THE IMPACT OF IMPROVED TECHNOLOGIES ON THE PRODUCTIVITY OF MAURITIAN SUGAR CANE GrowERS

By

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Technology, Extension, Productivity.

Abstract

The changes operating in the global economic environment are threatening the competitiveness of the Mauritian sugar industry. With a view to maintaining long-term viability and sustainability, it is imperative for sugarcane growers to revisit their farming operations to attain the twin objectives of reducing production costs and improving sugar yield per unit area. A major component of the Research and Development Programme of the Mauritius Sugar Industry Research Institute (MSIRI) has been geared towards the development of improved cultural practices and labour-saving techniques. These practices and techniques have been promoted through various extension activities, such as field visits, on-farm trials and demonstrations, and group meetings. The impact of the adoption of these practices on productivity, more precisely on production costs and optimum use of resources, was assessed among a few sugarcane growers operating in different ecological environments. Results showed in particular a reduction in labour utilisation, which could be mainly attributed to adoption of labour-saving techniques, such as partially mechanised planting (PMP). This technique led to a reduction of approximately 40% in plantation costs on one estate. Improvement in crop productivity was also noted and could be largely explained by the development of an appropriate variety strategy and the adoption of a rational harvesting programme. One estate achieved an annual increase of 2.5 t/ha in terms of cane yield through the adoption of better performing varieties like R 575, M 1176/77 and M 1400/86 coupled with more efficient irrigation systems, the centre pivot and drag line. A change in management practices and the implementation of a rigorous monitoring procedure, mainly at field level, were observed. The study indicated the need to replicate such investigations among other growers to establish appropriate benchmarks for the industry. Results could also assist extension officers in their endeavour to promote new technologies among their target clientele.

Introduction

Under the Sugar Protocol of the Lomé Convention, the African-Caribbean-Pacific countries are benefiting from a preferential price on a guaranteed sugar quota exported to the European Union. However, this exceptional treatment, which has contributed extensively to the economic development of the Republic of Mauritius, is not likely to extend beyond 2008. With the recent changes operating in the global environment and with complaints to the World Trade Organisation from some sugar producing countries, there are clear indications that this preferential price will eventually be eliminated. This situation, coupled with the continuous increase in the price of important inputs, most particularly labour, will have serious repercussions on the competitiveness of the local sugar industry.

A major component of the Research and Development Program of the Mauritius Sugar Industry Research Institute (MSIRI) has been geared towards the development of appropriate technologies and improved cultural operations to maintain the long-term viability and sustainability of the sugar industry. Projects are implemented in different spheres, such as sugarcane variety improvement, mechanisation, plant nutrition, irrigation, weed management and cultural operations. Through various extension activities, growers were encouraged to revisit their farming operations and to improve their cropping systems through the adoption of the latest research findings. In response to the threat mentioned above, the government put forward a 2001–2005 Sugar Sector Strategic Plan (SSSP). The plan suggested urgent measures and
immediate actions to be undertaken by the different stakeholders to reduce production costs and improve sugar yield per unit area. Most of the proposals were in line with the different projects being implemented by the MSIRI.

A study by Pillay et al., (2001) revealed that, among a sample of the growers, a large majority were adopting improved or new technologies recommended by the MSIRI. Case studies were conducted in the different agro-climatic environments to assess the impact of these techniques on productivity.

Methodology

Four model estates operating in different geographical sectors of the island were selected. These are progressive growers who have enough resources, are committed to improving their farming operations, and also have thorough record keeping systems. Background information on these growers is summarised in Table 1:

<table>
<thead>
<tr>
<th>Table 1—Information on growers involved in the case studies.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estate</strong></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
</tbody>
</table>

Source: Arlidge and Wong Yon Cheong (1975).

MSC – Mountain Slope Complexes  LRP – Latosolic Reddish Prairies.
LHL – Low Humic Latosols  LBF – Latosolic Brown Forest.

Working sessions were planned with the four growers to inform them of the objectives of the study with emphasis on the changes that occurred in their farming operations and any improvement in productivity. A structured questionnaire was designed to collect information on the following:

- Land under cultivation/ existing labour force/ extent of equipment ownership.
- Diversity of farming operations.
- Resource requirement for each operation.
- Observations on changes that occurred with the adoption of new practices.

The main farming operations considered were: land preparation, planting, fertilisation and soil amendments, weed and trash management, cane harvest and transport, and post-harvest practices.

A pre-testing of the questionnaire was performed on one estate to check for its relevance and to correct for any loopholes. The MSIRI extension staff conducted the survey. It could be argued that an element of bias could exist, but it was strongly believed that there was no better alternative to the extension officer himself to evaluate any achievements with his clientele.

The survey consisted in initially holding meetings with the target estates to discuss the objectives of the study and the input-output data required and to ensure their collaboration. Several working sessions were organised with them both at the field and office level. These were important to strengthen the climate of thrust and confidence, ensure that the relevant input-output data are obtained and check their veracity. Access to the estates’ record keeping system facilitated the process of information retrieval.

The data collected were analysed by using the simple trend analysis and the partial budgeting technique to identify and measure the changes that occurred in resource use as a result of the adoption of
the new practices. Data on cane yields for the period 1990 to 2003 were also collected to assess the impact of the new technologies on sugar production.

Results and discussions

The findings of the survey are discussed below and the trends in changes observed in major practices are summarised in Annex 1.

Derocking and land preparation

Heavy derocking, a costly operation during land preparation, was observed to be quite extensive at estates B, C and D. It was a pre-requisite for appropriate farm planning and layout to facilitate mechanisation of certain farm activities to improve labour productivity. At estates B and D, the costs of this operation were borne by the growers and, depending on the degree of rockiness and extent of derocking, were US$2800 and US$800/ha respectively. At estate C, a contractor undertook derocking free of charge because the rocks were of an acceptable quality for sale to a stone crusher. Another positive outcome of derocking is the increase in the area of arable land. At estate C, an additional area of about 10 hectares is now under sugarcane. It was also reported that in subsequent ploughing, such intensive derocking would not be required, resulting in a lower cost for land preparation.

At estate A, due to the nature of the soil, derocking was not necessary. The estate has adopted the practice of minimum tillage planting (MTP), (McIntyre and Barbe, 1990) on approximately 72% of its land area. The grower observed a saving equivalent to about nine tractor-hours/ha as compared to the conventional method of land preparation.

Planting

Fields are harvested during the period of June to November and old ratoons may be replanted either in the same year from July to August (Short-season) or in the following year from January to March (Long-season). Short-season planting is more profitable than long-season (Tonta et al., 1998). However, long-season planting is the standard practice at estates A and B, owing to scarcity of labour during the crop season. Long-season planting is practised on 50% of the area at estate C to enable it to pursue a programme of derocking and field planning. The remaining 50% of the land at estate C was earmarked for short-season planting after undergoing a rotational period during which vegetables are cultivated to maximise revenue.

The method of planting at estates A and D is manual. A saving equivalent to 10 woman-days (WD) per hectare was observed at estate D because setts were no longer neatly aligned. Estates B and C have adopted the practice of partially mechanised planting (PMP), (Seeruttun et al., 1997) resulting in an overall reduction of about 40% in the planting cost. A saving of four man-days (MD) per hectare was noted at estate C but more tractor hours were required. Although the monetary gain might not be clearly perceived, the capacity to depend less on labour is considered a major benefit.

Fertilisation

Fertilisers are costly inputs and efforts are not spared to ensure their judicious use among growers. The four growers have taken advantage of the free soil analysis service provided by the MSIRI and have adopted a fertiliser regime based on soil analysis results and field yield potential.

Soil acidity at estates A and D, located in the superhumid zone, is corrected at planting. Complex fertilisers are generally used to cut down on labour. However, straight fertilisers are also applied where necessary. For example, triple super phosphate is applied to correct P deficiency at planting on the four estates and calcium ammonium nitrate is used as supplementary N on estates A and D. Fertiliser application is manual on all estates, except at estate C, where 45% of the area is fertilised mechanically.

Irrigation

Irrigation is required at estates B and C, which are located in the low rainfall areas. In order to save on operating costs and make efficient use of the limited irrigation water, a shift from the traditional surface system to centre pivot or drag line (an overhead sprinkler system where sprinklers are connected by means of portable hoses and permanent or semi-permanent pipes to a pressurised water supply) systems has been installed.

Currently, centre pivot occupies 57% and 34% and drag line 32% and 46% of the area at estates B and C, respectively. A saving of around 84 to 92% on labour costs for operating these two systems was noted.
Weed management

Manual weeding is inefficient and labour intensive (Pillay Samoo and Barbe, 1998) and is restricted to the eradication of tough weeds such as *Paspalum* and *Panicum* spp on estates B and C. A spot herbicide application is carried out on estate D for that purpose. On estate A, hand weeding is only practised to retain field workers.

Chemical weed control has been widely adopted and has led to better weed management and cost saving by reducing the use of labour. Improvement in spraying techniques, proper timing of application, and use of new products with longer residual effects, (i.e. oxyfluorfen) have reduced the number of herbicide applications to a maximum of two. On estate C, where trash blanketing is practised, only one application is required on 30% of the area to control weeds. Herbicides are generally applied manually using back-pack sprayers except on estate C where mechanical herbicide application is applied on 40% of the area.

Recruiting and earthing up

Recruiting (a practice aiming at filling gaps of 60 cm or more resulting from non-germinated setts or dead stools), to insure a uniform stand during the crop cycle, is a common practice in plant cane with all the growers, with the extent varying between five to 12%. In ratoon cane on estate C, recruiting was effected in only mechanically harvested fields and in the 4th ratoon on estate D. It is performed either through stool splitting or use of setts or plantlets issued from one-eyed cuttings. On average either 3 MD or 5 WD/ha are required to make furrows and effect planting. In order to reduce costs on labour, estate C adapted tractor-mounted equipment for mechanical furrowing prior to transplanting setts by hand.

Earthing-up (creating a ridge profile along the cane row by bringing soil from the interrows) is only practised on estate D in plant cane due to excessive rainfall to prevent stagnation of water in the furrows. This practice is done by hand. Labour productivity has improved with an average reduction of five WD/ha in fields that have been derocked.

Pre-harvest trash management

Cane is either manually trashed (stripping of dry leaves from the cane stalk) or burnt to facilitate harvest to ensure the delivery of clean cane to the mill. Under certain conditions, burning instead of trashing is undertaken to reduce labour costs. A reduction of 11 WD/ha was noted at estate D, by reducing the number of trashing operations to only one instead of the two operations carried out in the past (one during the elongation phase and the second one about two to three weeks prior to harvest). Estate B switched from two trashing operations to burning, and this allowed for a saving of 47 WD/ha. The practice of two trashing operations in plant cane and one in ratoon has not changed at estate A. It is interesting to note that at estate C, with mechanical green cane harvest, the practice of burning prior to harvest has decreased by 15%. Reduced burning improves the public perception of sugarcane farming in the local tourist sensitive economy.

Harvest and transport

In general, a gradual shift from manual to either partially or fully mechanised harvest has been noted. At estate A, cane is harvested manually, stacked in field borders and transported by side-loaders of five to seven tonne capacity. This is a change from the previous way of manually loading in four to five tonne baskets of self-loaders. At estate B, tractors with larger payloads have replaced self-loaders for the transport of cane. This had a positive impact on harvest scheduling and transport costs. At estate C, 58% of the harvest area is fully mechanised and, on the remaining area, manual cutting and mechanical loading are performed. A saving of 15% on costs of harvest and transport was achieved on the area where harvest was fully mechanised in 2003. At estate D, where harvest is still manual, labour productivity has improved by the elimination of obstacles, such as rock piles and rocks in the cane rows.

Post-harvest trash management

Because of high labour costs, little is done with respect to post-harvest trash management, even under superhumid conditions. The practice of trash-blanketing offers the added advantage of controlling weed proliferation. No change in practices was reported at estate A, where trash is lined on every alternate interrow, which requires 14.4 WD/ha. At estate B, the present practice is to leave any unburnt trash *in situ* after harvest while, in the past, all the trash was removed from the fields and used as fodder. There is presently no intervention on 90% of the area at estate C, where burning before mechanical harvest is practised. On the remaining area (trashed prior to harvest) trash-blanketing is performed. For estate D, the
present practice consists of removing trash over the harvested cane rows so as to facilitate regrowth; hence, trash is maintained in every interrow. The grower claimed a saving of six WD/ha and observed no adverse effect on cane yield.

**Variety strategy and cane productivity**

Presently, a good variety strategy that takes into consideration variety performance, maturity behaviour and tolerance to mechanical harvest, was observed at estates B and C. The two predominant late-maturing varieties, namely M 555/60 and R 570, are being gradually replaced by new varieties such as R 573, R 575 and M 1176/77, adapted to earlier harvesting periods.

On estates A and D, where a ‘mono-variety’ situation existed at the beginning of the 1990s, there has been some evolution with respect to variety strategy and some diversity is now noted. Though these estates still predominantly grow varieties R 570 and M 3035/66, respectively, there are indications of their further expansion of newer varieties, such as M 52/78, M 1400/86 and R 579.

Analysis of cane yield data for the period 1990 to 2003, excluding the severe drought year of 1999, revealed an annual increase in cane productivity in the order of 2.5 and 1.3 t/ha for estates B and C, respectively. Appropriate data were not available for estates A and D to enable any major inference.

**Change in management practices**

It was generally perceived that management had improved efficiency both at the field and administrative levels. This was due to several factors, among which were more trained personnel, use of Information Technology, closer contact with extension, and research and opportunities provided by mechanisation. In practice, this was reflected in better control over field operations, improved collaboration between managers and field workers, and significant improvement in labour and resource utilisation.

Respondents believe that training is important for efficient management but it requires significant resources and time. Estate B trained field workers in partially mechanised planting and the use of drag line irrigation. The manager of estate C was trained in the use of specific computer software. It is worth noting, however, that while estate B claims to have a good record keeping system, the managers of the other three estates wish to improve their existing record keeping systems.

**Conclusions**

There are clear indications that the growers, conscious of the challenges ahead, are reviewing their farming operations to ensure the viability of their sugar cane business. Research findings are being adopted and/or adapted to improve productivity.

Reduction in production costs are evidenced through the adoption of minimum tillage planting with a saving of about nine tractor-hours/ha, the use of side loaders and tractors with larger payloads for cane transport, the adoption of partial mechanised planting, with a decrease of about 40% in plantation costs, and a reduction in the number of herbicide applications.

The mechanisation of some field operations has led to a reduction in labour requirement, hence reducing the dependency on this scarce and expensive input.

An increase in production has been achieved with adoption of a sound variety strategy, better irrigation systems and rational use of fertilisers.

There is a need to replicate a similar study among a larger group of growers in order to establish appropriate benchmarks, which could also be useful for growers, research specialists, and extension officers.

**Acknowledgement**

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**REFERENCES**


L’IMPACT DES TECHNOLOGIES AMELIOREES SUR LA PRODUCTIVITE CHEZ LES PLANTEURS DE CANNE A SUCRE A MAURICE

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MOTS-CLES: Canne à Sucre, Producteurs, Recherche, Technologie, Vulgarisation, Productivité.

Résumé

AVEC les changements qui surviennent au niveau de l’environnement économique global, la compétitivité de l’industrie sucrière mauricienne est menacée. Pour maintenir leur durabilité, les planteurs de canne à sucre doivent impérativement revoir leurs opérations culturales s’ils veulent atteindre le double objectif qui est de réduire leurs coûts de production et d’augmenter leur production par unité de surface. Une des composantes majeures du programme de recherche et développement du Mauritius Sugar Industry Research Institute (MSIRI) est axée sur la mise au point de pratiques culturales améliorées et de techniques nécessitant moins de main-d’œuvre. La promotion de ces pratiques et techniques se fait à travers diverses activités de vulgarisation telles que les visites et les essais au champ, les démonstrations et les réunions de groupes. L’impact de l’adoption de ces pratiques sur la productivité, plus précisément sur les coûts de production et l’utilisation optimale des ressources, a été évalué chez quelques planteurs situés dans différentes zones écologiques. Les résultats démontrent une réduction de la main-d’œuvre requise, qui peut être attribuée principalement à l’adoption de techniques telles que la plantation partiellement mécanisée, entre autres. Cette technique a permis une réduction d’environ 40 % sur le coût de plantation d’une exploitation. Une productivité améliorée, largement due à une stratégie variétale appropriée ainsi qu’à un programme de récolte rationnel, est aussi notée. Chez un exploitant, une augmentation annuelle de rendement de l’ordre de 2,5 tonnes/ha est aussi observée. Ceci est attribué à l’adoption des variétés plus performantes telles que R 575, M 116777 et M 1400/86 et la mise en place de système d’irrigation plus efficient, comme le pivot et le drag line. Un changement dans les pratiques de gestion et la mise au point d’un suivi rigoureux, surtout au niveau des champs, sont notées. L’étude révèle la nécessité d’étendre cette investigation à d’autres planteurs afin d’établir des points de référence appropriés pour l’industrie. Par ailleurs, les résultats pourraient aider les vulgarisateurs dans leur démarche à promouvoir les nouvelles technologies auprès de leur clientèle.
EL IMPACTO DE TECNOLOGÍAS MEJORADAS EN LA PRODUCTIVIDAD DE PRODUCTORES DE CAÑA DE AZÚCAR DE MAURICIO

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PALABRAS CLAVE: Productores de Caña de Azúcar, Investigación, Tecnología, Extensión, Productividad.

Resumen

Los cambios que se están dando en el ambiente económico global están amenazando la competitividad de la industria azucarera de Mauricio. Con vistas a mantener la viabilidad y sostenibilidad a largo plazo, es imperativo para los productores de caña de azúcar revisar sus operaciones agrícolas para alcanzar los objetivos simultáneos de reducción de costos y mejorar el rendimiento de azúcar por unidad de área. Un gran componente del Programa de Investigación y Desarrollo del Instituto de Investigaciones de la Industria Azucarera de Mauricio (MSIRI, por sus siglas en inglés) ha sido orientado hacia el desarrollo de prácticas culturales mejoradas y técnicas para el ahorro de mano de obra. Estas prácticas y técnicas han sido promovidas a través de varias actividades de extensión, tales como visitas de campo, ensayos y demostraciones de finca y reuniones de grupos. El impacto de la adopción de estas prácticas en la productividad, más precisamente en los costos de producción y el uso óptimo de los recursos fue logrado en algunos productores de caña de azúcar operando en diferentes ambientes ecológicos. Los resultados mostraron una reducción en el uso de mano de obra, lo que podría ser atribuido a la adopción de técnicas para reducir mano de obra, tales como la siembra parcialmente mecanizada (PMP, por sus siglas en inglés). Esta técnica llevó a una reducción de aproximadamente un 40% en costos de siembra en una finca. También se observaron mejoras en la productividad del cultivo, las que podrían ser muy bien explicadas con el desarrollo de una adecuada estrategia de variedades y la adopción de un programa de cosecha racional. Una finca logró un incremento anual de 2.5 t/ha en términos de rendimiento de caña por medio de la adopción de mejores variedades como las R 575, M 1176/77 y M 1400/86, junto con sistemas de riego más eficientes como el pivote central y el de avance frontal. Se llevó a cabo un cambio en las prácticas de manejo y se implementaron rigurosos procedimientos de seguimiento, principalmente a nivel de campo. El estudio indicó la necesidad de replicar tales investigaciones entre otros productores para establecer buenas bases de referencia para la industria. Los resultados también podrían ayudar a los agentes de extensión en sus rutinas de promoción de nuevas tecnologías entre sus clientela objetivo.
### Annex 1—Summary of changes observed in past and current practices on the four estates.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Estate A</th>
<th>Estate B</th>
<th>Estate C</th>
<th>Estate D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derocking and land preparation</td>
<td>Mechanical</td>
<td>MTP *</td>
<td>Light and selective</td>
<td>Heavy and more intensive</td>
</tr>
<tr>
<td>Planting season</td>
<td>Short-season</td>
<td>Long-season</td>
<td>Long-season</td>
<td>Long-season</td>
</tr>
<tr>
<td>Soils analysis</td>
<td>Not performed</td>
<td>Performed regularly</td>
<td>Not regularly performed</td>
<td>Performed</td>
</tr>
<tr>
<td>Type of fertiliser used</td>
<td>Straight only</td>
<td>Straight and complex</td>
<td>Straight only</td>
<td>Straight and complex</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Not required</td>
<td>Not required</td>
<td>Mainly surface</td>
<td>Mainly centre pivot and drag line</td>
</tr>
<tr>
<td>Weed management</td>
<td>Manual and chemical</td>
<td>Manual and improved chemical</td>
<td>Manual and chemical</td>
<td>Improved chemical and less manual</td>
</tr>
<tr>
<td>Recruiting</td>
<td>Plant cane only</td>
<td>Plant cane only</td>
<td>Plant cane only</td>
<td>Plant cane only</td>
</tr>
<tr>
<td>Earthing up</td>
<td>Not done</td>
<td>Not done</td>
<td>Not done</td>
<td>Not done</td>
</tr>
<tr>
<td>Pre-harvest trash management</td>
<td>Two in plant cane and one in ratoon</td>
<td>Two in plant cane and one in ratoon</td>
<td>Two in both plant cane and ratoon</td>
<td>Burning</td>
</tr>
<tr>
<td>Harvest and transport</td>
<td>Manual cutting and loading</td>
<td>Manual cutting and mechanical loading</td>
<td>Manual cutting and mechanical loading</td>
<td>Manual cutting and mechanical loading</td>
</tr>
<tr>
<td>Post-harvest trash management</td>
<td>Lined on every alternate interrow</td>
<td>Lined on every alternate interrow</td>
<td>Trash removed and used as fodder</td>
<td>Trash left in situ</td>
</tr>
<tr>
<td>Variety strategy</td>
<td>Only one variety (R570) cultivated</td>
<td>Newly released varieties planted</td>
<td>Mainly late maturing varieties planted</td>
<td>A mix of early, middle and late varieties planted</td>
</tr>
</tbody>
</table>