THE MANAGEMENT OF CANE HARVEST AT THE SMALL-SCALE GROWER LEVEL: A SOUTH AFRICAN CASE STUDY

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Abstract

The South African sugar industry relies for a significant part of its production on a large number of small-scale growers. Placed today in a context of liberalism and international competitiveness it needs to improve the efficiency of this group of farmers. In that respect the management of the cane harvest and supply to the mill represents a key-issue regarding both the reduction of burn to crush delays, the regularity of deliveries and the reduction of production costs. A study conducted in 1998 in two sub-committees supplying the Amatikulu mill analyses the impacts of the decisions made both by small-scale contractors, sub-committees and small-scale growers in terms of harvest management. It highlights the irregularity of small-scale contractors' performances and the low profitability of their business. It also stresses the difficulties encountered by the sub-committees in co-ordinating the relationship between contractors and growers. Some kinds of improvement are proposed with regard to both the management of contractors' business and the role of the sub-committees.

Keywords: harvest, management, small-scale grower, contractor, performance, South Africa

Introduction

Since the publication of the Sugar Act in 1936 the South African sugar industry has sought to integrate small-scale farmers by facilitating access to mills and credit. These producers number roughly 50000 out of which 30000 regularly supply cane each year accounting for 10 to 15% of the total deliveries (source: Cane Growers statistics). But the recent de-regulation of the industry has led to a search for greater competitiveness on the international market (O'Reilly, 1998). As the small-scale growers' yields are usually poor (30 to 50 t/ha vs 50 to 80 t/ha for the large-scale growers) and their harvesting system poorly organised there is growing concern in the industry to improve their technical and economic performances.

The improvement of harvest management is a point frequently raised in the sugar industry especially since the mills are supplied by a number of small-scale growers (Gaucher *et al*., 1997). Various objectives are being pursued such as reducing burn-to-crush delays (Barnes *et al*., 1998), ensuring a regular delivery to the mill or optimising sugar recovery from a diversity of cane quality (Higgins *et al*., 1998; Wynne, 2001a). Harvest management frequently leads to co-ordination problems between the different operations being carried out and the different stakeholders who are involved, such as cutters, growers, service providers and millers. On this level the South African situation is characterised by frequent under-delivery in the small-scale growers' zones with respect to their allocations and long burn-to-crush delays from the fields to the mill (Meyer *et al*., 2001).

As the mill tends to blame these problems on the contractors that carry out the harvest for a number of growers, a study was conducted in 1998 by the French Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (CIRAD) and the Institute of Natural Resources (INR) on behalf of the South African Sugar Association (SASA) in order to understand the constraints faced by both small-scale growers (SSG) and small-scale contractors (SSC) while managing the cane flows from the fields to the mill (Le Gal and Requis, 1999). This paper presents the main results of this study and some suggestions for action.

General organisation of cane delivery

The study was conducted from May to August 1998 at the Amatikulu mill. This site was chosen as it includes a large number of both SSG among its suppliers (about 11000 registered) and contractors with problems (A'Bear *et al*., 1997). Most of the SSG cane delivered to the mill passes through intermediate loading zones, where the cane is stored before being transloaded to the mill. These zones are managed by sub-committees which are managed by some SSG representatives. The mill assigns a daily delivery allocation to each sub-committee, that it has to fulfil by collecting the cane from SSG. As most of the growers are too small to own equipment (between 1 and 1.5 ha each), cane haulage and sometime cutting are contracted to local SSC.

SSC are paid according to a scale established by local associations, which consists of several sub-committees. The tariffs take into account the tasks carried out and the distance from the field to the loading zone, on a rand per ton of cane basis. Usually the sum is based on the previous year's figures and the inflation rate. There is no evaluation of costs related to the real situations faced by SSC, such as the state of equipment, the amount of work carried out or the labour costs. In addition contractors have no incentive to improve the quality of the cane delivered since the tariff does not take account of cane quality when calculating the payment to be made to the grower.

Cane delivery from the field to the loading zone is organised in the following way. The grower wanting to harvest his cane contacts a contractor and once an agreement has been reached as to a particular date, the cane is burnt, cut and put into stacks of 2 to 7 tons. Each stack is chained, loaded onto a trailer with the assistance of a hydraulic winch, and transported to the loading zone where it is weighed using a crane and identified with a label put in place by an employee of the sub-committee.

The mill distributes the sub-committee's weekly allocation over 5.5 days and converts it into a number of 35-ton lorries. These are sent to the loading zone once a sufficient quantity of cane has been confirmed by radio. The stacks are loaded into the lorries and the chains are taken off and left at the zone before being collected by the owners. The grower is given an estimate of the sucrose percentage when his delivery has filled a lorry. Otherwise the average rate for the zone is applied.

Within this supply chain the sub-committee plays a central role since it has to regulate the individual growers' cane deliveries in order to fulfil its allocation. To achieve this objective efficient co-ordination between all the stakeholders involved in the process is needed. This efficiency can be evaluated using various indicators: compliance with the delivery allocation during the season, burn-to-crush delays, amount of non-harvested cane carried over to the next year and costs of the different operations. Bearing in mind the information locally available only the first and fourth aspects are analysed in this study.

Methodology

Based on previous research work conducted in La Réunion (Gaucher *et al*., 1997; Dagallier *et al*., 1997) the study focused on investigating the management rules used by the stakeholders, measuring the effects on performance of their activities and stressing the key variables determining this performance. The planning of delivery allocation from the mill to the sub-committees and then from the sub-committees to the growers and contractors was analysed, as well as the ways in which the mill and sub-committees adjust to various hazards such as irregularity of supplies, breakdowns and rainfall. The analysis of the SSC management processes included a description of the circumstances of their business, an investigation of their objectives and decisions processes regarding work organisation, maintenance and finance. Their technical and economic performances were evaluated using available data from the mill, the sub-committees and the contractors themselves.

Sampling was carried out inside the mill supply area in order to allow in-depth investigation of a diversity of cases rather than depending on statistical representativeness. Two sub-committees were chosen because of their mode of organisation. In Mvutshini the sub-committee operated on a decentralised model where it approves a group of contractors and assigns them a weekly delivery allocation for the season. Daily regulation is carried out afterwards at the loading zone, according to current deliveries. In Mpungose, the sub-committee lets the growers and contractors freely organise and regulate deliveries at the loading zone. No example was found in Amatikulu where the sub-committee plans and monitors the relation between growers and contractors throughout the entire season.

Since no accurate and exhaustive data was available, nine contractors were selected with the sub-committees according to the amount of cane they delivered and the number of days they worked the previous season. 20 growers were also questioned at random and on site. Both qualitative and quantitative data was recorded, based mainly on interviews since neither contractors nor sub-committees had a systematic and formal recording system of information (Table 1).

Table 1. Information collected by type of stakeholder.

Level investigated	Information collected
Sub-committee	• estimate of the amount of cane harvested during the season • management of delivery allocation and relations between growers and contractors • methods used to monitor the daily deliveries to the loading zone • ways of reacting to fluctuations in cane deliveries • ways of evaluating the season
Contractor	• business circumstances (equipment, labour, activities, history) • organisation of work (daily and annual goals) • maintenance of equipment • financial management • management of information • objectives and projects • technico-economic performances
Grower	• the place of cane in household activities • practices of cane cutting • knowledge of the cane quality and its relation with payment • criteria for choice of contractor • perception of the role of sub-committees

Results

The Muvtshini example pinpoints the fact that sub-committees seldom achieve the weekly allocation allowed by the mill during the crushing season (Figure 1). They tend mainly to under-deliver at the beginning of the season and surpass their allocation later on, with large day-to-day differences. As a result the mill needs to constantly adjust its supply from the SSG either by re-allocating the 6 lorries that they share, by looking for commercial growers ready to deliver more cane, by leaving the excess cane at the loading zone or by storing it at the mill yard. This process is quite uncertain and its success governs both the amount of cane carried over at the end of the season and the cane quality, while its roots lie in the sub-committees and contractors' behaviour.

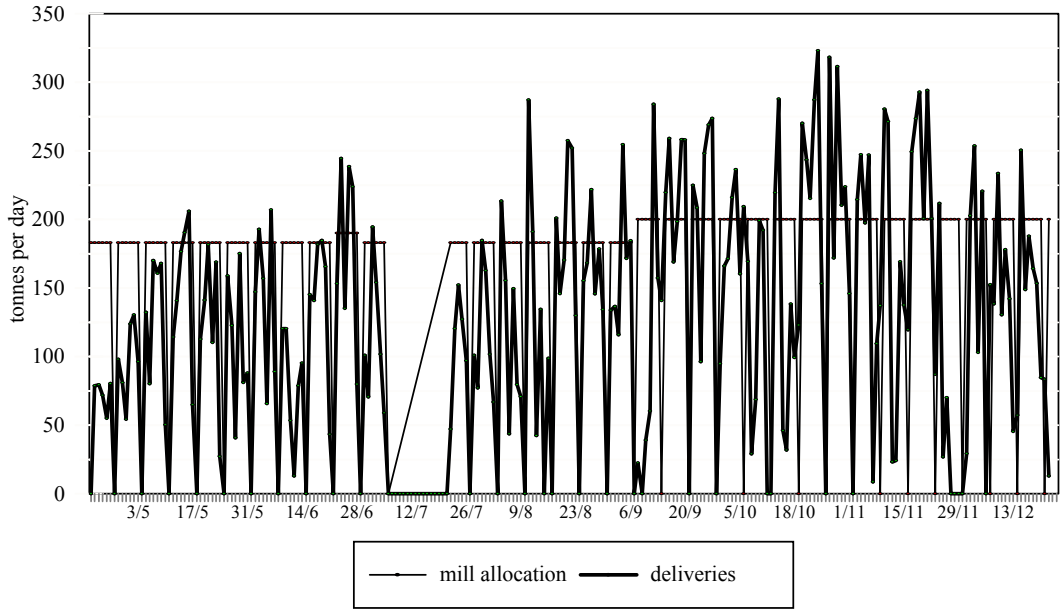

Figure 1. Daily allocations and deliveries in Mvutshini loading zone (1997).

Role and operation of the sub-committees

The management of cane supplies differs substantially depending on the sub-committee. In Mvutshini a formal procedure is used to co-ordinate the 1000 SSG and 30 SSC who operate in the area. Before the start of the season the sub-committee asks every registered contractor to provide an estimate of his maximum delivery capacity. This is based on the weight of a stack and the number of stacks delivered per day, which in turn depends on the number of cutters made available by the contractor at the rate of two cutters per stack per day, and on his number of chains.

The contractors' cumulative requests generally exceed the allocation provided by the mill. Therefore, the sub-committee contacts every contractors and negotiates until the two values are adjusted. The most reliable contractors usually benefit from a higher allocation. During the course of a season the sub-committee can transfer unfulfilled allocations from one contractor to another. It is therefore important that the sub-committee monitors each contractor' s supplies. During the day, the clerk responsible for completing the labels on the stacks adds up the weight of the stacks delivered. When the overall allocation authorized by the sub-committee is reached, the clerk tells the contractors to limit their deliveries, then forbids them to deliver more.

But these rules are not yet applied systematically and this gives rise to a number of difficulties. Thus, during the 1998 season the allocation agreed with the contractors was 3 to 4 times the allocation provided by the mill. Although no adjustment was made, the sub-committee found itself in a situation of under-supply throughout the beginning of the season. This position allows the sub-committee to avoid possible conflicts with contractors unhappy with their allocation, while getting some latitude to face individual under-supply. On the contractors' side, an over-estimation of their delivery capacity prevents them from being limited should some opportunities occur to increase their deliveries during the season (e.g. loan of chains or increase in the size of the cutter team).

In Mpungose, the sub-committee gives no particular instructions to the two permanent contractors who operate in its zone, since their delivery capacity is actually below the allocation provided by the mill. So the sub-committee contacts some contractors at nearby Mvutshini to reach its allocation. The deliveries recorded at the zone are the overall result of individual behaviours, but the sub-committee can only note *ex-post* digression from the overall allocation.

These rather unplanned processes lead to hectic deliveries which are amplified by the growers' behaviour. The survey conducted on a limited 20-case sample shows that their decision to cut the cane is made firstly because of a need for funds instead of taking account of the cane maturity. This priority makes long-term harvesting planning difficult and actually most of the growers warn contractors only one month in advance. Therefore the contractors cannot hope to plan their season and the growers can find themselves without a contractor at the end of a season, when everyone wants his field harvested.

Irregularity of contractors' deliveries

The contractors are usually growers who have decided to invest in a set of equipment (tractor, loader and chains) for different reasons. The younger ones (aged between 30 and 40 years) aim to develop a profitable activity locally, while the older ones aim more to offer a service to the community. Whatever their age, this investment enables them to be independent of other contractors and to acquire a certain degree of social prestige.

Basic equipment consists of an under-powered tractor usually bought second-hand from a commercial farmer, a back-end loader and a set of chains. The chains are central to the contractor's equipment and organisation since they control the potential number of daily trips. If he does not drive himself, the contractor employs a driver who is paid daily or monthly, depending on the volume of work. An assistant helps him with the chains and the loading of the stacks onto the trailer. Some contractors also provide cutters who are usually women. They influence harvest performance through their ability to execute tasks rapidly, stack size and the quality of work carried out (neatness of cane).

The total daily delivery of cane at the loading zone depends on the number of contractors operating each day and their average daily tonnage. In Mvutshini in 1997 the number of active contractors was approximately 10 out of the 33 potentially available, with a standard deviation of 4.2, and the daily tonnage per contractor was 15 tons with a standard deviation of 4.6 tons. The total amount of cane brought in each day depended more on the number of active contractors than on the average tonnage per contractor (coefficients of correlation respectively equal at 0.87 and 0.41).

Contractors' irregularity is a major problem for sub-committees. Only 6 of the 33 contractors in the Mvutshini area worked more than one day in two during the 198 days of the season (Figure 2). Close to 40% of them worked less than 20% of the available days. These results do not take account of possible days worked in other areas. But they demonstrate that the organisation chosen by the sub-committee in preparation for the season and which assigns allocations to each contractor is extremely unrealistic in comparison with contractors' real operating. To a large degree this explains why the sub-committee finds itself in a chronic situation of under-supply despite a potential deliveries number which is much higher than the allocation provided by the mill.

This contractors' irregular availability is amplified by the variability of the tonnage delivered daily by any given contractor. The case pictured in Figure 3 supplied some days more than 70 tons, others less than 10 tons. This irregularity is not a result of stack weight ($r^2 = 0.17$) which are controlled by the cutters. For all the cutters surveyed the weight varied from 4.2 to 4.8 tons with one exception at Mpungose (3.4) where the cutters are paid by the stack and not by the ton. This irregularity is mainly due to the number of deliveries conducted each day ($r^2 = 0.92$) which varies as much between individuals (2 to 5.5 deliveries in the sample investigated) as it does from one day to the next with the same contractor (Table 2). These variations are not linked to the total number of chains owned by the contractor, as they are under-utilised in every case.

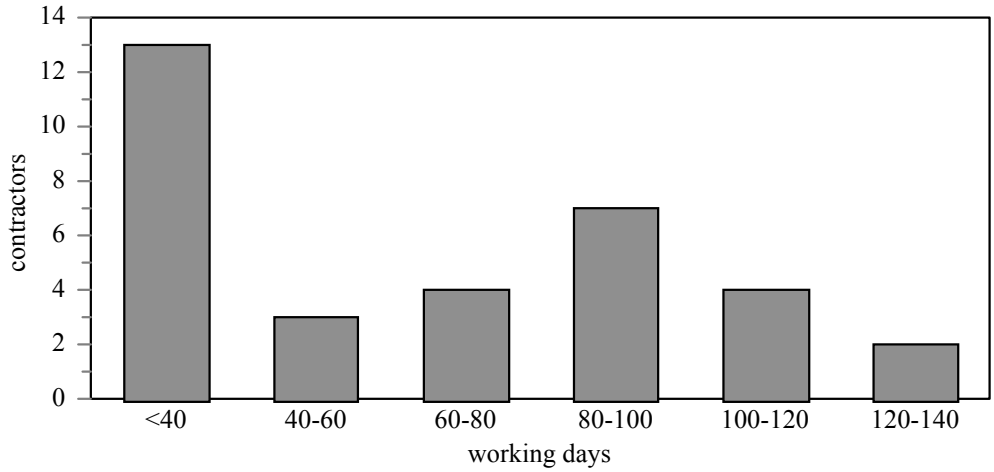

Figure 2. Contractors' distribution according to the number of working days during the 1997 season.

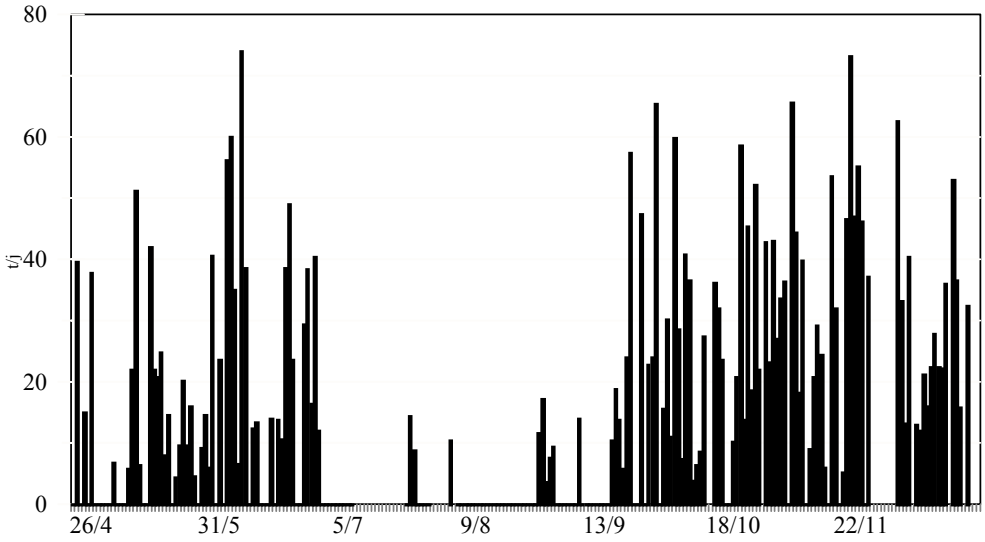

Figure 3. Delivery curve of a Mvutshini contractor during the 1997 season.

Table 2. Variation of the number of stacks delivered daily per contractor.

	P1	P2	PV1	PV2	V1	V2	V3	V6	V7
Pair of chains (n)	8	8	10	8	13	13	10	4	12
Stacks delivered/day:									
Average	3.2	3.8	5.3	4.1	4.7	5.6	3.7	2.0	2.0
Standard deviation	1.3	1.8	2.8	2.3	2.3	4.3	2.3	1.0	1.0

As a result the average total tonnage delivered per contractor at Mvutshini in 1997 was 910 tonnes, with huge differences between them (Figure 4). Only two contractors out of 33 managed to deliver more than 2000 tonnes. Both these differences between contractors and the gap between their potential capacities and current performances can be explained by the uncertainties they encountered at the outset of their activities and by the management decisions that they make to try and resolve them. Due to the shortness of our investigation and the small amount of available data on contractors we sought to ascertain, by interview, the main tendencies of operation which can explain these uncertain performances.

Contractors' management processes and profitability

Contractors potentially face 4 main constraints: labour management, equipment breakdowns, work planning and finances. Employee management does not generally give the contractors any problem as the tasks are simple and labourers are readily available. In contrast, worn out equipment is at risk of breaking down. If a breakdown occurs, its duration is dependent on cash availability or their ability to obtain a loan. They then attempt to undertake temporary repairs which often result in a similar breakdown. The lack of records does not allow us to assess the frequency of these breakdowns which influence the number of contractors active per day and the number of deliveries per day. In the light of our interviews, the risks seem limited as little engine power is needed to do the work. Nevertheless, this point needs to be quantified as does the relationship between the state of the equipment and the cost of fuel and lubricant.

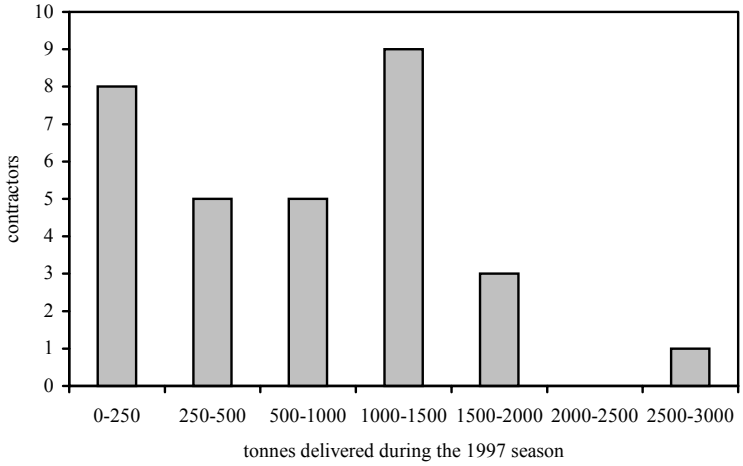

Figure 4. Contractors' distribution according to their total deliveries (Mvutshini, 1997).

Work planning relies essentially on growers' requests rather than canvassing clients. The requests are registered on a waiting list of which the horizon never goes beyond a month or even a week, especially amongst the contractors who do little work. No date of commitment is made to avoid disputes linked to delays due to breakdown, lack of cutters, rain, etc. The task duration is estimated for every client based on the number of stacks in the field and the number of cutters provided by the contractor. This calculation has a margin of error of about 20 % linked to the irregular size of the stacks and a second one due to assessment errors in production by growers. Furthermore, it assumes that the contractor is able to evaluate his work capacity (number of cutters, number of chains, travel time, unloading at the zone) and the demand of the zone (potential allocation agreed to).

The order to burn the next grower's field is given by the contractor once the current task is finished or, in a less frequently, the day before. This way of sequencing growers leads on certain days to small deliveries to the zone when the previous client is finished before the next one has really started. The time it takes to fulfil the task depends on factors that vary from one contractor to another and from one day to the next: length of working day, number of cutters available (sometimes supplied by the growers), type of loader (basket loaders take much longer to fill than mechanical ones), the number of available chains, power of tractor traction, accessibility of fields and distance from the field to the zone.

So theoretically contractors could plan their activities on a longer term and match them with the allocations provided by the sub-committee, by cumulating the growers' individual requests, taking an overall security margin linked to breakdowns and estimation errors, and then evaluating, on a monthly or weekly basis, the saturation of their planning. This kind of planning was not current amongst the contractors interviewed, probably because of the numerous hazards encountered during the season. Amongst them availability of cash and financial management are key factors explaining contractors' behaviour.

Most contractors run into financial problems because the mill only pays them at the end of the month which follows the harvest. Therefore at the beginning of the season, they have to advance two months of cash for salaries, fuel and spare parts when their equipment may need fixing. This critical situation is solved in a number of different ways. The contractors with the least activity are the most concerned. They cannot obtain a loan from the mill (granted if a minimum amount of 5000 tons is delivered) which delays their start until they have got enough money. Then their activity increases at pace with their funds. Some contractors start normally but delay the payment of salaries and bills for the first two months or stop as soon as they lack money, waiting for the mill to pay them. Only a minority try to plan their expenses by calculating their volume of work and available funds at the beginning of the season or reserve the necessary amount at the end of the previous season to cover the activities of the first two months.

In addition to these cash management issues, contractors have difficulty creating a working capital because they do not control their tariffs and they cannot easily evaluate their production costs. Without calculating a margin and without planning their volume of activity they cannot establish a cash plan or create provisions to renew and extend their set of equipment. Since access to credit is not systematic and often impossible for them, their performances are very sensitive to risks that require funds, like breakdowns. This misreading of their business comes from a lack of book keeping, processing and storage of information. Usually the contractors just note down their tonnage for every client in order to check their agreement with the payments. This data is usually destroyed once the payment has been made. Without records and without accountancy, contractors cannot monitor and evaluate their activities. They have no database to support their investments and planning decision-making.

This lack of information hinders the assessment of contractors' business profitability. A simulation program was developed in the course of this study to reconstruct and analyse contractors' production costs, based on some assumptions regarding operational costs (fuel, oil, tyres and spare parts essentially). The results obtained for 5 cases are quite contrasted (Table 3). Only V1 makes a real profit while saving money for the next season. V2 and P1 are balanced; the first reserves significant funds to pay cash for a new tractor, the second grants himself a fixed monthly salary. PV1 makes a substantial loss because his performance is too poor to pay his loan back to the bank. V6 is constrained by his low level of activity. The simulation tool enables us to evaluate, in each case, the impact of improvement in performance on these economic results. Thus P1 must aim for a tonnage of 3900 tons to balance his costs. He must increase the average weight of his stacks to 5 tons or he must increase his working week by half a day. However, this assumes his capacity to find enough customers and to re-organise his work planning as a result.

These results highlight the fact that contractors have great difficulty in making enough profit both to cover their needs and renew their equipment even on the second-hand market. On the one hand the prevailing tariffs are too low and do not coincide with an accurate analysis of the conditions of production and on the other hand, the contractors perform poorly in terms of total tonnage, number of days worked during the season and loads made per day. Amazingly these poor results do not appear to be sufficient to eliminate the small contractors who subsist, in spite of everything, from one year to the next.

Table 3. Simulated cost of production for five contractors.

	PV1	V1	V2	P1	V6
Amount of days worked per week	4	3	4	4	1
Weight of loads	4.3	4.6	4.3	3.4	4.6
Number of loads per day	5.3	4.7	5.6	3.2	2.0
Average tariff (R/t)	13.0	24.5	24.5	18.9	11.0
Salaries					
Contractors (R/month)	-	-	-	300	-
Driver (R/month)	-	400	650	400	-
Assistant (R/month)	300	200	300	300	-
Cutters (R/t)	-	10	10	-	-
Other expenses	loan	R12000[1]	18100[2]	-	-
Total tonnage loaded (t)	3370	2400	3600	1600	230
Total profit (R)	-2600	520	0	-180	-760
Production cost (R/t)	13.7	24.3	24.5	19.0	14.3

[1] Provisions to fund activities at the beginning of the season
[2] Provisions for renewing equipment

Based on these observations, the contractors encountered at Mvutshini and Mpungose can be divided into two extreme groups according to their amount of activity. The first group are those who deliver a high annual tonnage, above 2000 tons. They are enterprising which means they possess a substantial set of equipment, renewed regularly, qualified manpower, and management and organisational methods aiming at planning activities on a monthly basis at least. Nevertheless, within the current tarriff pattern, greater activity does not necessarily lead to improved profitability. On the opposite side, are the contractors who load less than 750 tons per season, have worn out material, conduct the work themselves and plan few or none of their activities. With no financial opportunities (pension, inheritance), their futures appear precarious and sensitive to financial risks and mechanical problems. The contractors situated between these two extreme classes are in a transition phase and their evolution will depend largely on their capacity to rationalise their activities and to find new customers. The social, educational and historical factors explaining these management differences still need to be investigated.

Discussion

Although conducted on a small sample, this study confirms the initial assumption that the contractors' poor performances explain most of the delivery problems encountered at the small-scale grower level. Sub-committees have to face irregular deliveries due to the contractors' unreliability regarding both their daily availability and loading output. This behaviour is due to three major constraints: lack of cash at the beginning of the season, poor planning capacity during the season including no formal contracts between contractors and growers and absence of book keeping. As a result most contractors face difficulties in balancing their costs with the present tariffs which are not negotiable, and also in renewing equipment which is often worn out.

But other stakeholders are also to blame for the problems experienced in harvesting the SSG cane. Growers display diverse behaviour in term of matching maturity and harvest. Some of them are hesitant to cut cane which is still immature and from which the yield can increase with age, while others do not have the available funds to pay cutters. The sub-committees also play a central role in these problems as they are responsible for co-ordinating the loads to the zone. The two zones studied show that no one is really able to plan and control deliveries by growers and contractors.

This attitude can only accentuate the difficulties regulating daily loads of cane to the factory. The mill does not have a clear position on the subject. By playing with the possible carry-over of deliveries between sub-committees on the one hand and between commercial growers and small growers on the other hand, it appears to adapt its operation to the hazards encountered rather than improving the control of deliveries at the sub-committee level[1].

This diagnosis requires to be validated on other cases. But it calls for a more efficient system of relations between growers, contractors and millers. At the contractor level, support for improving the control of their activities or their economic environment is clearly justified in the present context. Some training for fund management, planning activities, maintaining and renewing equipment and information management should be priorities. Some changes must be carried out in the contractors' environment such as creating mechanical workshops in the vicinity and access to flexible short-term credit facilities.

Combining these actions with drastic reduction of the number of contractors, keeping on only those who perform the best, requires further investigation if the aim is effective organisation at the mill supply area level. In the present case where the sub-committee plays a pivotal role between the mill, the growers and the contractors, two options can be considered. In the first one the sub-committee manages the planning of the contractor's supplies and adjusts them to the mill requests. The contractors continue to directly manage their relations with growers. In the second one the sub-committee manages relations between contractors and growers by establishing a plan for the entire season as a result of the allocation provided by the mill. These two options can include ownership and direct management of equipment by the sub-committees, even if this co-operative solution creates its specific constraints of co-ordination (Dagallier *et al.,* 1997).

In both cases, sub-committee executives must be trained and supported to monitor and control their plans: they will also need some financial incentive and acknowledgements from growers and contractors, which assumes that some profit will result from their actions. This evolution will also call for a review of the methods of payment to the contractors: uniform cutting tariff, payment based on cane quality in order to integrate this factor into their decision processes. Management and planning support tools need also to be designed.

A second organisational form would consist of getting rid of the intermediate role played by the sub-committee with two alternatives. In the first case the mill organises its supplies by dealing directly with the small growers, who will have to find contractors when they need them. This option seems unrealistic in the South African situation if one takes the small growers' low production and management costs into account. In the second case the mill delivers the allocations directly to the contractors. This system reduces the decision making chain and the number of stakeholders involved. It makes selecting the best contractors much easier. It would mean that the loading zones would have to be restructured, as their number and location would have to be reconsidered within another framework. But the contractors selected by the mill would have to show significant gains in productivity and reliability. They could be paid according to the quality of the delivered cane which would motivate them to reduce the delays between cutting and delivery to the mill (Wynne, 2001b).

These considerations stress that the improvement of harvest management does not concern only the small-scale growers and small-scale contractors, but requires an overall investigation at the mill supply area level. Some research work has been undertaken in La Réunion and Mauritius to design a decision support tool enabling stakeholders to investigate the effects of alternative organisation of supply management on the sugar production (Gaucher *et al.*, 1998). An application of this approach is currently being tested with a South African mill in order to address such issues as logistic

[1] Based on a similar premise, the Sezela mill and its sub-committees are currently implementing a formal planning and monitoring process, allocating each contractor a weekly amount of cane to be cut by specific growers (Thompson, pers. comm.).

choices, the rules governing supplies and the management of cane quality. It should provide some assistance to the Sugar Industry in its search for better efficiency and better integration of small-scale growers.

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