SHORT COMMUNICATION

ECONOMIC ANALYSIS OF HARVESTING BURNT VERSUS GREEN CANE UNDER IRRIGATED CONDITIONS

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Abstract

The costs and benefits of having a green cane trash blanket (GCTB) under irrigated conditions are investigated in this paper. For the case studies reported, the direct cost savings in water, energy, herbicides and fertiliser, were offset by an average increase in harvesting and haulage costs of 22% under a GCTB system. Although per hectare partial margins for both systems were similar, a GCTB farming system could allow a relatively larger area of cane to be irrigated for a given amount of irrigation water and this should result in increased overall returns. For example, in Pongola it was shown that the same amount of water used to irrigate an area of burnt N14 could be used to irrigate a 33% larger area where a GCTB system was used. The opportunity cost of water in the above example was R3 544/ha converted to a GCTB system. For sectors of the industry which may face significant reductions in irrigation water allocations, the option to try and maintain production and supply of cane to Sugar Mills through conversion to a GCTB farming system should be considered. If a GCTB system is considered unfeasible due to harvesting constraints, early morning or 'cold' burns should be adopted. The larger amount of trash and tops which remain relative to a 'hot' burn should then be scattered to cover the soil surface and the fields watered as if they were fully trashed.

Keywords: green cane trash blanket, burnt sugarcane, irrigated sugarcane, economic analysis

Introduction

Sugarcane farmers are under increasing pressure to demonstrate that they are managing the water used for irrigation effectively and efficiently. The results from a research project reported by Olivier *et al*. (2009) are evidence that there is potential to save substantial amounts of non-beneficial, consumed components of the irrigated sugarcane water balance, using a green cane trash blanket (GCTB). However, the incorporation of a GCTB into a sugarcane farming system has many challenges, not least of which are the perceived negative impact that a GCTB will have on harvesting operations and whether any additional costs incurred by having a GCTB will be offset by potential savings in, for example, water and energy. The costs and benefits of a GCTB system versus a burnt cane system under irrigated conditions and for two different varieties of sugarcane are investigated in this communication.

Methodology

A decision support tool named *Irriecon* V2 was used for the economic analysis. Developed by the South African Cane Growers Association and the South African Sugarcane Research Institute (Lecler *et al*., 2008), *Irriecon* V2 is an economic analysis tool which can be used to determine detailed capital, operating and marginal costs for various irrigation scenarios. Cost implications relating to associated/affected farming practices, including fertiliser, herbicide, planting, harvesting and haulage operations are incorporated in the tool. Information or data needed to undertake analyses with *Irriecon* V2 includes the crop yields and irrigation water use associated with certain agronomic practices, the harvesting and haulage details and the costs of energy and water.

Water balance and crop yields

A combination of experiment-derived information on the crop yields of GCTB versus burnt irrigation scenarios (Olivier *et al*., 2009) and water balance simulations with a GCTB water balance simulation model (Jones and van den Berg, 2006) were used to predict crop response and associated irrigation water requirements of GCTB versus burnt scenarios. Nine years (1998-2007) of daily climate data from the Pongola station and six years (2001-2007) of data from the Komatipoort (Coopersdal) station were used for the study. Irrigation water applications of 35 mm were simulated to take place when 35 mm of soil water had been depleted for all of the different systems. It was assumed that the Total Available Water content of the soil profile was 100 mm.

The GCTB simulation model is not yet able to represent all the mechanisms which impact the yield of a crop grown under GCTB conditions. For the analyses reported here, it was assumed that the crop yields of cane grown under bare soil and GCTB conditions were equal, based on the evidence of trial results reported by Olivier *et al.* (2009). These results also showed that, on average, the two varieties used in the trial, N14 and N26, gave similar total sucrose yields under burnt or GCTB conditions, provided irrigation watering was adjusted appropriately. The sucrose content of N26 was on average 20% higher than that of N14. These varietal differences in sucrose content and, therefore, the associated cane yields were represented in *Irriecon* V2 as they had an impact on the harvesting and haulage costs.

To obtain some indication of yield variation between seasons, the accumulated seasonal transpiration simulated under burnt conditions for varieties N14 and N26 was used in Equation 1 (after Thompson (1976) as modified by Lecler (2004)) to predict sucrose yields under both burnt and GCTB scenarios.

$$Y = -22.65 + 4.923((T_A/100) \times 1.05) - 0.149((T_A/100) \times 1.05)2 \qquad \text{Eq. 1}$$

where

Y = reference sucrose yield (t/ha)

T_A = simulated seasonal transpiration (mm).

Farming practices and associated cost implications

Representative farming practices were assumed based on research at SASRI and information from growers, for example, as reported in Wynne and van Antwerpen (2004). Costs were based on 2007 prices and affected agronomic practices were as follows:

Herbicides: a reduction in pre-emergent weed control costs resulted in a saving of approximately R800/ha for the GCTB scenarios.

Fertiliser: nitrogen (N), phosphorous (P) and potassium (K) assumed for the burnt cane scenarios were 160 kg/ha, 33 kg/ha and 150 kg/ha respectively. The fertiliser amounts assumed for the GCTB scenarios for N, P and K were 147 kg/ha, 26 kg/ha and 130 kg/ha respectively. The fertiliser deficits on the GCTB fields were assumed to be contributed by the trash itself. Furthermore, the more expensive limestone ammonium nitrate was used for the GCTB scenarios because of the risk of high volatilisation losses if urea was used.

Harvesting: it was assumed that the harvesting rate for the GCTB scenario was 3.5 tons/day compared to a rate of 6 tons/day for the bare soil scenarios. The lower rate for GCTB cane is because the trash needs to be removed.

Transport: the costs to load and transport the GCTB cane (most trash removed) were estimated to be R34.05/ton compared to R32.70/ton for cane grown on bare soil.

The capital recovery method (Oosthuizen *et al*., 2005) for estimating depreciation and interest costs was employed in this study, assuming a nominal interest rate of 13.5% and an annual inflation of 7%. Irrigation costs were based on designs and 2007 prices provided by Zululand Irrigation Pty Ltd, together with information provided in Oosthuizen *et al*. (2005) and electricity tariffs from Eskom.

Results

The economic margins reported here reflect only partial cane margins after rewarding all production factors that may be directly impacted on by changes in farming systems associated with irrigation, varieties or having a GCTB.

Crop yields and irrigation water requirements

Simulated water savings due to a GCTB were greater in Komatipoort than in Pongola, typically exceeding 200 mm/an in Komatipoort and just less than 200 mm/an in Pongola. These results are in agreement with data reported by Olivier *et al*. (2009). The water requirements for N26 were slightly lower than for N14 due to the slower rate of canopy development, but differences were marginal. Although cane yields were much higher for N14 than for N26, sucrose yields were similar.

Financial results

Partial margins above allocated costs calculated for cane grown under burnt conditions and under a GCTB were fairly similar. Burnt cane had a slight advantage that varied between R38/ha/an and R205/ha/an depending on the location and variety. Partial cane margins were lower in Pongola than in Komatipoort, concurring with the associated sucrose yields. The variable irrigation costs for N26 and the harvesting and haulage costs were lower than the corresponding costs for N14. This is due to the lower irrigation requirements associated with the relatively reduced canopy development rates and the higher sucrose contents in N26 resulting in more efficient harvesting and hauling operations. However, based on the cane yield assumptions, whereby yields were predicted based on actual transpiration from burnt cane, sucrose yields of N26 were slightly lower than yields of N14 in Pongola and almost equal to N14 in Komatipoort.

Under a GCTB farming system, the direct cost savings in water, energy, herbicides and fertiliser were offset by an average increase in harvesting and haulage costs of 22%. The trends may change with differences in price differentials for fertiliser, herbicides, electricity, water and especially diesel and sucrose.

Analysis of the results further indicated that in water stressed situations the GCTB farming systems, which require less water, allow for a larger cane area to be irrigated and were therefore substantially more profitable where extra land was available or where the saved water could be stored and used during droughts to maintain production areas. For example, in Pongola it was shown that the same amount of water used to irrigate an area of burnt N14 could be used to irrigate a 33% larger area if the fields were watered less, as is appropriate with a GCTB system. The opportunity cost of water in the above example was R3 544/ha converted to a GCTB system and was much greater than the direct per hectare cost savings related to using less water.

Although not conclusive, trial results reported by Olivier *et al*. (2009) for one ratoon crop, provide evidence that even if burnt fields are irrigated as if they had a GCTB, the yields may be little affected. This observation needs further substantiation, but nevertheless provides motivation for growers to consider 'cold' or early morning burns while there is still heavy dew, scattering the remaining tops and trash and saving water by irrigating as if the cane was grown under a full GCTB.

Conclusions

Under a GCTB farming system, the direct savings in, for example, water, energy, herbicides and fertiliser are likely to be offset by the substantial increase in the harvesting costs incurred. There is, therefore, a need to focus efforts on developing an efficient, relatively low cost harvesting system to facilitate adoption of a GCTB system.

The opportunity cost of water has a substantial influence on the selection of an appropriate farming strategy. GCTB farming systems that use less water relative to burnt farming systems allow a relatively larger area to be irrigated for a given amount of water. In most South African catchments where there is a substantial amount of irrigated sugarcane, there are varying degrees of stress on irrigation water supplies. Thus, the option to maintain production and supply of cane to sugar mills, via using less water with a GCTB system, could be critical to the survival of certain sectors of the industry which face reduced water allocations. If a GCTB system is considered unfeasible due to harvesting constraints, early morning or 'cold' burns should be adopted. The larger amount of trash and tops which remain relative to a 'hot' burn should then be scattered to cover the soil surface and the fields watered as if they were fully trashed.

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