IMPROVED PROFITABILITY BY RE-ORGANISING MILL SUPPLY:
A DECISION SUPPORT APPROACH

By

C. LEJARS¹, P.Y. LEGAL¹, E. MEYER², P. LYNE², S. AUZOUX¹
and B. SIEGMUND¹.

¹Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
²South African Sugarcane Research Institute (SASRI)
caroline.lejars@cirad.fr

KEYWORDS: Sugarcane, Supply Management,
Delivery Scheduling, Decision Support, Grower-Miller Relations.

Abstract
GREATER competitiveness and deregulation in the sugar industry require new forms of co-
ordination between growers and millers to increase the efficiency and profitability of the mill
supply chain. This issue involves many stakeholders along the chain, with various objectives,
constraints and decision-making processes. A decision support approach has been designed in
order to facilitate discussion and negotiation between the stakeholders while exploring
collectively satisfactory solutions. This research has been conducted in La Réunion and South
Africa where millers have to deal with numerous and diverse growers. In both cases the
supply chain has been described in order to determine the stakeholders' objectives, operation
processes and performances regarding the cane supply from the farms to the mill. A generic
conceptual model was designed and developed in an application called MAGI². MAGI²
allows one to simulate cane flows from production units to a mill, by capturing the mill
supply area structure, the mill characteristics, operators' capacities along the chain, cane
quantity, cane quality curves and delivery rules for each production unit. Scenarios may vary
according to each of these parameters. They are compared according to the total sugar
production for the season and for each production unit. This approach has been tested by
comparing rearrangements of cane supply taking into account quality variations within some
mill supply areas. In these cases, production units are determined as sub-areas showing
similar patterns in cane quality throughout the year. Delivery rules are then modified so as to
match harvest windows per production unit with quality variations between them and with
capacities along the chain. Such modifications could increase total sugar production by 3% to
5%. Thus, an organisation of the harvest schedule taking into account quality differences
within a mill area can give overall benefits to the mill and the growers. The approach supports
discussion between growers and millers about organisational changes by providing quantified
assessment indicators. Related issues such as agronomic impacts or economic consequences
of alternative cane supply management can then be raised and investigated with the
stakeholders.

Introduction
Managing a mill supply in the sugar industry is a co-ordination issue between numerous
stakeholders.

The management of cane supply from growers' fields to the mill involves many stakeholders and
many tasks to be carried out along the chain, the successful combination of which impacts on the efficiency
and profitability of the mill area (Figure 1).

It is mainly a matter of co-ordination between stakeholders to regulate the quantity and quality of
flow of raw material from the farmer to the miller.

This regulation process involves interaction between several sets of constraints (Gaucher et al.,
2003). Millers aim at controlling supplies in order to fully utilise their industrial capacities while adjusting
to market demands.
Farmers have to adapt to the miller’s requirements according to their own constraints of land, labour and equipment. Contractors and hauliers face equipment and financial constraints when fulfilling their commitments to the farmers and millers.

Co-ordination processes cause frequent conflicts between stakeholders regarding the observance of contracts, payment for individual efforts, and the day-to-day management of cane supply.

Solving these conflicts requires the stakeholders to switch from individual points of view to the search for collective growth strategies. Simulation models can be particularly useful in assisting stakeholders involved in this process.

Fig. 1—Representation of mill supply structure.

Designing the model enables one to highlight disagreement points and critical interfaces between stakeholders within the chain. Simulation provides a quick and reliable way to assess and compare alternative scenarios for chain circumstances and supply organisation.

**Method**

A decision support approach based on the modelling of cane flows and a simulation tool called MAGI™ has been experimented with in La Réunion and in South Africa to address cases with numerous independent stakeholders interacting within the supply chain (see Gaucher et al., 2003 and Le Gal et al., 2003, for details).

The approach aims at assessing and comparing alternative supply scenarios referring to changes in capacities or planning/operational rules. The model is based on a simplified representation of the various operators in the supply chain, and their constraints and relationships.

Changes in structure, capacities and planning/operation rules are simulated, and their consequences in terms of sugar production are quantified at the mill area level (Figure 2).

The issues addressed by MAGI™ include the restructuring of mill areas (industrial and agricultural capacities, supply chain structure), changing delivery allocation rules and season duration, and dividing the mill area according to variations in cane quality.

MAGI™ simulates the mill supply over the season on a weekly basis. It takes into account agricultural and industrial capacities, cane production by homogeneous units at the mill area level, and some mill operating variables such as length of milling season and mill opening and closing dates.

Each production unit is characterised by its cane area, cane yield, harvest-transport capacity and sucrose curve obtained from the mill database. Scenarios of supply are compared according to weekly and total sugar production over a season.
Results and discussion

The potential impact of quality-based allocations on sugar production at the mill level was assessed. This approach was used in order to assess the profitability improvement achievable by modifying cane supply according to variations in cane quality within the supply area and throughout the season.

As the current supply system is based on uniform delivery allocation in all regions throughout the milling season, alternative supply systems were simulated based on a reduction of harvest windows for homogeneous quality sub-areas.

The study was conducted both in Le Gol Mill in La Reunion and Sezela Mill in South Africa. In each case, the mill area was split into sub-areas showing significantly different patterns in cane quality curves throughout the year.

Different rules governing the delivery allocations of these sub-areas were simulated to ascertain the benefits from new scenarios taking into account these quality curve differences.

Delivery rules were modified to match harvest windows per sub-areas with capacities along the chain to benefit from cane quality differences within the supply area.

For example, in South Africa, the Sezela mill supply area was split into two main sub-areas (Coastal and Inland), which have significantly different curves of Recoverable Value (RV) (Figure 3). Five scenarios were simulated and compared to the benchmark scenario (Table 1).

On the benchmark scenario (the current one), the length of the season (LOMS) is 38 weeks and the Daily Rateable Delivery (DRD) is uniform over the season for each sub-area. Scenario A keeps rateable deliveries for all zones but postpones the opening date of the season to week 16 in order to profit from the asymmetric nature of the recoverable value curve. In scenarios B and E, the length of the milling season is reduced by 2 weeks. In scenarios B, C, D, and E, the rateable deliveries and season length are different for Inland and Coastal sub-areas.

Fig. 2—Conceptual framework of MAGI.

Their harvest windows are modified to give priority to the zone with the highest quality (Inland). In scenario D and E, the rateable deliveries are not uniform throughout the season, and coastal growers deliver more towards the end of the season than in the beginning.

![Graph showing recoverable value](image)

**Fig. 3—Curves of Recoverable Value for the two sub-areas of Sezela mill supply area (inland and Coastal)**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Benchmark</th>
<th>Scenario A</th>
<th>Scenario B</th>
<th>Scenario C</th>
<th>Scenario D</th>
<th>Scenario E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting week numbers</td>
<td>13–50</td>
<td>16–53</td>
<td>16–52</td>
<td>13–50</td>
<td>13–50</td>
<td>13–51</td>
</tr>
<tr>
<td>Length of milling season (weeks)</td>
<td>38</td>
<td>38</td>
<td>37</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Harvest windows*</td>
<td>Uniform*</td>
<td>38</td>
<td>37</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>DRD**</td>
<td>Uniform**</td>
<td>Rateable**</td>
<td>Adjusted**</td>
<td>Variable**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Harvest windows are adjusted when they differ from one zone to another; otherwise they are uniform.

**The Daily Rateable Delivery (DRD) is Rateable when the tonnage to be delivered by a zone remains the same throughout the harvest window; otherwise the DRD is Variable.

The five different scenarios (A, B, C, D, E) have been simulated and compared to the benchmark scenario. The difference between the recoverable value tonnage produced in the benchmark scenario and recoverable value tonnage produced in alternative scenarios were computed. The results showed that such rearrangements could increase total sugar production by 3%–5% (Figure 4). Thus, new delivery rules based on cane quality variations can improve both mill profitability and growers' incomes.

Though these rearrangements impact differently on the farmers' income according to their location in the mill supply area and their production system, production gains were great enough to continue on this track (Guilleman et al., 2003; Lejars et al., 2003).

**Conclusion**

These two case studies (Reunion and South Africa) have stressed the potential of this modelling and simulation approach in addressing supply organisation issues at the mill supply area level.

Focusing on cane flows between farmers, contractors, hauliers and miller, and taking into account their interactions along the chain, would complement daily logistic tools and economic evaluation tools such as length of milling season (LOMS) analysis.
Simulating scenarios provides a powerful and quick way to assess the impact of proposed changes on the profitability of the chain. Stakeholders can use this information to support their negotiation and decision-making processes.

The need for further investigations was identified regarding the impact of alternative harvest scheduling both on farm agronomic and operational practices and on logistic organisation. For example, the consequences of new delivery rules on both cane yield and labour force availability have to be addressed. There is also a need to evaluate the costs attached to these alternative harvest schedules and to investigate ways of optimising transport systems.

These rearrangements impact differently on the farmers’ income according to their location in the mill supply area and their production system. So, both growers and miller would like to compare alternative cane payment systems which would encourage growers to deliver good quality cane while sharing fairly the total gains obtained from new supply arrangements between stakeholders.

REFERENCES


PROFITABILITE ACCRUE A TRAVERS LA RE ORGANISATION DE L’APPROVISIONNEMENT DE L’USINE: UNE APPROCHE D’AIDE A LA DECISION

C. LEJARS, P.Y. LEGAL, E. MEYER, P. LYNE, S. AUZOUX et B. SIEGMUND

MOTS CLES: Canne à Sucre, Gestion de l’Approvisionnement, Planification de la Livraison, Aide à la Décision, Relations Planteur/Usinier.

Résumé

UNE COMPETITIVITE accrue et la dérégulation dans l’industrie sucrière exigent d’autres formes de coordination entre les planteurs et l’usinier, afin d’améliorer l’efficacité et la rentabilité de la chaîne d’approvisionnement des moulins. Cette question importante implique la participation de nombreux partenaires dont les objectifs, les contraintes et les prises de décision diffèrent de l’un à l’autre. Un plan d’aide à la décision a été élaboré pour faciliter les discussions et les négociations entre les partenaires tout en explorant collectivement les solutions...
MEJORA EN LA RENTABILIDAD AL REORGANIZAR EL ABASTECIMIENTO DEL INGENIO: UN ENFOQUE DE APOYO DE DECISIONES

C. LEJARS1, P.Y. LEGAL1, E. MEYER2, P. LYNE2, S. AUZOUX1 y B. SIEGMUND1

1Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
2South African Sugarcane Research Institute (SASRI)

caroline.lejars@cirad.fr

PALABRAS CLAVE: Caña de Azúcar, Administración de Abastecimientos, Calendarios de Envió, Apoyo de Decisiones, Relaciones Productor-Ingenio.

Resumen

Mayo r competitividad y desregulaciones en la industria azucarera requieren de nuevas formas de coordinación entre productores e ingenio para aumentar la eficiencia y rentabilidad de las cadenas de abastecimiento del ingenio. Este aspecto involucra a muchos interesados a lo largo de la cadena, con variados objetivos, condicionantes y procesos de toma de decisiones. Un enfoque de apoyo de decisiones ha sido diseñado de manera de facilitar las discussiones y negociaciones entre los accionistas interesados mientras se exploren soluciones de satisfacción colectiva. Esta investigación fue llevada a cabo en la Isla de La Réunion y en Sudáfrica, donde los ingenios tienen que negociar con muchos y diversos productores. En ambos casos, la cadena de abastecimiento ha sido descrita para determinar los objetivos de los accionistas interesados, procesos de operación y desempeño relacionados al abastecimiento de caña de las fincas al ingenio. Un modelo conceptual genérico fue diseñado y desarrollado en una aplicación llamada MAGIO. MAGIO permite similar el flujo de caña de las unidades de producción hacia el ingenio, capturando la estructura del área de abastecimiento del ingenio, las características del ingenio, las capacidades de los operadores a lo largo de la cadena, cantidad de caña, curvas de calidad de caña y reglas de envío para cada unidad de producción. Los escenarios pueden cambiar de acuerdo a cada uno de estos parámetros. Son comparados de acuerdo al total de producción de azúcar de la zafra y para cada unidad de producción. Este enfoque ha sido probado comparando rearrreglos de abastecimiento de caña tomando en cuenta variaciones en calidad en algunas áreas de abastecimiento de ingenios. En estos casos, las unidades de producción son determinadas como sub áreas que muestran patrones similares de calidad de caña a lo largo del año. Las reglas de envío pueden entonces ser modificadas para ajustarse a las ventanas de la zafra por unidad de producción con variaciones en la calidad entre ellas y con capacidades a lo largo de la cadena. Tales modificaciones podrían aumentar el total de producción de azúcar en un 3% a 5%. Por lo anterior, la organización de un calendario de zafra que toma en cuenta diferencias de calidad dentro del área de un ingenio puede brindar beneficios globales al ingenio y a los productores. El enfoque apoya la discusión entre productores e ingenio acerca de los cambios organizacionales al proveer indicadores determinantes cuantificados. Aspectos relacionados tales como el impacto agronómico o consecuencias económicas de la administración del abastecimiento alternativo de caña pueden ser considerados e investigados con los accionistas interesados.