of south Florida communities should sugarcane acreages decline or shift between muck and sand soils in response to alternative land-uses that have been proposed (Everglades restoration initiatives, regional water storage, urban development pressures, re-zoning efforts of agricultural land to industrial land use, etc).

In the past 20 years, several important changes have taken place within Florida's sugar industry that has affected grower costs and returns from producing sugarcane. Some of these changes include:

- Complete mechanization of harvesting operations.
- Increase in the implementation of Best Management Practices (BMPs).
- Decline in the acreage of sugarcane grown by independent growers.
- Declining acreage due to the conversion of land from sugarcane production to public water storage as part of the Comprehensive Everglades Restoration Plan, and
- Changes in factor and output prices.

## **DESCRIPTION OF FARMING OPERATIONS**

### **Representative Farms**

All data used in this analysis come from enterprise budgets previously developed for sugarcane production on sand and muck soils in south Florida (Roka et al. 2009; Roka et al.

2010). These budgets describe typical production practices, input usage, material costs, and net returns. Revenues are based on 2008 prices of raw sugar. Enterprise budgets for both sand and muck farms assumed a representative farm size of 2,000 hectares. The farm size was based around the collective opinion of producers and sugarcane scientists to 1) facilitate mechanical harvesting; 2) achieve economies of scale in production; 3) portray current land tenure; and 4) make cost and return extrapolations easier and more reliable. The budgets reflect production and marketing conditions during the 2008-2009 sugarcane harvest season.

Budgets for sand and muck farms were similar in that they assumed the same crop cycle, consisting of one harvest of plant-cane and three harvests of ratoon crops. Plant-cane is harvested generally 15 months after planting. Thereafter, at approximately 10 to 12 month intervals, ratoon crops are harvested from the sugarcane stubble. Whether a particular block of sugarcane continues through a second, third or higher ratoon depends on the yield expectation of the next ratoon crop. A grower would prefer to harvest several ratoon crops and defer replanting costs for as long as possible. For a variety of reasons including disease, plant damage from mechanical harvesting operations, an inferior clonal selection for a particular block, and weed pressures, a grower will decide to replant various blocks after only the first or second ratoon. As a result, acreage by crop age declines over a multi-year cycle. This is reflected in the land distribution data for sugarcane production in south Florida reported by Rice et al. (2009). The authors described harvested acreage during the 2008-2009 season as 32.9% in plant-cane, 31.5% in first ratoon, 25.6% in second ratoon, 8.4% in third ratoon, and 1.6% in fourth ratoon or older. The land distribution for both representative sand and muck farms follow the percentages reported by Rice et al. (2009).

### **Differences in Harvested Land Area**

While the percentage of harvested land by plant-cane and ratoon crops are similar between sand and muck farms, the total acreage harvested from a representative farm is different between sand and muck farms. A higher percentage of total acreage is harvested commercially from a muck farm than from a sand farm for three reasons: 1) less area devoted to infrastructure, 2) less fallow land, and 3) less area dedicated to seed-cane production (Table 1).

Infrastructure for a sugarcane farm includes areas for buildings, harvest loading areas, perimeter roads, and irrigation/drainage. Sand farms require more land in infrastructure mainly due to increased number of ditches. Sugarcane in south Florida is irrigated primarily from surface water. Ditches are needed to convey irrigation water from canals and rivers to the fields. The same ditches are used to drain excess water away from fields, especially during the south Florida rainy season (June – September). Muck soils have a higher water holding capacity than sand soils, hence fewer ditches are required. As a rule of thumb, irrigation ditches on sand farms are spaced 45 meters (150 feet) apart. On muck farms, ditch spacing increases to 135 meters (450 feet). Generally, fields on both sand and muck farms are laid out in 1.6 by 0.8 kilometer (one mile by half-mile) blocks. Vehicle traffic moves along perimeter roads surrounding each section (one-square mile or 259 hectares). For a muck farm, infrastructure is estimated to require 100 hectares, 5% of the total farm area. With the requirement for more closely-spaced irrigation

ditches, infrastructure for a sand farm is increased to 150 hectares or 7.5% of the total farm area.

The inclusion of a fallow period for production on sand soils reflects an important difference in the land utilization between sand and muck farms. A fallow period for any given block might last from six to nine months depending on when the last ratoon crop was harvested and when the block was replanted in the fall. Successive planting is a cultural practice where sugarcane is replanted a few weeks after harvesting the final ratoon crop, thus eliminating the summer fallow period. In south Florida, successive planting generally is not practiced on sand soil in Florida, while it is done on roughly half of the muck lands (Rice et al. 2009). On muck farms, successive planting tends to occur on blocks where the last ratoon crop is harvested during the fall months. On blocks where the last ratoon crop is harvested in late winter (February and March), there is not sufficient time to successively replant and harvest a new crop of plant-cane before the end of next year's sugarcane milling season, which typically ends in March or April. Consequently, blocks harvested in late winter will lay fallow until the (following) fall when planting occurs. As shown in Table 1, a sand farm incorporates a fallow period prior to the establishment of the next plant-cane crop. For a muck farm, half of the newly planted acreage follows a fallow period. The remaining muck acreage is successively planted after the last ratoon is harvested.

It is important to note that many sugarcane growers in south Florida on both sand and muck soils produce other agricultural crops on fallow land. Many sugarcane growers lease fallow land to vegetable farmers who grow crops such as sweet corn and green beans. On muck soils, some sugarcane growers flood their fallow fields and cultivate rice. In addition to the value of the rice crop, this practice helps stem the loss of organic soils to subsidence, significantly reduces soil insect populations, and provides a yield boost for the next cycle of sugarcane production (Alvarez and Snyder 2004). The representative budgets for both sand and muck farms did not incorporate any income (or costs) associated with growing other crops during a fallow period. Instead, the representative budgets considered only the costs of maintaining fallow ground.

Sugarcane is propagated vegetatively and sugarcane used for planting (seed sugarcane) is usually cut from selected blocks of plant-cane. Planting rates of 13.4 metric tons per hectare (6 short tons per acre) are assumed for both sand and muck farms. Since more area of a muck farm is being planted, more tonnage of sugarcane for seed is required. However, as will be discussed in the next section, sugarcane yields from muck soils are 20% higher than from sand soils. Higher yields on muck soils allow the production of the required tonnage of sugarcane for seed to occur on fewer acres. Overall, a net difference of 5 fewer hectares is dedicated to seed production for our representative 2,000-hectare muck farm (Table 1).

The cumulative effect from less land devoted to farm infrastructure and production of seed material, and with more land in successive planting rotations, allows a muck farm to harvest more sugarcane acreage annually. The representative muck farm harvests nearly 79% of its available land, or 1,573 hectares. The comparable sand farm harvests 1,298 hectares annually, or

65% of its total farm area (Table 1).

## PRODUCTION

Yield estimates by crop age and type of farm were developed through a two-stage process. First, overall average annual farm yields for the representative sand and muck farms were estimated. Second, land distribution percentages from crop land census data were used to determine a weighted average annual yield estimate for plant-cane, first, second, and third ratoon acreage.

Annual farm production of sugarcane in south Florida averaged 83 gross metric tons per hectare (37 tons/ac) over a 10 year period from 1998 through 2007 (USDA-ERS, 2009). Gross tonnage includes trash and debris and this average reflects production from all crop ages and from sugarcane harvested on both muck and sand soils. Muck soils account for 80% of the production area in south Florida (Rice et al., 2009). Therefore, a state wide average of 83 metric tons per hectare reflects a weighted average from both sand and muck soils, or

$$83 \frac{mt}{ha} = .8(x) + .2(y)$$

where  $x$  is the average (gross) sugarcane yield from farms on muck soils and  $y$  is the average (gross) sugarcane yield from farms on sand soils. Interviews with several sand land sugarcane producers suggest that 72 gross metric tons per hectare (32 tons/ac) is a good representative average annual sugarcane yield from farms on sand soils. Combining the above data suggests that a representative muck farm averages 86 gross metric tons per hectare (38 tons/ac) annually. The yield average for muck farms reflects not only yield differences among plant-cane and ratoon crops, but also production differences between successive planting and a new sugarcane cycle following a fallow period. Generally, plant-cane yields from experimental plots are higher when following a fallow period (USDA-ARS, annual issues).

Given average yields of 72 and 86 metric tons per hectare of gross sugarcane from sand and muck farms, respectively, yield estimates for plant-cane, first, second, and third ratoons were determined by using the land distribution percentages as reported in Rice et al. (2009). Yields for sand and muck farms by plant-cane, first, second, and third ratoons are reported in Table 2. For each crop age gross tonnage of sugarcane is higher for muck soils than for sand soils. The percentage differences declines in the second and third ratoons. Plant-cane and first ratoon yields from muck soils are estimated to be between 17 and 31% higher than yields from sand soils. By the third ratoon, yields from muck soils are only 3% higher than from sand soils (Table 2).

Growers harvest “gross tons” (GTs) of sugarcane, but cooperative and independent producers are paid on the basis of total sugar. Before calculating total sugar, trash and debris, which are included in GTs, must be estimated and subtracted from the tonnage delivered to the mill. Generally, all sugarcane is burned prior to harvest, thus eliminating most of the potential

debris. Several growers and industry experts have commented that debris ranges between 5 and 9% with not much difference between sand and muck areas. From these comments, a constant debris factor of 7% is assumed for both sand and muck farms. Deducting the trash content from the gross tonnage of sugarcane delivered to the mill yields “net tons” (NTs). Total sugar is determined by simply multiplying NTs by the sucrose content of the delivered sugarcane, which is measured as “normal juice sucrose.” Sucrose content in sugarcane varies by variety, crop age, and growing conditions. Generally, sucrose percentages from sugarcane grown on sand soils tend to be higher than sugarcane grown on muck soils (USDA-ARS, annual issues). The enterprise budgets for the representative sand and muck farms assumed normal juice sucrose percentages of 15.75% and 14.50%, respectively. Given the yields presented in Table 2 and acreage values by crop age presented in Table 1, a 2,000-hectare sugarcane farm on sand soils produces 13,647 metric tons of raw sugar annually. Despite a lower sucrose percentage, total annual sugar produced from a similarly sized muck farm produces 18,185 metric tons, or 4,500 more metric tons than what is produced from a sand land operation.

## FINANCIAL RETURNS

### Revenues

The Sugar Act of 1934 specified the methodology to calculate revenues for sugarcane growers. Although the Act expired at the end of 1974, its mechanisms are still applied in the settlement between the mills, cooperative members and independent producers (USDA 1974). Essentially, the methodology provides a consistent way to compute net standard tons (English units) of sugarcane and determine a grower’s price that allows for an equitable share of mill profits between growers and mill owners. In this paper, a “standardized” price per net metric ton of sugarcane was computed on the basis of: 1) the average price of raw sugar during 2008 was 21.3 cents/lb; (USDA-ERS 2009); 2) the minimum fair price determination factor of 1.15 as specified in the Sugar Act of 1934 (USDA 1974); and 3) the “quality factors” for sugarcane with normal juice sucrose of 15.75% and 14.50% - 1.325 and 1.200, respectively. Quality factors adjust the volumes of harvested sugarcane for the amount of sucrose as compared to a “standard” ton, which contains 12.5% normal juice sucrose. Based on the above assumptions, the grower price for sugarcane grown on muck soil was \$32.44 per net metric ton. The higher sucrose content of sugarcane grown on sand soils translated to a higher grower price of \$35.78 per net metric ton.

Molasses is an important secondary product produced during the milling/crushing of sugarcane. Revenue from molasses revenue assumes an average historical yield of 1.68 liters (7 gal/ net short ton) of blackstrap molasses per net metric ton of sugarcane at a price of \$0.7620 per liter paid to the grower after the required adjustments and settlement amounts are taken into account (USDA-ERS 2009).

Revenues per hectare are shown in Table 3 for sand and muck soils by crop age. They are based on the projected yield of total sugar as presented in Table 2 and grower prices of \$35.78 and \$32.44 per net metric ton of sugarcane grown on sand and muck soils, respectively. Since

molasses is a by-product of the milling process, molasses revenues are reported in Table 3 as an average per harvested hectare. Total revenues were computed by crop age for each representative farm and the differences between sand and muck farms are reported in the last column of Table 3. Summing the revenues across the crop cycle, a representative 2,000-hectare sand farm generates more than \$3.23 million in annual revenues. A 2,000-hectare muck farm earns considerably more revenue. The combination of higher yields and more harvested hectares at each crop age allow a muck farm to earn more than \$4.2 million in annual revenue, \$1.02 million more annual revenues than from a sand farm (Table 3).

### **Production Costs**

Table 4 summarizes and contrasts the costs of sugarcane production for sand and muck farms. Costs are listed by activities – fallow, land preparation, planting, plant-cane and ratoon crop cultivation, harvest, and general overhead. The area associated with each crop activity follow from the land distribution data presented in Table 1 and from the previous discussion on fallow and successive planting practices on sand and muck farms. Costs per hectare for each activity include both the cost of field operations and materials. Prescribed field operations are described in the representative budgets and expensed as custom rate charges (Roka et al. 2009; Roka et al. 2010). Custom rate charges incorporate all variable costs such as fuel, machinery repairs and wages paid to the equipment operator, as well as all fixed costs of equipment ownership costs, such as depreciation, insurance, interest and personal property taxes. Custom rates may to some extent overstate costs since they include a profit margin to the equipment owner. Alternatively, custom rate charges fully account for all costs, including administrative overhead charges that an owner-operator may neglect to include in their cost accounting.

The per-acre cost to maintain fallow land is estimated to be \$59 per hectare for both sand and muck operations. Land preparation costs are greater on a muck farm since an additional 40 hectares are being planted annually (520 ha versus 480 ha, Table 1).

There are significant cost differences between sand and muck farms to grow plant-cane and ratoon crops. Production costs to establish and grow plant-cane on sand soils are \$166 per hectare higher than on muck soils. For ratoon crops, costs per hectare are \$216 higher on sand than on muck soils. The higher production costs result primarily from fertilizer inputs. Sugarcane growers on sand soils apply between 200 and 225 kilograms of nitrogen fertilizer per hectare. Growers on muck soils apply little, if any, supplemental nitrogen. In addition, rates of phosphate and potash fertilizers are slightly higher on sand than on muck soils. Despite the fact that the representative muck farm cultivates a higher percentage of total area, higher per-hectare costs result in higher total costs to grow plant-cane and ratoon crops on sand soils (Table 4).

Total harvesting costs on muck farms are higher for two reasons – more land harvested and more tonnage per hectare. The unit cost of harvesting is assumed to be the same, \$7.17 per gross metric ton, on both sand and muck farms. The higher tonnage of sugarcane from muck soils results in the average per hectare harvest cost to be more than \$100 higher than on sand soils. In combination with the increased number of harvested acres, the representative 2,000-

hectare muck farm annually spends nearly \$300,000 more than a comparable 2,000-hectare sand farm to complete its harvest (Table 4).

Overhead costs received special attention during the development of the respective enterprise budgets. Many times these costs are overlooked or underestimated by agricultural producers. Overhead costs are those expenses that are distributed across the entire farm, and not to any specific crop age or field operation. The representative budgets list most of the important overhead costs along with an estimate of their annual budget. Overhead costs associated with muck farms are assumed to be \$123,500 more than on a sand farm. Since the predominate area of muck soils fall within the Everglades Agricultural Area (EAA), the “Agricultural Privilege Tax” of \$61.75 per hectare (a consequence of legislation that impacts farm operations within the EAA) are included in the muck farm’s overhead costs. While some sand land sugarcane production areas are assessed special environmental fees (such as the C-139 Basin), most of the sand land production area is not assessed special fees.

Except for “overhead” costs, all costs listed in Table 4 are variable costs, meaning that if the farm were to be shut down today the grower would not incur these costs. As previously discussed, “custom” rates are used in this paper to describe costs of land preparation activities, planting, and annual application of various materials. Thus avoiding explicit itemization of fixed costs associated with equipment ownership. Clearly, this is a simplification from the reality of most sugarcane farms where even leased machinery would be part of the fixed-cost portion of a farm’s income statement.

In summary, total production costs from a 2,000-hectare representative muck farm are higher than a similar sized farm on sand soils. Annually, the representative muck farm spends more than \$3.456 million on production, harvesting, and overhead costs. A sand farm, on the other hand, spends approximately \$3.095 million in annual costs. The net difference in total annual costs is roughly \$361,000 of higher costs on muck (Table 4).

### **Net Returns**

A higher percentage of land is harvested for sugarcane on a muck farm as compared to a similar size sand farm (Table 1). Together with higher yields, a muck farm produces 4,500 metric tons of additional raw sugar than from a sand land operation (Table 5).

A grower price for a net metric ton of sugarcane from a sand farm is \$3.34 higher than for a net metric ton from a muck farm (\$35.78 versus \$32.44) due to the assumed higher sucrose content of the sugarcane. Average revenue per hectare, however, is higher on a muck farm by \$217 (\$2,709 versus \$2,492).

Production costs on a 2,000-hectare muck farm are \$361,000 higher than on a 2,000-hectare sand farm (Table 4). More importantly, the unit cost of production on a muck farm is lower. Dividing total cost by total harvested area, the average unit cost to grow and harvest one hectare of sugarcane on a muck farm is \$2,198, \$187 lower than the average per-hectare cost of

production on a sand farm.

Higher revenues and lower unit costs translate into higher profitability for sugarcane farms on muck soil. Annual net returns to land, management, and risk are nearly \$665,000 higher on muck than on sand farms (Table 5). Net returns per farm hectare are \$70 on a sand land farm. Net returns per muck farm hectare are five-fold higher, or \$402.

**Table 1. Assumed land distribution for a representative 2,000-hectare sugarcane farm on sand and muck soils in south Florida.**

<b>Item</b>	<b>Sand (ha)</b>	<b>Muck (ha)</b>
Infrastructure <sup>a</sup>	150	100
Fallow <sup>b</sup>	480	260
Plant sugarcane	480	520
Acres harvested for seed <sup>c</sup>	72	67
Acres harvested for sugarcane	408	453
Stubble sugarcane:	890	1,120
1 <sup>st</sup> ratoon	400	520
2 <sup>nd</sup> ratoon	340	400
3 <sup>rd</sup> ratoon	150	200
Harvested sugarcane acres (for sugar)	1,298	1,573
Farm size (acres)	2,000	2,000

<sup>a</sup> Farms on sand soils require drainage ditches every 45 meters (150 feet). Farms on muck soils only require drainage ditches every 135 meters (450 feet).

<sup>b</sup> All planted area on sand farm is assumed to go through a fallow period. For muck farms, only 50% of the planted are replanted each year follows a fallow period. The other 50% of muck area is successively planted after the last ratoon crop.

<sup>c</sup> Growers are assumed to supply their own sugarcane for seed and plant 13.4 gross mt/ha (6 gross tons/acre). Sugarcane for seed is harvested annually from plant-cane acreage. For example, sugarcane for seed acreage on a sand farm is calculated as follows: [(480 ha of new planted area \* planting rate of 13.4 mt/ha) /90 mt/ha = 72 ha], where 90 mt/ha is the assumed yield from plant-cane (see Table 2).

**Table 2. Production per hectare by crop age for representative 2,000-hectare sand and muck sugarcane farms in south Florida, 2008-2009.**

Crop Age	Production: (gross mt/ha)		Sugar Production: (kg/ha)	
	Sand	Muck	Sand	Muck
Trash <sup>a</sup>			7%	7%
NJS <sup>b</sup>			15.75%	14.50%
Plant-cane	90.0	105.0	13,131	14,159
1 <sup>st</sup> ratoon	67.0	88.0	9,849	11,867
2 <sup>nd</sup> ratoon	62.0	74.0	9,028	9,979
3 <sup>rd</sup> ratoon	58.0	60.0	8,535	8,091
<b>Farm Average</b>				
<b>Gross (mt/ha)<sup>c</sup></b>	<b>71.8</b>	<b>85.8</b>	-	-
<b>Annual Production (mt)<sup>d</sup></b>	-	-	<b>13,646.8</b>	<b>18,184.6</b>

<sup>a</sup> Trash assumed to be 7% for sugarcane from both sand and muck soils.

<sup>b</sup> Normal juice sucrose (NJS) percent

<sup>c</sup> Average farm yield estimated to be 82.9 mt/ha (37 tons/ac) across both muck and sand farms and across all crop ages. Source: NASS annual Florida production data of 10-year average production (metric tons) from south Florida plus data that indicates planted area distributed as 20% sand and 80% muck.

<sup>d</sup> Total sugar production (mt) calculated multiplying per hectare yields by areas listed in Table 1 and respective sucrose percentages, then summing across the different crop ages.

**Table 3. Difference in revenues from representative 2,000-hectare sugarcane farms on sand and muck soils, 2008-2009.**

Crop Age	Sand		Muck		Revenue Difference (Muck – Sand)
	ha	\$/ha <sup>a</sup>	ha	\$/ha <sup>a</sup>	\$/year
Plant-cane <sup>b</sup>	408	\$2,838	453	\$3,165	\$216,331
1 <sup>st</sup> ratoon	400	\$2,238	520	\$2,652	\$484,142
2 <sup>nd</sup> ratoon	340	\$2,051	400	\$2,230	\$194,743
3 <sup>rd</sup> ratoon	150	\$1,939	200	\$1,808	\$70,786
Molasses <sup>b,c</sup>	1,298	\$104	1,573	\$124	\$60,325
<b>Total Revenues</b>		<b>\$3,235,155</b>		<b>\$4,261,482</b>	<b>\$1,026,327</b>

<sup>a</sup> Price per net metric ton of sugarcane is \$35.78 and \$32.44 for sand and muck sugarcane, respectively. The price of sugarcane is based on 2008 raw sugar price (21.3 cents per pound), a fair price determination factor of 1.15, and Quality Factors of 1.325 and 1.200 for sand and muck sugarcane, respectively.

<sup>b</sup> Only refers to commercially harvested hectare for sugar. Acreage devoted to production of seed material is not included.

<sup>c</sup> See text in the “Revenue” section of this paper for a complete discussion of molasses payment.

**Table 4. Differences in production cost between representative 2,000-hectare sugarcane farms on sand and muck soils, 2008-2009.**

Crop Activity	Sand		Muck		Cost Difference (Muck – Sand)
	ha	\$/ha	ha	\$/ha	\$/year
Fallow	480	\$59	260	\$59	(\$13,047)
Land Preparation	480	\$596	520	\$665	\$59,800
Plant-cane	480	\$1,214	520	\$1,048	(\$37,544)
Ratoon Crops	890	\$763	1,120	\$547	(\$66,623)
Operating Interest	2,000	\$55	2,000	\$53	(\$4,019)
Harvest	1,298	\$514	1,573	\$615	\$299,245
Overhead	2,000	\$371	2,000	\$432	\$123,553
<b>Total Costs</b>		<b>\$3,095,441</b>		<b>\$3,456,806</b>	<b>\$361,365</b>

Sources: Roka et al., 2009; Roka et al., 2010.

**Table 5. Summary of production, revenues, costs, and net returns to land, management, and risk for representative 2,000-hectare sand and muck sugarcane farms in south Florida, 2008-2009.**

	unit	Sand	Muck	Difference (muck – sand)
Farm size	ha	2,000	2,000	-
Harvested sugarcane (for sugar)	ha	1,298	1,573	275
Sugar produced	mt	13,647	18,195	4,548
Revenues	\$/yr	\$3,235,155	\$4,261,482	\$1,331,464
Avg revenue per ha	\$/ha	\$2,492	\$2,709	\$217
Avg price per net mt	\$/mt	\$35.78	\$32.44	(\$3.34)
Costs	\$/yr	\$3,095,441	\$3,456,806	\$361,365
Avg <b>cost</b> per harvest-ha	\$/ha	\$2,385	\$2,198	(\$187)
Net Returns LMR <sup>a</sup>	\$/yr	\$139,714	\$804,676	\$664,962
Net return/farm hectare	\$/ha	\$70	\$402	\$332
Net return/harvest hectare	\$/ha	\$108	\$512	\$404

<sup>a</sup> LMR: land, management, and risk.

## CONCLUSIONS AND IMPLICATIONS

Sugarcane is an important agricultural industry to the state of Florida, and particularly to the economy of south Florida. The sugar industry in Florida is vertically integrated from the production of sugarcane itself to milling of raw sugar and finally to the refined sugar for retail consumption. Overall, the industry generates more than \$2 billion of annual output and more than \$4.5 billion when indirect economic impacts associated with the sugar industry are included.

During the 2008-2009 harvest season, 80% of Florida's sugarcane production occurred within the Everglades Agricultural Area (EAA). The EAA is more than a 284,000 hectare area south of Lake Okeechobee and is composed primarily of organic, or muck soils (Ollis and Redfield 2009). The EAA provides a rich environment to grow sugarcane. Annual net returns from sugarcane production on muck soils are estimated to be \$400 per hectare, five times higher than net returns from growing sugarcane on mineral or sand soils. Sugarcane growers on muck soils enjoy two distinct advantages over their counterparts farming sugarcane on sand soils. First, total farm revenues are higher because of greater sugarcane tonnage per acre and a higher percentage of land that can be grown for commercial sugarcane harvest. Second, the inherent organic matter in muck soils allows growers to apply substantially less fertilizers and results in an overall lower cost of production per hectare of sugarcane.

Despite the fact that sugarcane production receives a significant economic boost from muck soils, sugarcane production on sand soils is important. Sugarcane has been grown on sand soils since the 1960s, and since 1985, acreage of sand land sugarcane has been expanding to supply the Florida sugar industry with additional production volume of sugarcane. The production of sugarcane from sand land farms helps maintain the economic viability of the sugar milling and processing facilities in Clewiston, Florida, which straddles the geographic boundary between sand and muck soils. Whether a net return of \$70 per hectare is sufficient to sustain sand land production into the foreseeable future depends on a number of economic and political forces, which include the economic feasibility of alternative crops, continued pressures to accommodate urban/industrial land development, and ongoing efforts to design Everglades restoration strategies.

At the present time, there is not a financially attractive alternative for all sugarcane currently being grown on sand soils. Much, if not all, of the sugarcane land on sand soils was once grazed by cattle. The conversion of pasture land into sugarcane was done explicitly to increase per acre returns from what a cow-calf enterprise could be expected to earn. While vegetable crops like sweet corn, green beans, tomatoes, and watermelons earn substantially higher per acre returns, their collective footprint on the agricultural landscape in eastern Hendry and Glades Counties (i.e. sand land area) is not sufficient to displace the current 30,360 hectares being harvested as sand land sugarcane. It is important to note that several vegetable crops, such as green beans, sweet corn, and watermelons, are already being grown during the fallow period. Sugarcane growers either earn a direct income from these vegetable crops or receive lease

payments from vegetable growers. The revenues and net returns listed in this paper do not include income directly from the sale of “fallow” crops or lease payments from the seasonal use of fallow land.

Citrus, the only other agricultural enterprise that could economically compete for the land area sand land sugarcane now occupies is undergoing severe economic stress as it battles the potentially devastating disease, HLB or citrus greening. Until the economic future of citrus brightens substantially, agricultural investors are not likely to increase their acreage in citrus production.

Expansion of urban and residential communities, which only a few years ago seemed destined to overtake the entire southern Florida peninsula, has virtually ceased. Undoubtedly the construction of new homes will resume with the abatement of the economic recession. However, no one is expecting major housing developments to move into the current sugarcane production areas on either sand or muck soils. Agricultural land owners who do not have the opportunity to “cash-out” to real estate speculators will need to maintain their sugarcane operations as the best economic use of their land.

Everglades’ restoration has received a significant amount of political attention. Restoration of historic water flows from Lake Okeechobee into the Everglades was the primary impetus behind the state’s recent interest in acquiring the US Sugar Corporation land holdings around Lake Okeechobee. If this environmental objective moves forward, some sugarcane production on muck soils will be stopped. Sugarcane production on sand land may become increasingly important to make up for lost tonnage from muck farms. Maintaining cost-efficient sugar milling and processing facilities depends on having a sufficient volume of sugarcane within a reasonable distance. As shown in this paper, however, shifting sugarcane production from muck to sand soils comes at a cost of reduced economic efficiency as measured by the higher unit cost of production on sand soils.

### **ACKNOWLEDGMENTS**

The authors wish to thank Dr. John Duncelman for numerous reviews and consultations during the course of this research. Dr. Jim Shine, Mr. Mike Ireby, and Mr. Wynne Jones also provided valuable insights and comments.

### **REFERENCES**

1. Alvarez, J. and G. Snyder. 2004. The rice effect: sugar production in Florida following rice. EDIS paper FE474, Coop. Ext. Serv., UF/IFAS, Gainesville, FL, Rev. Mar 2009.
2. Eiland, B. 2009. Excerpts from the president’s message – Florida division. Sugar Journal 72(1):7.

3. Hodges, A., R. Mohammad, and D. Mulkey. 2004. Economic impacts of agricultural, food, and natural resource industries in Florida in 2004. EDIS paper FE680, Coop. Ext. Serv., UF/IFAS, Gainesville, FL, Rev. Dec 2004.
4. Ollis, S., and G. Redfield. 2009. Introduction to the 2009 south Florida environmental report. In: 2009 South Florida Environmental Report – Volume I. S.Fl.Wat.Mgmt.Dist., W. Palm Beach, FL, Table 1-1.
5. Rice, R., L. Baucum and B. Glaz. 2009. Sugarcane variety census Florida 2008. Sugar Journal 72(2):6-12.
6. Roka, F., J. Alvarez, and L. Baucum. 2009. Costs and returns for sugarcane production on mineral soils of south Florida, 2007-2008. EDIS paper SC087. Coop. Ext. Serv., UF/IFAS, Gainesville, FL, Sept 2009.
7. Roka, F., L. Baucum, and J. Alvarez. 2010. Costs and returns for sugarcane production on organic soils of south Florida, 2008-2009. EDIS paper SC088. Coop. Ext. Serv., UF/IFAS, Gainesville, FL, Mar 2010.
8. USDA-ASCS. 1974. Sugarcane prices, Florida 1974 Crop. Fed. Reg. Dec. 3, 1974 (39 F.R. 41826) and Dec. 13, 1974 (39 F.R. 43406), Wash D.C.
9. USDA-ARS. Annual issues. Evaluation of New Canal Point Sugarcane Clones. Wash D.C.
10. USDA - ERS. 2009. Table 4--U.S. raw sugar price, duty fee paid, New York, monthly, quarterly, and by calendar and fiscal year. Sugar and Sweeteners Yearbook. Wash D.C. <http://www.ers.usda.gov/Briefing/Sugar/data/Table04.xls>, verified Dec. 4, 2009.
11. USDA - ERS. 2009. Table 15: U.S. sugarcane: area, yield, production, sugar output, recovery rate, and sugar yield per acre, crop years. Sugar and Sweeteners Yearbook. Washington D.C. <http://www.ers.usda.gov/Briefing/Sugar/data.htm/yearbook>, verified Dec. 4, 2009.
12. USDA – NASS. 2009. Cash receipts by commodity and selected commodities, Florida: 2004-2008. Farm Cash Receipts and Expenditures, Oct. report. Florida Field Office, Maitland, FL.