

THE SELF REGULATING DELIVERY MECHANISM: OPTIMISING THE CANE SUPPLY LOGISTICS CHAIN

WYNNE A T

*South African Cane Growers' Association, PO Box 888, Mount Edgecombe, 4300, South Africa
awynne@canegrowers.co.za*

Abstract

If the South African sugar industry is to remain internationally competitive in the long term it needs to reduce costs and increase overall sugar production efficiencies by exploiting its competitive advantage; viz its well developed infrastructure and capacity to organise and innovate. Cane supply logistics is one area that requires innovation and better organisation, as it is intrinsically difficult to optimise due to the involvement of large numbers of independent stakeholders. What is required is an institutional framework that incentivises growers and millers to align cane deliveries with mill crush rates. Such alignment is expected to reduce no-cane stops, improve cane transport logistics, streamline the cane transport fleet, reduce burn harvest to crush delays, enhance mill performance and ultimately increase the profitability of an entire mill area. Furthermore, the resultant increase in delivery certainty should better enable growers to optimise variety selection and harvest scheduling to maximise cane quality and overall sugar recoveries per hectare. The Self Regulating Delivery (SRD) has evolved with these principles in mind and in so doing challenges the current South African sugar industry approaches to rateable deliveries and 'relative' cane payment. It also attempts to create incentives that rationalise harvest and transport contractor behaviour, and provides for the consolidation of numerous smaller scale growers into more cost effective delivery groups. The SRD mechanism has yet to be implemented but has nevertheless being designed to be flexible, simple and cost effective, which are pre-requisites to be operative in the dynamic sugar production environment.

Keywords: cane supply, logistics, incentives, self regulation, penalties, profitability

Introduction

If the South African sugar industry is to remain internationally competitive in the long term it needs to reduce costs and increase overall sugar production efficiencies by exploiting its competitive advantage; viz its well developed infrastructure and capacity to innovate and organise. Cane supply logistics is one area that requires innovation and better organisation, as it is intrinsically difficult to optimise due to the involvement of large numbers of independent stakeholders. What is required is an institutional framework that incentivises growers and millers to align cane deliveries with mill crush rates. The Self Regulating Delivery (SRD) mechanism has evolved with these principles in mind. Initial thinking around this approach developed during Local Area Agreement negotiations and was further refined through industry forums and discussions at the Umfolozi mill area in particular. This paper outlines the progress to date with an objective of stimulating further debate. All the mathematical equations used are referenced in Appendix 1.

Determining principle parameters

By definition, cane deliveries can only be aligned with mill crush rates given a finite cane supply tonnage and factory size. In reality both these factors vary between seasons in any one mill area due to exogenous factors such as climate, breakdowns, etc; resulting in varying length of milling seasons (LOMS). Assuming all endogenous factors (e.g. cane area and factory size expansions) are constant, the minimum LOMS is expected to be a large percentage of the maximum LOMS. Therefore, the foundation of the SRD mechanism is built on the premise that cane deliveries can be aligned with mill crush rates for the minimum LOMS and the efficiencies created therein carried over into the relatively short period thereafter. Therefore, the three principle parameters on which the SRD mechanism is based are: (1) the minimum LOMS as agreed by the Mill Group Board (MGB); (2) 'available milling capacity' within the minimum agreed LOMS as notified by the miller; and (3) the historical cane deliveries within the agreed minimum LOMS for each Grower Code as determined by the MGB.

Determining cane delivery allocations

In terms of the SRD mechanism, growers will be required to apply for a Grower Code from the MGB at the mill which they wish to deliver cane. This code will be retained in subsequent seasons. The MGB shall then determine a 'fixed allocation' for each Grower Code based on that Grower Code's historical rolling average 'actual deliveries' within the agreed minimum LOMS (Equation 1), which shall remain fixed for the entire season (this creates a disincentive for growers to change Grower Codes to avoid levy payments or to supply inaccurate estimates to increase their delivery allocation). If the sum of all 'fixed allocations' is in excess of the 'available milling capacity' within the minimum LOMS, each Grower Code's allocation shall be reduced pro rata, such that the sum of all the Grower Codes' 'fixed allocations' equals the 'available milling capacity' within the minimum LOMS. If the sum of all 'fixed allocations' is less than 'available milling capacity', the difference is deemed to be 'extra allocation' (Equation 2). On receiving an application from interested Grower Codes, the MGB will distribute this 'extra allocation' in the following priority order:

- a. To Grower Codes with a 'fixed allocation' and an accepted motivation for previously 'undelivered allocation';
- b. To Grower Codes with a 'fixed allocation' that can substantiate significant vertical growth;
- c. To inward diversion cane; and lastly,
- d. To Grower Codes with or without 'fixed allocation' who have new cane areas.

Hence, a Grower Code's 'total allocation' is the sum of its 'fixed' and 'extra allocation' less 'undelivered allocations' during the minimum LOMS (Equation 3).

Managing deliveries within the minimum LOMS

The MGB will calculate a 'weekly delivery allocation' from each Grower Code's total allocation multiplied by a 'variance factor' (e.g. 0.95) to account for cane supply difficulties and variable crush rates (Equation 4). This 'weekly delivery allocation' is effectively the minimum weekly delivery tonnage each Grower Code must deliver, otherwise the 'undelivered allocation' portion is forfeited from the Grower Code's 'total allocation'. Grower Codes can catch up 'undelivered allocations' by successfully applying to the MGB for 'extra allocation' during the season. 'Extra allocation' in a particular crushing week is

calculated in accordance with Equation 6 and distributed in the same priority order as at the beginning of the season.

‘Fixed allocation’ and ‘extra allocation’ will be exclusively linked to individual Grower Codes but they may be ‘traded’, and ‘fixed allocations’ may be ‘transferred’ between Grower Codes.

- ‘Trading’ fixed and/or extra allocation between Grower Codes does not require MGB notification because the Grower Codes concerned take full responsibility for redistributing cane proceeds from deliveries made in the current season amongst themselves.
- ‘Transferring’ fixed allocation between Grower Codes requires MGB notification prior to the start of the season to ensure the accurate allocation of ‘fixed allocation’ and cane payments accrue to the correct Grower Codes in subsequent seasons. ‘Fixed allocation’ can be exchanged independently of, or together with, land transfers. If land transfers take place during the milling season, parties will be required to enter into a fixed allocation ‘trading’ arrangement for the remainder of the season.

These ‘trading’ and ‘transferring’ facilities unlock Grower Codes from current rateable delivery requirements enabling Grower Codes to better optimise sugar recoveries per hectare through the adoption of early and/or late maturing cane varieties. The incentives created by the SRD mechanism should maintain rateable deliveries at a mill area level but not necessarily at a Grower Code level.

Crushing beyond the minimum LOMS

The total LOMS should be unrestricted, this will allow millers to maximise marginal milling profits and provide existing and new growers with opportunities to crush additional cane (e.g. because of cane area expansion, a ‘bumper’ crop, fire cane or cane infected by pest or disease). However, all cane delivered within the minimum LOMS should be paid according to the ‘relative’ recoverable value (RV) % cane payment mechanism (APPENDIX 2) and all cane delivered after the minimum LOMS should be paid on ‘actual’ RV % cane. There are three reasons for this. Firstly, it creates an incentive for Grower Codes to optimise their deliveries within the minimum LOMS because a Grower Code’s average ‘relative’ RV % cane within the minimum LOMS should always be higher than the average ‘actual’ RV % cane achieved at the end of the season. This should have the effect of reducing no-cane stops and maintaining rateable deliveries at a mill area level. Secondly, it ensures that Grower Codes who deliver efficiently within the minimum LOMS are not be prejudiced through a reduced average ‘relative’ RV % cane by (1) Grower Codes who do not deliver efficiently, (2) Grower Codes expanding their area under cane or (3) by new entrants. Thirdly, it allows the ‘market’ to determine a mill’s and ultimately the industry’s economic cane supply area based on seasonal RV % cane and other prevailing economic circumstances. In practice, the amount of cane crushed after the minimum LOMS will be clarified by the MGB as follows:

- a. By consent between miller and grower representatives.
- b. By the calculated tonnage the miller failed to crush during the minimum LOMS as requested by growers (Equation 7 to Equation 10).
- c. By the calculated tonnage the growers failed to deliver during the minimum LOMS as requested by the miller (Equation 11 to Equation 12).

For the purpose of calculating the default tonnages to be delivered and crushed by the growers and miller respectively and any associated penalties, the MGB must agree at the start of each season on a budgeted grower no-cane stoppage allowance inclusive of no-cane stops caused by rain for the minimum LOMS.

Penalties

Any delivery made at any time within the agreed season length that is without or in excess of its 'weekly delivery allocation' shall be deemed 'unauthorised cane' (Equation 13), such that all proceeds from 'unauthorised cane' will be automatically placed into a 'holding account'. If the actual season length is less than or equal to the minimum agreed LOMS, 'unauthorised cane' proceeds will be paid retrospectively from the 'holding account' with interest. If the actual season length is greater than the agreed length for whatever reason, the proceeds from 'unauthorised cane' will be forfeited; i.e. the miller will pay 100% of the Grower Code's 'unauthorised cane' proceeds from the 'holding account' directly to the MGB, which will be used to mitigate the Board's expenses. The calculated tonnages that the miller (Equation 7 to Equation 10) and collective grower group (Equation 11 to Equation 12) failed to crush during the minimum agreed LOMS will also attract a per ton cane penalty as agreed by the MGB at the start of the season, which will also be used to mitigate the Board's expenses. These miller and Grower Code penalties are calculated in respect of Equation 14 to Equation 15 and Equation 16 to Equation 17, respectively.

Incentives for contractors

Providing a contractor is responsible for both harvesting and transport operations, a Grower Code can justifiably transfer the entire per ton cane penalty for delivery failure (i.e. to compensate the miller) onto this contractor (Equation 16). An additional claim can be submitted to the contractor for poor contractor performance to compensate the Grower Code (Equation 19). With these efficiency incentives in place, Grower Codes within a mill area should have the confidence to consolidate cane supply operations through the appointment of a few efficient large-scale commercial contractors. This would help streamline the cane supply logistics chain by reducing the number of contractors, increasing capital utilisation, reducing operational costs and improving synchronisation between cane supply and crush rates given the expected reduction in cutting fronts. It should also facilitate the adoption of sophisticated vehicle scheduling computer packages that will further enhance efficiencies. Grower Codes' cash flows need not be affected by a reduced number of cutting fronts if a pro rata tonnage of each Grower Code's total crop is harvested each month during the crushing season; i.e. monthly payments as per the current dispensation should be retained.

Delivery groups

Consolidating numerous smaller-scale Grower Codes into delivery groups that are serviced by efficient large-scale commercial contractors would help increase the recoverable value in cane and capture size economy efficiencies. To achieve this, the MGB must agree on an acceptable minimum 'total allocation' tonnage (expected to vary between mill areas), such that Grower Codes with a 'total allocation' below this threshold can either proactively create a delivery group or be allocated to a collective default delivery group. Grower codes with a 'total allocation' in excess of the minimum are not precluded from participating in a delivery group. For each delivery group, the MGB will calculate the number of weekly delivery time slots per Grower Code *pro rata* to total allocation tonnages (Equation 20), the timing of which can be adjusted by 'trading' to optimise cane quality at a farm and field level. The risk

of one delivery group member being forced to deliver in the extension period when payment is made on 'actual' recoverable value % cane can be mitigated using an interim payment and retention interest approach similar to that of relative payment (Appendix 3). These delivery group proposals can be implemented under the current dispensation, independently of the SRD mechanism. The point is that the consolidation of large numbers of growers can significantly improve logistics, efficiencies and operational costs.

Conclusion

Under the Self Regulating Delivery Mechanism growers have the incentive to align their delivery rate with the mill crush rate to ensure (1) none of their allocation is forfeited in the current and subsequent seasons due to actual under-deliveries and (2) none of their proceeds are forfeited from actual over-deliveries. Furthermore, growers that do not meet their allocation will financially compensate the miller and, similarly, the miller will compensate performing growers for poor mill performance (i.e. the miller has an incentive to set realistic crushing targets). The resulting alignment created between cane supply and mill crush rates is expected to reduce no-cane stops, improve cane transport logistics, streamline the cane transport fleet, reduce burn harvest to crush delays, enhance mill performance and ultimately increase the profitability of an entire mill area. Furthermore, the resultant increase in delivery certainty should better enable growers to optimise variety selection and harvest scheduling to maximise cane quality and overall sugar recoveries per hectare. However, this new approach has yet to be implemented but has nevertheless been designed to be flexible, simple and cost effective, which are prerequisites to be operative in the dynamic sugar production environment.

Acknowledgements

Numerous individuals were involved directly and indirectly in crystallising the development of the Self Regulating Delivery mechanism during the numerous discussions that have taken place, notably A Church, J de Lange, J Field, G Groom, H Hackmann, M Kirkland, A Koen and G Moor.

A summarised version of this paper was presented by the author at the XXV International Society of Sugar Cane Technologists Congress in February 2005 in Guatemala, reference details are as follows: Wynne, A (2005). The Self Regulating Delivery Mechanism: optimising length of milling season and cane supply. Proceedings of the International Society of Sugar Cane Technologists XXV Congress, February 2005, Guatemala, Volume 2, pp 26-30.

APPENDIX 1: Equations

Equation 1

$$\text{Fixed Allocation (FA)} = \frac{\text{Individual Grower's rolling average "Actual Deliveries" within the Agreed LOMS}}{\text{Individual}}$$

Equation 2

$$\text{Extra Allocation (EA)} = \frac{\text{Milling Capacity (MC)}}{\text{Total}} - \frac{\text{FA}}{\text{Total}}$$

Equation 3

$$\text{Total Allocation (TA)} = \frac{\text{FA}}{\text{Individual To-date}} + \frac{\text{EA}}{\text{Individual To-date}} - \frac{\text{Undelivered Cane}}{\text{Individual To-date}}$$

Equation 4

$$\text{Weekly Delivery Allocation (WDA)} = \frac{\frac{\text{TA}}{\text{To-date}}}{\text{Individual in Week "n"}} \times \text{Variance Factor} \times \frac{\text{Agreed LOMS}}{\text{Weeks}}$$

Equation 5

$$\text{Undelivered Cane} = \frac{\text{WDA}}{\text{Individual Week "n"}} - \sum \frac{\text{Actual Deliveries}}{\text{Week "n"}}$$

Equation 6

$$\text{Extra Allocation} = \frac{\text{MC}}{\text{Week "n"}} - \frac{\text{TA}}{\text{Fixed To-date}}$$

Equation 7

$$\text{Miller Default Tonnage} = \frac{\text{MC}}{\text{Mill Adjusted}} - \frac{\text{Authorised Deliveries}}{\text{Mill Area Total}}$$

Equation 8

$$\frac{\text{MC}}{\text{Mill Adjusted}} = \frac{\frac{\text{MC}}{\text{Fixed}}}{\frac{\text{LOMS}}{\text{Agreed}}} \times \left[\left(\frac{\text{Nocane stops} - \text{Nocane stops} - \text{Force Majeure stops}}{\text{Budget for Agreed LOMS} - \text{Actual in Agreed LOMS} - \text{Actual in Agreed LOMS}} \right) \times 168 \right] + \frac{\text{LOMS}}{\text{Agreed}}$$

Equation 9

$$\text{Authorised Deliveries} = \frac{\text{Actual tons Crushed in Agreed LOMS}}{\text{Mill Area}} - \frac{\text{Unauthorised Cane}}{\text{Mill Area}}$$

Equation 10

$$\text{Unauthorised Cane} = \sum \frac{\text{Actual Deliveries in LOMS}}{\text{Individual Final}} - \frac{\text{TA}}{\text{Final}}$$

Equation 11

$$\text{Grower Code Default Tonnage} = \frac{\text{MC}}{\text{Grower Adjusted}} - \frac{\text{Authorised Deliveries}}{\text{Mill Area Total}}$$

Equation 12

$$\frac{\text{MC}}{\text{Grower Adjusted}} = \frac{\text{TA}}{\text{Mill Area Total}} - \frac{\text{Unauthorised Cane}}{\text{Mill Area Total}} - \left[\frac{\text{MC}}{\text{Fixed}} - \left\{ \frac{\text{MC}}{\text{Fixed}} \times \left[\frac{\text{LOMS}}{\text{Agreed}} - \left(\frac{\text{Force Majeure stops}}{168} \right) \right] \right\} \right]$$

Equation 13

$$\text{Unauthorised Cane} = \sum \frac{\text{Actual Deliveries}}{\text{Individual Week "n"}} - \frac{\text{TA}}{\text{Agreed LOMS}}$$

Equation 14

$$\text{Miller Penalty} = \frac{\text{R/ton cane penalty} \times \text{Miller's Default Tonnage}}{\text{Mill Area}}$$

Equation 15

$$\text{Mill Performance Penalty} = \frac{\text{Mill Penalty}}{\text{Individual Grower Code Proceeds}} \times \frac{\text{Authorised Deliveries within the Agreed LOMS}}{\text{Mill Area}} \times \frac{\text{Authorised Deliveries within the Agreed LOMS}}{\frac{\text{Individual Final}}{\text{Mill Area Final}}}$$

Equation 16

$$\text{Grower Code Penalty}_{\text{Mill Area}} = \text{R/ton cane penalty} \times \left(\frac{\text{Default Tonnage}}{\text{Calculated for Agreed LOMS}} - \frac{\text{Tonnage Delivered}}{\text{In the Extension}} \right)$$

Equation 17

$$\text{Default Penalty}_{\text{Cost to Individual Grower}} = \frac{\text{Default Penalty}_{\text{Total Proceeds due to Miller}} \times \frac{\text{Displaced Deliveries within the Agreed LOMS}_{\text{Individual}}}{\text{Displaced Deliveries within the Agreed LOMS}_{\text{Mill Area}}}}{\text{Displaced Deliveries within the Agreed LOMS}_{\text{Mill Area}}}$$

Equation 18

$$\text{Displaced Deliveries}_{\text{Within Agreed LOMS}} = \frac{\text{TA}_{\text{Final}} - \text{Actual tons Crushed in Agreed LOMS}}{\text{Final}}$$

Equation 19

$$\text{Contractor Performance Penalty}_{\text{Individual}} = \frac{\text{Displaced Deliveries}_{\text{Individual Final}} \times \text{R/ton cane penalty}}{\text{Individual Final}}$$

Equation 20

$$\text{Number weekly time slots}_{\text{Round up to the nearest integer}} = \frac{\text{TA}_{\text{Individual}}}{\sum_{\text{All non-rateable deliverers}} \text{TA}} \times \text{Agreed LOMS}$$

APPENDIX 2: Recoverable Value and Relative Payment

The recoverable value (RV) % cane payment mechanism is commonly represented as:

$$\text{RV \% cane} = S - dN - cF$$

Where S = Sucrose % cane delivered
 N = Non-sucrose % cane delivered
 F = Fibre % cane delivered
 and d = The relative value of sucrose lost from sugar production per unit of Non-sucrose taking into account the value of molasses recovered per unit of non-sucrose.
 c = The loss of sucrose from sugar production per unit of Fibre.

The system of relative payment was introduced to account for non-rateable deliveries (e.g. small-scale growers), which is commonly represented below:

$$\text{Relative RV \%} = \text{Growers weekly average RV \%} \text{ minus } \text{Mill weekly average RV \%} \text{ plus } \text{Mill season average RV \%}$$

The underlying assumption of the Relative Payment system is that for any single cane delivery the relationship between the individual's RV percentage and the mill average RV percentage is presumed to be the same for the entire season. The mill season average RV % in the Relative RV % formula can only be determined upon completion of the season. It is therefore necessary to operate during the season with an estimated season average and at the end of the season the data is updated accordingly.

APPENDIX 3: Mitigating season length risk for members of a delivery group

Each 'Delivery Group' can mitigate against the risk of being paid on actual RV% if a member's deliveries are made after the minimum LOMS by instructing the MGB to apply the following interim payment measures to each Grower Code in the Delivery Group:

$$\text{Interim Payment} = \text{consignment tonnage} \times \text{Relative or Actual RV \%} \times (\text{Interim RV Price} - \text{retention})$$

Individual Individual Individual

The MGB shall agree on an appropriate retention percentage at the start of the crushing season. If all members of the 'Delivery Group' deliver their full allocations (fixed allocation plus extra allocation) within the minimum LOMS all members will be paid according to Relative RV% and no 'Delivery Group' adjustment will be made at the end of the season. Each individual's final payment will be according to the following formula:

$$\text{Final Payment} = \left(\text{Final RV Price} \times \text{tons relative RV} \right) - \text{all previous payments} + \text{retention interest}$$

Individual Individual Individual Individual

If one or more members of the 'Delivery Group' deliver in whole or in part after the minimum LOMS then a 'Delivery Group' adjustment will be made to all members final end of season payment due in March as follows:

$$\text{Final Payment} = \left(\text{Final RV Price} \times \text{total tons RV} \times \frac{\text{total tons cane}}{\text{total tons cane}} \right) - \text{all previous payments} + \text{ret int}$$

Individual Group Individual Group Individual Individual

The risk of such adjustments can be mitigated using the contractor incentives already described, through peer pressure between members of the delivery group and transparent rules agreed by the group (e.g. if a member delivers after the minimum LOMS x times his delivery group membership will be terminated).