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Final report SRDC project BSS261
Measurement and feedback systems for improving market signals for harvesting

Willcox, TG

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FINAL REPORT – SRDC PROJECT BSS261
MEASUREMENT AND FEEDBACK SYSTEMS FOR IMPROVING MARKET SIGNALS FOR HARVESTING

by
TG WILLCOX¹, R JUFFS², J CRANE³ AND P DOWNS⁴

¹Area Development Manager, BSES Limited, Bundaberg
²Coordinator-Productivity Initiative, CSR Limited, Townsville
³Manager Grower Services, Mackay Sugar Co-operative Association Limited, Mackay
⁴Cane Supply Manager, Maryborough Sugar Factory, Maryborough

SD05013

Contact:
Trevor Willcox
Area Development Manager
BSES Limited
Private Bag 4
Bundaberg DC  Q 4670
Telephone:  07 4132 5200
Facsimile:  07 4132 5253
Email: twillcox@bses.org.au

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SUMMARY

One of the market impediments hindering the adoption of best practice for harvesting is the one-price, dollar-per-tonne payment method for harvesting. It provides no incentive for growers to improve farm layout or presentation for harvest, because the same price is paid for harvesting under all conditions. Harvester operators do have an incentive to reduce cane loss. However, they have no incentive to reduce extraneous matter and soil in the cane supply. This project worked with harvesting groups, millers and cane growers at Maryborough, Mackay and Burdekin to determine and pilot pricing structures to reflect quality and quantity of work and to improve efficiency through better feedback systems for improving market signals at harvest.

Initially, surveys were carried out to determine current payment methods and attitudes towards change. At Racecourse and Pioneer, most contractors were paid per tonne of cane, with the only variations being for long haulage distances. At Maryborough, most contracts used a base rate plus fuel. Many survey respondents saw a need to change to a more equitable system that reduced the current cross subsidisation.

Harvesting groups at the three locations recorded log-book information, including fuel use, engine hours and elevator hours. In year two, GPS/web-based data-logger units were fitted to most harvesters to provide additional information. Information from participating harvesting groups was linked to farm data and analysed to produce relationships with parameters such as crop size, row length, haul distance, fuel use and field efficiency. It also enabled the calculation of the cost of harvesting for several payment methods. These were:

- an hourly rate,
- a base rate plus fuel,
- a base rate plus fuel priced above normal to allow for labour and machinery,
- a sliding scale based on crop yield,
- a sliding scale based on crop yield plus fuel, and
- a combination of hourly rate and base rate.

The payment method that gave the strongest market signals was hourly rate. Although hourly rate should be the preferred payment method, it is anticipated that it could be difficult for growers to accept unless monitoring equipment is fitted to the harvester. In addition, if growers did not understand harvesting best-practice principles, there could be a tendency to expect operators to go ‘flat out’ to get as many tonnes per hour as possible in the bin. This has prompted the development of sliding scales based on crop yield with or without growers paying for the fuel used. These methods send clear signals whilst maintaining the positives of the conventional $ /tonne system, for example, cane loss is also a cost to the harvester operator.

By bringing together harvester operators from different regions using different payment systems, this project has highlighted the potential of a new system to change attitudes. The aim of any new system is to accelerate the adoption of Harvesting Best Practice (HBP) to improve industry profitability. Of all the aspects of HBP, the one recommendation that has proved most difficult for operators to adopt is a reduction in pour rate to improve cane quality. Reduced pour rate increases harvesting costs, which neither growers nor operators want. One way to reduce instantaneous pour rate without
paying increased harvest price is to improve farm layout leading to a more efficient harvesting operation. With less time spent turning on headlands or waiting for haulouts to traverse rough headlands, more time is available to cut cane which enables a reduction in average elevator pour rate without extra hours of operation. The only costs are associated with changes to farm layout or improving conditions for harvesting.

On the cane quality aspect, project officers worked with mills at Maryborough and Mackay to establish cane-quality indices using NIR. At Mackay, there are close linkages between this project and the SRDC Mackay Sugar Cooperative project MSA003 ‘A cooperative systems model for the Mackay regional sugar industry in developing a cane-quality system’. Maryborough is also using the NIR CAS for cane payment by directly measuring CCS. This is working well.

The alternative payment methods identified by the project were:

1. **Base Rate plus Fuel (BR+F)**. This method is widely used at Maryborough. There, the base rate varies between $5.50 and $5.80 per tonne depending whether burnt or green. The fuel is paid for by the grower but delivered to the contractor’s tank. The system is easy to monitor and ‘police’, because it is a simple system. It is fair, because the grower pays for fuel actually used on the farm. It does reduce the level of cross subsidisation, but still puts the cost of bad blocks back onto the harvester. BR+F still sends the market signal for high pour rates to maintain viability, but not as much as $/tonne. The system is commercially proven in Maryborough.

2. **Base Rate plus Fuel +$.** This method is the same as BR+F, but the fuel is priced higher (e.g. $2/L) to allow for labour. The system is used by some groups in New South Wales. The amount of fuel used is measured and the grower invoiced at set price. The reasoning behind this system is that paying for fuel alone does not compensate for machinery and labour costs.

3. **Hourly Rate.** This method pays on engine hours similar to the hire of most earthmoving equipment. Rates used for pilot group examples were $350-420/h, depending on the number and size of haulouts. This rate would be negotiated between grower and contractor. For acceptance, monitoring equipment is needed for growers to know that the machine was working as contracted, e.g. fan speed, forward speed, GPS tracking. Hourly Rate sends the best market signals, as it creates the greatest variation in price per tonne and reflects true cost, as most variable costs are accumulated on an hourly basis. This encourages best-practice farming, as the more efficient a farm is to harvest and the better the crop size and yield, the lower the cost per tonne to harvest. By providing a stable income to the operator, it allows the grower to prescribe the mode of harvester operation for each block. If a grower does not understand the financial benefits of Harvesting Best Practice (HBP), this could lead to unwise decision-making focused on minimum time and, hence, minimum cost at the expense of high cane loss, low cane quality and poor ratoons. To operate efficiently, hourly rate needs to be linked to a cane-quality measurement system at the mill to provide targets for cane quality. In addition, there is no incentive for the harvester to reduce cane loss, so settings of the harvester, such as extractor fan speed and forward speed, need to be monitored.
4. **Sliding-Scale Base Rate plus Fuel.** This method uses a sliding scale based on crop yield to calculate a base rate, e.g. $6.30 for 35-45 t cane/ha to $5.70 for 95-105 t cane/ha. Fuel is purchased by the grower. The system would operate along the same lines as the Maryborough Base Rate plus Fuel methods to supply fuel. This appears a simple system with good market signals. It is transparent and easy to apply. The base rate covers cane loss issues and true fuel costs are covered. The sliding scale covers some of the labour and machinery costs associated with crop size. It reflects true cost a little better, but is still a tonnage rate, which encourages maximising pour rate and delivery rate.

5. **Current System - $/t.** This system encourages maximum efficiency in terms of maintaining a high delivery rate. It encourages minimal loss, because every lost tonne is lost income (however, some losses are incurred in the pursuit of maximising output). It is easy to monitor and understand, but sends a very clear market signal that tonnes per hour equals dollars per hour and quality is a minor focus (especially since growers are more likely to change operator for pricing reasons rather than job-quality issues).

The project has created considerable interest throughout the sugar industry. It featured as two BSES Bulletin articles and was chosen for presentation at the December 2003 BSES Activate Breakfast in Brisbane. Presentations were also invited at QMCHA meetings and the 2004 Tully Awards function. A paper was also presented at the 2004 ASSCT conference. Project participants formed the panel at the Workshop on Alternative Harvest Payment held as part of activities for the SRDC launch of the booklet *Cane Harvesting to Improve Industry Performance* at Bundaberg in February 2005. Researchers and harvester operators presented their ideas on harvest payment and fielded questions from the industry audience.

The project has demonstrated that the current payment systems provide little incentive for cane growers or harvesters to apply best practice. To be successful, a payment method needs to form part of an overall package that varies price per tonne with farm layout, crop yield and haul distance; provides timely feedback on cane quality; and provides incentive payments based on a cane quality index.
1.0 BACKGROUND

Hildebrand (2002) viewed the present contract harvesting system as clearly unsustainable. Prices for contract harvesting are, in general, lower than cost. Contractors are not able to withstand the pressure from those farmers with high-cost, difficult-to-harvest farms “riding” on the quote from an easier-to-harvest neighbour, thus creating a harvester loss and/or a cross subsidy to the higher-cost farm. Existing practice is for independent contractors to operate on no documentation at all, for a season at a time, while their equipment has a life of 4-5 years and a minimum replacement cost in the order of $1 million. Hildebrand’s assessment saw that rationalisation of harvesting structures and operation in Queensland is inevitable. His assessment viewed recovery of any substantial loss of sugar in the field during harvest as being the most obvious and potentially the least costly economic gain available.

In the past, the adoption of best-practice farming for harvesting and cane quality has suffered through the lack of clear market signals in harvesting charges and the price paid for cane. The simple one-price system paid for harvesting has been recognised for some time as a barrier to the adoption of best-practice farming for harvesting. Ridge et al. (1996) developed a harvest-transport model to predict throughput and costs for particular field conditions. The model was seen as a valuable aid in determining prices for contract harvesting. The contractor could set prices that reflected field conditions, rather than applying the current pricing system, which does not vary greatly between farms. With clearer price signals, individual growers would be encouraged to take measures to improve field conditions and reduce their harvesting charges, and cross-subsidisation of farms with poor harvesting conditions would be reduced. The model received limited use at the time, but has been developed further since. To date, the idea of establishing a price for each block on each farm has been viewed as too complicated.

Chapman and Grevis-James (1998) examined options for arriving at a charging formula for the harvest of cane within a harvesting cooperative in New South Wales with the goals of increasing field efficiency and minimising harvest costs. Options included the traditional flat-rate tonnage method, an hourly rate, and a combined flat/hourly rate. They showed that the concept of a differential rate of charging for harvesting has advantages and disadvantages with winners and losers. The NSW Cooperative did not adopt the new system. Barriers to the adoption identified were: compensation for wet weather and distance to receival pads; the project was seen as complicated; project was viewed as a threat to the philosophy of equality among members; human error in clocking on and off; reliability of hardware and software; servicing of equipment problems due to remote locations; data verification was too time consuming. Chapman and Grevis-James advocated a compromise of an initial differential rate that stays within a certain fixed range.

Powell et al. (2001) advocated the use of a simple logbook system to analyse the differences in harvesting productivity among blocks and farms. This information could be used to develop a harvest plan based at the block and farm level. They noted that the current system of planning a harvest at group level and applying an average harvest daily allotment and charging a flat rate per tonne may not facilitate best-practice harvesting. A system based on a best-practice harvest plan and linked to a cane-quality measurement
system at the factory to provide incentives for supplying quality cane was seen as a way of facilitating cost management and improving cane quality.

Agnew et al. (2002) reported on a project aimed at increasing sugar industry profitability through harvesting best practice. The project demonstrated that adoption of harvesting best practice (HBP) can provide at least an extra $100/ha to the industry. However, until growers and operators receive timely and accurate feedback, progress will be restricted. Better feedback is vital to overcome the flawed harvester-payment system and enable negotiation of the best possible job at an acceptable price for individual blocks. The timeliness of feedback will be improved to all participants with the use of NIR at mills to determine individual fibre and other quality parameters. The use of harvest plans must be an integral part of the package.

The timeliness of feedback is being explored by Mackay Sugar using their web site (Markley et al. 2003). The recording of information on location and operational settings of harvesters was investigated using BIGmate (www.bigmate.com.au), an on-line real-time monitoring system. One harvester was fitted with a BIGmate system in 2002 and this continued for 2003 and 2004.

The use of on-line cane analysis by near infra-red (NIR) spectroscopy was described by Staunton et al. (1999). NIR was shown to have application in both cane payment and process control. Prediction results showed that NIR fibre is a more meaningful estimate of individual rake fibre than that supplied by class fibre, and the system provided information to assist growers and contractors in managing their operations. NIR was also shown to be an accurate measure for juice brix, juice polarisation, CCS, water, ash, pol in open cells, inorganic substances and extraneous matter.

Staunton has used NIR to measure several cane-quality parameters, such as sucrose, impurities, fibre, ash and dry matter, to develop a Cane Quality Index. This method of determining cane quality has many potential benefits: as a benchmarking tool for productivity; adjusting cane payment using a cane quality bonus/penalty scheme with the current payment system; as a new measure of cane quality for products other than sugar e.g. ethanol, power; as the quality index in a new payment system. Use of a system such as NIR to measure cane quality to provide clear market signals is viewed as a critical step in achieving best-practice harvesting.

While it has long been recognised that the current payment systems do not have built-in incentives to adopt best practice or supply quality cane, the politics of changing the systems has been a major block. The current acceptance of inevitability of change in the industry and the moves in pilot areas to facilitate change have made it timely to identify payment methods for harvesting that are more indicative of true cost, remove much of the cross-subsidisation that currently occurs, and provide financial incentives to adopt best practice. In addition, new measures of cane quality at the factory will provide tools to implement incentive schemes to reward farmers and harvesting contractors who supply a quality product.

This project was a collaborative effort among BSES, CANEGROWERS, CSR, Mackay Sugar, Maryborough Sugar, Queensland Mechanical Caneharvesters Association and cooperating harvesting groups at Burdekin, Mackay and Maryborough to develop
alternative payment methods for harvesting. The project also supported the further use of NIR data to develop Cane Quality Indices as a measurement of cane quality to reward good harvesting and cane growing practice at Mackay and Maryborough.

2.0 OBJECTIVES

The project aimed to determine optimal structures and policies that increase whole-of-industry profitability through requiring buyers and sellers of harvesting services to establish meaningful pricing structures that reflect quality of work and output, and that improve efficiency and market satisfaction.

It set out to improve understanding of market signals and facilitate changes in industry performance, through five objectives:

1. Determine the critical success factors for valuing harvesting services using three locations, Burdekin, Mackay and Maryborough, as models.
2. Determine and evaluate payment systems that address these critical success factors and maximise industry returns.
3. Facilitate the adoption of payment systems that encourage best practice and maximise returns to all parties.
4. Evaluate changes in practices resulting from the adoption of arrangements incorporating improved market signals.
5. Identify pathways to adopt new payment methods beyond the pilot areas to other industry locations.

The project met all of these objectives; this is summarised below. The participative nature of the project and the keen interest of project participants broadened the scope of the project as it progressed and achievements were more than initially envisaged. An example is the effort put in to develop web-based GPS technology to monitor harvester performance in the second year of the project. This project assisted in the development of GPS-based systems that are now being installed throughout the industry.

**Objective 1 - Determine the critical success factors for valuing harvesting services using three locations, Burdekin, Mackay and Maryborough, as models.**

Critical success factors for valuing harvesting services were developed from surveys of harvesting groups in the Maryborough, Racecourse and Pioneer mill areas and industry focus groups conducted at Maryborough, Mackay and Burdekin. The surveys identified problems with the current payment systems and pooled ideas for better systems. These were discussed and developed further at focus group meetings and alternative methods identified. It was generally agreed that a new payment system needed to maintain some degree of cross-subsidisation to preserve the group size, but should vary with the major cost determinants to provide incentives for low-cost harvesting situations. A system to measure cane quality was an integral part of any system, so that growers and operators were rewarded for the supply of high quality cane. The success factors for a new payment system to be adopted were that it must vary with harvesting conditions and cane quality, it must be simple to calculate and it must be transparent, so that the drivers of change in price were obvious and manageable.
Objective 2 - Determine and evaluate payment systems that address these critical success factors and maximise industry returns.
The focus group meetings identified several alternative payment methods for harvesting:
- Base rate plus fuel;
- Hourly rate;
- A sliding scale based on crop yield;
- A sliding scale base rate plus fuel.

Participating harvesting groups collected the information required to implement the various payment methods. For example, fuel use was measured and recorded so that the Base Rate plus Fuel method could be applied, and engine hours were recorded to apply the Hourly Rate method. The alternative methods were applied to data collected from participating harvesting groups over the 2003 and 2004 harvests. This identified and gave quantitative measurements of the major factors that influenced the cost of harvesting. These were field efficiency (determined by time spent harvesting versus time spent in the field), crop size and haul distance. To maximise returns to industry, factors such as cane loss at harvest and cane quality from a milling perspective must also be considered. These factors were considered by the groups when evaluating payment methods for harvesting.

The project also worked with sugar mills at Maryborough, Mackay and Burdekin to develop Cane Quality Indices (CQI), principally based on near-infra red (NIR) technology, to measure a range of quality parameters. New payment methods incorporating incentives for good quality could be applied using the CQI. Methods of returning this information expediently to operators and growers were also explored.

Objective 3 - Facilitate the adoption of payment systems that encourage best practice and maximise returns to all parties.
This objective was met by piloting new payment methods with innovative harvesting groups at Maryborough, Mackay and Burdekin. This showed how the various methods provided links to farming, harvesting and milling practices and identified variations in price that would occur between fields and farms. By working through these parameters with the individual groups and, by bringing the groups together on a district and state-wide basis, these experiences were shared and consensus developed on the most-likely methods to be adopted that gave clear market signals on the major critical success factors. Feedback from industry on how to instigate change in the harvesting payment methods was also sought via industry forums at Mackay and Bundaberg, publications and presentations at industry meetings and discussion groups. The Workshop on Alternative Harvest Payment at Bundaberg in February 2005 was particularly valuable in obtaining industry perception of the likelihood of significant change. Despite considerable industry negativity on the need to change, innovative groups throughout the industry have already seen the benefits and are changing to new systems such as Base Rate plus Fuel. This has also been prompted by the volatile diesel price.

Objective 4 - Evaluate changes in practices resulting from the adoption of arrangements incorporating improved market signals.
Surveys of harvest operators and growers involved in the project were conducted at the start and end of the project. At the completion of the project, virtually all participants were aware of the need to change to a payment method that gave better market signals,
but only a small number of groups had actually changed their payment method. As this change in attitude continues, it is likely that a large number of groups will change next season. This will need to be nurtured to some extent to provide good information on alternative systems, so that implementation is without problems and the method operates smoothly.

**Objective 5 - Identify pathways to adopt new payment methods beyond the pilot areas to other industry locations.**

Pathways to extend adoption of new payment methods beyond the pilot areas were developed at a project meeting at Mackay. The way forward is to draw on the experiences of Maryborough and recommend a base-rate-plus-fuel system as a starting point. The current fluctuations in diesel price would be a driving force for adoption of this method. Further variations of this system such as a sliding-scale base rate based on crop size or a higher payment per litre of diesel to account for wages and repairs and maintenance would then occur. A number of options should be put forward as some groups may prefer to move to systems such as an hourly rate that gave the strongest market signals.

### 3.0 METHODOLOGY

The project outputs were derived from six initiatives:

1. Survey results from baseline and end surveys;
2. Log book and electronic data from participating harvest groups;
3. Derived relationships between harvester, crop and field parameters;
4. Documentation of alternative payment methods and how these vary with harvester, crop and field parameters;
5. NIR data from Maryborough and Mackay and proposed Cane Quality Indices;
6. Recommendations for wider implementation of more profitable harvesting practices and harvest payment structures across the Australian industry.

#### 3.1 Work with participating groups

The project team attended the Harvesting Workshop held at SRI on 23 May 2003. The workshop identified the main issues influencing the adoption of harvesting best practice and endorsed the objectives of this project. Clear market signals are required to provide incentives to adopt best practice.

Surveys of harvester owners were carried out in the Maryborough, Racecourse and Pioneer mill areas. The surveys sought information on current harvesting equipment, payment methods, advantages and disadvantages of current systems, attitudes towards change, and whether they were interested in taking part in the project. Surveys were posted to recipients and follow-up telephone calls and publicity were used to improve the response rate.

Harvest groups were selected at Maryborough (3), Racecourse (5) and Burdekin (4) from those who volunteered. Visits were made to these groups to inform them of the
methodology, provide recording sheets, fit elevator hour meters, and ensure that fuel use could be measured. Groups were selected to cover a range of sizes, localities and group types. Groups selected at each centre, together with some details, are listed below.

Mackay

Name: DC, Mrs MP, DR and RC McLennan  
Location: Walkerston  
Type: Grower/Contractor  
Group size: 50,000 t  
No. of farms: 11  
Harvester: 1998 Austoft full track

Name: MJ, CC and KG Grech  
Location: Sunnyside  
Type: Grower/Contractor  
Group size: 34,000 t  
No. of farms: 7  
Harvester: Cameo full track

Name: Oakenden Harvesting  
Location: Oakenden  
Type: Cooperative  
Group size: 61,300 t  
No. of farms: 9  
Harvester: 1997 Austoft 7700

Name: Casey Zarb Pty Ltd  
Location: Homebush  
Type: Grower/Contractor  
Group size: 54,000 t  
No. of farms: 10  
Harvester: 1994 Austoft 7000, Case IH 1998 7700

Name: E R Scriha  
Location: Stock Route Road  
Type: Grower/Contractor  
Group size: 32,500 t  
No. of farms: 4  
Harvester: 1999 Austoft 7700

Burdekin

Name: G Miller  
Location: Pioneer  
Type: Grower/Contractor  
Group size: 54,000 t
No. of farms: 5
Harvester: 1997 Cameo

Name: Pirrone Harvesting
Location: Klondike-Old Clare Road - Rossiter's Hill
Type: Grower/Contractor
Group size: 46,000 t
No. of farms: 4
Harvester: Toft 7000

Name: HCL Harvesting
Location: Brandon
Type: Cooperative
Group size: 92,000 t
No. of farms: 7
Harvester: 1995 Cameco

Name: Ron Gendrolius
Location: Inkerman
Type: Contractor (harvesting only)
Group size: 70,000 t
No. of farms: 5
Harvester: 1996 Cameco

Maryborough

Name: Tinerra Harvesting
Location: Mungar
Type: Cooperative
Group size: 50,000 t
No. of farms: 11
Harvester: Toft 7700

Name: JW & RL Dowling
Location: Maryborough
Type: Contractor
Group size: 48,000 t
No. of farms: 12
Harvester: Toft 7000 and Toft 7700

Name: Petersen Farms
Location: Maryborough
Type: Grower/contractor
Group size: 64,000 t
No. of farms: 7
Harvesters: Toft 7700 and 2001 Cameco
Details recorded by each group on a daily basis included date, farm, block(s), estimated tonnes cane per hectare, tonnes cut per day, engine stop/start time, elevator hours, harvester fuel, haulout fuel and any comments such as whether the block had been multiplied (two or three rows mechanically gathered such that the normal single row harvester cuts multiple rows at once). The row length and haul distance for each block were measured from farm maps.

Hour meters were fitted on all harvesters to record elevator hours; elevator hours, as a proportion of engine hours, are a measure of field efficiency. The elevator hour meters provided thought-provoking information for the harvester operators, as they saw that they generally spent less than 50% of their time actually cutting cane.

Extension officers also worked with the groups to do stop-watch measurements of cutting time, turning time, the haul cycle and time to empty (unload) at the siding. This additional information helped to firm up some of the assumptions for the Harvest Haul model.

A list of equipment and its value was also been drawn up for each group.

Once the results of the surveys were known, focus group meetings were held. The groups comprised people from participating harvesting groups, BSES Limited, Queensland Mechanical Caneharvesters Association, CANEGROWERS and millers. The information obtained from the three surveys, as well as background information on harvesting, was presented. The groups brainstormed different payment methods and then selected the ones they would like to explore further in the following season.

The information from the log books was placed in spreadsheets to examine relationships such as fuel use per tonne cut versus crop size. Different payment methods were then applied to determine which methods provided incentives for good farm layout and farming practices. The payment methods applied included hourly rate, base rate plus fuel, base rate plus fuel priced above normal to allow for labour and machinery, a sliding scale based on crop yield, a sliding scale based on crop yield plus fuel and a combination of hourly rate and base rate.

Throughout the 2003 harvest, follow-up meetings were held with co-operators at Mackay, Burdekin and Maryborough to deliver the preliminary results and spark interest in the project. At Mackay, an end-of-season meeting was held with operators to provide feedback on the data that they had collected.

Most harvest groups fitted electronic monitoring units for the 2004 harvest in an attempt to obtain more detailed information on harvesting efficiency, time spent and machine performance. Units were fitted to participating contractors at Maryborough (3), Racecourse (3) and Burdekin (3). A daily log was still kept and fuel use was recorded manually. The remaining groups at Mackay (1) and Maryborough (1) used logbooks to record all information.

Alternative payment methods were applied using this second set of data. These alternatives included hourly rate, base rate ($/t) plus fuel, a sliding scale based on crop
yield, a sliding scale based on crop yield plus fuel and a combination of hourly rate and base rate.

3.2 Cane-quality indices

Steve Staunton visited all three mills at the start of the project and worked with them to establish cane-quality indices using NIR at Maryborough and Racecourse, and other measurements at Pioneer. Maryborough used the NIR CAS for cane payment by directly measuring CCS. At Mackay, there were close linkages between this project and the SRDC Mackay Sugar Cooperative project MSA003 ‘A cooperative systems model for the Mackay regional sugar industry in developing a cane-quality system’ in developing a cane-quality system.

3.3 Refining alternative harvesting payment methods

Project participants met at Bundaberg in February 2005 to discuss findings from the 2004 harvest and further refine alternative harvesting payment methods. Participants also formed the panel at the Workshop on Alternative Harvest Payment held as part of activities for the SRDC launch of the booklet Cane Harvesting to Improve Industry Performance. Researchers and harvester operators presented their ideas on harvest payment and fielded questions from the industry audience.

A final meeting of the project team was held at Mackay in June 2005 to finalise the project.

3.4 Technology transfer

All group and mill participants were kept informed of the project progress at the numerous meetings detailed above.

Broader interest in the project was gained through two BSES Bulletin articles, and presentations to the December 2003 BSES Activate Breakfast in Brisbane, to the Mackay branch of the QMCHA and to the Tully Awards function in April 2004. A paper was also presented at the 2004 ASSCT conference and posters were presented at BSES field days.

4.0 RESULTS FROM BASELINE AND END SURVEYS

4.1 Baseline surveys

Surveys were sent to all harvester owners in the Maryborough, Racecourse and Pioneer mill areas. These were publicised at mill pre-season meetings and follow-up telephone calls were made to all recipients to encourage return. The return rate was relatively low and follow-up telephone calls showed that non-respondents were largely groups that cut
only their own cane or contractors who felt that they could not discuss price with their clients as they may lose clients. Most respondents were those who saw need for change.

During follow-up visits and telephone calls to survey non-respondents comments were made about the project. Some of these were:

- Harvesting contractors are price takers, not price setters. Have little influence in the price that they are paid. Either accepts what is offered, or the growers will find someone else to cut the cane.
- Contractor groups did not want to get involved in case their growers got frightened into thinking that they were going to charge more for harvesting.
- Contractor groups did not want to get involved in case it resulted in them getting paid less.
- They thought that the project was going to cause trouble for them, even if they were not directly involved.
- The survey proved a little confusing with a lot of responses given not in the same context as the question was asked, eg direct debit, slow payments, etc, not answering how the payment was formulated.
- A lot of comments in relation to the distribution of bins, and that this is an issue for contractors.
- A need for written agreements between harvester contract operator and growers in-group to protect the investment made in machinery by the contractor/operator.
- If the group wishes to discontinue the harvesting agreement before the expiry date, they must purchase the machinery from the contractor at market price.
- Once harvesting contract gets above a certain level (50,000-60,000 t), it becomes less viable as a third haul out unit is required meaning extra capital cost and wages.
- This project is too difficult and they wish us luck!

Replies to the survey questions for each district are given below.

**Racecourse (Mackay)**

Survey forms were sent to 58 harvesting groups. 10 replies were received.

Follow-up telephone calls showed those that cut only their own cane (19) could not see the relevance, and some contractors were nervous about being involved as they feared they could lose clients.

Groups comprised seven grower/contractors, two contractors and one cooperative.

Group size. The average group size was 37,034 t, ranging from 10,510 t to 61,300 t. The average area cut was 462 ha, ranging from 93 ha to 900 ha.

Number of farms per group. The average number of farms in each group was 7, ranging from 2 to 11.

Percentage of group rated as good going. The average figure was 85% with estimates ranging from 60% to 100%.
Make and model of harvesters

Make and model of haulouts
- 15 t EHS elevator tippers with JCB Fastracs.
- 20 t EHS elevator tippers (rubber tracked) with Cat tractors.
- 14 t Corradini elevator/tipper with JCB Fastracs.
- 10 t BSM trailers with JCB tractors.
- RORO Double-bin trailers.

Backup wet weather gear
- Full track transporters 10-11 t.
- Ford tractor with tipper.
- Toft full track tipper bin, two 5-t side tippers on four-wheel drive tractors.
- Half-tracks and two tipper bins.
- Side wheels.
- 12 t Westhill full track transporters.
- For several groups base equipment has wet weather capability.

Payment method. Flat rate/tonne for all. Average charge $6.78, ranging from $6.55 to $7.70 per tonne.

Vary with crop size
- One cooperative: Yes, more tonnes harvested reduction in fixed costs.
- One grower/contractor: 30 c/t more for burnt cane.
- Remainder: No.

Other payment methods
- Charge 20c/t extra for long carts.
- More for long haulage and farm conditions.
- Cartage allowance.
- Automatic deduction from mill to harvester account.
- Remainder: No.

Advantages of current system
- Five groups said “none”.
- Every grower pays the same price.
- Simple
- Our system is OK, as we cut only one farm (in the family) outside of our own.
- No work for group members. Harvester receives money owing straight away.

Problems with current system
- Good cane is subsidising bad cane. Poor cane pays the same as good cane.
- Farmers don't pay more for small crops. You are expected to have all of the wet-weather equipment and are not paid any more for harvesting.
• Cross subsidy of harvesting cost.
• Small tonnes, short drills.
• Unfair.
• Do not get any extra if poor cane.
• Farmers object strongly to any pay rise for last 8 years.
• None.

Which payment system would you choose?
• Good question - needs a lot of thought.
• Hourly rate - or more when crop is under a certain tonnage.
• Delivery rate for each farm.
• Present system - cane under 50 tonnes /hour grower pays fuel.
• Price would vary on sliding scale for crop quality, farm layout, haul distance, siding size - would have to be easy to work formula.
• Flat rate and growers pays fuel to encourage growers to grow better cane.
• Mill controls payment to contractor not farmers or some controlling body who is more impartial.
• Mill deductions.

Rewards of a new system
• Growers with tonnes per hectare and short hauls and well-presented farms (farm layout) would pay less.
• Less cost for farmers.
• Price would vary on sliding scale for crop quality, farm layout, haul distance, siding size - would have to be easy to work formula.
• Dad grows good cane, so it doesn't apply.
• Growers will grow better cane to use less fuel - cheaper for them.
• Mill computers have information on quantities of cane per hectare for each farm etc. so extra payments for top crop could be awarded.
• ?

Better feedback on cane quality?
• Yes - feedback used to be good, not now.
• Time wasted from bad farm layout, e.g. small blocks when you could harvest through into the next block.
• Yes - dirt, EM, cut-crush, billet quality compared and relative to sugar content.
• Yes - incentive payment.
• Yes - extraneous matter levels, dirt levels reported on a daily basis.
• No.
• Yes - How much extraneous matter, billet length and quality.
• Yes - tonnes per block of cane or hectare per farm.

Important issues that need to be addressed
• Milling - crush rate/quality
• Growing – varieties.
• Harvesting - less, with more being viable. Varying sizes.
• Bad farm practices in growing crops.
- Lack of interest.
- A better and fairer system of payment to contractors.
- Harvesting and transport.
- Mill transport and marketing.
- Water availability.
- Better price for sugar.
- More water availability.
- Better varieties.
- Irrigation water supplies.
- Reduction of compaction of paddocks.
- Farms to become larger.
- More irrigation water at cheaper prices.
- More money for our cane.

Do you calculate costs for farms/blocks?
- One ‘Yes’.
- Remainder “No”.

Find out more about including group in project?
- Seven “Yes”.
- One “No”.
- Others not answered.

**Burdekin**

Eleven respondents took part in the survey.

Groups compromised three grower/contractors, seven contractors and one cooperative.

Group size. The average group size was 57,000 t, ranging from 40,000 t to 92,000 t.

Number of farms per group. The average number of farms per group was five.

Percentage of group rated as good going. The average area of good going is 85%, ranging from 60 to 100%.

Make and Model of harvester

<table>
<thead>
<tr>
<th>Machine</th>
<th>Tonnes cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997 Cameco</td>
<td>54,000</td>
</tr>
<tr>
<td>1997 Cameco</td>
<td>60,000</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>40,000</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>64,750</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>51,000</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>62,000</td>
</tr>
<tr>
<td>1997 Toft 7000</td>
<td>44,000</td>
</tr>
<tr>
<td>1995 Cameco</td>
<td>92,000</td>
</tr>
</tbody>
</table>
Haulout equipment
- 1972 Acco.
- Two UD Nissan trucks.

Wet weather back up
- None (4)
- Five had 1/2 tracks
- One had 3/4 tracks

Payment method for harvesting. All groups use a flat rate. The range for the price charged is $5.50 to $5.80/t.

Do you use any other payment method? Some pay extra for long carts and for cutting green.

Benefits of current payment system
- None.
- Simplicity.
- Everyone pays the same, no changes.
- Regular cash flow.

Problems with the current system
- None.
- Simplicity.
- Good farms subsidize bad farms.
- Some blocks cost the contractor $$ to harvest.
- Cost of machines are not considered in the current pricing arrangement.
- No extra money for long carts or cutting green.

Which payment method would you choose if you could?
- Hourly rate.
- Pay more on poorer blocks and less on better blocks.
- Pay more for long carts, small blocks, angled drills and cutting one way unnecessarily.
- Base price plus more for poor practices – who will judge?
- 60-40 split in favour of harvester.
- Grower pays for fuel – fuel quality?
- Satisfied with present system.
- Mill deductions.
- All pay a set price across district, which is increased in relation to fuel, etc.

How would these system reward growers and encourage HBP?
- The more they grow the more money growers make – that is their incentive.
- Growers would grow better cane to use less fuel – cheaper for them.
- Better conditions take less time.
Do you want better feedback on cane quality?
- Yes – Percent of damaged billets (reliable and consistent testing).
- Yes – dirt, EM, cut-crush, billet quality with ratings and payment bonus as incentive for contractor.
- Yes – incentive payment.
- Yes – More consistently checked.
- Yes – EM, Billet length and quality. No (5).

Important issues that need to be addressed:
- Milling - crush rate/quality.
- Farming practices need to improve.
- A better and fairer system of payment to contractors.
- Mill transport system in relation to bin deliveries.
- Better price for sugar.
- Soil productivity and health.
- Developments of new products from cane.
- Profitable fallow cropping.
- Better resale value on used cane harvesters.
- Keep burnt cane, no change to green harvesting.
- No 24-hour harvesting.
- Better consultation with cane inspectors.
- More reliable and fairer allotments of bins.
- More cooperation about swapping to closer sidings.
- Improvement on grub control at less cost (cost is prohibitive at present).
- Research into more suitable cane varieties resistant to canegrubs.
- More cooperation between mill and contractors in regards to bin allotments.
- Written contracts between growers and contactors.

Do you calculate costs for farms/blocks?
- All “No”.

Do you want to find out more about including group in project?
- Four “Yes”.
- Six “No”.
- One not answered.

**Maryborough**

Ten growers took part in the survey.

Groups comprised eight grower/contractors, one contractor and one cooperative.

Group size. The average group size was 25,000 t, ranging from 4,000 to 50,000 t.
Number of farms per group. The average number of farms per group was 6 ranging from 1 to 12.
Percentage of group rated as good going. The average area of good going was 71%, ranging from 60 to 90%

Make and Model of harvester

<table>
<thead>
<tr>
<th>Machine</th>
<th>Tonnes cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994 Cameco full track</td>
<td>21,000</td>
</tr>
<tr>
<td>Toft 6000</td>
<td>19,000</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>26,000</td>
</tr>
<tr>
<td>1999 Toft 7700</td>
<td>50,000</td>
</tr>
<tr>
<td>1993 Toft 7000</td>
<td>4,000</td>
</tr>
<tr>
<td>2002 Cameco + 1998 Toft 7700</td>
<td>50,000</td>
</tr>
<tr>
<td>1998 Toft 7000 + 1999 Toft 7700</td>
<td>48,000</td>
</tr>
<tr>
<td>Toft 6500 + 1995 Toft 7000</td>
<td>15,000</td>
</tr>
<tr>
<td>Toft 6500</td>
<td>4,000</td>
</tr>
<tr>
<td>Toft 7000</td>
<td>13,500</td>
</tr>
</tbody>
</table>

Haulout equipment

- Ford TW 20 8t haulout bin
- 2 Chamberlain tractors
- M160 10 t tipper, Chamberlain 8 t tipper
- 1998 M135 8 t tipper, 2000 TM 150 8 t tipper
- Toft 4 t
- EHS self-propelled 9 t, 2001 TM 150 EHS 8 t bin
- 8910 Case 9 t bin, 8910 Case 12 t bin
- McLean tipper
- NA
- Toft 600 Hi lift

Wet weather back up

- None
- None
- ¾ tracks for Toft
- Rubber tracked buggy with bin
- None
- Full-track harvester
- Full-track harvester
- None
- None
- Half-tracks

Payment method for harvesting. All groups used a flat rate and grower pays for fuel. The average price charged was $5.30 for burnt and $5.80 for green plus fuel.

Any other payment method? Small growers pay an extra 20c per tonne to cover the cost of moving the machine.

Benefits of current payment system

- Plus fuel system encourages better layout longer rows cutting over headland, wider headlands. Larger crops use less fuel per tonne to cut.
• Fuel is a major cost in varying and bad conditions.
• Farmer and contractors know where they stand.
• No need to chase money.

Problems with the current system
• The good grower pays the same as the bad.
• No payment for short rows or light crops.

Which payment method would you choose if you could?
• Each farm is different.
• Hourly basis.
• Base price plus fuel. Engine hours * elevator hours.
• One rate in cane over 100 t/ha, one rate under 50 t/ha.

How would these systems reward growers and encourage HBP?
• Best job under the conditions.
• Better conditions take less time.
• The more cane you grow the cheaper the harvesting cost.

As well as providing information on current harvesting arrangements, farming practices and skills and aspirations, the baseline surveys identified harvesters who were willing to participate in the project. This proved to be the key to success of the project, as it relied heavily on operators keeping accurate log books and recording fuel use daily. The willing cooperation of the participants continued throughout the project.

### 4.2 End of project surveys

These surveys were limited to the harvesting groups that had participated in the project.

**Mackay Harvesters**

Three grower/contractors and one cooperative responded to the survey.

Group size ranged from 45,000 t to 58,000 t, with area harvested ranging from 609 to 720 ha.

The number of farms in each group ranged from 7 to 10.
A new payment method was in place for one group, but the other three were still using the same flat rate per tonne payment method ($6.70 and $6.73/t) as at the start of the project. One of the groups using the flat rate per tonne adds an extra 20 c/t for carts over 5.0 km. Another group varies the flat rate per tonne between farms from $6.95 to $7.25/t. The new method in use was:

- Base rate ($6.00/t) plus grower pays for fuel.

The advantages of the new payment systems listed by the harvester were:

- Less tonnes/ha = more fuel which the grower pays for and vice versa.
- As fuel price increases, grower pays more and vice versa.

For those that did not change the reasons listed were:

- A new system identified the real cost and the high cost areas were reluctant to change.
- Too much trouble.
- Farmers are not getting enough money for their cane.

Harvesters were asked to list a preferred payment system. These were:

- Base rate plus fuel.
- Sliding base price associated with crop size plus fuel.
- Different price per farm, we already have the costing worked out, there is $1.50/t variance in our crop.
- Delivery rate per hour – real measurement of harvesting cost.

Feedback of information on cane quality from the mill had improved, some comments were:

- More well-presented crops than the previous season.
- GPS units on harvesters.
- Web site info from Mackay Sugar for dirt, EM, PRS, bin weight.
- We try our best at all times to do the best job in the field and for the cane being sent to the mill in different field conditions.

**Burdekin Harvesters**

Comments from Burdekin harvesters at the end of the project were:

- Need a fairer system
- Need Quality incentives – both for sugar and harvesting job
- Base rate + fuel appeared the most practical system
- Sliding scale incorporating yield bonus/penalty also deserved consideration
- Some were happy with base rate
- Still interest in hourly rate

**Maryborough Growers**

Seven growers from the Nikenbah and Tinerra harvesting groups responded to the follow-up farming practices survey and the nature of the responses indicate a good awareness of harvesting costs and the link between farming practices and harvest costs.
The outcomes of this survey were:

- Nearly all growers allowed the operator to harvest adjoining blocks in one pass to reduce turning times.
- Growers regarded their headlands as wide and smooth to improve harvest efficiency.
- Most felt that their current plus fuel system rewarded good farming practices and this is a critical driver for adopting best practice farming for harvesting.
- All growers said they were prepared to change farm layout to improve harvesting efficiency but felt that they had already made significant changes to layouts where possible. This is no doubt a result of having improved market signals for over 10 years.
- When asked what new payment system they would choose if they were to change, the majority indicated that they were more than happy with the current system. Suggested improvements to the payment system were linking quality/performance with harvesting price. With NIR now installed at the Maryborough Sugar Factory, there is the potential to introduce a cane quality scheme which could reward operators for superior performance.

Overall, Maryborough growers demonstrated a good understanding of farm parameters that impact on harvesting costs due to the long running plus fuel system. This has been a key factor driving growers to continually monitor and improve their presentation for harvesting. Not surprisingly, the popularity of a base price plus fuel system is spreading state-wide, which should have a significant impact on grower attitudes in other districts.

5.0 LOG BOOK AND ELECTRONIC DATA FROM PARTICIPATING HARVEST GROUPS

Harvesting groups at Maryborough, Mackay and Burdekin recorded log book information including:

- farm and block;
- fuel use (haul unit and harvester);
- kilometres travelled (haul unit);
- haul conditions;
- harvest conditions;
- crop lodging (%);
- engine hours;
- elevator hours.

Analysis of this information produced relationships between parameters such as crop size, row length, haul distance, fuel use and field efficiency. An example of log book information is shown in Table 1.
Harvester performance was also recorded electronically for eight harvesting groups by units incorporating a GPS (accurate to ± 5 m), a data logger and a telephone modem. Additionally, the GPS units were connected to sensors to record:

- machine location as latitude and longitude;
- ground speed;
- if the engine is running;
- elevator on or off;
- chopper on and off;
- extractor fan speed.

Fuel use was recorded manually and subsequently added to the data set.

The GPS units used were leased from BIGmate (Mackay), MTData (Melbourne) and Transcomm (Bryon Bay).

BIGmate has a web site that can display some information, such as engine monitoring data, but not time-performance data. The units in the harvesters are downloaded each night (the unit can store up to 20 days of data if the machine is in a poor reception area). Each night a server makes a telephone call to each GPS units and downloads data from the unit. These data are then forwarded to the CHOMP server. The CHOMP server interprets the GPS data to determine machine performance. In this process, the GPS co-ordinates are overlaid on GIS maps of the cane blocks to determine in which block the harvester is operating. By interpreting the sensors, the following data are derived for each block (or part-block):

- cut area;
- first time in the block;
- last time in the block;
- time spent cutting;
• time spent waiting for haul-outs;
• time spent turning;
• average fan speed.

By combining this with block tonnes, it should have been possible to calculate:
• field efficiency;
• elevator pour rate;
• delivery rate;
• harvest duration;
• cutting time;
• turning time;
• waiting for haul-outs time;
• moving time;
• fan speed.

These data were forwarded to Agtrix Pty Ltd for interpretation where GPS coordinates are overlaid on GIS maps of the cane blocks to determine in which block the harvester was operating. By interpreting the sensors, the above data are derived for each block. Examples of these data are shown in Figure 1.

Any or all of these data can be reported back to the co-operators. This may take the form of a web-site report or a paper-based report.
The BIGmate screen in Figure 2 shows the location of a harvester, i.e. where it cut for the day and the speed of operation. Note that the harvester was moved on a truck at the end of the day and travelled at speeds of 100 km/h.

The location data is used by Mackay Sugar to identify the area harvested and the tonnes harvested from this area are then compared to the estimate for that area.

BIGmate data in the computer screen in Figure 3 shows working time and elevator cycle. This data is recorded in 30 sec intervals. The percent of 30 sec intervals that the machine undertakes each function allows an exact time for each operation to be calculated. The CHOMP software does these calculations automatically.

These data were used to derive relationships among harvester, crop and field parameters (Section 6).
Figure 2  BIGmate screen showing the location of a harvester

Figure 3  BIGmate screen showing working time and elevator cycle
These log-book data were linked to mill harvest and field book data to enable relationships to be calculated between harvesting parameters such as engine hours, elevator hours and fuel use with farm information such as row length, haul distance and crop yield and mill information such as tonnes supplied and cane quality index.

6.0 DERIVED RELATIONSHIPS AMONG HARVESTER, CROP AND FIELD PARAMETERS

Information from the log-book data was analysed to test relationships for row length, crop size and haul distance with factors such as fuel use and delivery rate. If there was a good relationship, payment methods that reflected fuel use or delivery rate should provide incentive for growers to improve row length or crop yield and provide accurate information to calculate additional charges for long hauls. The information would also enable calculations for harvesting charges to compare alternative payment methods.

Example relationships from 2003 harvest data are shown for row length and delivery rate (Figure 4), crop size with fuel used and delivery rate (Figures 5 and 6), haul distance with fuel used and delivery rate (Figures 7 and 8).

![Figure 4](image_url)

Figure 4  Relationship between row length and delivery rate (Burdekin data)
Figure 5  Relationship between crop size and fuel use (Mackay data)

Figure 6  Relationship between crop size and delivery rate (Mackay data)
Figure 7  Relationship between haul distance and total fuel used (Mackay data)

Figure 8  Relationship between haul distance and delivery rate (Mackay data)
2004 harvest data allowed further calculations on the various payment options, such as:

- Dollars per hour plus dollars per tonne;
- Sliding scale based on t cane/ha;
- Sliding scale based on t cane/ha plus fuel use;
- Any other payment method.

6.1 Mackay

In 2004, there were four groups involved in the project. Three of these groups (Steve Young, Grech Bros and Oakenden Harvesting) had electronic logging equipment installed on their harvesters and haulouts. Linkages were established to the Mackay Sugar cooperative systems project, so that data from these units were shared between the projects.

Each of the units was down-loaded each day and presented on the web site. To help the contractors use the web site, a meeting was held with the BIGmate representative. At this meeting, the loggers, their function and how to access data on the web site were explained to the contractors. Each of the contractors was set up with a password that allowed them to access all of the data of the harvesters in the project. However, no analysed data were returned to the contractors, as no software was available to link the BIGmate data with farm-map and cane-delivery data. Considerable effort was put into developing the software, but it proved more difficult than first anticipated. This software had been the ‘missing link’ to fully utilise GPS based data, which is a critical component of payment systems based on hourly rate or delivery rate. A system to link GPS data with GIS map data was developed by Agtrix Pty Ltd using Transcomm GPS units in New South Wales. This software did not give the same outputs with BIGmate units, as they do not record time-performance data to allow for turning on headlands.

Data were available from log books for the 2004 harvest. This was analysed to confirm relationships between harvest and crop parameters. Examples follow in Figures 9-17.
Figure 9  Relationship between harvester fuel use per tonne of cane harvested and crop yield for Steve Young’s harvester for the 2004 harvest at Mackay (block data)

Figure 10  Relationship between harvester fuel use per tonne of cane harvested and crop yield for Grech’s harvester for the 2004 harvest at Mackay (block data)
Figure 11  Relationship between total haulout fuel used per tonne of cane harvested and haul distance for Grech Bros for the 2004 harvest at Mackay (block data)

Figure 12  Average fuel used per tonne of cane for harvester, haulouts and total for farms harvested by Grech Bros for the 2004 harvest at Mackay
Figure 13  Relationship between total haulout fuel used per tonne of cane harvested and haul distance for McLennan for the 2004 harvest at Mackay (block data)

Figure 14  Relationship between total haulout fuel used per tonne of cane harvested and haul distance for McLennan for the 2004 harvest at Mackay (whole-farm data)
Figure 15  Relationship between harvester fuel use per tonne of cane harvested and crop yield for McLenann for the 2004 harvest at Mackay (whole-farm data)

Figure 16  Average fuel used per tonne of cane for harvester, haulouts and total for farms harvested by McLenann for the 2004 harvest at Mackay
In 2004, three groups collected log-book information in relation to harvesting practices and efficiencies. These include:

- farm and block;
- fuel use (haul unit and harvester);
- kilometres travelled (haul unit);
- haul conditions;
- harvest conditions;
- crop lodging (%).

This information has been collected in conjunction with electronic recording of harvester efficiency indicators including:

- elevator on/off;
- engine on/off;
- chopper on/off;
- ground speed.

The three groups were kept up to date throughout the season via a group meeting and one-on-one visits and explanation on how the data were being collected. This also involved the allocation of usernames and passwords to all participants to allow access to the BIGmate website where output from the units are displayed.

Reports relating to the information captured with cane delivery information were communicated to the groups involved, the local Harvesting R&D group and other interested parties through the Burdekin Cane Productivity Initiative.

Relationships derived between harvest and crop data are shown in Figures 18-21.
Figure 18  Relationship between harvester fuel use per tonne of cane harvested and crop yield for the HCL group’s harvester for the 2004 harvest at Burdekin (block data)

Figure 19  Relationship between total haulout fuel used per tonne of cane harvested and haul distance for the HCL group’s harvester for the 2004 harvest at Burdekin (block data)
Figure 20  Relationship between harvester fuel used per tonne of cane harvested and row length for the HCL group’s harvester for the 2004 harvest at Burdekin (block data)

Figure 21  Fuel use (harvester, haulouts and total) per tonne of cane harvested for the HCL group’s harvester for the 2004 harvest at Burdekin (whole-farm data)

6.3 Maryborough

Three harvesting operations were involved in the Maryborough component of the project in 2004. Tinerra Harvesting (Darryl Cronau), Nikenbah Harvesting (David Petersen) and John Dowling’s harvesting operation all used a logbook-based recording system to supply
data on fuel usage, elevator hours, engine hours and other relevant information such as
difficult field conditions. BIGmate GPS logging units were fitted to Petersen’s and
Dowling’s harvesters to give additional data on the harvesting operations, such as fan
speed and ground speed.

To give the operators an idea of the data being gathered, individual passwords were set up
to allow access to the BIGmate website where operators could review their harvesting
operations online as often as they wanted. The easy-to-use website enabled operators to
track machine performance parameters on a daily, weekly or monthly basis.

Maryborough has been paying for harvesting services using a base price plus fuel system
for well over 10 years, which means that changes in attitudes and practices have had time
to occur. Figure 22 shows fuel use in litres per tonne for each farm cut by Tinerra
Harvesting. There are not large differences among farms, reflecting a gradual
improvement in farm layouts over the years that the base price plus fuel system has been
used.

![Figure 22](image)

**Figure 22** Fuel use in litres per tonne for each farm cut by Tinerra Harvesting in
2004

Comments from operators and growers in the region indicated that, because growers can
see a direct (financial) link between harvesting costs and their own costs, there has been
an effort by farmers to setup farms for more efficient harvesting. Figure 23 shows
average elevator pour rate and delivery rate for farms cut by Nikenbah Harvesting for the
2004 harvest at Maryborough. This shows that field efficiencies were all over 50% and as
high as 87% for one farm, and suggests that the pricing system has had significant positive
impacts on farming practices and attitudes.
Maryborough’s already high cane quality is a result of numerous factors, including efficient harvesting and transport plus favourable weather conditions, and the impact of the payment system over the years has played a big part in creating these efficiencies. With the installation of a NIR system at Maryborough mill, cane quality will become an even higher priority for growers giving strong incentives to adopt HBP. If a reward scheme for high quality cane could channel funds to both growers and operators, there is the potential to further improvement in farm presentation for harvesting.

Once information such as harvesting hours, fuel use and crop yield were related, alternative payment methods such as hourly rate and base rate plus fuel were applied and compared with the current system.

7.0 DOCUMENTATION OF ALTERNATIVE PAYMENT METHODS AND HOW THESE VARY WITH HARVESTER, CROP AND FIELD PARAMETERS

The key focus for the project has been to increase total industry revenue through adoption of HBP. Therefore, any new payment system must:

- Encourage best practice farming and harvesting practices which increase revenue;
- Reflect the true cost of harvesting to ensure the sustainability of the harvesting sector;
- Be a ‘workable’ system, i.e. a transparent system that is easy to monitor and ‘police’;
- Not be able to be manipulated to benefit one party at the detriment of another.
7.1 Alternative payment methods identified after 2003 harvest

Focus group meetings in the first year of the project identified alternative payment methods:

- A base charge (e.g. $5.80/t) plus grower supplies fuel;
- A sliding scale, variable rate per tonne based on crop yield. (e.g. $7.00/t at 40 t cane/ha to $6.40/t at 100 t cane/ha);
- An hourly rate, e.g. $350/h;
- Hourly rate (e.g. $350/h) below a certain tonnage (e.g. 80 t/ha);
- Hourly rate plus a flat rate, e.g. $150/h plus a flat rate of $3.00/t;
- Flat rate ($/tonne) plus fuel;
- A sliding scale based on crop yield such as the ‘Rossi’ system used in one group in Mulgrave.

Figures 24 and 25 show how the cost of harvesting ($/t) would vary at different crop sizes and haul distances when calculated using Base Rate (BR) plus fuel, hourly rate and a sliding scale based on yield termed the Rossi method.

![Figure 24](image_url)  
**Figure 24** Cost of harvesting for four different payment methods applied in relation to crop yield
Figure 25  Cost of harvesting for four different payment methods applied in relation to haul distance

7.1.1 Base rate plus fuel (BR+F)

This method is widely used at Maryborough, where the base rate varies between $5.50 and $5.80 per tonne depending whether burnt or green. The fuel is paid for by the grower but delivered to the contractor’s tank.

Comments are:
- The system is easy to monitor and ‘police’ because it is a simple system.
- It is fair because the grower pays for fuel actually used on the farm.
- It reduces the level of cross subsidisation, but still puts the cost of bad blocks back onto the harvester.
- BR+F still sends the market signal for high pour rates to maintain viability, but not so much as $/tonne.
- The system is commercially proven (>10 use in Maryborough).

7.1.2 Base rate plus fuel +$  

This method is the same as BR+F, but the fuel is priced at $2.00/L to allow for labour as well. The system is used by some groups in NSW. The litres of fuel used would be measured and the grower invoiced at $2.00/L.

The rationale behind this system is that paying for fuel alone does not compensate for machinery and labour costs.
7.1.3 Hourly rate

This method pays on engine hours similar to the hire of most earthmoving equipment. Rates used for Mackay examples are between $350 and $420/h, depending on the number and size of haulouts. This rate would need to be negotiated between grower and contractor.

Comments are:
- Are engine hours the appropriate measure?
- What monitoring equipment would be needed for grower to know the machine was working as contracted e.g. fan speed, forward speed, GPS tracking?
- What is an appropriate starting point for rate negotiations?
- Sends the best market signals i.e. greatest variation in price per tonne.
- Reflects true cost, as most variable costs are accumulated on an hourly basis
- Encourages BMP farming as the more efficient a farm is to harvest and the better the crop size and yield, the lower the cost per tonne to harvest.
- Gives stable income to operator, therefore allowing grower to dictate mode of harvester operation (farmer can decide if HBP is appropriate for each block).
- If a grower does not understand the financial benefits of HBP this could lead to unwise decision making focussed on minimum time therefore minimum cost at the expense of high cane loss, low cane quality and poor ratoons.
- Needs to be linked to a cane quality measurement system at mill to provide targets for cane quality.
- No incentive for harvester to reduce cane loss so settings of the harvester such as extractor fan speed and forward speed need to be monitored.

7.1.4 Rossi sliding scale

This method was used by Mark Rossi’s group at Mulgrave and changes the per tonne price depending on crop size as follows:

<table>
<thead>
<tr>
<th>Crop Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-45 t canes/ha</td>
<td>$7.00</td>
</tr>
<tr>
<td>45-55</td>
<td>$6.90</td>
</tr>
<tr>
<td>55-65</td>
<td>$6.80</td>
</tr>
<tr>
<td>65-75</td>
<td>$6.70</td>
</tr>
<tr>
<td>75-85</td>
<td>$6.60</td>
</tr>
<tr>
<td>85-95</td>
<td>$6.50</td>
</tr>
<tr>
<td>95-105</td>
<td>$6.40</td>
</tr>
</tbody>
</table>

The Rossi group set the price for each farm at the start of the season based on the estimate for the farm, and adjusted it at the end of the season depending on actual yield.

Comments are:
- Are the prices appropriate for other districts?
- Is 1 cent per tonne sufficient or too much?
- What about row length and haulout distance?
7.1.5 Sliding scale base rate plus fuel

This method uses the sliding scale to calculate a base rate. The sliding scale shown in the Rossi example is reduced to become a base rate, e.g. $6.30 for 35-45 t cane/ha to $5.70 for 95-105 t cane/ha. Fuel is purchased by the grower.

The system would operate along the same lines as the present Rossi system with the Maryborough BR+Fuel methods to supply fuel.

Comments:
- What base rate is appropriate when grower supplies the fuel?
- Appears a simple system with good market signals.
- Transparent and easy to apply.
- The base rate covers cane loss issues and true fuel costs are covered. The sliding scale covers some of the labour and machinery costs associated with crop size.
- Reflects true cost a little more (but are these all just indirect ways to pay for costs incurred on an hourly basis without charging by the hour).
- Still a tonnage rate, which encourages maximising pour rate and delivery rate.

7.1.6 Current system - $/tonne

This system encourages maximum efficiency in terms of maintaining a high delivery rate. It encourages minimal loss, because every lost tonne is lost income (however, some losses are incurred in the pursuit of maximising output).

Comment:
- Easy to monitor and understand, but sends a very clear market signal that tonnes per hour equals dollars per hour and quality is a minor focus (especially since growers are more likely to change operator for pricing reasons rather than job quality issues).

7.1.7 $/tonne plus $/hour

An appropriately balanced combination of these two could capture the positives of both systems giving the operator stability of income and, therefore, the flexibility to adopt HBP, whilst empowering growers to have input into harvesting decisions. A contract incorporating not just pricing arrangements but job quality expectations forms a critical part of this payment system (or any new system for that matter).

Comment:
- Any system must go hand in hand with an education/extension program ensuring growers/operators/millers understand HBP and its implications for each of their sectors.
7.1.8 Matrix system based on crop size and haul distance

This system sets a $/t harvesting rate dependent on crop size and haul distance. The matrix could have other variables to cover cane quality, delivery rate and best practice.

7.2 Payment methods piloted during 2004 harvest

7.2.1 Mackay

Groups piloted alternative payment arrangements for the 2004 harvest. The methods selected by the groups were:

- Casey Zarb Pty Ltd (Steve Young) – This group preferred a base rate plus fuel system, where the base rate is a sliding scale based on crop yield and haul distance (Matrix plus ModRossi). The group also fitted a BIGmate on the harvester and hub meters to measure distance on a haulout.
- Grech Brothers – This group wished to pilot a base rate plus fuel, where the base rate is a sliding scale based on crop yield (ModRossi). The group also fitted a BIGmate to the harvester.
- Oakenden Harvesting (Joe Muscat) – This group wanted to revisit the 2003 data and test how the sliding scale base rate plus fuel (ModRossi) and hourly rate methods compared. This information would be taken to the cooperative’s group to select their preferred option. This harvester had a BIGmate fitted the previous year and this continued for the 2004 harvest.
- E R Scriha and McLennan’s – These groups could not attend the project meeting but expressed interest in piloting base rate plus fuel methods.

2004 harvest data from the log books was used to model alternative payment methods selected for each harvesting group. Relative differences between payment methods for all farms harvested by the four Mackay groups (Grech, McLennan, Oakenden and Young) are summarised in Tables 2-5.

Table 2 Relative differences among farms for a base rate plus fuel payment method for all farms harvested by Young

<table>
<thead>
<tr>
<th>Farm</th>
<th>Fuel use (L/t)</th>
<th>Fuel cost</th>
<th>Harvest cost for base rate ($6) plus fuel ($/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.17</td>
<td>0.82</td>
<td>6.82</td>
</tr>
<tr>
<td>2</td>
<td>1.53</td>
<td>1.07</td>
<td>7.07</td>
</tr>
<tr>
<td>3</td>
<td>1.22</td>
<td>0.85</td>
<td>6.85</td>
</tr>
<tr>
<td>4</td>
<td>1.28</td>
<td>0.89</td>
<td>6.89</td>
</tr>
</tbody>
</table>
Table 3  Relative differences among farms harvested by Grech Bros with a sliding base rate plus fuel payment method

<table>
<thead>
<tr>
<th>Farm</th>
<th>Yield (t cane/ha)</th>
<th>Total fuel (L/t)</th>
<th>Sliding base rate $6.50 at 50 t/ha, fall 1c/t ($/t)</th>
<th>Plus fuel at 70 c/L ($/t)</th>
<th>Harvest cost for sliding base rate plus fuel option ($/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4160</td>
<td>64.7</td>
<td>1.76</td>
<td>6.35</td>
<td>1.23</td>
<td>7.59</td>
</tr>
<tr>
<td>4164</td>
<td>73.6</td>
<td>1.65</td>
<td>6.26</td>
<td>1.16</td>
<td>7.42</td>
</tr>
<tr>
<td>4166</td>
<td>94.5</td>
<td>1.54</td>
<td>6.06</td>
<td>1.08</td>
<td>7.13</td>
</tr>
<tr>
<td>4167</td>
<td>91.5</td>
<td>1.5</td>
<td>6.08</td>
<td>1.05</td>
<td>7.14</td>
</tr>
<tr>
<td>4172</td>
<td>71.7</td>
<td>1.53</td>
<td>6.28</td>
<td>1.07</td>
<td>7.36</td>
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<td>4176</td>
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<td>1.51</td>
<td>6.09</td>
<td>1.06</td>
<td>7.15</td>
</tr>
<tr>
<td>4252</td>
<td>66.4</td>
<td>1.76</td>
<td>6.34</td>
<td>1.23</td>
<td>7.57</td>
</tr>
<tr>
<td>4165A</td>
<td>93.5</td>
<td>1.56</td>
<td>6.07</td>
<td>1.09</td>
<td>7.15</td>
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<tr>
<td>4165B</td>
<td>84.9</td>
<td>1.4</td>
<td>6.15</td>
<td>0.98</td>
<td>7.13</td>
</tr>
</tbody>
</table>

Table 4  Relative differences among farms for base rate plus fuel and hourly rate payment methods harvested by Oakenden.

<table>
<thead>
<tr>
<th>Farm</th>
<th>Yield (t cane/ha)</th>
<th>t/hour</th>
<th>Total fuel (L/t)</th>
<th>Harvest cost for base rate ($6) plus fuel ($/t)</th>
<th>Harvest cost for hourly rate ($/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4204</td>
<td>85</td>
<td>53.7</td>
<td>1.43</td>
<td>7.43</td>
<td>6.70</td>
</tr>
<tr>
<td>4206</td>
<td>71</td>
<td>43.2</td>
<td>1.73</td>
<td>7.73</td>
<td>8.33</td>
</tr>
<tr>
<td>4239</td>
<td>85</td>
<td>54.1</td>
<td>1.38</td>
<td>7.38</td>
<td>6.65</td>
</tr>
<tr>
<td>4530</td>
<td>101</td>
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<td>1.27</td>
<td>7.27</td>
<td>6.73</td>
</tr>
<tr>
<td>4533</td>
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<td>54.1</td>
<td>1.40</td>
<td>7.40</td>
<td>6.65</td>
</tr>
<tr>
<td>4537</td>
<td>92</td>
<td>54.0</td>
<td>1.46</td>
<td>7.46</td>
<td>6.67</td>
</tr>
<tr>
<td>4219A</td>
<td>85</td>
<td>59.1</td>
<td>1.31</td>
<td>7.31</td>
<td>6.10</td>
</tr>
<tr>
<td>4521A</td>
<td>83</td>
<td>50.2</td>
<td>1.47</td>
<td>7.47</td>
<td>7.17</td>
</tr>
<tr>
<td>4521B</td>
<td>85</td>
<td>49.4</td>
<td>1.53</td>
<td>7.53</td>
<td>7.29</td>
</tr>
<tr>
<td>4521C</td>
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<td>41.0</td>
<td>1.80</td>
<td>7.80</td>
<td>8.78</td>
</tr>
<tr>
<td>4525A</td>
<td>81</td>
<td>51.4</td>
<td>1.37</td>
<td>7.37</td>
<td>7.01</td>
</tr>
<tr>
<td>4525B</td>
<td>87</td>
<td>55.1</td>
<td>1.58</td>
<td>7.58</td>
<td>6.54</td>
</tr>
<tr>
<td>4545C</td>
<td>92</td>
<td>45.2</td>
<td>1.57</td>
<td>7.57</td>
<td>7.97</td>
</tr>
</tbody>
</table>
Table 5  Relative differences among farms using the base rate plus fuel payment method for farms harvested by McLennan.

<table>
<thead>
<tr>
<th>Farm</th>
<th>Yield (t cane/ha)</th>
<th>Total fuel (L/t)</th>
<th>Fuel cost ($)</th>
<th>Harvest cost with base rate ($6) plus fuel option ($/t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3162</td>
<td>86</td>
<td>1.52</td>
<td>1.07</td>
<td>7.07</td>
</tr>
<tr>
<td>3163</td>
<td>70</td>
<td>1.76</td>
<td>1.23</td>
<td>7.23</td>
</tr>
<tr>
<td>3251</td>
<td>96</td>
<td>1.22</td>
<td>0.85</td>
<td>6.85</td>
</tr>
<tr>
<td>3275</td>
<td>99</td>
<td>1.14</td>
<td>0.80</td>
<td>6.80</td>
</tr>
<tr>
<td>3279</td>
<td>75</td>
<td>1.43</td>
<td>1.00</td>
<td>7.00</td>
</tr>
<tr>
<td>3280</td>
<td>94</td>
<td>1.23</td>
<td>0.86</td>
<td>6.86</td>
</tr>
<tr>
<td>3424</td>
<td>89</td>
<td>1.36</td>
<td>0.95</td>
<td>6.95</td>
</tr>
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<td>3278A</td>
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<td>0.81</td>
<td>6.81</td>
</tr>
<tr>
<td>3294A</td>
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<td>1.37</td>
<td>0.96</td>
<td>6.96</td>
</tr>
<tr>
<td>3294B</td>
<td>92</td>
<td>1.28</td>
<td>0.89</td>
<td>6.89</td>
</tr>
</tbody>
</table>

7.2.2  Burdekin

For the Burdekin, it was decided that HCL Cooperative would focus on two payment methods to trial for the 2004 season:
- Base rate plus hourly rate
- Hourly rate

These options were decided upon as they were thought to capture the influences on field efficiency (one-way harvesting, poor haul and field conditions). Both methods were run simultaneously, with meetings throughout the season to gauge the performance of the different methods.

To gain a more accurate picture of what is happening in the field; it was thought that a BIGmate recording system would assist with both the collation of data and as a basis for the hourly rate component of the two options.

For the other Burdekin group, J.J McDonald, it was thought important to capture the large haul distance component. This was captured by the use of a system based on fuel use or time. For this reason, two methods were compared:
- Flat rate/tonne plus fuel;
- Hourly rate.

It was thought that an hourly rate would be hard to sell and could be sending the wrong message, but would be used for comparison purposes. A BIGmate system was installed to assist with data collection.

Log book data were related to yield information to calculate the harvesting costs had new payment methods been applied. Results for the HCL group are shown in Figures 26 and 27.
Figure 26: Differences in harvesting costs among farms in the HCL group in 2004 that had a Base Rate plus Fuel payment method operating.

Figure 27: Differences in harvesting costs among farms in the HCL group in 2004 that had a sliding scale base rate plus fuel payment method operating.

7.2.3 Maryborough

Three Maryborough groups, JW & RL Dowling, Petersen Farms and Tinerra Harvesting, agreed to select two or three alternative payment systems to run in parallel with the
current system during 2004. The groups examined the impact of the methods on a block-to-block basis to determine the effects on harvesting costs on good and bad blocks, on whole farms and whole groups to determine the net effects of alternative systems, i.e. does a new system leave some growers better off and some worse off, or does it average out across a farm. Obviously, the latter makes ‘selling’ a new scheme easier, but in reality there will be some farms whose viability is heavily impacted by any system that reflects the true cost of harvesting. Methods were also contrasted on what the implications would be for the industry as a whole if some farms become less viable under any new system. Is cross subsidisation necessary to the survival of some districts? Can the industry survive if we keep cross subsidising as we are now or do we all go down together?

The base-rate-plus-fuel system used at Maryborough does not have a big impact on the cost of harvesting, as it only captures increases in fuel usage. It is a weak payment signal, in that does not negate cross subsidisation, variations in wages and other variable costs. The system sends a clear message to growers on harvesting costs without making some blocks or farms too expensive to harvest. As indicated in Figure 28, an hourly rate would probably reflect the true cost of harvesting but, without any cross subsidisation, this might lead to some blocks and farms no longer supplying cane. This would have very serious implications for mill viability.

![Figure 28](image)

**Figure 28** Evaluation of payment options on farms harvested by Petersens
The key to the success of any new payment system is having grower awareness that their costs are directly linked to harvesting efficiency, which then leads them to make on-farm changes. Figure 19 illustrates these points, with the lowest elevator pour rates occurring on farms with higher harvesting field efficiencies. This suggests that good farm layout encourages HBP pour rates, producing higher quality cane with no increases in harvesting costs. Interestingly, delivery rate, which impacts on hourly income, is higher as field efficiency increases.

7.3 Payment methods short-listed at February 2005 project meeting

The February 2005 project meeting developed a short-list of alternative payment methods for harvesting based on 2004 experience and a list of incentives/problems for each method.

Four alternatives were considered:

- Base rate plus fuel;
- Hourly rate;
- Delivery rate;
- Sliding scale based on crop yield plus haulage.

7.3.1 Base rate plus fuel (BR+F)

Variants of this model were discussed. The base rate should be variable, based on crop yield to take some account of the time component for the hours the harvester is in the field, not just the fuel consumed. A Quality Contract between the harvester and grower should be part of the deal. Levels would be set from the group average. Other points raised were:
• Labour – this model does not account for the labour component of time spent harvesting, only the fuel. One option is to increase the price the grower pays for the fuel used to account for labour.
• Distance from the siding/haulage costs. This problem does not arise at Maryborough, as there is a loading pad on every farm. In other centres, growers further away from sidings would feel disadvantaged by the higher cost of fuel. It was felt that there needs to be some cross-subsidy to get the volume needed for a viable harvesting operation.
• A problem is that this payment method is not linked to cane quality. Further analysis of data linking parameters such as field efficiency, delivery rate to a Cane Quality Index (CQI) was required which may redefine the system.
• The BR+F system seemed more for the harvesting sector than the growing sector.
• Sugar Quality Incentives should be split between the mill, harvester and grower.
• Needs some $ on the table to get adoption.

7.3.2 Delivery rate/Hourly rate

These two options were thought to be the same, as delivery rate is the tonnes cut divided by the number of hours. Other points raised were:
• For delivery rate, the charge is on a per tonne basis, calculated from a set hourly rate. For example, a delivery rate of 50 t/h would result in a per tonne price of $7 if the hourly rate was $350/h. Similarly, a 70 t/h delivery rate would result in a price per tonne of $5.
• Takes account of all components.
• Delivery rate was considered easier for the grower to understand than hourly rate.
• The price per tonne is set after the event. Grower and contractor would agree in principle to a sliding scale of payment based on delivery rate and calculated from an hourly rate.
• Job quality would determine the hourly rate charged with the rate varied by an agreed proportion of the cane quality incentives.

7.3.3 Sliding scale based on crop yield plus haulage

This method was used at Mulgrave, principally by the Rossi group. Discussion comments were:
• This method does sent a price signal for cane loss as it is paid per tonne.
• It needs to link to cane quality, as there is currently no incentive for cane quality.
• There is also no incentive for Harvesting Best Practice, such as reducing extraneous matter or doing a better ground job.

The transaction between grower and harvester to pay for harvesting also needs to include an amount to reflect cane quality and provide incentives/penalties accordingly. The overall scheme needs to have a method of assessing cane quality such as an NIRCAS and a Cane Quality Index (CQI) to distribute incentives/penalties. These were examined at Maryborough and Mackay as part of the project. When the project was initiated, it was thought that Burdekin may also install NIR, but this did not eventuate.
8.0 NIR DATA FROM MARYBOROUGH AND MACKAY AND PROPOSED CANE QUALITY INDICES

8.1 Mackay

NIR was put on line at Mackay sugar for 2004 season and provided feedback to growers and harvester operator via the mill web site. Steve Staunton worked with Mackay Sugar to develop a Cane Quality Index (CQI) for Mackay. Some examples of what is already available on Mackay Sugar’s web site are given in Figures 29-31.

Figure 29 Example of percent recoverable sugar data on Mackay Sugar website
Figure 30 Example of cane quality data on Mackay Sugar website
8.2 Burdekin

There have been no significant developments in the Burdekin with Cane Quality systems.

8.3 Maryborough

The use of NIR at Maryborough developed rapidly with the CAS system being used for direct cane payment for the 2004 season. A number of samples were still done using the conventional brix, pol and fibre method as a check on the NIR CAS. Results were good and this system is expected to become standard practice at Maryborough.

Steve Staunton worked with Maryborough to develop a new Cane Quality Index. A summary of this is given in Table 6.
Table 6 Summary of new cane quality indices at Maryborough

**New Definitions for equation solution**

Data for definitions from Maryborough 2003 + 2004 CAS data

<table>
<thead>
<tr>
<th>Premium Cane</th>
<th>Standard cane</th>
<th>Sub-standard cane</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC/Fibre</td>
<td>1.8</td>
<td>PIC/Fibre</td>
</tr>
<tr>
<td>PIC/BIC</td>
<td>0.94</td>
<td>PIC/BIC</td>
</tr>
<tr>
<td>Ash/DM-Ash</td>
<td>0.01</td>
<td>Ash/DM-Ash</td>
</tr>
</tbody>
</table>

**New CQI Formula**

\[
CQI = 0.5 + 0.9053\times(PIC/Fibre) - 1.1872\times(PIC/BIC) - 1.3577\times(A/DM-A)
\]

**Formula Application**

1. CQI calculated on individual rake basis
2. At end of season data sorted by CQI in descending order
3. Top 30% by weight shares 70% of sugar quality bonus pool (divide dollars available by tonnes to give $/tonne bonus)
4. Next 40% by weight shares 30% of sugar quality bonus pool (divide dollars available by tonnes to give $/tonne bonus)
5. Bottom 30% by weight misses out.

**2003 data (2003_breakdown by tonnes)**

Minimum CQI for Premium = 0.55
% of tonnes Premium = 30.67

Minimum CQI for Standard = 0.44
% of tonnes Standard = 39.4

**NOTE:** Using this method the Premium/Standard CQI will vary from season to season depending on cane supply
8.4 Cane quality schemes – progress and current thoughts for the future as of February 2005

Steve Staunton presented an overview of the CCS formula and cane-payment formula at the February 2005 project meeting at Bundaberg. The current system provides incentives for growers to increase their CCS above 12, and for the miller to improve their coefficient of work above 90 - growers would receive no increase due to higher sugar recovery. The deficiencies of the current formula are that it divides growers and millers; the focus is on the size of the split not the size of the cake, productivity increases are not shared equally, and it cannot cope with non-sugar income. Examples were given to highlight these deficiencies.

The Mackay Sugar cane-payment proposal was outlined. The central themes are to form a partnership between all stakeholders, align the objectives of stakeholder to optimise returns, and reduce conflict between stakeholders. Proposed changes are to fix the split between growers and millers based on historical norms, apply the split to all net revenue pools, thereby determining cane price by the contribution to each pool.

Discussion was:
- Mackay is looking at three way contracts between grower, harvester and mill to provide direct incentives.
- The balance must be maintained between cane loss and cane quality. Care must be taken not to pursue cane quality at all costs as one may be additional cane loss through extractors. Monitoring for cane loss can be achieved by monitoring fan speed and billet length.
- A better measurement for cane loss would close the quality loop.
- One problem identified at Mackay in 2004 was that early harvest on dewy mornings generally produces poorer quality cane and this produces arguments against the scheme.

9.0 RECOMMENDATIONS FOR WIDER IMPLEMENTATION OF MORE PROFITABLE HARVESTING PRACTICES AND HARVEST PAYMENT STRUCTURES ACROSS THE AUSTRALIAN INDUSTRY

9.1 Extract from Report on Workshop by Human Factor Australia

SRDC hosted an industry workshop on alternative harvest payment at BSES Bundaberg on 22 February 2005. The workshop was facilitated by Ted Scott from Human Factor Australia. Panel members were drawn from the project team and harvesting groups participating in this project. The following extract from Human Factor’s report summarises the outcomes.

The workshop on 22 February followed on from the launch of the booklet *Cane Harvesting to Improve Industry Performance*. It began with a facilitated panel discussion. The panel members represented the personnel from the case studies delivered at the workshop on the previous day.
They were:

<table>
<thead>
<tr>
<th>Area</th>
<th>Panel Members</th>
</tr>
</thead>
</table>
| Maryborough | Daryl Cronau – grower/harvester  
Peter Downs – Cane Supply Manager Maryborough Sugar Factory |
| Burdekin  | Ian Haigh – grower/harvester  
Dale Chapple – BSES Extension Adviser Burdekin |
| Mackay    | Steve Young – grower/harvester  
Brad Hussey – BSES Extension Adviser Mackay |

Prior to the workshop the following questions had been distributed to the panel members.

**Question 1: What is wrong with the current harvest payment system?**

**Question 2: What are the harvesting improvements you have implemented in your group?**

**Question 3: What are the challenges you faced, and how have you overcome them?**

**Question 4: What is your vision for future harvest payments and who needs to be involved to achieve this?**

The format of the discussion was that the grower harvester in each group was first asked one of the set questions. After their response, the other team member was invited to add comment. After the question had been put to all three groups, the audience were invited to comment or ask questions.

Following the panel discussion a break was taken. After the break, the audience was invited to comment on the key issues arising from the case studies and to identify priorities for further action.

The two concerns that seemed to come out most strongly from the discussions were:

- Many of the participants seemed risk averse, and
- Much of the research on the benefits of reducing cane loss and improving cane quality did not seem to be accepted, particularly by growers.

As a result, there was suggestion that any trials using new payment methods should be underwritten to at least guarantee the returns that would have been obtained using the existing methodology.

Also there were calls to undertake demonstration projects in different mill areas. (Whilst this might help, one might wonder how much demonstration is going to be required to secure belief!).

It was a source of some frustration to me [Ted Scott] that I could not get group consensus on a specific action plan. Nevertheless I believe that the suggestions outlined in the report are a useful starting point.
Some Additional Considerations

The resistance to change in the industry seemed quite marked. Despite the fact that there were additional opportunities for increased revenue through reducing cane loss and improving cane quality, there seemed little incentive to pursue these opportunities, because there was no agreed mechanism about how to share the gains.

In order to propagate the change agenda, there is additional work to be done to quantify the additional cane delivered to the mill through best practice processes. The additional monies that are available to stimulate a new approach to harvesting and more appropriate farm management are from:
- Returning more cane to the mill, and
- Through better harvesting practices achieving a better sugar content.

Despite the research in these areas, it seemed a broadly held view that more could be done to establish the magnitude of cane loss due to poor harvesting and farm-management practices. Similarly, although there has been research to establish the improved delivery of sugar to the mills from better harvesting practices, more practical demonstrations of these benefits would be useful in helping to propagate better harvesting practices.

It is disappointing to see the low acceptance of the research findings by the industry. It seems that it is necessary to augment the research with communication strategies to ensure that the message is heard by a largely reactionary industry. It may well be useful to bring on board a professional marketing firm to assist with selling the message.

Conclusion

The introduction of better harvesting practices to improve industry performance is a significant change agenda in a conservative industry. The literature on organisational change indicates that changing culture is a slow process with time frames of three to five years to achieve change of any significance quite typical. Change across an entire industry is obviously even more difficult.

Successful change management requires a holistic approach with considerable attention paid to the social issues surrounding the change.

Where change is implemented in a consultative way the new practices are embedded easier. However, it is always difficult (and perhaps impossible), to gain consensus on change initiatives that have some losers. The sugar reforms will ultimately be to the detriment of inefficient, high cost, participants. Typically, these people will resist change until the bitter end, stalling the process to the detriment of the whole industry.

In any change program it is usually helpful to identify “early adopters” (These are people who are believers who are prepared to take the plunge and demonstrate the new techniques, behaviours etc.). It would be useful to identify such people in the industry and facilitate their operation under the new regime. I suspect some of those already involved in the case studies would fall into this category.
In changing organizational and Industry cultures it is useful to find those people who are the “culture carriers” and to spend additional effort to try and convince them of the benefits of the change. In organizations and, indeed in industry, there are those who are influential in determining the culture. Often they have influence far beyond their status and they may not be in positions that have traditional authority. Nevertheless, such people are often very influential and are worthy of extra effort if we are to manage a successful change agenda.

In managing change it is always useful to be able to describe in an attractive way the future that is being envisioned. We need to make the future look a desirable and attractive place for those who choose to come there with us. Consequently there is a large selling job to be done. Good change programs include a communications strategy. This is an area where I recommend there is probably a need for considerably more effort. As mentioned above, part of the communications strategy will be to sell the research results as mentioned above.

In summary, I believe the workshops were useful in identifying options to go forward. There is no doubt that the participants were engaged and given a lot of material to ponder on.

On a procedural basis, I felt the panel discussion and subsequent audience input worked quite well with a very wide ranging discussion ensuing. That we could not resolve a consensus on how to go forward is largely due to the differing vested interests of the parties and the lack of acceptance by some parties of the research results.”

9.2 Key issues from the workshop as viewed by the project team

- People issues are an overriding factor in introducing any new system.
- Risk management – need to ensure stakeholders are not exposed to excess risk when implementing a new system i.e. model predicted outcomes of new system to assess potential risk versus benefits. SRDC could underwrite a pilot trial as insurance.
- Need to demonstrate that the rewards are real.
- Incentive scheme is required to encourage the first step.
- Why don’t people believe the evidence/trials that show that HBP is profitable?
- Quality needs to be maintained as a focus and bonus schemes are needed. Cane Quality Index must send the right signals. Care must be taken not to drive shorter billets or higher fan speeds.
- Farmers need to get behind it. Why don’t they get involved in harvesting issues now?
- Mill needs to have a measurement system in place linked to a feedback system.
- Demonstration trials to prove that HBP works – cost a lot and would it work?
- Social issues just as important as the money issues. Need prominent people to take the first step and lead others.
- Mackay Sugar is keen to be involved and will be installing 40 GPS units this year.
- Mossman example – paid 50c/t to slow down and the benefits were clear but no long term uptake.
- Hard evidence is required. Not every area will benefit e.g. Maryborough is very close to HBP.
• SRDC suggested that a number of options/systems be considered in such a pilot project.
• Education/capacity building is a vital part – need to get a level of understanding amongst all industry participants.
• When asked “What are we going to do?” discussion stalled. Ideas were to install GPS units and provide real data on costs, yield and cane quality, discuss results amongst the group, and have a cane quality system feeding benefits to all stakeholders.
• Have a “dry run” to convince a group of the benefits and then take the next step.

9.3 Mackay project meeting

Recommendations on how to get growers and harvesters to accept and implement a new method of payment were discussed again at the Mackay project team meeting in June 2005. Ideas were:
• The purpose of a new payment system was to drive the adoption of Harvesting Best Practice and the first step was to get growers and operators to understand the benefits of HBP. There was still a lot of disbelief on the potential gains from implementing HBP, as it was hard to quantify losses.
• Acceptance would be better if the change was more gradual and built on current payment systems.
• Payment for harvesting should be part of an overall package so that there were linkages to cane quality and cane payment. This is the process planned for Mackay.
• There would be differences between regions in the grower acceptance of different payment methods. Some methods would create large variations in price at Mackay, but may be much the same in the Burdekin.
• The industry has a culture of cross-subsidisation and a system that introduces actual cost recovery would have winners and losers and this would cause problems.
• Care must be taken not to send the wrong signals with an incentive scheme. A focus on bin weights may increase cane loss as harvesters produce shorter billet and lower extraneous matter to increase bin weight.
• The industry also needed to test new technology to provide sound recommendations. For instance, approximately 40% of harvesters have been fitted with anti-vortex extractor fans over the last 2 years, but many operators have not reduced the operating RPM to suit and cane loss is undoubtedly higher.
• The new payment systems must have a grower focus, i.e. what will they accept? Some marketing research was warranted to find out what would motivate growers to change.
• Promotion of HBP could be achieved using the Caneharvesters magazine and website.
• The current move by large sections of the industry to fit GPS units to harvesters to manage the cane supply offered opportunity to provide additional information to help with costing and make new systems more transparent, so growers understood variations that occur due to crop size, row length, haul distance and other factors.
• Assistance should be given to pilot groups/areas wanting to change to achieve good outcomes, which would rapidly be taken up by the rest of the industry once it was demonstrated that the new systems were more equitable than the current system.
• The current uptake of MTData units will provide additional information on harvesting once the conversion software is commercially available. This will start growers and operators talking about field efficiency etc rather than just CCS and tonnes cut.
• The way forward is to draw on the experiences of Maryborough and recommend a base rate plus fuel system as a starting point. The current fluctuations in diesel price would be a driving force for adoption of this method. Further variations of this system such as a sliding scale base rate based on crop size or a higher payment per litre of diesel to account for wages and repairs and maintenance would then occur.
• A number of options should be put forward as some groups may prefer to move to systems such as hourly rate that gave the strongest market signals.

10.0 OUTCOMES

This project has facilitated changes in industry performance by providing a focus on the mixed market signals currently driving different sectors of the industry. The focus occurred through:
• Surveys of harvest operators in the Maryborough, Racecourse and Pioneer mill areas;
• Working with participating harvest groups in the Maryborough, Mackay and Burdekin districts;
• Working with the milling groups Maryborough Sugar, Mackay Sugar and CSR to review and implement new cane quality schemes;
• Working with QMCHA;
• Presenting interim findings to the industry through an ASSCT paper, BSES Bulletin article and addresses to industry groups.

Indicators that change is occurring are:
• Widespread interest and purchase of NIR CAS;
• Widespread interest and purchase of GPS based data-logging units to monitor harvest;
• Harvest groups moving to new payment methods, principally base rate plus fuel throughout the industry;
• Results of surveys showing that growers and harvest operators are adopting best practice farming and harvesting techniques to reduce harvesting costs and gain incentives for cane quality.

11.0 FUTURE RESEARCH NEEDS

The project team and participating harvest groups met on several occasions to share experiences and develop alternative payment methods for harvesting. This provided an excellent forum for research engineers, extension officers, cane-supply managers, cane-quality staff, harvest operators and cane growers to discuss harvesting and cane-quality issues. Key areas identified for further research are:
• Further extension of new systems and package of alternatives, workshops throughout the industry to introduce them, assistance for innovators wishing to adopt them.
• Continued research into harvesting and testing of updates to harvester components.
• Development of real-time cane loss monitor.
• Further development of GPS monitoring with in-cab readouts.
• Market survey of growers to identify obstacles to new payment methods.

11.1 Further extension of new systems

This project was initially submitted as a 3-year project, with the third year set aside to take the findings beyond the pilot groups to the rest of the industry. Project participants felt it was imperative that this occurs. Harvester operators and cane growers are generally aware of the need for change in the harvesting sector. However, there is a strong culture of cross subsidisation of costs in the industry, which hinders radical change. This project has identified several alternative payment methods that provide incentives for best practice but still allow cross subsidisation, and will therefore be readily adopted. The experience of participants, particularly the Maryborough operators, should be drawn upon to help guide other operators to tried and proven systems that work. This degree of certainty will help reduce the perceived risk of moving away from the current system.

Ideas to implement change drawn from project meetings were:
• The purpose of a new payment system was to drive the adoption of Harvesting Best Practice and the first step was to get growers and operators to understand the benefits of HBP. There was still a lot of disbelief on the potential gains from implementing HBP as it was hard to quantify losses.
• Acceptance would be better if the change was more gradual and built on current payment systems.
• Payment for harvesting should be part of an overall package, so that there were linkages to cane quality and cane payment. This is the process planned for Mackay.
• There would be differences between regions in the grower acceptance of different payment methods. Some methods would create large variations in price at Mackay, but may be much the same in the Burdekin.
• The industry has a culture of cross-subsidisation and a system that introduces actual cost recovery would have winners and losers and this would cause problems.
• Care must be taken not to send the wrong signals with an incentive scheme. A focus on bin weights may increase cane loss as harvesters produce shorter billet and lower extraneous matter to increase bin weight.
• The new payment systems must have a grower focus, i.e. what will they accept? Some marketing research was warranted to find out what would motivate growers to change.
• Promotion of HBP could be achieved using the Caneharvesters magazine and website.
• Assistance should be given to pilot groups/areas wanting to change to achieve good outcomes, which would rapidly be taken up by the rest of the industry once it was demonstrated that the new systems were more equitable than the current system.
• The way forward is to draw on the experiences of Maryborough and recommend a base rate plus fuel system as a starting point. The current fluctuations in diesel price would be a driving force for adoption of this method. Further variations of this
system such as a sliding scale base rate based on crop size or a higher payment per litre of diesel to account for wages and repairs and maintenance would then occur.

- A number of options should be put forward as some groups may prefer to move to systems such as hourly rate that gave the strongest market signals.

11.2 Continued research into harvesting and testing of updates to harvester components

The industry needs to continually test new technology to provide sound recommendations on its use. For instance, approximately 40% of harvesters in the Australian industry have been fitted with anti-vortex extractor fans over the last 2 years, but many operators have not reduced the operating RPM to suit and cane loss is undoubtedly higher. This is also highlighted by the movement of harvester manufacturers off-shore, leaving the Australian industry to finance its own research and development to suit our unique conditions.

11.3 Development of real-time cane loss monitor

The missing link in obtaining adoption of best practice harvesting is an in-cab real-time cane loss monitor. Further research in this area, if successful, would be of tremendous value to the industry, now that measuring equipment is on-line to measure cane quality and harvester settings as well.

11.4 Further development of GPS monitoring with in-cab readouts

The current move by large sections of the industry to fit GPS units to harvesters to manage the cane supply offers opportunity to provide additional information at harvest. This will help with costing and make new systems more transparent so growers understand variations that occur due to crop size, row length, haul distance and other factors.

The current uptake of MTData units will provide additional information on harvesting once the conversion software is commercially available. This will start growers and operators talking about field efficiency etc rather than just CCS and tonnes cut. The industry needs to assist innovators with the development and commercialisation of this technology and interpretative software.

11.5 Market survey of growers to identify obstacles to new payment methods

Project team members felt that further market research would help identify barriers to uptake of new payment methods and allow strategies to be developed to overcome them and achieve adoption.
12.0 RECOMMENDATIONS

Payment for harvesting should be part of an overall package so that there were linkages to cane quality and cane payment. This is the process planned for Mackay. The major components of an ‘ideal’ package would be:

- Farm layouts and cultural operations that enable efficient harvesting.
- Harvesters set up and operating at best practice monitoring position, forward speed, delivery rate, extractor fan speed and other parameters through a GPS based data logging unit linked to a central web site.
- Payment for harvesting based on a system that mirrors harvesting costs and provides incentives for best practice farming and harvesting. Options include:
  - Hourly rate;
  - Base rate plus fuel;
  - Base rate plus fuel plus $;
  - Sliding scale on yield plus fuel.
- Payment for cane based on a Cane Quality Index that varies with parameters that influence sugar quality measured automatically using a system such as NIR.
- A data-feedback system that returns data on cane quality immediately to harvester operators and cane growers so that adjustments may be made when quality falls.

The payment methods that provide the best market signals are those based on hourly rate/delivery rate. Methods where the fuel is charged to the grower send weaker market signals, but still link to best practice and provide incentive to change. The methods most likely to be adopted in the short term are the BR+F methods. Details of the recommended methods follow.

1. Base Rate plus fuel (BR+F) - This method is widely used at Maryborough. There the base rate varies between $5.50 and $5.80 per tonne depending whether burnt or green. The fuel is paid for by the grower but delivered to the contractor’s tank. The system is easy to monitor and ‘police’ because it is a simple system. It is fair because the grower pays for fuel actually used on the farm.

It does reduce the level of cross subsidisation, but still puts the cost of bad blocks back onto the harvester. BR+F still sends the market signal for high pour rates to maintain viability but not as much as $/tonne. The system is commercially proven in Maryborough.

2. Base Rate plus fuel +$ - This method is the same as above but the fuel is priced higher (e.g. $2.00/L) to allow for labour as well. The system is used by some groups in New South Wales. The litres of fuel used would be measured and the grower invoiced at a set price. The purpose of this system is that paying for fuel alone does not compensate for machinery and labour costs.

3. Hourly Rate - This method pays on engine hours similar to the hire of most earthmoving equipment. Rates used for pilot group examples were between $350 and $420/h, depending on the number and size of haulouts. This rate would be negotiated between grower and contractor. For acceptance, monitoring equipment would be needed for growers to know the machine was working as contracted e.g. fan speed, forward speed, GPS tracking.
Hourly rate sends the best market signals as it creates the greatest variation in price per tonne and reflects true cost as most variable costs are accumulated on an hourly basis. This encourages best practice farming, as the more efficient a farm is to harvest and the better the crop size and yield, the lower the cost per tonne to harvest. By providing a stable income to operator, it allows the grower to prescribe the mode of harvester operation for each block. If a grower does not understand the financial benefits of Harvesting Best Practice (HBP), this could lead to unwise decision-making focussed on minimum time therefore minimum cost at the expense of high cane loss, low cane quality and poor ratoons. To operate efficiently, hourly rate needs to be linked to a cane quality measurement system at mill to provide targets for cane quality. Also, there is no incentive for the harvester to reduce cane loss, so settings of the harvester such as extractor fan speed and forward speed need to be monitored.

4. **Sliding scale base rate plus fuel** - This method uses a sliding scale based on crop yield to calculate a base rate e.g. $6.30 for 35-45 t cane/ha to $5.70 for 95-105 t cane/ha. Fuel is purchased by the grower. The system would operate along the same lines as the Maryborough Base Rate plus Fuel methods to supply fuel.

This appears a simple system with good market signals. It is transparent and easy to apply. The base rate covers cane loss issues and true fuel costs are covered. The sliding scale covers some of the labour and machinery costs associated with crop size. It reflects true cost a little more but is still a tonnage rate which encourages maximising pour rate and delivery rate.

5. **Current system - $/t** - This system encourages maximum efficiency in terms of maintaining a high delivery rate. It encourages minimal loss because every lost tonne is lost income (however some losses are incurred in the pursuit of maximising output). It is easy to monitor and understand but sends a very clear market signal that tonnes per hour equal dollars per hour and quality is a minor focus (especially since grower are more likely to change operator for pricing reasons rather than job quality issues).

13.0 PUBLICATIONS

Full copies of the following publications are in Appendices 1-4.

Chapple D. Poster papers for BSES 2004 Burdekin Field Day.


14.0 REFERENCES


**Harvesting the Rewards**

By Trevor Wilcox

A new research project is making excellent progress towards finding practical ways to reward best practice in our harvest sector. BSES central regional manager, Trevor Wilcox, reports.

To achieve the most efficient harvest sector possible, both harvest contractors and growers who engage them have to work with payment and pricing structures that realistically reflect the quality of work and output – that is, a payment system that rewards excellent and careful work, and sends strong messages so that poorer work is identified and improved.

BSES has been working on a project, funded by SRDC, which aims to improve industry’s understanding of market signals, and use that new understanding to make positive changes to improve industry performance.

To do this, BSES researchers are looking at a wide range of issues including payment systems that encourage best practice. Three locations are being used for evaluations: the Burdekin, Mackay and Maryborough.

The need for this project was highlighted by a SRDC Harvesting Forum which determined that the one-price payment method for harvesting, as well as a lack of incentives for cane quality, were hindering the adoption of harvesting best practice.
Just prior to the start of the project in June 2003, researchers surveyed harvester owners for their input.

Although the response rate was generally lower than hoped for, most harvester owners who responded saw the issue as important and wanted to be part of the project.

Researchers visited 12 harvest groups, selected to examine alternative payment methods around the state, to inform them of the testing process, commence recording, fit monitoring equipment, give out farming practices surveys, and conduct stop-watch measurements.

Focus groups with the harvester owners and industry personnel were conducted at Mackay, Burdekin and Maryborough. These groups identified several alternate payment methods that will be examined this year.

On the cane quality side, BSES Meringa senior researcher, Steve Staunton, visited mills in Mackay, Burdekin and Maryborough. Steve is working with the mills to establish cane quality indices using near infra-red (NIR) based technology at Maryborough and Racecourse, and other measurements at Pioneer. At Mackay, there are close linkages between this project and the SRDC Mackay Sugar Cooperative Systems project that aims to develop an improved cane quality system.

This important new project is progressing well, largely due to the harvester owners who recognise the importance of establishing a fairer pricing structure where good performance and minimal loss are rewarded.

Future Bulletin articles will keep you informed about new knowledge this project gives us about alternate payment systems, harvesting field efficiency, good farm layout and farming practice.
Measurement and Feedback Systems for Improving Market Signals for Harvesting

Project Aims:

- Determine factors for valuing harvesting services
- Facilitate adoption of payment systems that encourage best practice
- Maximize returns to all parties

Field Efficiency is Engine Hrs / Elevator Hrs

- As Field Efficiency decreases, fuel use increases
- Field Efficiency is affected by row length, haul length, & yield

Contact: Dale Chapple
BSES Limited
Office: 47825455
Mobile: 0429 645 715
An increase in the tonnes harvested/hour leads to a decrease in fuel consumption (litres/ton).
Encouraging harvesting best practice by improving market signals to contractors and growers

> Brad Hussey

**Why change**

In the past, the adoption of harvesting best practice and cane quality has suffered through the lack of clear market signals in harvesting charges. The simple one-price system paid for harvesting has been recognised for some time as a barrier to adoption of harvesting best practice.

The fixed price system used per tonne is for all cane harvested regardless of the crop yield, haul condition or row length. This system provides no incentive for growers to improve their farm layout or presentation for harvest, as the same price is paid for harvesting either way. Harvester operators do have an incentive to reduce cane loss, as they are paid for each tonne harvested therefore loss of cane equals loss of income. No incentives exist to reduce extraneous matter and soil in the cane supply to improve cane quality. In fact, extra weight in the bin, be it soil or trash, leads to higher income for the contractor.

**What we did**

Through the SRDC funded market signals project, 12 harvesting contractors in Mackay, Maryborough and Burdekin regions kept detailed records of all their harvesting operations. The data, recorded on a daily basis, included date, farm, block(s), estimated tonnes cane/ha, tonnes cut per day, engine stop/start time, elevator hours, harvester fuel, haulout fuel, and comments such as whether the block had been multiplied. The row length and haul distance for each block were measured from farm maps.

Hour meters were fitted on all harvesters to record elevator hours (elevator hours as a proportion of engine hours are a measure of field efficiency). The data obtained from this process provided thought-provoking information for the harvester operators. It highlighted that they generally spent less than 50% of their time actually cutting cane.

Extension officers worked with the groups to carry out stop-watch measurements of cutting time, turning time, the haul cycle and time to empty (unload) at the siding. This additional information helped to firm up some assumptions for the Harvest Haul model.

**What we found**

When the data was analysed it became apparent very quickly that cane yield was one of the biggest factors affecting harvester productivity or the amount of cane a harvester can cut in one hour and therefore the income produced from the harvester. When the cane yield increases, the number of tonnes harvested per hour increases (see chart 1). Also as the cane yield increases the fuel used by the harvester falls per tonne of cane (see chart 2) reducing the operational cost of harvesting.

Haul distance was found to be a major factor influencing harvesting productivity and harvesting cost. As the haul distance increases the amount of fuel used by the haulouts consistently increases (see chart 3). It must be noted that fuel is only one of the costs: wages, repairs and maintenance of the equipment should also be considered.

Further analysis of the data showed that a great deal of variation exists between farms in a harvesting group in terms of fuel use and harvesting productivity (see chart 4).
6 bees bulletin

Chart 1
The effect of cane yield on harvester delivery rate.

![Chart 1](image)

Chart 2
The effect of cane yield on the fuel used by the harvester.

![Chart 2](image)

Chart 3
The effect of haul distance on haulout fuel use.

![Chart 3](image)

**Note:** The total haul distance includes the distance travelled from the field to the siding and back as well as the distance travelled in the field to fill the haulout. In short haul situations, the distance travelled in the field can be the larger part of the journey.

Chart 4
Haul, harvest and total fuel used on farms in a Mackay harvesting group.

![Chart 4](image)

**How to move forward**

After analysing the data, various payment options were discussed. From the data recorded the team identified the factors that have the largest impact on a contractor’s ability to deliver high pour rates and achieve low cost harvesting. These were:

1. **Yield** – tonnes of cane per ha;
2. **Haul distance** – the distance from the field to the mill transport system;
3. **Row length** – impacts the field efficiency of the harvesting crew.

Several payment options were then identified which would better match the price charged for harvesting to the actual cost of the harvesting operation. These options include:

1. Hourly rate;
2. Sliding scale based on crop size;
3. Sliding scale based on crop size and haul distance;
4. Lower base rate plus fuel.

Each of the four payment options do improve the matching of the actual cost of harvesting to the price charged for the service. The hourly rate does this best, with a relationship between the time taken to harvest a block and the real costs associated. The weakest relationship between the two is provided by the base rate plus fuel method.

**Adopting a new payment system**

Before any of the contractors adopt a new payment system it must be "transparent" so that both growers and contractors can fully understand how the new harvesting price is calculated. For ease of operation, a new payment system that comprises a fixed base rate plus the cost of fuel has been adopted by some contractors.

Under this new payment system growers that have poor harvesting conditions and are therefore high fuel users will be required to pay more for harvesting, while those growers with good harvesting conditions will pay less.