

RELATIVE CANE PAYMENT: REALIGNING GROWER INCENTIVES TO OPTIMISE SUGAR RECOVERIES

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Abstract

Cane payment is a sensitive issue and is seldom debated and documented in the public domain. As a result, misunderstandings arise over time. In the South African sugar industry, much confusion has arising between relative cane payment and the Recoverable Value (RV) cane payment. The objective of this paper is to clarify these terms and to revisit the appropriateness of the current relative cane payment approach. Multiplicative relative payment is the preferred approach because it creates a clear incentive for each and every grower to deliver cane with the highest possible RV% relative to the mill weekly average RV% and thereby optimises the mill weekly average RV%. Consequently, the current additive relative payment approach should be replaced with the multiplicative relative payment approach. However, both millers and growers are 'blinded' to the consequences of the rapid drop off in RV% at the beginning and ends of the season as a result of relative payment. This can be overcome if both millers and growers collectively agree to a defined season length in their mill area during which multiplicative relative payment shall apply. The penalty for poor delivery performance post the defined season length is payment on actual RV%. This system can be accommodated within the ambit of existing Mill Group Board policies and procedures. Essentially it sharpens the incentive for growers to collectively ensure that no-cane stops are minimised and milling capacity and harvesting equipment are optimised. Not only does this reduce costs, but it results in increased sugar recoveries from an equivalent tonnage of cane, enhancing revenue for both millers and growers!

Keywords: relative cane payment, cane quality, season length, incentives, Recoverable Value

Introduction

Cane payment is a sensitive issue and is seldom debated and documented in the public domain. As a result, misunderstandings arise over time. In the South African sugar industry, much confusion has arisen between relative cane payment and the Recoverable Value (RV) cane payment. The objective of this paper is to clarify these terms and to revisit the appropriateness of the current relative cane payment approach. In achieving this objective, a brief description of the composition of sugarcane is provided followed by an explanation of the RV cane payment mechanism. The inequities associated with the seasonal RV variation are then discussed, followed by explanations of the additive and multiplicative relative payment approaches. Shortcomings of relative payment are then explored and some conclusions are drawn that recommend the implementation of a revised payment system.

Composition of sugarcane

In broad terms, sugarcane is composed of four major elements. The major value element of sugarcane is its 'crystal sugar' component known as sucrose, which is usually determined cost effectively by a polarimeter, which measures 'pol' or apparent sucrose. True sucrose needs to be measured by complicated higher cost gas liquid chromatography. The second element is other soluble substances, termed non-sucrose or impurities, which are processed into the marketable by-product called molasses. Collectively, sucrose and non-sucrose are termed 'brix', comprising all dissolved solids. The term 'brix' was derived from the person who first measured the amount of total dissolved solids using a refractometer. Non-sucrose is calculated by subtracting sucrose (or 'pol') from 'brix'. The third element is fibre which, until recently, had no value except as a fuel in the form of bagasse for factory boilers. This situation is changing in view of an increasing world demand for sustainable sources of fuel. Some mills currently use surplus bagasse to produce steam for the production of cogenerated electricity. Other mills use the bagasse to manufacture paper and board, furfural and animal feeds. Numerous technologies are on the horizon that are expected to attract significant value to sugarcane fibre. The last element is water. A broad representation of how these elements fit together is presented in Figure 1.

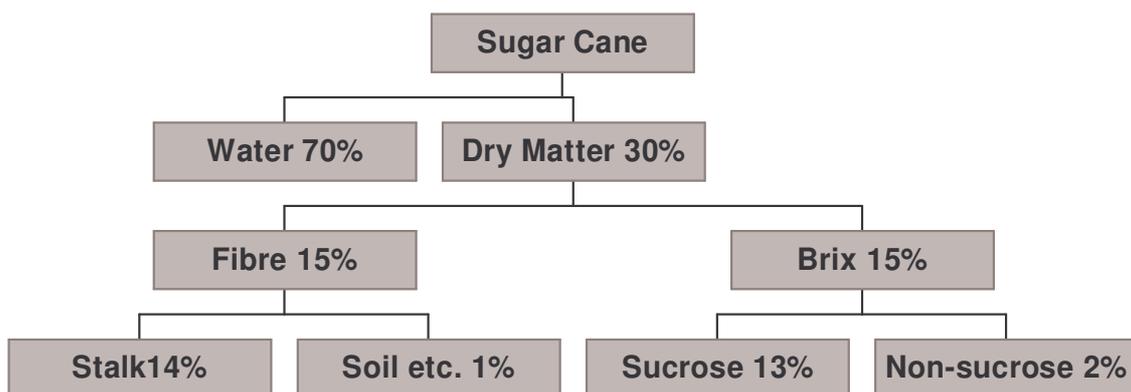


Figure 1. Sugarcane composition.

Sugarcane payment

Up until the 1925/26 season, South African sugarcane growers were paid on the quantity of sugarcane delivered to the mill at a fixed price per ton of cane. This changed to a sucrose cane payment system in the 1926/27 season which lasted until the 1999/2000 season, whereby payment was made for the quantity of sucrose (more specifically 'pol') in the cane, at a fixed price per ton of sucrose. The sucrose content of the sugarcane was recognised as the most important value determinant (Moor, 2003). However, in 1995 the South African Sugar Industry embarked on a self-review process to identify factors that could improve its global competitiveness. In this process, a Cane Quality Task Group was formed that proposed recognising the impact of non-sucrose and fibre in sugar production. This concept in a very simplistic form is illustrated in Figure 2.

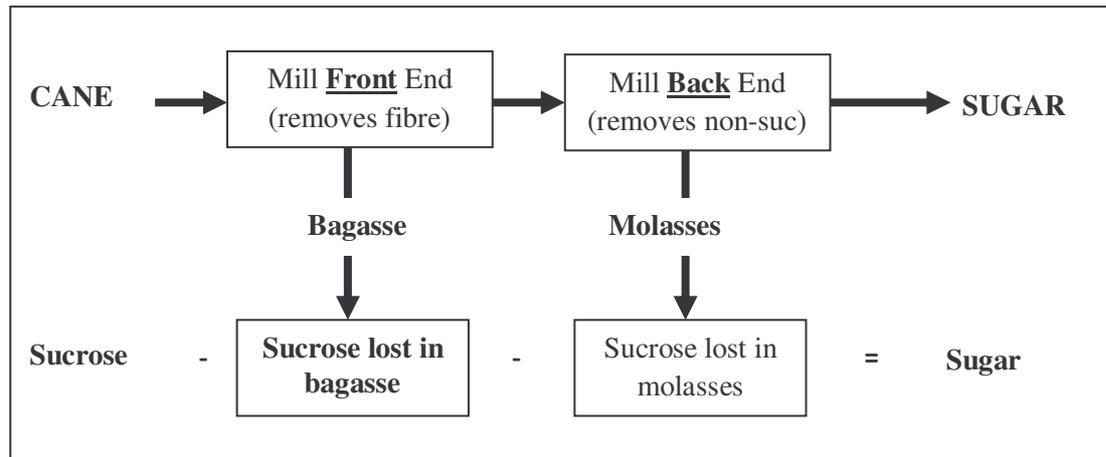


Figure 2. Explanation of sucrose losses in the milling process.

The concept presented in Figure 2 had previously been formalised in quantitative terms as the Estimated Recoverable Crystal (ERC) formula (Van Hengel, 1974):

$$\text{ERC}\% = aS - bN - cF$$

Where:	S	=	Sucrose % Cane
	N	=	Non-sucrose % Cane
	F	=	Fibre % Cane
	a	=	undetermined loss of sucrose from sugar production, including filter loss
	b	=	loss of sucrose from sugar production per unit of N
	c	=	loss of sucrose from sugar production per unit of F

The ERC formula is, however, a factory performance measure and does not fully reflect growers and millers share in sugar and molasses proceeds. As a consequence, the ERC formula was adapted for cane payment purposes, whereby the ERC 'a' factor is omitted in the Recoverable Value (RV) formula because undetermined losses in the factory are the domain of the miller and outside the control of growers. Furthermore, the ERC 'b' factor needed to be adjusted to accommodate the value of molasses attributable to each unit of N delivered, which is achieved by multiplying the ERC 'b' factor by the ratio of the molasses value per unit of N relative to the sugar value lost per unit of N to give the RV 'd' factor.

Where

$$d = b \times \left\{ 1 - \frac{\text{Mol value gain / unit N}}{\text{Sugar value loss / unit N}} \right\}$$

$$d = b \times \left\{ 1 - \frac{M \times P_m}{R_s/es \times b \times P_s} \right\}$$

and:	M	=	Industry average molasses yield per unit N delivered
	P _m	=	Industry average net realization per ton mol (R/t Mol)
	R _s /es	=	Industry average recovery of sugar from Estimated Sugar (ES) delivered (where ES is equivalent to ERC, but without the 'a' factor applied to S in the ERC formula)

$$\begin{aligned}
 b &= \text{ERC } b \text{ factor (see ERC equation above)} \\
 P_s &= \text{Industry average net realization per ton saleable sugar} \\
 &\quad (\text{R/t sug})
 \end{aligned}$$

The resultant RV formula, therefore, as derived from the ERC formula is as follows:

$$\text{RV \% Cane} = S - d N - c F$$

This RV payment system was introduced at the start of the 2000/01 season. It creates an incentive for growers to maximise sucrose production and at the same time to minimise non-sucrose and fibre in their cane deliveries, thereby improving cane quality and overall sugar recovery. The major farm management factors that contribute to good cane quality are cane freshness, appropriate topping height, mature cane, the appropriate use of ripeners, the selection of late/early season varieties and short milling seasons. Some geographic areas and specific farms/fields inherently have low/high cane quality potential, which from an economic perspective attracts a lower/higher land value. Nevertheless, farm management plays an important role throughout the South African industry in terms of maximising on farm revenue through the RV cane payment system.

Inequities associated with the seasonal variation of RV in cane

Sucrose, non-sucrose and fibre components of cane follow seasonal patterns, which has a major effect on RV and subsequent cane payments. During any season, the sucrose content of cane will commence at a low level in April/May and will rise gradually to peak in September/October. Thereafter, the sucrose content will decline until sucrose levels begin to climb again in April/May. The reverse is true for fibre and non-sucrose levels. Consequently, the harvesting period should be as short as possible to optimise the amount of RV delivered to the mill, coinciding with peak sucrose and minimum fibre and non-sucrose. However, the actual milling season tends to be 35 to 37 weeks because of logistics associated with utilising labour and machinery efficiently, both in the milling and cane haulage operations. Consequently, inequities can occur in the absence of rateable deliveries; i.e. when a grower or group of growers deliver all or most of their cane during high RV periods forcing other growers to deliver the majority of their cane during low RV periods. However, there are some noteworthy examples where rateable deliveries are inappropriate:

- Suppliers of small tonnages whose daily allocation is such that it would not constitute an economic delivery. Logically, the entire crop should be cut within a confined period.
- Where mechanised harvesting is used, the economic daily tonnage to be harvested is likely to be in excess of the average producer's daily allocation. Consequently, this operation might be undertaken on a group basis resulting in a departure from rateability. This rationale applies equally to contractor operations and simple harvesting and transport syndicates.
- Where cane has been damaged from fire, frost or pest infestation.

Relative payment – Additive approach

To address the inequities caused by non-rateable deliveries, a system of 'relative payment' was introduced in the 1975/76 season which had previously been introduced into the Australian sugar industry. Relative payment is the adjustment of each grower's actual RV%

cane to accommodate for the time period in which the cane was delivered; i.e. the total RV paid by the miller for the season still equals the total RV payment received by all growers for the season. The system needed to be credible to be accepted. The additive relative payment approach was adopted, which compares each individual's weekly average RV percentage with the mill average for the week and the mill average for the season as follows:

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

For example, if an above average grower delivers good quality cane in April at 9% RV, where the mill weekly average is 8% RV and the forecast mill season average is 11% RV, this grower will be paid 12% RV. Similarly, if the same above average grower delivers cane in September at 13% RV, where the mill weekly average is 12% RV and the forecast mill season average is 11% RV, this grower will be paid 12% RV. Effectively, the additive relative payment flattens the natural seasonal RV% pattern. Therefore, if the difference between a grower's actual RV percentage and the mill weekly average RV percentage is the same for every delivery during the entire season, a grower will be paid the same amount as if he had delivered his entire crop rateably. Based on this assumption, harvesting arrangements can be rationalised to provide greater flexibility as there is no apparent RV benefit/prejudice to delivering cane at any particular time of the season. Within a defined length of milling season, the advantages of relative payment include:

- Smaller scale growers are not prejudiced by non-rateable deliveries.
- Larger scale growers have the liberty of optimising harvesting and haulage logistics on their farms or estates.
- Groups of growers can freely form harvesting and haulage syndicates.
- Growers delivering rateably have the effect of a 'smoothed' cash flow.
- Milling capacity is better utilised because growers have an incentive to deliver at the beginning and end of the defined season.

Relative payment – Multiplicative approach

In recent times, the additive relative payment approach assumption of a constant difference between a grower's actual RV percentage and the mill weekly average RV percentage during the entire season has been questioned. This is best illustrated by a grower that delivers cane with hypothetically zero RV% in April, where the mill weekly average is 8% RV and the forecast mill season average is 11% RV, this grower will be paid 3% RV! Although Mill Group Board policies and procedures should mitigate the delivery of extremely poor cane quality consignments, this example illustrates the fallibility of the additive relative payment approach. An alternative multiplicative relative payment approach can mitigate this problem:

$$\text{Relative RV\%} = (\text{Growers weekly average RV\%} \text{ divided by Mill weekly average RV\%}) \text{ multiplied by Mill season average RV\%}$$

This multiplicative approach alleviates much of the concern associated with the inappropriate incentives created by the additive approach, whereby the new assumption is that for a grower to receive the same payment whether deliveries are made rateably or not is that there is a consistent relationship between a grower's actual RV percentage and the mill weekly average

RV percentage for every delivery during the entire season. An empirical comparison between the additive and multiplicative approaches is presented in Table 1.

Table 1. Comparison of the additive and multiplicative relative payment approaches.

Approach	Quality	Grower Actual RV %	Mill Weekly Avg RV %	Mill Season Avg RV %	Grower Relative RV %
Additive	Average	10.0	10.0	12.0	12.0
	High	11.0	10.0	12.0	13.0
	Low	9.0	10.0	12.0	11.0
	Nil	0.0	10.0	12.0	2.0
Multiplicative	Average	10.0	10.0	12.0	12.0
	High	11.0	10.0	12.0	13.2
	Low	9.0	10.0	12.0	10.8
	Nil	0.0	10.0	12.0	0.0
Difference	Average				0.0
	High				0.2
	Low				-0.2
	Nil				-2.0

Although mill supply areas are not homogenous and climatic and management factors are known to vary differentially within a season, this multiplicative approach creates a clear incentive for each and every grower to deliver cane with an RV% that is as high as possible relative to the mill weekly average RV%. The rewards for significantly better than average cane are enhanced, paid for by the reduced revenues accruing to suppliers of significantly poorer quality cane; average quality cane will be unaffected. The inevitable consequence is that the mill weekly average RV% rises to its optimum inherent potential. This in turn optimises revenues available for distribution to both millers and growers. As with the additive system, the total RV paid by the miller for the season still equals the total RV payment received by all growers for the season. Unlike the additive approach, however, the authors are unaware of this multiplicative approach having been applied anywhere in the world to-date.

Shortcomings of relative payment and mitigating actions

Both the additive and multiplicative relative payment approaches suffer the shortcomings of (1) the cash flow implications for millers having to pay more for low quality cane at the beginning and ends of the season that has lower recoverable sugar, and (2) the need to have to estimate the mill season average RV % until it can be calculated accurately at season end. The initial shortcoming was accommodated in the 'division of proceeds' calculation between millers and growers, taking into account that the miller also pays less for high quality cane mid-season. The latter shortcoming was easily overcome by progressively estimating and adjusting the mill season average RV% and making a final adjustment at season end. This 'estimation' element of the payment system was already an inherent part of the existing cane payment mechanism prior to its implementation in the 1970s, arising from Cane Testing Service adjustments and time lags associated with sugar and molasses sales. As a consequence, growers receive a provisional monthly payment for the cane they deliver one month in arrears. This provisional payment has been adapted to accommodate both the RV

and relative cane payment changes, whereby a reserve is deducted from the monthly provisional RV price and retained by the miller to account for both unexpected fluctuations in the RV price and in the estimate of relative tons RV to be delivered during that season. At the end of the season, a final payment is made on the 31st March, which results in the grower receiving all monies retained by the mill, plus interest. This final adjustment to the season's payments is calculated as follows:

Final payment

$$\text{R/ton} = \{ \text{Final RV Price} \times \text{Cumulative tons Relative RV delivered} \} - \text{All Previous Provisional Payments}$$

Provisional monthly payment

$$\text{R/ton} = \{ [\text{Estimated RV Price Last Month} - \text{Mill Retention, e.g. 2,5\%}] \times \text{Cumulative tons Relative RV delivered} \} - \text{All Previous Provisional Payments}$$

Actual payment of interest on all monthly Mill Retention amounts is received by each grower as a lump sum amount on the 31st March together with the final cane payment and is calculated as follows.

Monthly retention interest

$$\text{R/ton} = \{ [\text{Cumulative tons Actual RV delivered} \times \text{Final RV Price}] - [\text{Cumulative tons Relative RV delivered} \times \text{Estimated RV Price last month less Retention}] \} \times 1/12 \text{ of the annual interest rate}$$

Another shortcoming of any relative payment approach is its effect of disguising the rapid drop-off in RV% at the beginning and ends of the season. The effect is that season lengths can be inadvertently extended, resulting in what might appear to be an insignificantly lower mill season average RV%. However, when the full mill area cane tonnage is multiplied by the mill season average RV% loss, the financial implications can be significant for the grower collective. This problem is aggravated by (1) the high degree of error of the within season estimates of the mill season average RV%, and (2) the delayed calculation of the actual mill season average RV%, which only takes place after crushing has finished. The effect is that both growers and millers are 'blinded' to the consequences of the rapid drop-off in RV% at the beginning and ends of the season, which dilutes their urgency to keep the season length short. Both millers and growers are always prejudiced by longer milling seasons, assuming a finite cane supply and fixed maximum mill throughput capacity. This lack of urgency is also manifested in high no-cane stops and sub-optimal use of milling capacity and harvesting equipment, which collectively can add significant costs to the value chain.

The problem of both millers and growers being 'blinded' to the consequences of the rapid drop-off in RV% at the beginning and ends of the season can be overcome if both millers and growers collectively agree on a defined season length in their mill area, during which multiplicative relative payment shall apply. The consequence for poor delivery performance post the defined season length is payment on actual RV%. Although this has no revenue impact for a rateable grower that does not change his delivery pattern other than a relatively small cash flow advantage, the RV% drop off at the end of the season will become patently clear, which will strengthen the existing incentive to deliver the same crop within the shorter

defined season length, resulting in increased revenue from a higher average RV% cane. If all growers responded in this manner, no-cane stops at the mill would reduce and the use of harvesting equipment and milling capacity would be improved. This would result in reduced costs throughout the value chain as well as increase sugar recoveries from the same tonnage of cane, enhancing revenue for both growers and millers! The miller, therefore, also has an incentive to facilitate vehicle scheduling and optimise mill performance. However, non-rateable deliverers could be severely prejudiced if forced to deliver outside of the defined 'relative payment' season and cognisance should be taken of this at a local mill area level. This may result from poor milling performance and/or excessive rain, which has no effect on a fully rateable deliverer who is no better or worse off being paid on relative RV% or actual RV% over the same 'extended' season length.

Conclusions

Multiplicative relative payment is the preferred approach because it creates a clear incentive for each and every grower to deliver cane with the highest possible RV% relative to the mill weekly average RV% and thereby optimises the mill weekly average RV%. Consequently, the current additive relative payment approach should be replaced with the multiplicative relative payment approach.

Furthermore, the current application of the relative cane payment system to all cane deliveries within a season should be replaced with its application to a defined period, outside of which actual RV% applies. This strengthens the incentive for all growers to deliver their same crop in a shorter season, resulting in reduced costs and enhanced revenue for both growers and millers. The caveat is that such an arrangement could severely prejudice non-rateable growers and cognisance should be taken of this at a local mill area level. Overall, this system can be accommodated within the ambit of existing Mill Group Board policies and procedure.

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