

# INCREASING THE CAPACITY TO IDENTIFY AND ACTION VALUE CHAIN INTEGRATION OPPORTUNITIES

## FINAL REPORT

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Australian Government  
Sugar Research and  
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# **Value Chain Research in Sugar**

## **A Review of Successes and Learnings**

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## Executive Summary

This report provides a review of the past value chain sugar research in Australia and other countries, and formulates key messages that the Australian industry can learn upon for future value chain activities. Compared to farming systems research, value chain research in sugar is not widely understood in the Australian industry, nor are the benefits of its existing research activities or new opportunities. In this document there are 11 current and past Australian projects reviewed that addressed value chain issues. An additional five projects from overseas sugar industries are also reviewed. Attitudes towards value chain research have been captured through focus groups and interviews in Maryborough and the Herbert, which are also summarised in this report.

Value chain research in the Australian sugar industry has evolved substantially since its beginnings in 1997. Significant changes are in terms of learning from earlier projects incorporating their successful facets, and the increased value chain opportunities being addressed. Evolution of value chain issues and breadth of chain addressed is due to a growing acceptance within the industry of the change to achieve the benefits, but also external forces which create new priorities. This evolution is illustrated in Table 1 for the Australian sugar industry projects from 1997 to 2005, with the projects in ascending chronological order or start date.

**Table 1: Value chain issues addressed in the Australian sugar industry in chronological order of project start time**

<i>Project</i>	<i>Main issues addressed</i>	<i>Farm</i>	<i>Harvest</i>	<i>Transport</i>	<i>Mill</i>	<i>Marketing</i>	<i>Shipping</i>
1	Harvest and transport logistics		✓	✓			
2	Logistics to exploit yield variability	✓	✓				
3	Regional expansion		✓	✓			
4	Business integration and transparency	✓	✓		✓		
5	Harvest and transport logistics and rationalisation		✓	✓			
6	Logistics, rationalisation and diversification		✓	✓	✓		
7	New markets through co-generation	✓	✓	✓	✓		
8	Information transparency, new payment formulas	✓	✓	✓	✓		
9	Logistics				✓	✓	✓
10	Logistics and expansion		✓	✓			
11	Logistics and rationalisation	✓	✓	✓	✓		

There are some noticeable trends, which are also highlighted further in Section 3.1. There has been an increase in the range of value chain scenarios considered in recent years (e.g. projects 6-9 compared to 1-3) and the breadth of the sectors considered has also generally increased. In reviewing the projects, much of this evolution has been from new knowledge and understanding gained from earlier projects. Even when the earlier projects (e.g. projects 1, 2 and 4) have had limited (or no) success in explicit adoption, we found they have produced legacies in the form of increased industry understanding of the opportunities, pitfalls to avoid, and greater influence, which further projects have built upon. We expect this trend to continue with future value chain projects as well.

About half of the Australian value chain projects have focused on the harvesting and transport interface of the chain, primarily addressing logistics and rationalisation issues across the operational through to strategic scales. These projects have shown potential benefits between

about \$1.00 and \$2.50 per tonnes of cane, depending upon the level to which the solutions are implemented and the amount of rationalisation that takes place. Compared to the other projects, we found the issues and potential benefits in the harvesting and transport interface to be much more tangible. Only three projects have heavily focused on non-logistical value chain issues such as, information transparency, chain responsiveness, business integration and new markets. Other agriculture and food commodity chains have had a much stronger focus on these types of issues compared to sugar, with the view that the benefits to the chain exceed improvements in logistics and better use of capital. However, we found the potential benefits in these types of issues to be much less tangible than the harvesting and transport projects that focus on logistics. As a result of the review of the Australian projects, we recommend the industry increases its effort in the non-logistical issues such as information transparency, chain responsiveness, business integration and new markets.

Some other key messages and insights are as follows:

- All projects addressing issues upstream of the mill (i.e. not the milling marketing interface) involved active participation by industry through a working group (of some form) involving representatives across the relevant sectors. This is not surprising since all of the projects have had funding from or been led by industry bodies.
- In most projects (2, 5, 7, 9) that have resulted in some change so far, the benefits and type of adoption have been considerably different than anticipated at the start of the projects. While this is neither positive nor negative, it does highlight the variability and uncertainty in value chain projects.
- All projects have been influenced or impacted by events external to the project. These include changing regional priorities, moving around of industry participants, changes in cross sectorial relationships, changes in funding to implement solutions and new implementation barriers. The broad sectorial scope in value/supply chain initiatives makes it highly vulnerable to these variables, particularly compared to traditional research focused on advances in single sectors. A recommendation is the value chain initiatives/projects need to be flexible to accommodate or change as a result of external events.
- Success of the projects on a regional basis has been heavily dependent upon the quality of the relationship between participants across the sectors involved and the strength of the industry leadership towards the issues being addressed. This has been clearly indicated in Mackay through project 8, NSW through project 10, Herbert through project 5 and Maryborough through project 7.
- Many projects have produced intangible benefits and legacies, which are not well known amongst others. These include influence for future change, government funding, increased co-operation between millers and growers, good starting points for future projects, and influence on other regions to start looking at their own chain. These intangibles have led to the benefits of some projects (particularly projects 1,2 and 4) being under-rated.
- The scientific and technical modelling in the value chain research was very complex and heavily limited by resources and budget. Value chain research was found to be very expensive in some projects due to the amount of ground-breaking science (hard and soft) required while working closely with industry. This will be a major challenge for future projects, particularly addressing complex issues whilst maintaining scientific integrity.
- The projects have shown a rapidly growing industry acceptance and desire to employ a rigorous value chain modelling approach versus a simplified analysis that misses many of the cross-chain impacts.

In order to obtain a better understanding of people's experience with and attitudes towards value chain research in Australia, interviews and focus groups were conducted with people from the farm, harvest, transport and Mill sectors in the Herbert and Maryborough regions. The topics covered in the interviews and focus groups included: definitions of value chain research, achievements, strengths, limitations and success factors of value chain research, areas for improvement and future opportunities for value chain research (see Section 4 for a detailed analysis). A summary of key findings are as follows:

- Contrasting experience and attitudes towards value chain research in the Herbert and Maryborough regions. For instance, while participants in the Herbert discussed value chain research in terms of maximising efficiencies and returns across the industry sectors, participants from Maryborough saw value chain research more as a framework for examining the effects of change across industry sectors. Similarly, while participants in the Herbert region focused on relationships across industry sectors and highlighted the history of poor relations between industry sectors, participants in Maryborough focused more on the kinds of research partnerships that value chain research involved. Another difference between the regions emerged in relation to the way in which value chain model outputs were perceived.
- Some participants noted that value chain research had achieved some improvements in communication and cooperation within and between industry sectors in the Herbert, which was identified as a key strength;
- Most participants in Maryborough felt that the value chain research in their region had increased their understanding of their industry system.
- When asked to identify future opportunities of value chain research, there was diversity in the feedback from participants across the mill regions. The commonly known applications were suggested, such as ethanol production and harvesting pricing, though the Maryborough participants did emphasise value-adding opportunities such as bio-plastics. Several non-value chain issues were also suggested, which highlights the need for increased understanding of value chain research across the industry

Participants from the Herbert and Maryborough identified the following factors as necessary ingredients for successful value chain research:

- Each industry sector understand the factors and drivers influencing each sector and the connections between these;
- Value chain models should be available as part of providing this;
- Value chain research be region-driven with committed relationships between industry sectors that are transparent, honest and open and involve the appropriate people;
- Practical implications of certain changes are taken into account;
- Value chain research needs to be seen as a partnership between the industry sectors and researchers and have clear communication.

Based on the analysis of people's experiences of and attitudes towards value chain research in the Herbert and Maryborough, there are some lessons that have emerged about value chain research.

- The social and historical context of value chain research is an important influence on the process and outcomes of such research;
- Value chain research should pay attention to both technical and social dimensions in order to find an appropriate balance between innovations in technical procedures and novel social and organisational arrangements;
- Processes such as conflict resolution, social learning and negotiation should be a part of value chain research.

Value chain issues are being considered by other sugarcane producing countries as well. Optimising across the harvesting and transport sectors in the chain came out as a major concern when examining the five international projects. It might be profitable to interact more with the South African industry to determine their longer-term value chain goals and current success with improving industry function. Their benchmarking tools such as Sugar Logistic Improvement Programme that have been developed may be useful in mill region rationalisation and improving sectors functions (i.e., growing, harvesting transport, milling, and marketing).

The potential implications are Brazil's continued success at managing their sugar/ethanol value chains will continue to have an impact. Particularly their cost of production advantage and greater vertical integration is driving their supply chain research in a different direction than what can be

expected in Australia. The structure of the Australian industry makes the value of building trust, business integration, transparency and customer focus paramount. We suggest that continued research that fosters these aspects of chain building will lead to increased efficiency, better joint planning and better shared rewards. Australia will thus be in a better position to model their success by continuing to investigate other terminal market products that can be partnered with sugar.

While the current perception in general is that value chain research from other countries is not broadly applicable to the Australian sugar industry, valuable tools may emerge which can be adapted. The Sugar Logistic Improvement Programme project is an example of this. Ongoing interaction should continue to contrast our domestic value chains' performance with others to understand their competitive advantages and maximise the exploitation of our own.

# 1 Introduction

Value chain research goes beyond component based R&D, in that the industry issues explicitly impact and require change in, more than one sector of the sugar value chain. While various sugar regions have engaged in R&D activities with a value chain focus, there is still a major lack of understanding of the real value and potential of value chain research by the industry and research providers. Lack of knowledge of existing value chain research, how it all fits together, the tangibles and intangibles, and how it is all nodes of a bigger change means the potential is not being achieved. The industry does not fully understand the participatory process required for developing and implementing value chain R&D, and the unified commitment required to achieve the beneficial outcomes possible from value chain R&D. Importantly, this contributes to an inability to identify new R&D opportunities for value chain integration which can lead to a more sustainable industry. This report provides a review of the past value chain sugar research in Australia and other countries, and formulates key messages that the Australian industry can learn upon for future value chain activities.

## 2 Definition of value chain research

It is firstly important to have a clear definition of a value chain and value chain research. We consider a value chain project (or issue or opportunity) as one that affects decision making in the value-adding processes in more than one sector of the chain which generates improved outcomes for the participants and value to the ultimate consumer. This is consistent with the wider literature on supply and value chains. For example, season length is a value chain issue because a change in season length requires alternative operational/tactical planning in the growing, harvesting and milling of cane, which can affect the value of the intermediary and final products. Other issues, such as harvest best practice, harvesting efficiencies, new varieties, and climate forecasting have often been considered under a value chain banner. While they lead to benefits to more than one sector of the industry chain, the changed decisions takes place in one sector only and therefore should not be considered value chain issues.

Less obvious from the literature is the orientation to supply chains rather than value chains. According to Cox (1999), a supply chain focuses on combining particular resources to create and deliver specific products, while value chains focus on the flow of revenue and organise supply chain resources around the “value in exchange.” The value chain focus requires higher consumer focus and strategic planning than supply chain improvement.

## 3 Review of value chain research in sugar industries

### 3.1 Value chain research in Australia

Eleven value chain studies or activities were identified in the Australian sugar industry. Details of each project are summarised in Table 2. Full details, including reasons or objectives for the work, the methodology, main results (including the extent of the value chain addressed) and the outcomes and learnings, are given in Appendix 1.

**Table 2: A summary of major outcomes for Australian sugar value chain research projects in chronological order of start time**

Project No.	Investigators	Duration	Title	Major outcomes and learnings
1	Grimley et al	1997-2000	<b>Implementation of Improved Harvest/Transport System Utilising Developed Optimisation Models</b>	<ul style="list-style-type: none"> <li>• The project which commenced in 1997, was the first value chain integration project in harvesting and transport, and prior to a real industry understanding of the change management required to achieve implementation of such a model.</li> <li>• The use of an expensive external consultant was high risk. At later stages of the project, when difficulties were experienced with the models, Sugar North had difficulty in getting the model fixed properly, due to the unavailability of the consultants and the very high additional costs. The models were constructed in a specialised software package, which made it difficult for staff at Sugar North to make the necessary corrections. When the project team became more aware of the implementation barriers at hand, changes to the model could not be made for implementation to occur.</li> </ul>
2	Higgins et al.	1997-2005	<b>Harvest Scheduling for Increased Sugar Production</b>	<ul style="list-style-type: none"> <li>• The use of participatory research in each of the regions worked well to get the project off the ground.</li> <li>• Difficult to evaluate benefits of implementing the optimised harvest schedules due to a lack of reliable benchmarks, which made additional adoption difficult to encourage.</li> <li>• The research focused too heavily on trying to overcome implementation barriers such as equity and wet weather risks to achieve a regional implementation, rather than having flexibility to accommodate these barriers.</li> <li>• The project tried to accommodate system constraints by introducing additional complexity into the modelling. A realisation several years into the research was that it is far better from an industry perspective to reduce complexity and increase flexibility.</li> </ul>
3	McGregor	1999-2002	<b>Implementation of the Rocky Point Strategic Plan as a Model for Local Area Industry Development</b>	<ul style="list-style-type: none"> <li>• The vision of the project was not achieved due to external influences as well as internal reasons.</li> <li>• The capacity within the project was small given the large number of activities.</li> <li>• The principal investigator noted that the project life was too short for the project goals and suggested a project life of 5 years.</li> </ul>
4	Milford	2001	<b>The State of Value Chains in the Australian Industry</b>	<ul style="list-style-type: none"> <li>• Identification of the range of drivers for the Australian sugar Industry.</li> <li>• The identification of the strengths in the sugar industry value chains examined were awareness of chains and good leadership. Now the next step should be taken to the development of value chains through learning by doing.</li> <li>• The acknowledgement that the relationship building phase must be improved to achieve transparency which will lead to results (efficiency gains and rewards sharing). This area of weakness for these chains studied resulted in significant transaction costs relating to negotiations, lack of trust and a lack of common quality measures for cane. Initiative could be provided through outside assistance. However it is not stated how far removed from the chain this assistance should be. Outside the region? Outside the industry? Outside agriculture?</li> <li>• The study gives examples for priorities of value chain improvement as harvesting price variation, cane and harvesting quality and responses to price signals by producers.</li> </ul>
5	Higgins et al.	2002-2006	<b>Integrating and Optimising Farm-to-Mill Decisions to Maximise</b>	<ul style="list-style-type: none"> <li>• The research must be driven by the local region at all times. Actual benefits are larger than predicted by the modelling work. In part this is due to the social capacity for value chain work being increased.</li> <li>• Adoption was slow and can be difficult for the more favourable scenarios.</li> </ul>

Project No.	Investigators	Duration	Title	Major outcomes and learnings
			<b>Industry Profitability</b>	<ul style="list-style-type: none"> <li>Regions with poorer relationships between the growing, harvesting and milling sector had more potential benefits (tangible and intangible) compared to regions with good relationships.</li> </ul>
6	Rudd et al	2003-	<b>A Regional Partnership Approach to Developing a Sustainable Sugar Cane System (Mossman)</b>	<ul style="list-style-type: none"> <li>Whilst the project outcomes have been positive, they have been highly subjected to external factors outside the control of the project team.</li> <li>The influence and credentials of the harvesting/transport working group appears to have increased since the start of the project, with the level of change increasing. While the project is not complete yet, an intangible benefit is better understanding and co-operation by harvester owners, which may be a platform to realise further tangible benefits by the end of the project.</li> </ul>
7	Thorburn et al.	2003 - 2005	<b>Integrated Value Chain Scenarios for Enhanced Mill Region Profitability</b>	<ul style="list-style-type: none"> <li>An increased understanding of participants own raw sugar value chain and increased capacity to consider a wide range of value chain scenarios were valuable outcomes.</li> <li>The project prevented a region from entering into a co-generation venture that would have been highly unprofitable.</li> <li>The project showed that a whole-of-value-chain model can be developed through industry participation, and under tight time frames, and assist regional planning and decision making.</li> <li>Project had high transaction costs and will be high risk.</li> </ul>
8	Fleming et al	2003-2005	<b>A Co-operative Systems Model for the Mackay Regional Sugar Industry</b>	<ul style="list-style-type: none"> <li>Considerable effort will still be required in education and communication to ensure the Mackay industry has the capacity to achieve maximum benefits from the co-operative systems model. It does have the advantage in that the computer models were developed by the local industry rather than by an external party, so it already has a significant level of industry acceptance.</li> <li>Since the project focuses on improving the information and knowledge platform for the different sectors to draw upon, rather than addressing a specific issue such as reduced harvesting costs, quantifying the full benefits and impact (tangible and intangible) will be difficult even if they are major. It will be important that there is some measure or benchmark of benefit/impact, particularly as this project is unique in sugar. Reflections from other industries would help.</li> <li>The project is different to the other major value chain project currently being undertaken in the sugar industry from a perspective that the R&amp;D funding from SRDC covers a very small percentage of the overall resources put into the project objectives by the industry organisations. This is primarily a result of minimal involvement from R&amp;D organisations, and should mean continued momentum after the R&amp;D funding finishes.</li> </ul>
9	Higgins	2004	<b>Scheduling at the Milling-Marketing Interface of the Australian Sugar Supply Chain</b>	<ul style="list-style-type: none"> <li>The modelling work can be extended to capture other issues at the milling-marketing interface such as quality degradation in storage, vessels line-ups, mill stops and road-rail receivals, which may require a similar multi-agent supply chain approach to the "Integrated Value Chain Scenarios" project.</li> </ul>
10	Beattie et al.	2004-	<b>Achieving World's Best Practice Harvesting and Transport Costs for the NSW Sugar Industry</b>	NA
11	DiBella et al	2004-	<b>Adoption of Optimal Season</b>	NA

Project No.	Investigators	Duration	Title	Major outcomes and learnings
			<b>Length for Increased Industry Profitability (Herbert)</b>	

The first supply/value chain projects within the Australian sugar industry with significant funding were the harvesting and transport system optimisation (project 1, Table 2) and harvest scheduling project (project 2, Table 2). Both of these projects achieved ground breaking systems modelling and optimisation for the Australian sugar industry, though implementation barriers at the growing and harvesting sectors quickly became stumbling blocks to adoption. While it is easy to see now how these projects could have been improved, they had no prior learning to build upon. Both projects achieved significant intangibles and legacies, from which future projects (Projects 5 and 8 in particular) built on this knowledge. The work highlighted the significance of the opportunities and implementation barriers at the harvesting and transport interface.

Milford's work (project 4, Table 2) explicitly lays out criteria by which sugar chains can measure their degree of value chain integration. This can be used for benchmarking across the industry and by other sugar value chains to assess their strengths and weaknesses. In order to achieve these gains, individual sectors must learn to see themselves as a unit, as opposed to independent of each other. Milford's study highlights potential gains for the Australian sugar industry that can be realised by:

1. Improving the efficiency and growing the size of the rewards available to chain members as they build and improve their supply chains to maximise profitability and minimise unnecessary costs; and
2. Allowing vision and leadership to respond to opportunities for new markets.

Previous innovation in the Australian sugar industry has been achieved by improved process technology. Milford's study (project 4) suggests that value chain innovation will be informational, and that before the benefits can be realised, organisational relationship transformations must take place. There are indications that some participatory action research methods have been employed in other studies to maximise control of decision makers from across the value chain in directing outcomes and improve relationships.

Project 4 links value chains success and the social component. While this is highly intangible, it is also unlikely that value chain success will be achieved without the underpinnings of strong inter-sectoral trust and transparency. A serious limitation to value chain research is the size and complexity of developing projects. The mixed and poor outcomes from some of the projects were a result of both shifting goals and the requirement that such projects be broad based. For instance, investigators from project 3 (see Table 2) suggested that a 5 year term for the project would be required to achieve their outcomes.

Value chains work has lead to benefits applications and better social interactions. The integrated value chains project (project 7, Table 2) produced unforeseeable outputs and outcomes which new projects and initiatives need to be aware of. The outputs included the value chain framework model and improved capacity for value chains thinking. It is not a silver-bullet project, as many people could hope for it to be, and the benefits are greater and broader than what even the most complex modelling work can capture. For example, a specific co-generation scenario, leading to higher profits, was not found. However the project stopped the Maryborough region from making a costly investment in co-generation. Through the process greater trust in the working groups established and understanding of value chain impacts were achieved. Future projects will need to take into account that these types of intangible benefits will be achieved and are valuable. The methodology developed in this project can be extended to other regions and can address other industry issues. For it to be effective, the Australian sugar industry will need to become familiar with the methodology and value chain model developed in this project. This familiarity will promote an increased understanding of value chain research and the opportunities available.

In the majority of projects, there has been a substantial emphasis on improvements at the harvest/transport interface (see Table 3). This is an interface with a wide range of opportunities in logistics, rationalisation, and better seasonal planning. Many of the opportunities, particularly in logistics and scheduling, are easily adopted with benefits realised in the short term. In Table 4, about half of the Australian projects address logistics issues, but not necessarily at the operational

level as commonly seen in manufacturing systems. Improved planning at the strategic and tactical (seasonal) level have been opportunities to improve logistics within the Australian sugar chain. In Table 4, projects addressing logistical or efficiency issues, tended to be the ones with potential benefits known with some certainty, and measurable adoption.

There have only been four projects addressing broader activities, such as building trust, increasing transparency, building new markets or business process integration. These projects, 4, 6, 7 and 8 are characterised by involvement in more sectors and usually require bigger project teams. Compared to the logistics based projects, most of these project have had unknown (or hard to quantify) potential benefits, let alone known/quantifiable outcomes (Table 4). In other agriculture and food commodity industries, initiatives such as those found in projects 4, 6, 7 and 8 have achieved significant benefits, more so than in logistics and scheduling based activities. We expect the benefits to be high for the Australian sugar industry as well, though an evaluation of the benefits will be a challenge, due to the difficulty of isolating the benefits in the projects from other activities.

**Table 3: Frequency of individual sectors involvement in value chain research**

<i>Project No.</i>	<i>Farm</i>	<i>Harvest</i>	<i>Transport</i>	<i>Mill</i>	<i>Marketing</i>	<i>Shipping</i>
<i>Domestic</i>						
1		✓	✓			
2	✓	✓				
3		✓	✓			
4	✓	✓		✓		
5		✓	✓			
6		✓	✓	✓		
7	✓	✓	✓	✓		
8	✓	✓	✓	✓		
9				✓	✓	✓
10		✓	✓			
11	✓	✓	✓	✓		
Frequency	4	10	7	5	1	1
Percentage	36%	91%	64%	45%	9%	9%
<i>Overseas</i>						
12	✓	✓				
13		✓	✓			
14	✓			✓		
15	✓	✓		✓		
16		✓	✓	✓		
Frequency	3	4	2	3		
Percentage	60%	80	40%	60%	0%	0%
<i>Total</i>						
Frequency	7	4	2	3	1	1
Percentage	44%	88%	56%	50%	6.25%	6.25%

**Table 4: Focus and benefits of the Australian value chain projects**

Project No.	Primary focus to achieve VC benefits	Planning level (strategic, tactical, operational)	Potential benefits*	Adoption and Actual benefits to date <sup>#</sup>
1	Logistics scheduling	Tactical/Operational	\$2-\$3/tc though unclear how the project produced this figure	Tested at Mossman and Mulgrave but not adopted.
2	Exploitation of yield variability through scheduling	Tactical	75c-\$1.50/tc	Up to 10% of farms in Maryborough, Mossman. Benefits in MSF estimated at \$120/ha
3	Regional expansion	Strategic	550,000 tonnes per year production, dollar benefits not available	Non-adoption
4	Identification of key drivers – business integration and transparency	Strategic	Unknown with any confidence	Adoption or influence not tangible.
5	Logistics scheduling and infrastructure rationalisation	Tactical/Strategic	About \$2.20/tc	Adoption of some solutions by Herbert, Mourilyan and Mossman. Too hard to estimate benefits with any confidence.
6	Logistics, Rationalisation, diversification	Tactical/Strategic	Unknown	Fewer harvesters and better planning, though too hard to estimate dollar benefits
7	New markets through co-generation	Tactical/Strategic	\$1.1M/year through GCTB In Maryborough	\$5M saving to Maryborough from deciding not to pursue with their co-gen plan.
8	Information transparency and improved quality through new payment formulas	Tactical/Strategic	Unknown	Implementation in 2005, benefits unknown at this stage
9	Logistics scheduling	Tactical/Operational	About \$2M/year	Some adoption in 2005, though benefits unknown
10	Logistics and expansion	Tactical/Strategic	Unknown with confidence	Too early
11	Logistics and rationalisation	Tactical	Up to about \$1.20/tc	Too early

\*Potential benefits are highlighted when substantiated within the project through modelling or other analysis of a credible nature. This was not available for all projects.

# Actual benefits to date are those observed, and a best estimate dollar value is given where possible.

There has only been one downstream value chain project (project 9), which only addresses a limited number of issues in the production of sugar and its transport logistics. Its benefit to cost ratio is high though, particularly with Queensland Sugar Limited being the only client and in the absence of the implementation barriers found upstream in the chain. A recommendation is that the industry learns of the potential benefits from value chain modelling down-stream of the chain, particularly in relation to the work carried out in other agri-food industries (e.g. cotton, livestock). Overall, it is too early to gauge the level of success of this value chain project, though the potential seems high.

In terms of industry participation, all projects except 9 (due to a single client) have involved a local working/steering group of some form, comprising of representatives from more than one sector. This is not surprising since all of the projects have had funding from or been led by industry bodies. Projects 1, 6, 8 and 10 have gone a step further being conceived and led by the industry, with researchers providing a service role in some of these projects. There is no conclusive evidence from Tables 2, 3 and 4 as to whether the successes from industry led projects are any different to researcher led projects. This due to the limited number of projects with outcomes to date and successes/shortcomings with both industry and researcher led projects.

Nearly half of the projects in Tables 2, 3 and 4 (projects 5, 6, 8, 10 and 11) are not yet complete (when producing this report) and not all of the outcomes or learnings will be available yet, particularly for the latter four.

### **3.2 Value chain research in other sugar industries**

Due to time and practicality considerations, an overview of value chain research from overseas was conducted based on the literature that was available in the English press and recently published. This brief survey considered international research in the sugar industry to identify quality work that has been achieved in competitive markets, which would fall inside our definition of value chain research. This may provide research directions to consider, a sense of what is being achieved internationally in sugar supply chain work, or potential implications for the Australian industry. A summary of the basic outcomes from the articles considered is contained in Table 5.

The South African sugar industry is pursuing value chain research with some success. Their value chain work to date has focussed largely, but not exclusively, on improving quality of sugar cane through more efficient harvest/transport interactions (projects 13 and 15, Table 5). However the introduction of the recoverable value (RV) concept to the calculation of cane payment to growers in 1997 is having an effect on growers receipts and harvesting practices, leading to better quality cane milled (Groom, 1999). Using simulation methods project 13 achieved the greatest gains in minimising cut-to-crush delays by coordinating harvest/delivery activities with total cane delivered to the mill.

In particular, the Sugar Logistic Improvement Programme (SLIP) modelling project (project 15) (Perry and Wynne, 2004) could prove valuable in terms of concepts transferable to an Australian context. Some elements of the model development might be adapted for Australian sugar supply chain modelling. The capability of the Arena simulation system to generate the general model from flowcharting could expedite capturing specific characteristics of individual mill regions. These preliminary results show the potential of their whole-system modelling approach. This investigation confirms the value of simulation methods in modelling the complex interactions of the sugar supply chain. However, it does not go far enough downstream to include end products nor economic value of the processes. Thus there is no way to tie the current functioning of the system to some meaningful optimum. The value of this research to the Australian industry includes the potential establishment of standards for sectors and sugar supply chains. This tool would be valuable in encouraging adoption of efficient standard practice across industry. It would also be valuable in the rationalisation process for determining how mill regions should be changed. Data can be further used in value chain modelling of specific chains to derive the dynamics of the processes involved rather than assuming that they are functioning at optimal industry levels (i.e. value chain modelling assumes harvest best practice occurs in the harvest haul model).

The Indonesian value chain work (Yosnuar and Supsomboon 2004) had little applicability to Australian needs. The Linear Programming work (project 16) they conducted was highly sensitive to operations, such as cutting and loading, and assumed unlimited transport. Furthermore, due to low mechanisation and poorer scheduling in their market, such improvements could improve cane quality and sugar yields. However one would expect the value for Australia to be lower given much higher efficiencies that are present.

From Table 5 the Brazilian sugar industry focussed on greater efficiency in the mill region. Using Linear Programming (Barata et al, 1998) the authors showed how improved efficiency could be achieved by managing harvest-replanting and harvest-to-mill activities to maximise mill utilisation in the current and subsequent season. The value would be greater mill efficiency leading to consistent sugar production throughout the season. In the Brazilian industry structure, being far more vertically integrated with top down power structures, such mill focussed planning might be achievable. However, in the Australian context where independent ownership across sectors would make this type of coordination more difficult, this type of research requires a broader framework for successful application. The optimisation method could be used as a sub-modelling tool for some aspects of the supply chain, such as scheduling multi-mill area transport and shipping.

The radically different social contexts of Australia and Brazil make their approaches to value chain research quite different. It is not clear from Barata et al. (1998) if the whole supply chain is owned and operated by cane producers (costs of transport and milling are not really a concern) since it optimises for maximum benefit to that sector alone. This is not a problem of particular relevance in Australia since contractual agreements between the growers and the mill and harvest/transport schedules are determined in advance of the crush.

In overseas sugar industries, as in Australia, most value chain efforts focus on logistical improvement of harvest and transport (Table 5). This reflects that improved logistics efficiency activities represent the low hanging fruit in value and supply chain improvement. Given that efficiency in the Australian context is likely higher than in Indonesia and South Africa, little will be gained from direct application of their methodologies.

**Table 5: A summary of a survey of international sugar value chain research in chronological order**

Project No.	Investigators	Duration	Title	Major outcomes and learnings
12	Barata et al.	1998	<b>Optimization of Harvest and Crop renewal in Brazil</b>	<ul style="list-style-type: none"> <li>• This kind of multi-year discretely dynamic model can and should be viewed as an adaptive planning process with a long run horizon. It is applicable in the case where management takes decisions based on long run views but changes or adjusts their views every year.</li> <li>• Therefore, the model should be re-run every year such that the management will always be executing the first year prescriptions of the plan.</li> </ul>
13	Hansen et al.	1998	<b>Evaluating sugarcane harvest-to-mill delivery systems with computer simulation</b>	<ul style="list-style-type: none"> <li>• The research work gained greater clarity of the processes in the South African harvesting and transport system thus broadening the ability to consider the value chain as a whole.</li> <li>• The authors recognised that as a tool simulation was useful but does not lead to optimisation of itself. Implicitly this is an important recognition acknowledging the importance of involving chain managers in generating whole-system strategies which the tools can assist in efficiently evaluating.</li> </ul>
14	A.T. Wynne	2003	<b>Optimising length of milling season and cane supply in South African Sugar Industry</b>	<ul style="list-style-type: none"> <li>• The self regulating delivery mechanisms are easy to understand and inexpensive to implement.</li> <li>• Growers gain incentive to align their delivery rate with the mill crush rate. Through this system none of their current and subsequent season's allocation are changed due to under-delivery and there are no penalties for over-delivery.</li> <li>• Growers directly bear financial consequences of cane delivered as they are paid on "actual" recoverable value % cane and not "relative" recoverable value %.</li> </ul>
15	Perry and Wynne	2004	<b>Sugar Logistic Improvement Programme (SLIP): Improving supply chain efficiencies in the South African Sugar Industry</b>	<ul style="list-style-type: none"> <li>• Separate reports for growers and hauliers that encourage transparent exchange of information across the supply chain.</li> <li>• Comparing current chain performances against best practice to highlight collective inefficiencies.</li> </ul>
16	Yosnual et al.	2004	<b>An Integer Programming for sugarcane factory supply allocation in Indonesia</b>	<ul style="list-style-type: none"> <li>• This methodology could prove useful in assisting management scheduling decisions to improve mill function and increase crop quality (thus improving price to producers).</li> </ul>

## 4 Attitudes towards value chain research in Australia

In order to obtain a better understanding of people's experience with and attitudes towards value chain research in Australia, a series of focus groups and interviews were conducted with sugar industry members. Interviews and focus groups were conducted with people from the farm, harvest, transport and Mill sectors in the Herbert and Maryborough regions.

**Table 6: Data collection for the Herbert and Maryborough regions**

		Herbert	Maryborough
<i>Focus groups</i>	Number of groups	1	1
	Number of participants	7	5
	Sectors involved	Farm, transport and Mill	Farm, harvest, Mill and extension
<i>Interviews</i>	Number of interviews	2	2
	Number of participants	4	2
	Sectors involved	Farm and harvest	Farm and harvest

The topics covered in the interviews and focus groups included: definitions of value chain research, achievements, strengths, limitations and success factors of value chain research, areas for improvement and future opportunities for value chain research (see Appendix 2 for detailed schedules). The interviews and focus groups were recorded and the qualitative data were thematically analysed (see Appendix 3 for details on the major themes). A number of themes about value chain research in Australia emerged throughout the interviews and focus groups. The following sections outline the major themes relating to attitudes towards value chain research in the Herbert and Maryborough regions.

### 4.1 Results for the Herbert

#### *Maximising efficiencies and returns across industry sectors*

When asked to explain what value chain research means to them, participants from the Herbert often referred to efforts to maximise efficiencies and returns across industry sectors. This was sometimes accompanied by the perception that industry sectors should be better off, or at least not worse off by changes in the value chain. Examples of value chain issues that were discussed included siding rationalisation, changes to the harvesting price system and the effect of farm layout on harvesting efficiency.

#### *Understanding current systems and drivers*

Participants identified improved understanding of the current system, the drivers of each sector and the interactions across sectors as a key feature and an important achievement of value chain research. A related theme here was the way in which value chain research should be used to understand how the costs and benefits of change should be shared across industry sectors. Another major theme was the way in which value chain research allowed for the identification of weak links and blockages in the system.

#### *Relationships and interaction across industry sectors*

Discussions with the Herbert participants about value chain research centred on relationships and interactions across the industry sectors. Participants observed that value chain research involved complex negotiations between industry sectors. Some participants noted that value chain research had achieved some improvements in communication and cooperation within and between industry sectors in the Herbert. The improvements in industry relationships also included increased recognition of industry problems and an increased willingness to work together to solve these

problems. Many participants identified these improvements as key strengths of value chain research.

A significant theme in discussion with Herbert participants was the history of poor relationships between industry sectors. In particular, participants identified a widespread lack of trust as a key impediment to value chain research. Negative perceptions of the Mill were particularly evident in discussions with participants from the farm and harvest sectors. This history of poor relationships across the industry sectors was often used to explain the lack of implementation of value chain research in the region. Participants noted that the SRDC Cultural Imprint Analysis project had gone some way to addressing these issues, but that there was still work to be done.

### *Success factors*

Participants from the Herbert identified the following factors as necessary ingredients for successful value chain research:

- Members of each industry sector should understand the factors and drivers influencing each sector and the connections between the sectors;
- Value chain models should be available to provide reliable information on how certain changes will affect the industry sectors;
- Industry members should be committed to working together;
- Relationships between industry sectors should be transparent, honest and open; and
- Clear communication within and between industry sectors is crucial.

### *Improvements and opportunities for future value chain research*

When asked to identify areas for improvement for future value chain research, participants in the Herbert again identified the need to improve relationships between industry sectors. For instance, members of the harvesting sector emphasised that the different industry sectors should see themselves as joint venture partners and recognise that they need each other. Most participants also reinforced the need to address the lack of trust between industry participants.

Participants in the Herbert identified a range of possible opportunities for future value chain research. For instance, a major theme that emerged from the focus group was the potential role for value chain models in scenario analysis, which would enable industry members to better understand how certain changes could affect the industry sectors. Participants emphasised that such models would need to be flexible, interactive and readily available. Participants also noted that such models would require input from across the value chain in order to 'ground truth' the models and ensure that people were confident with the reliability of the model results.

Other issues that were raised in discussions about future opportunities for value chain research included:

- Exploring the potential of ethanol production;
- Increasing understanding of the importance of farm layout and its effect on the other industry sectors, particularly harvesting;
- Testing the effects of changing the harvesting price system;
- Investigating the effects of new varieties on the value chain, including genetically modified varieties; and
- Growing and milling for sugar quality, including changes to varieties and other elements in the value chain.

## 4.2 Results for Maryborough

### *Examining the effects of change across industry sectors*

Most participants from Maryborough described value chain research as research that examines the effects of particular changes across industry sectors. The experience that participants had through projects on co-generation and geographical harvesting were recurring examples of value chain research. Participants used these examples to highlight the importance of testing different scenarios in order to understand how changes in one industry sector might affect other industry sectors and the overall industry return. A related point here was the way in which the value chain research that had occurred in Maryborough demonstrated the practical challenges and costs associated with implementing changes, as in the case of geographical harvesting. However, some participants felt that the research on geographical harvesting did not fully explore the flow-on effects that geographical harvesting would have on the farm sector.

### *Increased understanding of the industry system*

Another recurring theme in the interviews and focus group in Maryborough was the way in which most participants felt that the value chain research in their region had increased their understanding of their industry system. For instance, some participants noted that one of the key achievements of the co-generation project was that it allowed them to have a better understanding of the resources that were out in the field (e.g. tops and trash) and the impacts of making changes in how those resources are used (e.g. the impacts of taking away the trash for co-generation). A related theme here was that the value chain research provided people with a better understanding of what could be done and where the industry was heading.

### *Research partnerships*

The importance of research partnerships was highlighted in discussions with participants about value chain research. For instance, participants noted that a key strength of the value chain research that had occurred in their region was that it brought together specialists and experts from across the industry sectors, which ensured that the research had an impact. However, research partnerships were also seen as a particular challenge associated with value chain research, since it was recognised that getting all the right people involved in such research can be difficult.

Furthermore, some of the participants noted that research partnerships could be complicated by certain parties having their own agendas or being unwilling to change. For instance, some participants felt that some researchers came into projects with their own agendas, regardless of local input. Similarly, some participants noted that there were people in their industry that were unwilling to participate in research or adopt innovations, although this point was qualified with the observation that some innovations suited some parts of the industry more than others.

### *Varied perceptions of value chain modelling*

Throughout discussions with participants from Maryborough, it became clear that there were varied perceptions of the modelling outputs of value chain research. For instance, one of the Mill representatives noted that he was quite impressed with the results of the harvest haul models, since he felt that these came very close to capturing their actual costs. However, in the case of the modelling outputs from the geographical harvesting project, some of the participants listed a range of factors that the modelling could not adequately deal with (e.g. new varieties or inaccurate data on CCS), which lead them to doubt some of the modelling results. Similarly, despite the region's decision not to go ahead with co-generation on the basis of the results of the co-generation project, participants noted that there were still disparate views on whether this was the right decision, including some doubts on how the costs of co-generation were calculated. Participants also noted that there were still a range of views in the region on the impacts of whole-crop harvesting.

### *Success factors*

Participants from Maryborough identified the following factors as necessary ingredients for successful value chain research:

- Ensuring that the appropriate people from across the industry and research sectors are involved is essential;
- Participation of local industry members is particularly important, so that the practical implications of certain changes are taken into account;
- Value chain research needs to be seen as a partnership between the industry sectors and researchers;
- Value chain research partnerships need to be flexible;
- Clear communication between research partners is essential; and
- Value chain research should be region-driven and should begin with a regional needs-analysis.

#### *Improvements and opportunities for future value chain research*

When asked to identify areas for improvement for future value chain research, participants in Maryborough reinforced the importance of ensuring that such research is founded on meaningful local participation. One of the recommendations associated with this point was that researchers need to work with the local industry to identify the key people that should be involved in value chain research and then ensure that they work closely with these key local people. A related issue here was the suggestion that increasing the involvement of growers would improve value chain research. This reinforced the point that participants felt that local industry members should have more influence over the direction of future value chain research.

On a practical level, one of the growers noted that the timing of workshops influenced the level of grower participation, since it was difficult for growers to attend workshops at certain peak industry periods in the year, such as the harvesting season. Another suggested improvement from one of the Mill representatives was that future value chain research should have a stronger emphasis on financial modelling and should ensure that the financial modelling can be more easily integrated with the Mill's existing financial models.

Participants in Maryborough identified a range of possible opportunities for future value chain research. A major theme that emerged in discussions of future opportunities was the potential gains that could be made across the industry sectors through value-adding. For instance, one of the Mill representatives noted that more attention needs to be given to investigating the business implications of value-adding, including issues such as route to market, competition and profitability levels. Members of the farm sector also emphasised the importance of value-adding, noting that they could no longer rely on income from raw sugar alone. In particular, growers raised issues such as the need for more trials to explore value-adding opportunities, including other uses of cane tops and alternative cane products such as bio-plastics and fibre.

Other issues that were raised in discussions about future opportunities for value chain research included:

- Increasing knowledge of the effect of changes to the farming system on the other industry sectors;
- Understanding the impact of mill mud;
- Investigating the effects of incorporating best management practices throughout the whole of the value chain to maximise production; and
- Testing the effects of new technologies in the harvest and transport sector (e.g. sending NIR information via SMS or placing sensors on trailers).

## 4.3 Discussion

The first part of this section will compare and contrast the overall themes that emerged from discussions with participants in the Herbert and Maryborough regions. The second part of this section will highlight some key lessons about value chain research.

### *Comparing attitudes towards value chain research*

Some interesting patterns emerged when people's experience with and attitudes towards value chain research in the Herbert and Maryborough regions are compared and contrasted. For instance, while participants in the Herbert discussed value chain research in terms of maximising efficiencies and returns across the industry sectors, participants from Maryborough saw value chain research more as a framework for examining the effects of change across industry sectors. Similarly, while participants in the Herbert region focused on relationships across industry sectors and highlighted the history of poor relations between industry sectors, participants in Maryborough focused more on the kinds of research partnerships that value chain research involved.

Another difference between the regions emerged in relation to the way in which value chain model outputs were perceived. For instance, using value chain models for scenario analysis was put forward as a potential future opportunity for value chain research in the Herbert region. In contrast, participants in Maryborough expressed more varied perceptions of the accuracy and future use of value chain models.

However, despite the differences in attitudes towards value chain research in the Herbert and Maryborough, participants in both regions associated value chain research with an increase in understanding of key features of their industry system.

### *Key lessons about value chain research*

Based on the analysis of people's experiences of and attitudes towards value chain research in the Herbert and Maryborough, it is possible to suggest a number of key lessons that have emerged about value chain research.

#### Influence of the social and historical context of value chain research

The differences between the regions in terms of perceptions of value chain research could be partly explained by differences in the social and historical context within which this research was carried out. In particular, participants in the Herbert identified the history of poor relationships between industry sectors as a key factor that shaped the value chain research in their region. This could explain why discussions in the Herbert focused more on understanding the interactions between industry sectors, while in Maryborough discussions focused more on particular changes and the effects they would have on the industry sectors. This suggests that the social and historical context of value chain research is an important influence on the process and outcomes of such research.

#### Interactions between technical and social dimensions of value chain research

Recognition of the importance of the social and historical context of value chain research is linked to another lesson, namely the way in which value chain research must take into account the interactions between technical and social dimensions. For instance, comments from participants in both regions highlighted the importance of the practical implications of changes and the potentially differential impacts these changes may have across the industry sectors. This in turn highlights the point that value chain research should pay attention to both technical and social dimensions in

order to find an appropriate balance between innovations in technical procedures and novel social and organisational arrangements (Leeuwis, 2004).

### Implications of new forms of co-ordinated action and co-operation

Comments from industry participants about the importance of relationships and partnerships in value chain research highlight the way in which such research requires collective action, which results in a need for new forms of co-ordinated action and cooperation among diverse industry stakeholders. The new forms of interaction, organisation and agreement that collective action is associated with means that participants involved in value chain research must pay more attention to issues such as juggling diverse interests and perspectives and managing conflict. This in turn suggests that processes such as conflict resolution, social learning and negotiation should be a part of value chain research (Leeuwis, 2004).

### Participation and social learning as key elements of value chain research

The importance of meaningful local participation in value chain research was a recurring theme in discussion with industry participants. There is a vast literature on the theory and practice of participatory research. Similarly, the growing literature on social learning also has interesting implications for value chain research. Although a detailed discussion of participatory research and social learning is beyond the scope of this report, some key insights from this literature highlight a number of lessons that are relevant to value chain research. For instance, Bouwen and Taillieu (2004: 138) highlight a number of conditions that are necessary for meaningful participation to occur:

- People should experience participation on an issue as feasible and realistic based on the task;
- The boundaries and the limits of people's authority and decision-making scope should be clearly defined and mutually accepted; and
- Participation thrives only in a climate of openness and trust.

Therefore, it is important to recognise that ensuring meaningful participation in value chain research requires a complex system of structure and processes, which reinforces the point made earlier about the need to pay attention to both technical and social dimensions of value chain research. The concept of social learning can provide relevant insights to assist in achieving this balance.

The concept of social learning is receiving more attention in a number of fields. Social learning can be defined as the collective action and reflection that occurs among different individuals and groups as they work together in an ongoing process of negotiation and learning to develop adaptive group strategies for problem solving (Keen et al., 2005; Pahl-Wostl & Hare, 2004). Pahl-Wostl and Hare (2004: 195) outline a number of key ingredients for social learning:

- Awareness of each other's sometimes different goals and perspectives;
- Shared problem identification;
- Understanding actor's interdependence;
- Understanding the complexity of the management system;
- Learning to work together;
- Trust; and
- The creation of informal as well as formal relationships.

These ingredients for social learning are very similar to the factors identified by participants from the Herbert and Maryborough as necessary for successful value chain research. When combined with the conditions for meaningful participation listed above, they reinforce the influence of social factors on the process and outcomes of value chain research.

## References

- Barata, M.Q.F, Tatizana, S.A. and Peres F.C. (1998). Economic optimization of harvest and crop renewal of sugarcane. Pages 117 to 123 in proceedings Seventh International conference on computers in agriculture.
- Bouwen, R. and Taillieu, T. (2004). Multi-Party Collaboration as Social Learning for Interdependence: Developing Relational Knowing for Sustainable Natural Resource Management. *Journal of Community and Applied Social Psychology*, 14 (3):137-153.
- Cox A. (1999). Power, value and supply chain management. *Supply Chain Management* 4(4): 167-175.
- Groom, G.M. 1999. An analysis of the 1998-1999 recoverable value (RV) cane quality scheme to determine the varying effects of growing conditions and management practices on cane quality. Pages 1ii-1vii in Proc S Afr Sug Technol Ass 73.
- Hansen, A.C, Barnes, A. and Lyne, P.W.L. (1998). Using computer simulation to evaluate sugarcane harvest-to-mill delivery systems. Pages 98 to 107 in Proceedings of the Seventh International Conference on Computers in Agriculture.
- Keen, M., Brown, V. and Dyball, R. (2005). Social learning: A new approach to environmental management, in Keen, M., Brown, V. and Dyball, R. (eds) *Social learning in environmental management: Towards a sustainable future*, London, Earthscan.
- Leeuwis, C. (2004) *Communication for Rural Innovation: Rethinking Agricultural Extension*, Oxford, Blackwell Science.
- Pahl-Wostl, C. and Hare, M. (2004). Processes of Social Learning in Integrated Resources Management. *Journal of Community and Applied Social Psychology*, 14 (3):193-206.
- Perry, I.W, and Wynne, A.T. (2004). The sugar logistic improvement programme (SLIP): An initiative to improve supply chain efficiencies in the South African sugar industry. Pages 69-80 in Proc S Afr Sug Technol Ass 78.
- Wynne, A.T. (2005). The self regulating delivery mechanism: optimising length of milling season and cane supply. Pages 26 to 30 in Proceeds of the XXV Congress of International Society of Sugar Cane Technologists(2005).
- Yosnual J, and Supsomboon S. (2004). An integer programming for sugarcane factory supply allocation. Pages 21.3.1-21.3.10 in Proceedings of the Fifth Asia Pacific Industrial Engineering and Management Systems Conference 2004.

# Appendix 1: Summary of research reports

## Australian sugar value chains research

### 1. Implementation of Improved Harvest/Transport System Utilising Developed Optimisation Models

Author: Grimley et al

Duration 1997-2001

Location: Mossman, Mulgrave, Tully, Sth Johnstone

#### **Reason/Objective**

The objective was to implement an optimised system of harvest/transport using mathematical models which have been developed and validated in one mill area. It was carried out by Sugar North, BSES, CQU, UQ and the Operations Research Group. Three models were developed that focus on optimising harvesting and transport activities at an operational, tactical and strategic level, to minimise costs. The project, starting early 1997, was the first value chain project that identified and addressed opportunities across the harvesting/transport interface of the chain, with potential cost reductions of \$2 and \$3 per tonne of cane. The models were developed for the Mossman, Mulgrave and Tully sugar regions, through consultation by Price Waterhouse Coopers (formerly the Operations Research consultancy group).

#### **Method and Results**

The methodology was based on tradition R&D, with the Operations Research Group developing the models with Sugar North (with some guidance from CQU and the mill), and refining the models to the satisfaction of Sugar North and representatives from the milling companies. After the completion of the models and the graphical user interface a decision was made to pilot the models for harvesting and transport scenarios at the Mossman mill. Whilst the models showed significant potential benefits, there was significant resistance from the harvesting community to implement the solutions. The model was not implemented as a result. Despite the modelling at the harvesting and transport interface being very innovative for the sugar industry at the time.

#### **Outcome/Learning**

there were learnings and short-comings as follows:

- The project which commenced in 1997, was the first value chain integration project in harvesting and transport, and prior to a real industry understanding of the change management required to achieve implementation of such a model. The optimisation model was developed as if the mill had full control of the harvesting sector, and a strong influence over grower equity. The milling sector would then sell the model to the other sectors. There was minimal influence or validation from the harvesting sector in the model development.
- The model was developed in a specialised software package for mathematical programming. It required specialised commercial solvers and expensive Unix workstation computers. This made the model quite inflexible and required simplifying assumptions to find a near-optimal solution. These simplifying assumptions were at the expense of representation of the real life problem. Essentially the harvesting and transport system was modelled as if it was a traditional supply chain.

The use of an expensive external consultant was high risk. At later stages of the project, when difficulties were experienced with the models, Sugar North had difficulty in getting the model fixed properly, due to the unavailability of the consultants and the very high additional costs. The models were constructed in a specialised software package, which made it difficult for staff at Sugar North to make the necessary corrections. When the project team became more aware of the implementation barriers at hand, changes to the model could not be made for implementation to occur.

## **2. Harvest Scheduling for Increased Sugar Production**

Authors: Higgins et al

Date 1997-2004

### ***Objectives***

Opportunities exist for increasing industry profitability through alternative harvest schedules that exploit differences in CCS and cane yield at harvest date, found across a mill region. Mathematical optimisation models, with the use of historical block productivity data, has shown average potential gains of at least \$1.00/tc through moving away from grower and harvesting equity and harvesting the farm paddocks at their optimal harvest dates.

### ***Method and Results***

On a region wide level, adoption of these harvest schedules requires growers to change the order of harvest of their farm paddocks, along with the percentage of cane cut in each harvester visit. The harvester needs to change the amount of time spent on a farm, the rotation order across farms, and for regional optimisation, the harvester may need to have varying bin quotas across the season. For regional optimisation the mill needs to modify transport schedules to accommodate the changes in harvester logistics.

From 2000 to 2005, adoption was achieved by numerous growers, harvesters, and millers, mainly in the Maryborough, Mossman and Mackay regions, though growers in other regions are now adopting the schedules. The level of adoption peaked to no more than 15% of a mill region, and mainly by those who have control over several farms. While the greatest increase in sugar production would be achieved through scheduling across the mill region as if it was one farm, this was never achieved due to the need for agreements between growers.

### ***Outcomes/Learning***

The research has several learnings and short-comings as follows:

- The use of participatory research in each of the regions, involving representatives from the growing, milling and harvesting sector worked well to get the project off the ground, developed in the right direction and accepted by industry. In two of the regions, the industry pull evolved into a research push, as the working group steadily increased their reliance on the facilitator and researchers to move forward. This happened without awareness at the time and led to adoption in the region evaporating temporarily, once the resources of the research team was substantially reduced.
- It was difficult to evaluate the benefits of implementing the optimised harvest schedules due to a lack of reliable bench marks, and this made it difficult to encourage additional adoption.
- The research focused too heavily on trying to overcome implementation barriers such as equity and wet weather risks to achieve a regional implementation, rather than having flexibility to accommodate these barriers. A huge effort was put in by the Mackay industry and research team to achieve the regional optimisation, and this cost outweighed the benefits on the ground. It took a long time for the project to realise that equity was a hard implementation barrier, by which time the resources for the research were mostly expended.
- The project tried to accommodate system constraints (e.g. transport, harvest rounds, wet weather, farm block preferences) by introducing additional complexity into the modelling. A realisation several years into the research was that it is far better from an industry perspective to reduce complexity and increase flexibility.

### **3. Implementation of the Rocky Point Strategic Plan as a Model for Local Area Industry Development**

Author: McGregor et al

Date: 1999-2002

Location: Rocky Point

#### ***Reason/Objectives***

The Rocky Point Strategic Plan was initiated as a direct result of concern from both growers and the sugar mill about the future viability of the local industry. The aim was to follow a similar procedure to the Maryborough cane industry with the vision of duplicating their success story. The project was conducted by the BSES between 1999 and 2002. Instead of formulating a single scenario for change across the value chain, the project considered several individual (and unrelated) activities across the chain to achieve the regional goal of reaching the annual cane production of 550,000 tonnes. These scenarios include high density planting, ripeners, irrigation, harvesting and transport, and horizontal expansion, with the latter two being value chain issues.

#### ***Method and Results***

The methodology in the project was primarily experimentation. Beaudesert was considered as a potential for region for horizontal expansion due to close transport proximity and suitable soil. About 40ha of cane was planted in that region with mixed success. Low sugar price and new restrictions on irrigation stopped expansion in Beaudesert. The small harvesting and transport component of the project looked at modifying the transport cane payment system, as an incentive for growers to move their loading pad to more suitable locations. There were 18 proposed changes in the harvesting and transport, though they were not implemented due to a lack of agreement.

#### ***Outcome/Learning***

Other learnings and shortcomings are as follows:

- The vision of the project (increased cane production towards 550,000 t) were not achieved. There were several reasons including external influences (climate, sugar price) as well as internal reasons (e.g problems setting up the trials in Beaudesert, delays in access to water). The goals in increased cane production make the project very high risk due to the problems that can influence the outcome.
- The capacity within the project was small given the large number of activities. For example, in the harvesting and transport portfolio group, there were several proposed changes. However, while proposed changes are easy to develop, agreement on change and capacity to change requires a huge effort which was not present.

The principal investigator noted that the project life was too short for the project goals and suggested a project life of 5 years.

#### **4. The State of Value Chains in the Australian Industry**

Author Bernard Milford

Dates Conducted: 2001

Organisations: UQ, Sugar CRC, CANEGROWERS

Funding: CRC, CANEGROWERS

Location: 3 milling areas

##### ***Reason/Objective***

This study examines current attitudes in supply chains in three mill areas to determine their sense of themselves as supply chains. This study built on previous work by Peterson et al. (2000) examining supply chain relationships in other agri industries. The work highlights value chain benefits such as reduced transaction costs and access to new resources. It clearly points out the benefits available in well functioning chains.

The desirable characteristics of well functioning chains are enumerated as follows:

- Awareness of customer needs (ultimate and intermediary)
- Trust among chain members
- Business Integration
- Efficiency which is achievable through joint planning
- Customer focus
- Transparency regarding costs and processes (largely a function of trust)
- Rewards (and penalty) sharing among participants
- Leadership
- Joint planning
- Partner selection and relationship development
- Optimised strategies which improve processes to ensure quality and optimisation

##### ***Method and Results***

The methodology involved conducting semi-structured interviews engaging the respondents in each of the characteristics of chain success outlined. Thirty-one participants were interviewed in 10 groups. Respondents represented growers, harvesters and millers. It was stated that this study could not be taken as representative of the industry as a whole since respondents did not represent a non-biased sample; it is indicative of the method's utility in measuring sugar industry performance.

Details of the response of each characteristics are reported but we will address the overall comparisons here. The summary of the overall results are as follows. Firstly, quoting the study, "the scores assigned to the sugar industry chains studied ranked lowly in the areas of awareness, trust, efficiency, transparency and rewards." Secondly, "they scored higher in the areas of integration, customer focus, leadership, planning and optimisation," however these chains still scored lower than the other industry chains looked at by Peterson et al. The final overall result suggests that although these sugar industry chains had the highest incidence of awareness of supply chain initiatives compared to other supply chains it scored the lowest incidence in seeing these projects as successful.

##### ***Outcomes/Learning***

Three major insights about sugar value chains emerged from the study. First, that there was room for improvement in the chains studied, particularly in regard to trust, transparency and rewards. It is significant that much of the requirements for building successful chains come out of the building of relationships between sectors, which were the weakest areas of the sugar chains in this study. One can think of this problem in these terms: the evidence of healthy supply chains may be efficiency and rewards, but these are based on the strength of relationships which, while less tangible, are fundamental to success. Secondly, the current state of relationships are causing significant transaction costs such as negotiations, lack of trust and lack of methods of measurement of quality parameters. Closer integration should reduce these and other costs. Thirdly other chain members should have access to resources required. The free movement of resources to processes as needed is a sign of mature supply chain develop. In particular mills, growers, harvesters require access to each other's resources. This suggests a highly interdependent organisational relationship would exist. Thinking and planning at the chain level would allow efficient use of existing resources, e.g. surplus harvesting resources.

The Outcomes from this study were:

- Identification of the range of drivers for Australian sugar Industry

- The identification of the strengths in the sugar industry value chains examined were awareness of chains and good leadership. Now the next step should be taken to the development of value chains through learning by doing
- The acknowledgement that the relationship building phases must be improved to achieve transparency which will lead to results (efficiency gains and rewards sharing). This area of weakness for these chains studied resulted in significant transaction costs relating to negotiations, lack of trust and a lack of common quality measures for cane. Initiative could be provided through outside assistance.
- The study gives examples for priorities of value chain improvement as harvesting price variation, cane and harvesting quality and responses to price signals by producers.

## **5. Integrating and Optimising Farm-to-Mill Decisions to Maximise Industry Profitability**

Author: Higgins et al

Date: 2002-

Location: Herbert, Mossman, Mourilyan

### ***Reason/Objectives***

The harvesting and transport sectors of the Australian sugar industry are poorly integrated due to separate and individual ownerships, along with large systems complexity. Several independent industry reports (e.g. Hildebrand, Boston Consulting) have indicated up to \$5.00/tc potential savings across these two sectors, which would be achieved through increased integration, increased efficiencies, and re-structuring. Through funding from CRC Sugar and SRDC (CSE005), involving researchers in CSIRO and BSES, a major project commenced in 2002 to explore opportunities for improvements in these sectors. We have also included a closely related project by the same project investigators in CSIRO, namely the harvester and siding roster optimisation work, which started in Mackay in 2000.

### ***Method and Results***

The project initially started in 2002 with case studies in Mourilyan, Mossman and Plane Creek, with the Herbert taking over as the main case study in 2004. For each of the case studies, a working group comprising of influential growers, harvesters and millers was set up to formulate a range of harvesting and transport scenarios that would be suitable to the region. The main value chain scenarios considered were: increased time window of harvesting, increased harvesting group size, reduced number or upgrading of sidings, and optimised siding rostering. All of these scenarios require changed decision making in the harvesting milling (transport) sectors to achieve adoption.

To achieve the analysis capability, a modelling framework was developed with the Mourilyan working group which provided an understanding of the numerous drivers across the harvesting and transport system. Existing component models (Harvest Haul, siding rostering) and new models (transport capacity planning, siding location) were then integrated into the framework to provide the analysis capability. Since the researchers conducted the modelling work closely with representatives of the working group, the industry developed confidence in the models. While the Mourilyan region anticipated about a \$5.00 /tc gain from integrating the harvesting and transport sectors, the modelling work only show potential gains up to about \$2.00/tc. Also, the bigger the gain in the scenarios, the large the change required to achieve benefits, with siding and group rationalisation requiring substantial capital investment.

### ***Outcome/Learning***

Adoption was generally been slow to begin (except for roster optimisation in Mackay), with Mourilyan and Mossman implementing an extended time window of harvest to about 17hrs in 2004. The Herbert is starting to adopt optimised harvester rosters and extended time window of harvest in 2005, though benefits are unclear at this stage. The project provided several learnings as follows:

- There have been some hard-to-measure tangible benefits (e.g. delay on costly purchase of new bins, reduced labour requirements for planning (Mackay harvester and siding rosters), economic benefits of reduced delays to harvesters) and intangibles (e.g. improved relations and planning capability between harvesters and millers, ability to achieve substantial funding from government from restructure package). This has been particularly noticeable when adoption has been in place for at least 2 years (e.g. Mackay rosters, and Mourilyan).
- The research must be driven by the local region at all times. It has been very easy, through the use of external facilitators and researcher dominance, for the industry representatives to become lazy in the process. After a while, the process can become researcher driven with a couple of industry representatives out of the many industry participants doing most of the work. This was particularly the case in the Mourilyan case study, which evaporated with the departure of the two industry representatives whom contributed the most to the project.
- Adoption was slow and can be difficult for the more favourable scenarios. Implementation of an extended time window of harvest required all (or at least most) harvesters to agree to alternative start times for the scenario to be effective. If the goal of the region is for a 20 hour time window of harvest and currently operates in daylight hours only, the first year of implementation may be a 14 hour time window (e.g. Mulgrave), with the second year extended to 16 hours. Change needed to occur in baby steps, to build trust and ensure the incremental steps were delivering benefits. While the working groups agreed that having fewer harvesters would benefit the region, it was not able to be achieved in practice in the Mourilyan case study. Through other initiatives outside this project, Mackay and Plane Creek, have achieved reduced number of harvesting groups through co-operatives and consolidations.

- Regions with poorer relations between the growing, harvesting and milling sector had more potential benefits (tangible and intangible) compared to regions with good relations. Interested regions such as Maryborough, Isis and Mulgrave, had a more efficient transport system and well serviced harvesting sector, compared to Mourilyan and the Herbert. However, regions such as Mourilyan and Herbert, required an intensive participatory process to move forward, where-as Mulgrave and Mossman didn't
- Insights gained from the research have left unforeseen legacies inside the case study regions and to other regions. Several regional plans submitted to the government for re-structuring funding, have been influenced by the learnings from this project. Industry representatives from regions not involved in the project are already promoting opportunities to others within their local region.

## **6. A Regional Partnership Approach to Developing a Sustainable Sugar Cane System (Mossman)**

Author: Rudd et al

Date: 2003-

Location: Mossman

### ***Reason/Objectives***

This project aimed to improve the overall sustainability of the Mossman sugar industry by implementing a strategic plan which enhanced the socio-economic and environmental viability guided by a joint venture partnership. It is a 4-year project (commencing in 2003) which addresses several relatively independent issues including farm aggregation, adoption of best practice, tree planting, and the value chain issues of agro-forestry and harvest/transport optimisation. For the agro-forestry component, issues addressed were potential markets, management, multi-purpose mill, environmental benefits and legislations. In harvest/transport optimisation, several opportunities were considered, including reduced number of harvesters and increased size, increased time window of harvesting, and harvest and transport co-ordination.

### ***Method and Results***

The methodology for harvest/transport optimisation involved a working group with participation from Mossman Agricultural Services, CANEGROWERS, Mossman Central Mill, and Queensland Mechanical cane Harvesters Association. This group met regularly to consider opportunities and plan towards implementation during the 2005 harvest season, as well as to overcome communication issues identified in harvest/transport management in the past. The project investigators have reported adoption of the harvest and transport plans in terms of reduced harvesting fleet, reduction of harvesting rounds, and harvesting and transport to be co-ordinated by Mossman Agricultural services. The agro-forestry component of the project focused heavily on workshops to promote and learn about the various opportunities in forestry mixed in with sugar. Through funding from the Australian Greenhouse Office, the goal was for 3000ha of plantation forests and 300ha of re-vegetation for biodiversity value. However, these goals have not been achieved yet due to delays in funding from the Australian Greenhouse Office. Despite this, several small environmental plantings have been achieved.

### ***Outcome/Learning***

The overall Learning to date from the agro-forestry and harvesting/transport components are:

- Whilst the project outcomes have been positive, they have been highly subjected to external factors outside the control of the project team (e.g. significant reduction in harvested cane from 2002 to 2004, uncertainty in funding from greenhouse office, and relations between members of the harvesting/transport working group).

The influence and credentials of the harvesting/transport working group appears to have increased since the start of the project, with the level of change increasing. While the project is not complete yet, an intangible benefit is better understanding and co-operation by harvester owners, which may be a platform to realise further tangible benefits by the end of the project.

## **7. Integrated Value Chain Scenarios for Enhanced Mill Region Profitability**

Author: Thorburn et al

Date: 2003-2005

Location: Maryborough, Burdekin

### ***Reason/Objectives***

This project looked beyond the harvesting and transport system and considered opportunities that required change to potentially all sectors of the chain. The two-year project commenced in 2003 and required collaboration between CSIRO, SRI and BSES to have the necessary skills and expertise to analysis whole-of-value chain scenarios. In the two case study regions, Maryborough and the Burdekin, the local reference groups agreed upon co-generation of electricity as the key scenario to be addressed. Unlike harvesting and transport integration that focuses on cost cutting to produce the same level of industry income, co-generation increases industry income through the production of other products as well as sugar.

### ***Method and Results***

The methodology has similarities to the harvesting and transport project, in that a local reference group was formed in each case study, comprising of grower, harvester and miller representatives. The project used participatory research principles in modelling the supply chain, formulating scenarios, developing results, and learning for successive iterations of the process. Prior to the start of the project, there was no value chain model available to the industry to provide a comprehensive whole-of-chain analysis for scenarios such as co-generation. Past attempts to measure the benefits of scenarios such as co-generation, were either rough "back-of-the-envelope" studies, or an application of some industry models (harvest-transport, transport scheduling, mill model) in a linear manner without capturing many of the important interactions across the chain. To capture the complex interactions across the chain whilst still being understandable by industry, a multi-agent supply chain model was developed. Instead of the industry models (APSIM, Harvest Haul, Transport scheduling, Mill Model) being directly built into the supply chain model, simplified versions of these models (e.g. diamond models or functional relationships) were developed.

### ***Outcomes/Learning***

Scenarios for co-generation of electricity were produced for the Maryborough and Burdekin regions, along with alternative scenarios that consider partial trash recovery for co-generation, and scenarios that look at ways of fine-tuning the harvesting and transport system to reduce costs. The main benefit of the project in Maryborough was that it highlighted additional costs that the Maryborough working group were unaware of (or didn't account for in their own analysis), which now made co-generation of electricity non-beneficial for the region. As a result, the outcome of the project for Maryborough was a decision not to go ahead with their original co-generation plans, and to further explore the alternative co-generation scenarios highlighted by the project. The following learnings and shortcomings resulted from the project:

- The outcomes from the project were different to those anticipated at the start of the project but local reference group agree they were still significant. An increased understanding of their own chain and capacity to consider a wide range of value chain scenarios were valuable outcomes for the local industry at Maryborough.
- The value chain project required a multi-organisational collaboration to achieve the necessary skills base, which requires a large amount of resources just to manage and co-ordinate. Projects of this type will have high transaction costs and will be high risk.
- The project had much less impact and influence on the Burdekin local reference group, compared to Maryborough. It may have been more beneficial to take on a replacement case study which had much more industry pull. These types of value-chain projects need mechanisms to reduce the risks and negative impacts.
- The value chain model was produced using Excel and produced the results necessary for this project. An extension of the value chain model to address other issues may require the model to be developed differently to handle the systems complexity, whilst being robust and understandable by industry. There is a considerable amount of new science and R&D to achieve this though, which would be difficult to fund exclusively by the Australian sugar industry.

## **8. A Co-operative Systems Model for the Mackay Regional Sugar Industry**

Author: Geoff Fleming

Date: 2003-

Location: Mackay

### ***Reason/Objectives***

The objective of the project is to develop a whole-of-chain management strategy underpinned by technology to facilitate reduction of costs and improved profitability and sustainability for all sectors of the Mackay sugar industry. It focuses on the development of a co-operative systems model, using participatory action learning principles, that integrates the links of the value chain in order to add value to its component parts. The co-operative systems were defined as computer based systems used by individual businesses to support integrated management decision making across the chain. It is a unique value chain project in the sugar industry in that it tries to improve information transparency across the chain, to provide a basis for better decision making across sectors. The project also tries to provide a means for increased adaptability to new markets and re-structuring. The co-operative systems model involved a large range of linked models and information tools in productivity performance, farm financial performance, farm management practice, harvesting performance, transport planning and scheduling, mill process control and process efficiency/quality.

### ***Method and Results***

The project methodology was based on action learning and a well organised consultative group of project teams in farming, harvesting/transport, milling. This consultative group was responsible for communication of the objectives and progress to growers through to industry leaders. There was also a project committee which also included an IT and change management teams. Across these teams, there were representatives from Mackay Sugar, Queensland Mechanical Cane Harvesters, Canegrowers, and BSES. The project, which is still current, has achieved a large amount of outputs to date (e.g. computer models, trials, web based tools). There are also some very important achievements/outcomes so far, including: a new cane payment system that promotes new markets and increased quality/efficiency; electronic consignments and NIR that will achieve more accurate information and better transparency of it; and a formulation of models across the industry that can be linked with the co-operative systems for better decision making across the chain. In 2005, the new cane payment system will be adopted by the entire Mackay industry, which the project leader suggests would have not happened without the participator research principles adopted by the project teams.

### ***Outcome/Learning***

The project will make the large scale availability of value-adding tools and information available on a large scale. If used effectively by the growing and harvesting community through a considerable amount of communication, this could lead to an efficient adoption mechanism and significant benefits and cost reductions. Though the project is only two years old, some learnings and potential issues to date are:

- Considerable effort will still be required in education and communication to ensure the Mackay industry has the capacity to achieve maximum benefits from the co-operative systems model. It does have the advantage in that the computer models were developed by the local industry rather than by an external party, so it already has a significant level of industry acceptance.
- Since the project focuses on improving the information and knowledge platform for the different sectors to draw upon, rather than addressing a specific issue such as reduced harvesting costs, quantifying the full benefits and impact (tangible and intangible) will be difficult even if they are major. It will be important that there is some measure or benchmark of benefit/impact, particularly as this project is unique in sugar. Reflections from other industries would help.

The project is different to the other major value chain project currently being undertaken in the sugar industry from a perspective that the R&D funding from SRDC covers a very small percentage of the overall resources put into the project objectives by the industry organisations. This is primarily a result of minimal involvement from R&D organisations, and should mean continues momentum after the R&D funding finishes.

## **9. Scheduling at the Milling-Marketing Interface of the Australian Sugar Supply Chain**

Author Andrew Higgins, Greg Beashel and Andrew Harrison

Date 2004

Location Cairns, Mourilyan, Lucinda, Townsville, Mackay, Bundaberg, Brisbane

### ***Reason/Objectives***

This project involved the scheduling of different brands of sugar to be produced across the sugar mills, and scheduling the ships into the 7 sugar terminals, with the overall objective to minimise costs. It is a complicated task to achieve manually, and computer based models would provide improved decision making. Changed decisions at the mills, storage facilities and shipping are required to achieve adoption. However, unlike the upstream sectors of the sugar value chain, the single desk seller has control of the decisions made at the milling-marketing interface. This control provides the advantages of a simple methodology (i.e. no intensive participatory process required), and easy adoption. However, the existing control over the milling-marketing interface means the potential supply chain improvements are much less compared to upstream of the chain.

### ***Method and Results***

The methodology was similar to that of a traditional supply chain research, such as in manufacturing. It simply involved working with Queensland Sugar Limited to formulate the problem and develop an optimisation model to provide a schedule with least cost. Upon validation using past data, the model was developed into a user-friendly application and applied by Queensland Sugar staff.

### ***Outcomes/Learning***

The project has the following learnings:

- While the benefits are small in comparison to other value chain opportunities, it was an example of low-hanging fruit and did not suffer the complex systems and multi-ownership issues found upstream in the supply chain. The industry should chase some more of these low hanging fruit.
- The research would potentially have major benefits in other sugar industries, such as Brazil, whom have greater inefficiencies at the milling-marketing sectors of the supply chain, compared to Australia.
- The modelling work can be extended to capture other issues at the milling-marketing interface such as quality degradation in storage, vessels line-ups, mill stops and road-rail receivals, which may require a similar multi-agent supply chain approach to the "Integrated Value Chain Scenarios" project.

## **10. Achieving World's Best Practice Harvesting and Transport Costs for the NSW Sugar Industry**

Author: Beatie et al

Duration: 2004-

Location: NSW sugar mills

### ***Reasons/Objective***

The objective of the project is to: build a least cost NSW sugar industry spatial harvest management system; provide a basis for harvesting group optimisation and the formation of one harvesting co-operative per mill area; and demonstrate the benefits to industry competitiveness by the adoption of optimised harvesting and transport arrangements. The project, which commenced in 2004, primarily focuses on the harvesting and transport interface of the value chain. Optimal location of additional loading pads was the main value chain issue addressed in the project. The intention of installing new loading pads was to reduce harvesting costs and improve transport efficiency, particularly with the introduction of co-generation of electricity. Another goal is to improve information accuracy about harvester logistics, consignments etc. This improved (or more accurate) information will serve as a basis for better decision making by harvesters and the mill.

### ***Method and Results***

The methodology is similar to other current projects aimed at improving efficiencies at the harvesting-transport interface, in that there is a working group who meet regularly to progress the research, development and implementation. The working group is diverse with representatives from NSW Sugar Co-operative, Caneharvesters, CSIRO, BSES and Agtrix P/L. Only representatives necessary to the project and its adoption are part of the working group. Unlike the "Integrating and optimising farm-to-mill decisions" project which the opportunities were identified during the project, this project was focused on a fixed set of harvesting and transport issues right from the start. The project is very young so there are very few learnings to date. The likelihood of success is high due to the strong industry pull and effort in the background, but also because there is federal government and industry money available to implement the research outputs. It would take at least another 1 to 2 years before the benefits of this value chain project would be fully understood.

### ***Outcome/Learning***

Too early to state any outcomes or learnings

## **11. Adoption of Optimal Season Length for Increased Industry Profitability (Herbert)**

Author: Di-Bella et al

Duration 2004-

Location: Herbert

### ***Reasons/Objective***

This project is aimed at increased industry profitability and sugar production in the Herbert by optimising season length and exploiting geographical variation in ccs and climatic conditions. The project has several value chain components: develop management strategies for early harvested cane; promote adoption of optimal season length by developing an economic model to assess optimal season start and finish times, cane payment options and cost benefit analyses for all industry sectors; develop an integrated model incorporating seasonal climate data, climate forecasts and soil data; optimise harvest schedules to improve industry profitability; establish a consultative group to develop a regional action and implementation plan for an extended harvesting season; and facilitate whole of system change using a participatory action research approach by achieving adoption of these plans and there support across the value chain.

### ***Method and Results***

The methodology involves a working group with representatives from across the sectors of the Herbert. While the project addresses a common issue, season length, it looks at a broad range of opportunities to maximise the benefits from different season start and finish times, such as staggered season start times across sub-districts mixed in with alternative harvest/transport rosters. Floating the start time of Macknade mill was another opportunity. It is the first project in the Australian sugar industry that goes beyond just measuring the impact of different season start times and lengths, and is a true value chain approach. The project started in 2004 and is still very young, and will take at least another year before the actual benefits will be clearer.

### ***Outcome/Learning***

No outcomes to report at this time.

## Overseas sugar value chains

### 12. Optimization of Harvest and Crop renewal in Brazil

Author M.Q.F. Barata, S.A. Tatizana and F.C. Peres

Duration 1998

Location Brazil

#### **Reasons/Objective**

This program seeks to manage harvesting and replanting decisions which is made more complicated because of the large size areas of sugar cane paddocks and farms in Brazil. While this paper does not describe the value chain directly it is implied as it proposed a decision model to optimise the coordination of planting, harvesting, replanting decisions to maximise. The parts of the value chain involved in this research are growing and harvesting.

#### **Method and Results**

A linear program was developed to deal with 5 specific problems: i) which areas should be ploughed out; ii) which variety should be cultivated in the ploughed areas; iii) when the ploughing should take place to produce a 12 -18 month –aged crop; iv) whether each homogeneous area should be harvested at the beginning, middle or end of the harvest season; and v) which variety to use for that value chain. In the model only three harvesting sub-periods (beginning, middle, late) were created partly to minimise computing time. Fifteen varieties of cane were allowed to be cultivated with some interaction with soil fertility so that only high fertility soils could use every variety. The LP models were constrained by when a block can be ploughed out; amount of sugarcane produced; the total area to be ploughed out per year and the number of hectares that can be ploughed out for 12/18 month cane; limits to the total area that can be ploughed out with a given variety; and limits to the total area that each variety can occupy.

The results from a case study mill region in Brazil managing about 60,000 ha with 1125 plots were shown. The best strategy found was the fast substitution of the varieties with late maturation and poorly adapted to the crop in the beginning of the crop period. The behaviour was verified with a number of cane varieties. The optimised plan also suggests an increase in the longevity of the cane plantation

#### **Outcome/Learning**

This kind of multi-year discretely dynamic model can and should be viewed as an adaptive planning process with a long run horizon. It is applicable in the case where management takes decisions based on long run views but changes or adjusts their views every year. Therefore, the model should be re-run every year such that the management will always be executing the first year prescriptions of the plan.

### **13. Using computer simulation to evaluate sugarcane harvest-to-mill delivery systems**

Author A.C. Hansen, A Barnes and P. W. L. Lyne

Location South Africa

#### ***Reasons/Objective***

This article addresses the problem of delays between harvesting and milling sugarcane by simulating the processes in the supply chain between burning to crush.

#### ***Method and Results***

Simulation was selected over other modelling methods because it best suited system complexity including dynamic queries. The Arena simulation system, which is a visual interactive modelling system, was selected. A single mill case study was selected for model development and information about various harvesting and transport processes was collected from records and verified by system participants.

Experimental factors varied included:

- Operation schedules
- Percentage of cane on various burn schedule
- Percentage of cane on direct transport
- Percentage of cane delivered to mill in bundles
- Percentage of cane not delivered to mill in bundles.

A sensitivity analysis of harvesting and transport determined the accuracy of inputs parameters and the requirement for further model development. Times for cutting, stacking, loading/unloading, and the mass of cane loads transported were experimental factors that tested in sensitivity analysis.

#### ***Outcome/Learning***

- The research work gained greater clarity of the processes in the South African harvesting and transport system thus broadening the ability to consider the value chain as a whole
- The authors recognised that as a tool simulation was useful but does not lead to optimisation of itself. Implicitly this is an important recognition acknowledging the importance of involving chain managers in generating whole-system strategies which the tools can assist in efficiently evaluating.

#### **14. Self regulating delivery mechanism: optimising length of milling season and cane supply in South African Sugar Industry**

Author A.T. Wynne

Duration 2004

Location South Africa

##### ***Reasons/Objective***

Increasing cane delivery and crush for growers and millers respectively will increase revenue, but would lengthen the crushing season. This could ultimately affect all growers' income negatively due to payment formulation. This paper explores an alternative, the Self Regulating Delivery mechanism, which attempts to protect non-expanding growers and create incentives that improve efficiencies within the cane supply logistics chain that are easily understandable, inexpensive to implement and benefit both millers and growers.

##### ***Method and Results***

##### ***Outcome/Learning***

- The self regulating delivery mechanism are easy to understand and inexpensive to implement
- Growers gain incentive to align their delivery rate with the mill crush rate. Through this system none of their current and subsequent seasons and there are no penalties for over-delivery.
- Growers directly bear financial consequences of cane delivered as they are paid on "actual" recoverable value % cane and not "relative" recoverable value %

## **15. Sugar Logistic Improvement Programme (SLIP): Improving supply chain efficiencies in the South African Sugar Industry**

Author I W Perry and A T Wynne

Location South Africa

### ***Reasons/Objective***

A programme was developed in the South African industry to capture logistics information in the sugar supply chain to benchmark for best practice. The objective is to make policy changes in the form of strategic planning by identifying individual (within sectors) and collective (across chain) inefficiencies. This study covered the growing, hauling and milling of sugarcane.

### ***Method and Results***

The methodology involved collecting data on a continuous basis from chains across the South African industry where data was available across the whole of each individual chain. The data was collated in a database called SLIP and industry-wide benchmarks were established. Broadly, the information included data on quantity and quality of cane supplied and the time transition between process stages.

The direct results of the research revealed the following inefficiencies as summarised as follows:

- Poor vehicle utilisation and over-fleeting which can lead to inefficient milling
- High mill queue delays, often a result of over-fleeting and influenced by crush rate fluctuations
- Low vehicle efficiency (highly variable among mills)
- High burn to crush delays leading to reduced cane quality.

### ***Outcome/Learning***

SLIP proposes to resolve key problems by:

- Separate reports for growers and hauliers that encourage transparent exchange of information across the supply chain. This should also eventually see international benchmarking to make improvement against international competitors.
- Comparing current chain performances against best practice to highlight collective inefficiencies. The SLIP efficiency committees is a step towards achieving long term commitment in the mill regions.

## **16. An Integer Programming for sugarcane factory supply allocation in Indonesia**

Author J Yosnual and S Supsomboon

Duration 2004

Location Indonesia

Funding Centre for Research of Agricultural Machinery and Post Harvest Technology and Khon Kaen University

### ***Reasons/Objective***

Three periods in exist in the crushing season: the start and end where cane is undersupplied to the mill and the middle where cane is in oversupply.

### ***Method and Results***

Linear programming is used to rationalise sugar cane supplied to the mill across the resources available for harvesting, transport and milling capacity. The objective is to maximise profit to sugar cane producers. The decision variables per area per round for the two types of vehicles used include sugarcane supply delivered, number of harvesters, quantity of standing sugarcane crop, number of transportation times, and quantity of cut cane accumulated. The objective function consisted of the revenue from the cane minus the costs due to the decision variables: costs due to waiting times of the cut cane and costs of harvest and transport. Constraints are mainly concerned with mass/transfer conservation between production and milling and the related costs that must be accounted for in the harvest and transport.

### ***Outcome/Learning***

- This methodology could prove useful in assisting management scheduling decisions to improve mill function and increase crop quality (thus improving price to producers). Under the model assumptions of unlimited transport resources (thus fully elastic transport costs) the model worked.

## Appendix 2: Value chain evaluation focus group and interview schedules

### Focus group structure

#### *Introduction*

**Brief preamble** to welcome everyone and thank them for participating in the focus group.

- **Explain the purpose:** Help us understand what people in your region think about value chain research. This is part of a wider review of value chain research in the sugar industry.
- **Explain the term Value Chain Research (Di)**

**Explain ground rules** of the focus group:

- everyone participates;
- speak briefly and often;
- be open and honest;
- be specific and talk about your own experiences;
- listen without interruption;
- there are no right or wrong answers;
- it is OK to disagree, since we are interested in exploring the range of views on value chain research in the region; and
- Participants' views will remain **anonymous**, i.e. we will not report on who said what.

**Explain note taking and recording** procedures – ask for consent to record focus group.

**Clarify duration** of focus group and catering.

- Focus group should last for about an hour to an hour and a half.
- Morning tea will be provided afterwards.

#### ***Focus group questions***

1. What would you be doing this morning if you weren't here?
2. What does value chain research mean for you?
3. What has value chain research achieved in your region?
4. What do you think are the strengths of the value chain research that has been carried out in your region?
5. What are the limitations of the value chain research that has been carried out in your region?
6. Based on your experiences with value chain research in this region, what factors are necessary for value chain research to be successful?
7. What could be done to improve future value chain research?
8. What opportunities are there for future value chain research in your region?
9. Are there any issues about value chain research that we have missed?

**Thank participants for their time and input and invite them to stay for morning tea.**

## **Interview structure**

### ***Introduction***

**Brief preamble** to explain the purpose of the interview, including an explanation of the term value chain research.

**Explain note taking and recording** procedures – ask for consent to record the interview.

### **Interview questions**

1. What does value chain research mean for you?
2. What has value chain research achieved in your region?
3. What do you think are the strengths of the value chain research that has been carried out in your region?
4. What are the limitations of the value chain research that has been carried out in your region?
5. Based on your experiences with value chain research in this region, what factors are necessary for value chain research to be successful?
6. What could be done to improve future value chain research?
7. What opportunities are there for future value chain research in your region?
8. Are there any issues about value chain research that we have missed?

**Thank participants for their time and input.**

## Appendix 3: Summary of focus group and interview data

**Table 7: Summary of Herbert focus group and interview data**

Question	Session	Comments
<i>What does value chain research mean to you?</i>	Focus group	<ul style="list-style-type: none"> <li>• Finding ways to maximise efficiencies in the system to achieve maximum returns.</li> <li>• Maximising efficiencies in the system so that all sectors get the benefits and no-one is disadvantaged.</li> <li>• Improving interaction between industry sectors.</li> <li>• Increasing the overall 'size of the cake'.</li> <li>• Understanding the current system, the drivers for each sector and ways to maximise the whole chain.</li> <li>• Finding outcomes that leave people better off or at least no worse off.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Integration across the sectors.</li> <li>• Maximising financial positions across industry sectors.</li> <li>• Finding efficiencies across sectors.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Finding out where the weakest link is.</li> <li>• Understanding how costs are shared among industry sectors.</li> <li>• Finding ways to create new markets and products.</li> <li>• Want to find ways to make the pie bigger and more valuable and to share the benefits across the sectors.</li> </ul>
<i>What has value chain research achieved in your region?</i>	Focus group	<ul style="list-style-type: none"> <li>• Improved relationships / connections between people.</li> <li>• Improved understanding of each sectors' business and how things impact on each sector.</li> <li>• Increased level of interest and cooperation.</li> <li>• Still a long way to go in terms of implementation.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Hard to identify particular value chain issues.</li> <li>• 1985 shift to green cane harvesting an example.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Changes in the harvesting sector have improved efficiency; however the Mill's transport system hasn't kept up with these changes.</li> <li>• Can't think of many examples of value chain research.</li> </ul>
<i>What do you think are the strengths of the value chain research that has been carried out in your region?</i>	Focus group	<ul style="list-style-type: none"> <li>• Improved relationships, communication and understanding between sectors.</li> <li>• Increased recognition of problems and willingness to take responsibility for problems and find ways to deal with problems across sectors.</li> <li>• Agreement to work together.</li> <li>• Realisation of the complexity of the problems.</li> <li>• Cultural Imprint Study a specific example of efforts to try and understand each sector.</li> <li>• Improved the capacity of the industry sectors to interact with each other.</li> <li>• Realisation of the importance of people's attitudes and values.</li> <li>• Formation of the Regional Industry Board (through the CPI) tried to make overall industry decisions at a regional level.</li> <li>• People are starting to realise that they need to have the same focus.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Any strengths are counteracted by lack of trust of the Mill.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Need to put resources where there is a benefit.</li> <li>• Need a better understanding of what needs to be done.</li> </ul>
<i>What are the limitations of</i>	Focus group	<ul style="list-style-type: none"> <li>• Lack of implementation of work that has been done.</li> <li>• Challenge to get people on board; people need to see results first.</li> </ul>

Question	Session	Comments
<i>the value chain research that has been carried out in your region?</i>		<ul style="list-style-type: none"> <li>• Perception that the Mill needs to be more reliable and responsive.</li> <li>• Perception that no-one should be worse off is unrealistic; compensation may be necessary, but this requires complex negotiations.</li> <li>• Sensible alignment between the sectors and rapid implementation is required.</li> <li>• Need to assess viability of certain industry members.</li> <li>• Value chain changes require complex negotiations between industry sectors.</li> <li>• Value chain changes partly depend on factors that can't be controlled e.g. the varieties growers can use and the weather.</li> <li>• Growers fear that certain value chain changes will result in a further lose of control.</li> <li>• Different industry sectors are exposed to risk.</li> <li>• Value chain changes may be difficult to reach because the different sectors might not be able to reach agreement on what should be done.</li> <li>• History of disagreement between the farm and mill sector.</li> <li>• Growers and Millers have their own long term plans but there is a lack of understanding about how these plans fit together and interact; Regional plan under consideration by the government.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Mill seen as only interested in making money.</li> <li>• Mill perceived as unwilling to share 'the whole pie' / profits with other industry sectors.</li> <li>• Lack of trust between the industry sectors.</li> <li>• Limited by commitment of partners in the industry.</li> <li>• Mill's perceived unreliability (e.g. transport and maintenance issues) seen as a major limiting factor.</li> <li>• Perception that the Mill regards growers and harvesters as service providers rather than partners.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• The Mill's transport system hasn't kept up with changes that have occurred in the harvesting sector.</li> <li>• The cost of change to e.g. green cane harvesting / trash mulching has been born by the harvesting sector.</li> <li>• The Mill makes decisions without properly consulting the other industry sectors, even though those changes affect the other sectors.</li> <li>• Implementation of change is a challenge.</li> </ul>
<i>Based on your experiences with value chain research in this region, what factors are necessary for it to be successful?</i>	Focus group	<ul style="list-style-type: none"> <li>• Need to understand each sector and the factors that each has to deal with.</li> <li>• Need to accept that you will never get things 100% right and that problems will happen.</li> <li>• Can't attribute blame to other industry sectors.</li> <li>• Need to see good / reliable results from the models to help address 'blockages'.</li> <li>• Need to use models to understand the affect of certain changes on different sectors, e.g. siding rationalisation; would help if models were interactive.</li> <li>• Concerns about the level of sophistication of models and the time frames required to develop reliable models.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Need to have a group of people that will make commitments and be willing to follow through.</li> <li>• Need to have transparency across the sectors; e.g. people need to be honest and open e.g. about the financial gains that particular sectors (e.g. the Mill) would receive from certain changes (e.g. season length and cogeneration).</li> <li>• Need to increase recognition of the importance of the harvesting sector.</li> </ul>

Question	Session	Comments
	Interview 2	<ul style="list-style-type: none"> <li>• Need to understand how you value and share gains across the sector.</li> <li>• Need appropriate benchmarking across the industry sectors (including the Mill).</li> <li>• Certain changes (e.g. ethanol) require action on the part of government and investors.</li> <li>• Perception that the Mill isn't committed to finding ways to improve the value of cane.</li> </ul>
<i>What could be done to improve future value chain research?</i>	Focus group	<ul style="list-style-type: none"> <li>• Need to have discussions / forums with the right people.</li> <li>• Attitudes need to change, people need to be willing to work together and drive the real changes.</li> <li>• Need to address lack of trust between and within industry sectors.</li> <li>• Use models to show the value of changes across industry sectors.</li> <li>• People need to have input into the models to build trust, ownership and confidence in the models.</li> <li>• Need to ground truth the models in order to gain acceptance.</li> <li>• Need to ensure that the models contain input from all sectors.</li> <li>• Models have the potential to bring people together to discuss a common point.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Need to get the proper people in a committee to know what projects should be done in that particular area, because different areas will have different interests.</li> <li>• Need to find ways to improve interaction between e.g. the farm and harvesting sectors to improve efficiency.</li> <li>• Described his project on harvest payment signals; helped improve understanding of the system for both farmers and harvesters.</li> <li>• Need to improve the culture of poor relationship between industry sectors.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Growers and harvesters want to be joint venture partners with the Mill to find new ways to add value to cane production.</li> <li>• Industry sectors need to recognise that they need each other.</li> <li>• Industry as a whole needs to capitalise on opportunities e.g. renewable fuels rebate.</li> </ul>
<i>What opportunities are there for future value chain research in your region?</i>	Focus group	<ul style="list-style-type: none"> <li>• Promote sustainability.</li> <li>• Work on integrating models with GIS to make the information available.</li> <li>• Use models to assist with scenario analysis, so that sectors can better understand how changes will affect them.</li> <li>• Models need to be more flexible, interactive and available.</li> <li>• Ethanol an important opportunity, need to understand more about how to use it and what the benefits and market potential might be.</li> <li>• Need to better understand the importance of farm lay out and its flow on effects e.g. for the harvesting sector.</li> <li>• Understanding the effects of changing the harvesting price system.</li> <li>• Understanding the way that new varieties might affect the value chain, including genetically modified varieties.</li> <li>• Opportunities re: NIR and precision farming.</li> <li>• Understanding how value adding can affect the industry sectors and how the advantages can be shared across the industry; a model could help with this.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Need to deal with the problem of the industry's culture / tradition of operation.</li> <li>• Opportunities exist to change harvest pricing system.</li> <li>• Improving the harvesting sector depends on improved interaction with and changes within the growing, transport and Mill sectors.</li> <li>• Need to understand how costs of change are shared across sectors.</li> </ul>

Question	Session	Comments
	Interview 2	<ul style="list-style-type: none"> <li>• Promote the benefits of ethanol.</li> <li>• Improve business models for value adding.</li> </ul>
<i>Are there any issues about value chain research that we have missed?</i>	Focus group	<ul style="list-style-type: none"> <li>• Ongoing issues at the growing / transport and harvesting interface, especially re: service reliability.</li> <li>• Some people don't understand the limitations of models and / or might be afraid of using computer-based models.</li> <li>• Sugar quality an important area where a value chain perspective would be helpful.</li> <li>• Communication and marketing required to make ethanol viable.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Most people in the growing and harvesting sectors have time for local Mill staff, but recognise that the local staff bear the brunt of their dissatisfaction.</li> <li>• Concern about people doing projects without fully understanding what goes on at a practice level in the industry sectors.</li> </ul>

**Table 8: Summary of Maryborough focus group and interview data**

Question	Session	Key themes
<p><i>What does value chain research mean to you?</i></p>	Focus group	<ul style="list-style-type: none"> <li>• Research that takes into account the effects of changes on every sector of the industry (both positive and negative).</li> <li>• Research that allows you to examine different scenarios and see whether the industry is going to be better or worse off. For example, the co-generation project showed there would be an overall negative return to the industry.</li> <li>• Research that ensures that you don't miss important findings in terms of how a certain change in one sector might affect other industry sectors.</li> <li>• SRDC's use of the terms value chain research is too selective. For instance, harvesting payment affects the whole value chain, as does farming practice. To some extent, every industry issue could be seen as a value chain issue.</li> <li>• SRDC's current approach to value chain research has been too focused on the harvesting and transport sector. More support needs to be given to value adding.</li> <li>• SRDC funding for value chain research has focused too much on reducing costs rather than trying to 'grow the pie'. More emphasis should be given to increasing industry revenue, e.g. through product development and value adding.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Searching for revenue streams other than raw sugar, e.g. bioplastics.</li> <li>• Co-generation and harvest group amalgamation two examples of value chain research.</li> <li>• Farming system changes such as moving from 1.5m rows to 2m rows are also relevant. The problem is however that the growing and harvesting sectors carry the costs of making these changes.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Finding ways to add more money to our bottom line, e.g. more money out of the cane or some of its by-products.</li> </ul>
<p><i>What has value chain research achieved in your region?</i></p>	Focus group	<ul style="list-style-type: none"> <li>• The value chain project on co-generation convinced the Maryborough region not to proceed with co-generation.</li> <li>• Have adopted some of the recommendations of the harvest and transport scheduling project.</li> <li>• Value chain research has provided the region with a framework, which allows the industry to identify key issues and test the effects of changes through models.</li> <li>• The co-generation project allowed the industry to better understand their system and what could be done.</li> <li>• The project on geographical harvesting demonstrated the many problems and difficulties that would have been involved in implementing geographic harvesting.</li> <li>• On the practical side, the start of each season has involved problems (e.g. wet or frost) which would have made implementing harvest schedules too difficult.</li> <li>• On the theoretical side, the project demonstrated that the farms that the model indicated that you should get into early wouldn't have supplied enough cane to be able to develop a harvesting regime around them.</li> <li>• The geographical harvesting project also showed that "what the computer model says is very hard to do out in the paddock. So don't waste too much money on that" (Grower).</li> <li>• New varieties of cane make the histories that the models are based</li> </ul>

Question	Session	Key themes
		<p>on irrelevant. This will always change, so the model can't keep up.</p> <ul style="list-style-type: none"> <li>• In theory geographic harvesting probably has great merit, but the practicalities of it are impossible.</li> <li>• Any gains from geographical harvesting will be negated by the costs involved.</li> <li>• Changes as a result of geographical harvesting would have flow-on effects for the growing sector and the model didn't take this into account.</li> <li>• The report from the geographical harvesting project didn't clearly identify the implications of geographical harvesting at the farm level, "so it wasn't even a true value chain assessment, because it didn't go right back" (Mill).</li> <li>• Some of the problems with geographical harvesting relate to the equity question, in terms of the disadvantages for some growers if they don't get an income until e.g. September; "If one company owned the lot it would be different" (Grower).</li> <li>• The co-generation project gave the industry a better understanding of what resources were there in the field, e.g. tops and trash. "A lot of that information was quite useful for us in other things we've been doing. I think besides the fact that it stopped us making a poor decision on co-generation, it also gave us a lot of other information that we didn't have" (Mill).</li> <li>• The project pulled together people with a range of importance expertise: it was good to have everyone involved, who knew a fair bit about each sector.</li> <li>• The understanding of what is the impact on growing cane if you take all the trash off was another benefit of the co-generation project.</li> <li>• There are still disparate views on whether taking trash off actually works or not, despite what the modelling suggests: "...we didn't actually get an outcome that everyone accepted, despite there being engagement right the way through, they couldn't explain why there was such a big difference in performance. There's people trash blanketing, getting lower productivities than the ones next door doing burning and tilling operations" (Mill).</li> <li>• However, more information isn't required because "the government will make the decision for us pretty soon: no burning" (Grower).</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Changes in transport and harvest scheduling have lead to big improvements in the region.</li> <li>• Harvest group amalgamations have shown that larger groups are more economically viable.</li> <li>• Value chain projects in the region have provided the opportunity to have a better understanding of where the industry is coming from and where they're heading.</li> <li>• The co-generation project didn't achieve what they wanted it to.</li> <li>• Still believes that some form of co-generation is viable for the Maryborough region, given the fact that other regions (e.g. Isis) can make it work.</li> <li>• In terms of the results of the co-generation project, expressed reservations about how the costs of changing to co-generation were calculated.</li> <li>• The value chain project workshops were very important in terms of outlining the positive and negative elements of co-generation.</li> <li>• Research into geographical harvesting also highlighted the advantages and disadvantages of changing the harvesting</li> </ul>

Question	Session	Key themes
		<p>schedule; highlighted particular challenges associated with harvesting in the Maryborough region, e.g. areas very spread out.</p> <ul style="list-style-type: none"> <li>• Suggested that appropriate variety selection was more important than geographical harvesting.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• The co-generation project showed them that co-generation wasn't going to make them money, and that the way they were going to go ahead with it was actually going to cost them money.</li> <li>• Harvesting research: some is a good idea but some of it is impossible to implement.</li> <li>• Some of the recommendations on scheduling harvesting to cut areas at different times will work in some years but not in others.</li> </ul>
<i>What do you think are the strengths of the value chain research that has been carried out in your region?</i>	Focus group	<ul style="list-style-type: none"> <li>• Specialists from different areas were involved and a lot of things were discussed and probably quite a few people changed their position on things because of it.</li> <li>• Being able to test different scenarios, test what would happen if you implemented certain things.</li> <li>• Probably the biggest benefit was that it proved why the region shouldn't go ahead with co-generation.</li> <li>• Identified that if they had gone ahead with co-generation, the growers and the harvesters and haul out sectors would have lost money: "that could have been disastrous" (Mill).</li> <li>• Discussed the implications of their findings about co-generation for NSW; e.g. although NSW has different conditions to Maryborough, wonder whether they understand the implications for logistics and the costs involved in the haul out for co-generation.</li> <li>• "What was done I was quite impressed with, because of how close it came, for example the harvest haul models produced, I reckon they were very, very close to our actual costs. And they're the sorts of things, the legacies which we can now have access to and do some good work with, I believe" (Mill).</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Important research, but have to be careful that the industry spends resources on future research wisely and ensure that grassroots level has input into research direction.</li> <li>• Harvest and transport scheduling work has had the biggest advantages; has highlighted the need to be flexible about how to organise harvesting in the region and provided figures to work out how to organise the harvesting system more efficiently.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• See previous question.</li> </ul>
<i>What are the limitations of the value chain research that has been carried out in your region?</i>	Focus group	<ul style="list-style-type: none"> <li>• The difficulty of getting to all the right people and getting them involved. There is one central group of people who are involved in everything and they are not necessarily all the ones you need.</li> <li>• The researchers need to go to the people directly, rather than expect a small group of people to come to a meeting; i.e. the researchers need to spend more time out in the field.</li> <li>• The researchers need to work with the locals to identify the key people they should be working with and "get out there and talk to the real people" (Mill).</li> <li>• The harvest scheduling project didn't "focus on the whole value chain, it missed a few of the parts of the value chain", which "is a limitation if you're doing a value chain project and forget about some of the parts of the chain or some sectors" (Grower/Extension).</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Sometimes researchers seem to have on blinkers and pursue a particular agenda regardless of what local input has suggested.</li> <li>• The industry needs to be prepared to make changes.</li> </ul>

Question	Session	Key themes
		<ul style="list-style-type: none"> <li>• There is always a spectrum of growers e.g. some are innovative, some will sit on the fence for a while and some won't be willing to change.</li> <li>• Important to recognise that some changes will suit some sections of the industry better than others; need to have a 'horses for courses' approach to change.</li> <li>• Researchers need to be more aware of the full practical implications of some of the changes they recommend.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Some of the information used in the research isn't accurate; e.g. some farmers don't record information about their farms accurately, which could affect the research on harvesting for CCS.</li> <li>• Implementation of geographic harvesting is a challenge because growing conditions can vary greatly across years.</li> </ul>
<p><i>Based on your experiences with value chain research in this region, what factors are necessary for it to be successful?</i></p>	Focus group	<ul style="list-style-type: none"> <li>• You need the right people there, in terms of both researchers and the local people. The people in the local area have to want to participate, not be dragged along.</li> <li>• Need to have some practical input for the local industry.</li> <li>• Need to be able to develop a good understanding of what it is they're trying to look at. The processes need to ensure that everyone is involved and you cover all the bases.</li> <li>• Researchers need to "come in with a less closed mind and project formed in their mind. So actually start with a blank slate, a real one, not someone's pet thing that they think they want to get up. So...do a needs-analysis for the region and then decide what needs to be done and who should come in. And maybe that means that SRDC may need to be a bit more active in that area, in doing that on a district basis, rather than just calling something and then saying come and do it" (Mill).</li> <li>• "Definitely important [that the researchers] come with a clean slate." (Grower).</li> <li>• The farming systems research "is the next opportunity, but is has to be managed well" (Mill).</li> <li>• Discussed the way that the data on sugar yield decline has been presented: "If SRDC wants the industry to adopt this, it's got to be presented in a better way" (Mill).</li> <li>• The yield decline research needs to be a value chain project because it is going to impact everybody.</li> <li>• The yield decline results are currently disputed; need to be able to demonstrate it: "That research needs to be done in a practical form out in the paddock" (Grower). E.g. the grain industry has been doing trials for 20 years.</li> <li>• Discussed changes that would need to be made and the costs involved e.g. changes to planting and harvesting associated with dual row harvesting. Not all of the technology is there to be able to properly implement the yield decline results.</li> <li>• Farming system research needs to be done starting from a clean slate, without having blinkers on (e.g. about row spacing).</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Grower participation is essential; growers need to highlight the positive and negative implications of certain changes.</li> <li>• Research needs to be a two-way street between the industry and researchers.</li> <li>• Although the majority of researchers realise the importance of getting grower participation, there is still a way to go on both sides in terms of ensuring research is approached as a partnership.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Need everyone involved, particularly need to get more growers</li> </ul>

Question	Session	Key themes
		<p>involved.</p> <ul style="list-style-type: none"> <li>• Recognised that it is very difficult to get growers involved because many growers just want to do their own thing and don't want to get involved in making changes.</li> <li>• Growers often might adopt changes after a few years much many are stuck in their ways.</li> </ul>
<p><i>What could be done to improve future value chain research?</i></p>	Focus group	<ul style="list-style-type: none"> <li>• The industry needs to have that focus first before we get the researchers involved.</li> <li>• More flexible team formation; still need experts from every sector of the value chain, but need to be flexible about who else needs to come in.</li> <li>• Relates to the recommendation that regions should do their own needs-analysis first and then try and put together a project team after that.</li> <li>• Reinforces the point about ensuring that researchers start projects with a clean slate.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Ensure true grower participation.</li> <li>• More field trials may be appropriate, although it takes a while to get the results.</li> <li>• All parties involved in research need to be flexible and listen to each other; getting a good understanding of the different sides of the story is important.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Try and get more growers involved, but don't know how you'd do that.</li> <li>• Need to get different opinions from different people.</li> <li>• Doing the best they can at the moment.</li> <li>• Weather conditions and price of sugar are a big influence.</li> </ul>
<p><i>What opportunities are there for future value chain research in your region?</i></p>	Focus group	<ul style="list-style-type: none"> <li>• Farming system research: e.g. what is the optimum planter design and lay out for the different areas in the district, because we do have wide variations in soil and rainfall, which means that not the one system will be applicable across the district. Can then pick up all the other things and benefits that can be built into the farming system, i.e. look at the effects of changes in the system at every point in the whole value chain and the implications of each of these changes for the whole of the value chain.</li> <li>• Value adding: if there is opportunity for mill mud, we need to understand what are the impacts everywhere, if we change anything in mill mud? This applies to any crop residues as well. We have a bit better understanding of what happens now and what percentage is tops, what percentage is trash and what is the impact of taking those away.</li> <li>• There is a bit that is missing in a lot of value adding work, it all fills up the back part of the supply chain but it doesn't look at the front part, e.g. what is the route to market, how is it going to be sold, who are the competitions, what is the profitability? Developing a full business case is important but it is a huge job. SRDC's current funding priorities don't recognise the importance of this.</li> <li>• Need funding for practical experiments out in the paddock to test opportunities for value-adding. Needs to be engagement of e.g. nutritional specialist to support such trials.</li> <li>• BMPs need to be included throughout whole of value chain to maximise production.</li> <li>• Feeling is that geographical harvesting isn't worth pursuing further; works well in theory but hard to implement.</li> <li>• Discussed opportunities to hook up NIR to SMS and send</li> </ul>

Question	Session	Key themes
		<p>information straight to the grower and harvester. If got the funding to do this, it would make a huge difference because people would get within an hour of harvesting, they would get notice of tonnage, so they can adjust what they're doing, and CCS, dirt, fibre. Would help the transport sector too. Could make a big difference, although it depends on when it goes through the Mill.</p> <ul style="list-style-type: none"> <li>• Possibly could put sensors on trailers to notify the control system when they get to a certain weight for the haulage transport planning; could improve operational efficiency in haulage.</li> <li>• Requires capital investment and influenced by certain restrictions.</li> </ul>
	Interview 1	<ul style="list-style-type: none"> <li>• Value-adding is the key future opportunity; e.g. new cane tops project is exploring how to get more value out of sugar cane; can no longer just rely on income from raw sugar.</li> <li>• Other value-adding opportunities include investigating bio-plastics and fibre as alternative products.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• Value-adding seen as a key future opportunity.</li> <li>• Find ways to sell their own sugar.</li> </ul>
<i>Are there any issues about value chain research that we have missed?</i>	Focus group	<ul style="list-style-type: none"> <li>• When projects are coming to completion and we've got a better understanding of the real financial implications, maybe there needs to be some involvement of people with real financial modelling skills, rather than a researcher trying to put together a financial model on something. Someone like that could actually use the formats that we have in our own financial models, which means that the inputs could flow straight into our models. Otherwise they need to reformat the financial models to be able to see what it does to their business.</li> <li>• The value chain idea is a good way of looking at things because you get to see right across how things are going to affect every sector. Probably needs to be applied to specific things e.g. agronomy work and the harvesting program should be viewed as part of the whole value chain. Otherwise you won't address the needs of each sector and the effects on each sector of implementing certain changes.</li> </ul>
	Interview 2	<ul style="list-style-type: none"> <li>• The current time (i.e. start of the harvest season) is a particularly difficult time for growers to be involved in research workshops; the timing of workshops influences grower participation in research.</li> </ul>