Potential Economic Cost of Ecosystem Restoration in EAA

Kayla J. Ouellette[1], Jing Zhong[2], John Capece[2], Kamal Alsherif[1], Ed Hanlon[3]

[1]Department of Geography, Environment & Planning, University of South Florida, Tampa, FL, USA
[2] Intelligentsia International, Inc., LaBelle, FL, USA
[3]Soil & Water Science Department, University of Florida- IFAS, Southwest Florida Research & Education Center, Immokalee, FL, USA

Introduction

Since 1948, about 700,000 acres of rich organic soils (Histosols) in the Everglades Agricultural Area (EAA) has been converted to intensively managed agriculture (McPherson et.al., 1996). EAA is located in the south of Lake Okeechobee and it is one of the most productive agricultural regions in US with an annual crop sales of around $1.5 billion (Aillery et.al., 2001). Sugarcane is the dominant crop in this area that covers 86% of total EAA's acreage and brings over $762 million in sales in 2001 (USACE and SFWMD 2003). However, under the Comprehensive Everglades Restoration Plan (CERP), pumping is limited and some major drainage canals will be removed for retaining more water under the surface as part of the ecosystem restoration program. Thus, the sugarcane farmers might face higher water tables and longer flood durations, which would lead to a sugarcane production reduction (McLean et.al., 2002).

The purpose of this paper is to estimate the potential net return loss of sugarcane production due to the increasing water storage for EAA ecosystem restoration. Two scenarios of water table managements are studied and compared.

Literature Review

❖ Optimum depth of water table (DWT) for sugarcane cultivation:

Glaz et al. (2002) found that the overall sucrose yield for nine sugarcane cultivars in shallow water table (<15-cm) only accounted for 91.7% of that in deep water table (between 15-cm and 38-cm), and one of the cultivars (CP 90-1743) contained a 25% less sucrose yield in shallow water table than the deep water table. Another study by Glaz et al. (2004) had found that the production of the cultivar (CP95-1376) had increased linearly according to the growth of DWT from 16 to 50 cm during non-flood period.

❖ Organic soil subsidence

The microbial oxidation and the decomposition of organic peat soil lead to the decline of soil depth and the wide-scale land elevation is lowered. With the declining depth of soil profiles in EAA, not only the soil is gradually lost from the crop land, but also the water storage space in the soil profile is reduced (Glaz et al., 2002). It was calculated that the current subsidence rate of organic soil is 1.4cm /yr (Shih et al., 1998). The rate of soil subsidence is decreasing proportionally with the DWT decline. However, higher water table (smaller DWT) can also result in the lower yield of some sugarcane cultivar (e.g. Saccharum spp. in EAA) (Glaz et al., 2002).

❖ Water retention

Under the CERP, one of the primary tasks is to capture and store the excessive wet-season discharges from the northern Everglades watershed (Aillery et al., 2001). The South Florida Water Management District has approved the management practice of maintaining a higher the water table for expanding the water-retention and phosphorus control. Also, the sugarcane growers in EAA were encouraged to plant the sugarcane cultivars which can yield well at DWT≤30-cm (Glaz, et. al., 2002).

Methodology

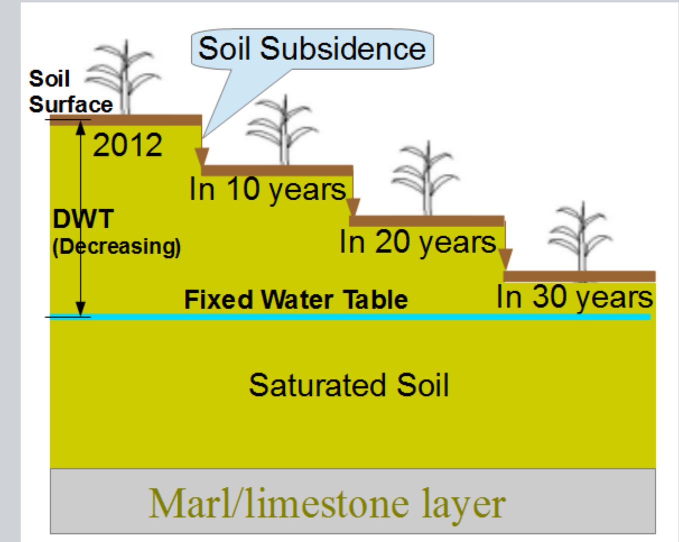
❖ Cane Yield Model

By given the value of DWT (in cm), the sugarcane yield can be easily calculated by using following model:

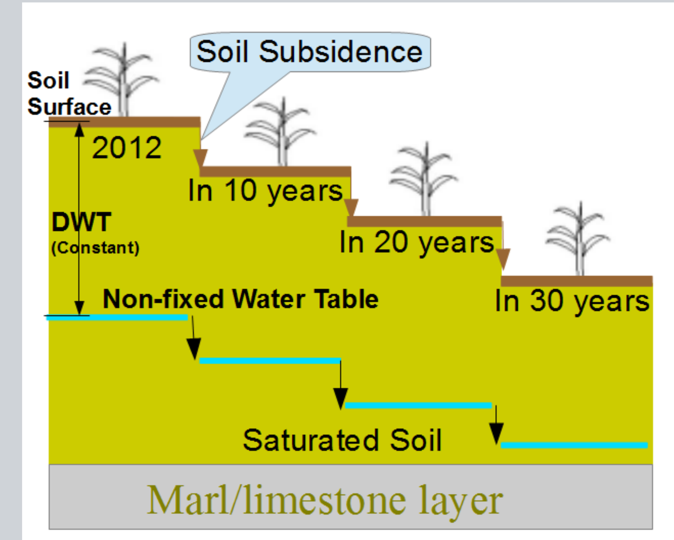
$$Y = 23.8 + 0.16\,x$$, (Glaz and Gilbert, 2006)

Y: cane yield (kg/m^2) ; x: depth of water table (cm)

Roka et al. (2010) had estimated that the total operation cost for a 5,000-acre sugarcane farm with 3,944 harvestable acres on muck soil, which was around $3,194,380 per year. Thus, an average cost of $639/acre is applied for this study to estimate the growers' net returns. The model is applied for studing the following two water table management scenarios.



Scenario 1: Fixed water table with decreasing Depth of water table (DWT)



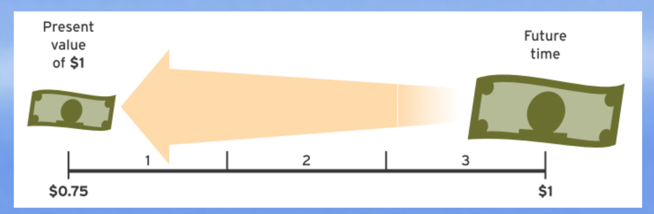
Scenario 2: Non-fixed Water table with constant depth of water table (DWT)

❖ Present Value of Net Return

Present value (***PV***) is the current value of an amount to be received in the future (future value(***FV***)). It is calculated by discounting a future amount for compound interest (***i***):

$$PV = FV/(1+i)^n$$, (Kimmel et al., 2008)

$$\$0.75 = \frac{\$1}{(1+0.10)^3}$$



❖ Data

(1) Initial soil depth: 100cm (Snyder, 2004 p.4); (2) Subsidence Rate: 1.40 cm per year (Shih et al., 1998); (3) Soil Porosity: 14%. (Izuno, 1994, p107); (4) Crop Prices: $24/ton (Roka et al., 2010, p4); (5) Interest Rate: 2% (Roka et al.,(2009, p7). (6) Initial DWT: 50cm (Glaz and Gilbert, 2006).

Preliminary Results and Discussions

Table 1: Net return and water retention comparison for two different water management scenarios

	Scenario 1 (Fixed Water Table)						Scenario 2 (Non-fixed Water Table , Constant DWT)					
	Soil Depth (cm)	DWT (cm)	Yield (tons/acre)	Net Return ($/acre)	Present Value of Net Return($/acre)	Water Storage (acre-foot)	Soil Depth (cm)	DWT (cm)	Yield (tons/acre)	Net Return ($/acre)	Present value of Net Return($/acre)	Water Storage (acre-foot)
2012	100.00	50.00	37.92	290.09	290.09	0.23	100.00	50.00	37.92	290.09	290.09	0.23
In 10 years	86.00	36.00	35.25	224.64	184.28	0.23	86.00	50.00	37.92	290.09	237.97	0.17
In 20 years	72.00	22.00	32.58	159.20	107.13	0.23	72.00	50.00	37.92	290.09	195.22	0.10
In 30 years	58.00	8.00	29.91	93.75	51.76	0.23	58.00	50.00	37.92	290.09	160.15	0.04

In scenario one, the depth of water table is decreasing with the soil subsidence as the water table is kept fixed. In 30 years, the DWT is halved and also the annual sugar yield will be decreased from 37.92 tons/acre to 29.91 tons/acre. At the same time, the annual net return for the farmer is sharply decreased from $290.09 per acre of production to $93.75 per acre of production, and the present value of net return decreased from $290.09/acre to $51.76/acre. However, the water storage will be kept at an annual rate of 0.23 per acre-foot.

In scenario two, the annual sugarcane yield is kept constant across 30 years as the depth of water table will be monitored to be the same for each year. Therefore, the net return for the farmer is not changing across the 30 years and it will only be discounted by the interest rate in order to get its present value. However, with the subsidence of soil, the water table is becoming lower and lower (as the DWT is constant). There is less and less space for water storage and the rate of water retention has declined from 0.23 foot-acre to 0.04 foot-acre.

Research Plan

In the future study, the effects of decreasing DWT on subsidence rate of soil will be evaluated for the study of Scenario 1. Moreover, the values of other ecosystem service, such as carbon credits, will also be taken into consideration.

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