INDUSTRY TRANSITION AND SUGARCANE FARM HOUSEHOLDS IN MARYBOROUGH[1]

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International competition and ageing canegrowers are two of the factors forcing the Australian sugar industry to plan its transition into the future. To be successful, industry plans must be consistent with the situation and objectives of canegrowing farm-households. A survey of Maryborough cane farmers aimed at identifying (a) farming resources, practices and outcomes; (b) household demographics, income sources and objectives. Statistical analysis is tailored to the partly qualitative data. Initial results show income-diversified households and age-related segmentation of farming. Findings will be used in developing regional policies in Maryborough that link the need for maintaining regional cane throughput with canegrowers' objectives.

Introduction

Since the mid 1990s, the Brazilian sugar industry has overtaken Australia's as the world's least-cost producer. The main institutional strength of the Brazilian industry is tight integration of the whole supply chain, from canegrowing to sugar marketing, usually through a single owner. This is in sharp contrast to Australia, where farms, harvesting and milling operations have mostly different owners (Figure 1), with potentially divergent interests.

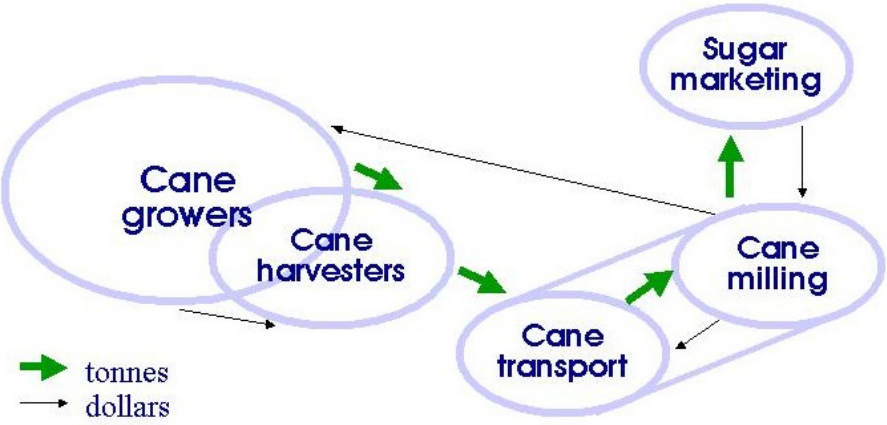

Figure 1. The Australian sugar supply chain

In addition, Brazil's advantage of larger farms and mills, as well as efficient transport, makes growing, harvesting, transport to the mill and milling all cheaper. While actual figures are notoriously difficult to obtain, anecdotal information and economic logic both indicate that declining cane throughput in most mill regions over the last few years has eroded the profitability of Australian sugar mills. To mitigate this effect, there has been a trend of amalgamating milling capacity by the closure of some sugar mills in multiple-mill regions. However, the 2003 closure of Bundaberg Sugar's Moreton mill (in Nambour) was the first

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case of a whole region being left without a processing facility, putting an end to the sugar industry in the region. This case in particular has brought into close focus the issue of sectoral profitability and relationships in the supply chain. In some regions these relationships have been characterized by conflict, in others by cooperation. However, in all of them the formal institutional framework has been traditionally set by pervasive government regulation (Antony et al. 2002). Deregulation has started in the 1990s, and recent Queensland legislation has deliberately overruled some traditional institutional relationships governing regional stakeholder relations. The main items of objection were (Qld Gov, 2003):

- compulsory membership of the statutory collective bargaining unit
- the existence of only one, statutorily privileged, collective bargaining unit
- the control of the single, statutory collective by a committee elected on a 'one-grower-one-vote' system
- the power of veto over other agreements between growers and a mill given to the members of the statutory collective.

The emerging new system will thus have much more need for market mechanisms and incentive-based relationships between stakeholders[4]. Development of the new, region-based institutions is further complicated by obstacles generally observable in the sugar industry. These were summarized in the Maryborough Strategic Plan (Maryborough 2003) as:

- Ageing grower population
- Lack of incentives for younger family members to stay on farms
- Low cane price and increased cost of production
- Land value boom including involvement with town planning engineers
- Vegetation management and environmental issues
- Lack of available finance
- Life style management of farms vs a business focus

The Sugar Research and Development Corporation is funding projects aimed at moving the sugar-industry supply chain towards a value chain, with a unity of regional focus and objectives towards better overall profitability. Research carried out at the Tropical Landscapes Program of CSIRO's Sustainable Ecosystems has Maryborough as one of its case studies. Part of the work is aimed at providing information to Maryborough stakeholders for their development of new regional institutions.

This paper describes a survey and results carried out among Maryborough canegrowers. The objective of the survey was to identify and measure production impediments perceived by canegrowers in Maryborough. A farm-household perspective is used in the survey, to account for diversification in household income sources and the influence of non-financial objectives on farm-business decisions. The description of the methods and results is followed by some implications for the incentive system in the regional sugar supply chain.

Stakeholder motivation in the sugar industry

Obtaining an indication of the motivation of stakeholders is the first step in developing a regional incentive system for the sugar industry. For mills not cooperatively owned by growers, one can safely assume that profit is the primary motivation. However, canegrowers' motivation is likely to be more complex. Policy recommendations for the sugar industry tended to assume a profit-oriented canegrowing sector, and promoted large and commercially-oriented farms (Hildebrand 2002). However, it is far from clear that large commercial farms are more sustainable than smaller "part-time" ones (Antony 2004), nor is the former segment characteristic of Australian sugarcane farms. It is ironic that, despite general awareness of farmers' widespread off-farm income sources, agricultural economists in their policy studies

[4] And it will be susceptible to the kind of market failure based on power that regulation was trying to pre-empt.

for developed countries tend to treat the farm as a profit-maximizing unit isolated from the household (Boisvert 2002). With notable exceptions addressing non-economic aspects of farm decision making (eg, Marshall 2004, Windle and Rolfe 2003), a farm-household focus seems to be reserved for developing countries.

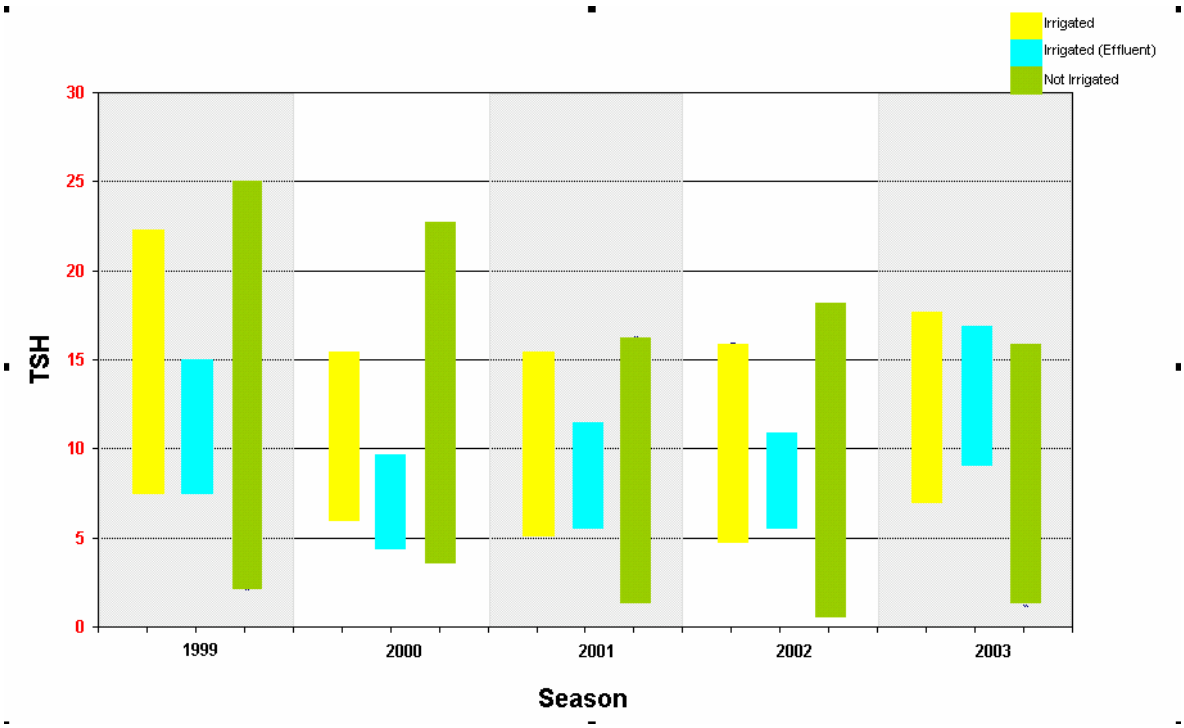
There have been previous studies of stakeholders' motivating factors in the sugar industry. Windle and Rolfe (2003) used choice modelling to account for non-economic variables in farmer decisions about diversification options and potential in five sugar regions. Her finding of substantial differences between the regions argues for a regional focus in studies of the sugar industry. Beyond that, the picture is of over-50 farmers, mostly without even secondary education, 37-46% with dependent children, 60-68% with debt, 40-49% with off-farm income, median sugarcane area of 66-114 ha, 28-53% with other agricultural activities besides sugar.

Kraack (2000) examined the sources of influence on farmer decisions about resource management in an ethnographic survey of two canegrowing regions. They found marked differences between the regions in priorities in sustainability (economic viability, soil protection, long-term survival, family sustainability and community sustainability).

Grasby et al. (2000) surveyed a random selection of 30% of Queensland and NSW canegrowers and all Western Australian growers. The median age of respondents fell between 50 and 54 years and the median farm size was 80 ha. Respondents typically had primary and junior high school education. On average, off-farm sources accounted for 35% of income, but the median figure was only 20%. Profitability was highest priority for 31% of respondents, maintaining productivity for 23%, environmentally friendly farming for 17%, community viability for 15% and maintaining a canegrower lifestyle for 14%. Respondents' opinions were also sought on a wide range of issues in the sugar industry.

Maryborough Farm-Household Survey

The objective of the Maryborough survey was to collect information for the development of an incentive system for canegrowers. At one level, it is in the interest of the region to maximize cane throughput, thereby improving the viability of the mill and gaining economies of size in infrastructure use. Figure 1 indicates that there is a large variation in per-hectare sugar yields in the region, even allowing for differences in soils, irrigation availability, crop age, etc.



Source: CSIRO value chain study

Figure 1 – Sugar yields in Maryborough

Hence, the mill is most interested in whether canegrowers maximize cane production, or if they don't why not?

At the farmer level, maximum cane production may not even be desirable from an economic point of view. Nevertheless, it may be one of a number of non-economic objectives that farmers have. The survey was intended to provide:

- an overview of farm resource endowment and use
- a review of farming activities and technical practices
- an indication of the profitability of the sugar business and farm debt
- baseline data on demographics of the households
- information on the income sources of the household
- an indication of the lifestyle preferences of the household

Resource limitations made a mail survey necessary, hence the questionnaire (see Appendix) was drawn up to facilitate and encourage response as much as possible, even at the cost of delivering less than ideal detail in the form of qualitative information. The local Canegrowers representatives and the mill were actively involved in designing, pilot testing, promoting and conducting the survey. 37% of the questionnaires were returned (60 out of 162), an excellent rate for an anonymous mail survey with no follow-up. The survey concerned the year 2003 for which all financial records were already available. Table 1 summarizes the major socio-economic characteristics of the respondents, compared to the regional averages where available. Note the term "sugar business": canegrowers often also engage in cane harvesting and various types of sugar-related contract work.

Table 1 - Socio-Economic Characteristics of Respondent Farm Households

	Survey response			Maryb ave in 2003
	Ave	**Median**	**Total**	
Farm area	189 ha	101 ha		95 ha
Cane area	90 ha	68 ha		70 ha
Cane yield	77 t/ha	74 t/ha		70 t/ha
CCS (sugar content in per cent)	13.2	14.0		14.0
Unpaid farm labour on farm	1.6	1.0		
Paid farm labour on farm	1.4	1.0		
Family members working on farm	1.9	2.0		
Family members working off farm	1.4	1.0		
Households with dependent family members			60%	
Number of dependent family members	1.3	1.0		
Operator's age	51 yrs	49 yrs		
Operator's education level – primary			12%	
Operator's education level – secondary			62%	
Operator's education level – trade			15%	
Share of sugar business in household income	54%	55%		
Share of off-farm income in household income	45%	40%		
Respondents stating that their sugar business is profitable			52%	
Respondents stating that sugar business is not profitable			42%	
Respondents to whom canegrowing means more than the income – "very much"			22%	
Respondents to whom canegrowing means more than the income – "somewhat"			35%	
Respondents with farm debt <$50,000			18%	
Respondents with farm debt $50,000-150,000			13%	
Respondents with farm debt >$150,000			21%	
Respondents who would use windfall time for leisure			35%	
Respondents who would use windfall time to earn income			50%	

Respondents to the Maryborough farm-household survey have a much larger average farm size, and a somewhat larger cane area, than the regional average. Consequently, the respondents are more involved in non-sugarcane agriculture than the regional population. Average yields and CCS (sugar content) in the sample is, respectively, 10% above and 6% below the regional average for 2003. In terms of age and schooling, the Maryborough sample seems to be very similar to the studies quoted above.

It is very encouraging that, despite the industry's current difficulties, half of the sample respondents still make a profit in their sugar-related businesses.

Analysis and findings

The mix of quantitative and qualitative information obtained prevented the analytical elegance of constructing an all-encompassing model. Instead, various combinations of individual questions were examined for implied relationships using a number of statistical methods such as regression, correspondence and logistical analyses.

Maximization of production

Table 2 shows the responses to the question "What is preventing you from maximising production?" Frequencies of responses in the sample are shown and note that multiple responses were allowed.

Table 2 – Factors preventing production maximization

[a]	Nothing, still maximizing production	30%
[b]	Short of cash to buy fertiliser	8%
[c]	Short of cash to irrigate	15%
[d]	Cash flow is too low	43%
[e]	Uncertain about industry future	37%
[f]	Off-farm work takes too much time	12%
[g]	Weed problems	8%
[h]	Pest problems	7%
[i]	Disease problems	2%
[j]	Industry position has reduced motivation	30%
[k]	Maximum production is higher than most profitable production	15%

The industry's troubles, current and future, dominate the responses. Current cash flow (d) is perceived the largest obstacle to production, followed by uncertainty about the industry's future (e) and low morale (j). Nevertheless, almost a third of canegrowers still aim for maximum production (a).

The reasons that appeared on their own were mainly (a), but also (d), (f) and (h). The fact that (a) also appeared together with other answers, namely (c), (d), (f), (g), (h), and (k) shows the different interpretation of the question by some respondents. One in seven respondents shows an understanding of production economics (k), and only one respondent ticked both (a) and (k). (e) and (j) often appeared together, sometimes as the only two reasons.

Regression analysis of sugar yield

Cane yields show a large variation in Maryborough, and bringing up the lowest yields closer to the regional average itself could be one way to boost regional throughput. Identification of the reasons of low yields is a first step in developing incentives to increase production.

Multivariate regression was performed for both irrigated and non-irrigated farms on a number of variables representing resource endowment, agronomic practices and household characteristics to see if any of them has a statistical relationship with sugar yield. The dependent variable in the regression is sugar yield per hectare. The independent variables are listed below:

1. Number of non-working family members dependent on the farm income;
2. Approximate share(percentage) of household income from cane in 2003;
3. Cane area in 2003;
4. Cane farmer's age at 2004;
5. Preference for using windfall time;
6. Farm debt; and
7. Use of ploughout-replant, fallowing, and crop rotations.

Variables 1 to 4 are numerical variables while variables 5 to 7 categorical variables. When performing regression, dummy variables were created and used for categorical

variables. Correlation analysis indicated that the correlation between any pair in the variable list above was low, so they can be regarded as independent variables when performing multivariate regression. The regression analysis could not identify any independent variable that was significant in explaining sugar yield for either of the irrigated and non-irrigated cases.

Regressions using a single independent variable were also performed for both irrigated and non-irrigated cases, and again none of the independent variables was significant in explaining sugar yield. All the regression analyses were not significant with R-squares much bigger than 0.5.

Correspondence analysis

Due to the mix of quantitative and qualitative information from the survey, correspondence analysis was considered best to assess relationships between the variables (Greenacre 1984). While more conventional statistical tests can also accompany it, this method is based on the visualization of the relationship between two categorical variables as the linear regression does for two quantitative variables. As the type of information used in our study is not conducive for statistical tests of significance, it is left to the reader to infer the strength of relationships.

Both sugar yield and age group were turned into categorical variables in the analysis of association between sugar yield and the farm operator's age. The definitions for sugar yield group and age group are outlined below:

Age groups:

- Young age less than 40 years
- Middle great than or equal to 40 but less than 55 years
- Old great than or equal to 55 years

Sugar yield groups:

- Low sugar yield less than or equal to 6.8 t/ha
- Median sugar yield great than 6.8 but less than or equal to 13.1 t/ha
- High sugar yield great than 13.1 t/ha

The cut-off points used above to determine the sugar yield groups were based on the last 12 years' block productivity data collected by Maryborough Sugar Factory.

Note that the age groups have distinct differences in some attributes that proved insignificant as explanatory variables in the regression analysis:

Table 3 – Major attributes of farm households by operator age

	Age group		
Attributes	**Young**	**Middle aged**	**Old**
Average age (years)	36	48	64
Average farm size (ha)	144.1	73.9	101.4
Average number of family members dependent on farm	3	2	2

Correspondence analysis on age and sugar yield has produced a map where the distance between the triangles representing yield groups and the dots standing for the age groups implies the strength of relationship (Figure 2).

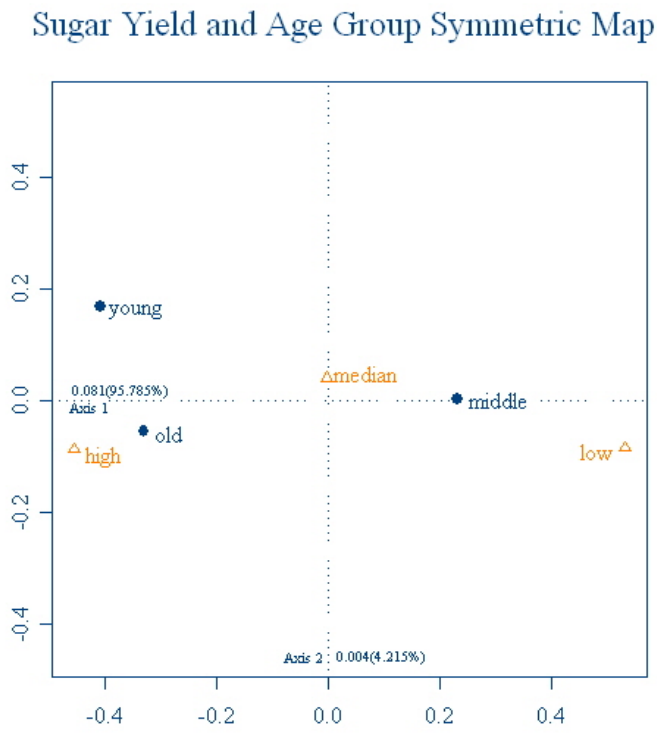


Figure 2 – Correspondence map on sugar yield and operator age

The map clearly separates the three farmer groups into two: middle aged vs young and old. The young and old people are closely associated with high sugar yield while the middle age people are half way between median to low sugar yield. This is an indication that there may be a differences in farming practices and management style between the two groupings.

Farming and farm-business differences between age groups

The percentages of people who irrigate their cane are similar across all three age groups, 66% for both the young and middle age groups and 58% for the old age group. While having irrigation is a matter of resource endowment, using the facility is subject to management decision: of the 66% who irrigate, about 51% of them use more than 50% of the allocated water for irrigation.

An important aspect of cane farming is the extent of monoculture. Immediate replanting of the ploughed-out remnants of the previous crop maximizes canegrowing area but is expected to have negative agronomic consequences (Garside and Bell, 2001). In contrast, while fallow periods and crop rotations with cane reduce the portion of cane in the cropping cycle, they are beneficial for agronomic sustainability. Growers were asked about their use of:

(a) ploughout-replant
(b) fallowing, and
(c) crop rotations with cane.

The responses in Table 4 reveal that most growers use a combination of approaches for crop succession.

Table 4 – Crop succession and operator age

	Age group		
Crop succession	**Young**	**Middle aged**	**Old**
a	0	5.7%	16%
b	17%	17%	11%
c	0	5.7%	0
ab	17%	17%	21%
ac	0	2.9%	0
bc	33%	23%	26%
abc	33%	29%	16%

There is a noticeable preference against ploughout-replant as the only method of crop succession among younger canegrowers in Maryborough. Fallowing seems to be similarly popular as the only method, but crop rotations on their own are only used by some middle-aged farmers. Much more widespread is the mixing of methods.

A correspondence analysis (see Figure 3) indicates that by fallowing and rotating with cane farmers will get median to higher sugar yield. The analysis also shows that both ploughout-replant and, contrary to expectations, crop rotation are associated with lower yields in the sample.

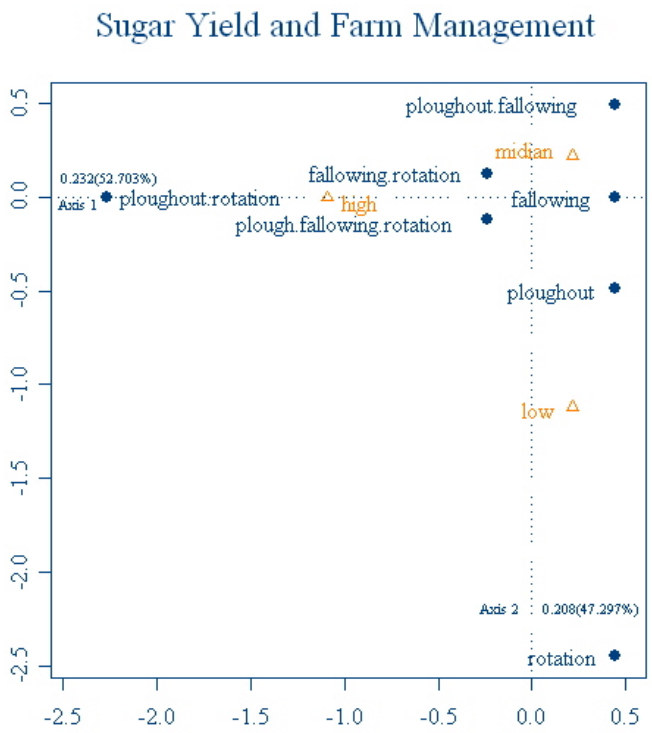


Figure 3 – Crop succession methods and sugar yield

Diversification within agriculture is a logical way of reducing exposure to an industry in difficulty. Agricultural options nominated by stakeholders for the survey were grain growing, horticulture, beef, baling cane trash and other agriculture. The frequency of the most common practices is shown in Table 5.

Table 5 – Agricultural diversification by farm operator's age

	Age group		
Agricultural diversification	**Young**	**Middle aged**	**Old**
Horticulture	17%	17%	11%
Beef		14%	21%
Other agriculture	17%	11%	21%

It appears that the oldest farmers are the most diversified, but prefer cattle over the horticultural pursuits of the young and middle-aged groups. This conforms with experience that the lower labour requirement of cattle makes is suitable for a 'pre-retirement' farming enterprise (Neil MacLeod, pers. comm.)

A comparison of farm debt across the age groups shows a polarization of debt towards the low and high dollar figures. Perhaps surprisingly, it also reveals that the old age group in general is no less in debt than the others.

Table 6 – Farm indebtedness by farm operator's age

	Age group		
Debt levels	**Young**	**Middle aged**	**Old**
Farm debt less than $50,000	40%	31%	38%
Farm debt $50,000-$150,000	20%	31%	19%
Farm debt more than 150,000	40%	38%	44%

Attitudinal differences between age groups

About 33% of the people in each of the young and old groups, compared with only about 14% in the middle age group, said that cane farming means more than just an income source to them.

About 42% of the people in the old age group would use a windfall extra free day a week to work more for money compared 37% in the middle age group and none in the young group. There is negligible difference in the proportion of people in all groups who would use the extra day for leisure. Farmers who have a debt of more than $50,000 also would use an extra day every to work for money. How an extra day every week would be used also depends on the number of persons a farmer has to care for. Farmers who care for more than four persons tend to allocate the extra day to work for money, while those care for no more than three dependents tend to use an extra day every week for more time off work.

Logistic analysis of profitability

Resource endowment and management practices are commonly considered to influence profitability. In this study, logistic analysis was used to test the relationships between a binary response (Yes or No to a question of profitability), and a number of factors.

Resource endowment was represented by the variables:

(1) Percentage of cane land irrigated;
(2) Farm size; and
(3) Cane area in 2003

Based on the information provided by this survey, the logistic model failed to identify any of the above factors as a significant factor in predicting sugar business profitability. The p-values associated with factors 1, 2 and 3 were 0.717, 0.255 and 0.19 respectively.

Five management variables are examined for their association with sugar profitability, again employing the logistic model. The five variables included in the models were:

(1) Cane yield in 2003;
(2) CCS in 2003;
(3) Number of ratoons aimed to have;
(4) Farming practices used in cane; and
(5) Percentage of water allocation used.

Variables 1-3 were numeric and 4-5 categorical. Analysis indicated that none of these variables were significantly associated with sugar business profitability. The p-values for significance tests on these variables were 0.947, 0.297, 0.695, 0.154, and 0.207 for variable 1, 2, 3, 4 and 5 respectively. The small number of data points for some of the variables probably affected the results.

Conclusions and implications

It has been demonstrated that the sugar business is only one of many sources of income for Maryborough farm-households with a share of just over 50%. Off-farm income is the second-largest source of income, at 40-45%. The clear implication is that the farm businesses cannot be analysed in isolation from the rest of the households' income-earning activities. Non-financial benefits are also demonstrable to being a cane farmer, further reducing the likelihood that the only farm objective is maximum profit.

The fact that a majority of respondents still make a profit in sugar indicates that the region still has the capacity to hold on financially. No individual factor could be identified as influencing profitability, including resource endowment or farming practices. However, responses indicate that there should be scope for improvements to help more local sugar-related businesses back into the black by, for example, dealing with weed, pest and disease problems that may not need more financial resources but rather better management techniques. More analysis is needed on the relationship of profitability and production techniques, including the detailed farm surveys that are planned for the region.

The industry's difficulties seem to have a considerable psychological impact on growers, causing some to hold back on production even if cash flow is not an issue. A publicity effort aimed at reassuring people about having a future in the industry may have positive benefits. Specifically, an explanation to what extent and why experience from industry shutdown in the neighbouring Moreton region is not applicable would need to be developed and communicated to growers.

Albeit without the power of conventional statistical tests of significance, a relationship could be identified between farming practices and yields. This suggests that there is scope for increasing yields through the extension of better farming practices.

Age-related trends can be expected to change canegrowing over a number of years. The youngest group of growers have higher sugar yields and tend to follow the agronomic practices currently recommended for better sustainability. Farm succession is a slow process, however, and this is not going to raise production in the short term.

As expected, the number of dependent family members and the farm debt level influence whether people would use extra time for income earning or leisure. There is still a positive attitude towards being a canegrower, and this seems to be recreated in the younger generation. Hence, the often-mentioned lifestyle benefit of cane farming is perceptible among the respondents, and it would provide the psychological incentive to do better.

There may be various ways to encourage higher yields in the short run:

- Since anecdotal information suggests that yields are partly a function of management intensity, to some extent they can be raised without added physical inputs. Peer incentives may be one way, such as reflecting yields in voting rights in the local area negotiations. However, if cane competes for time with other agricultural and off-farm activities, financial incentives are needed to stimulate the direction of more attention to cane.
- Reforming the cane-payment formula is the way to progressively reward cane yield and/or improved yield. In principle, increased regional throughput would allow unit-cost reductions in transport and processing, and some of these could be used as incentives. Modelling of the regional costs and benefits along the supply chain will be needed to have a feel for the potential in regional economies of size.

Acknowledgements

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Appendix

Maryborough Farm Survey

1. What is preventing you from maximising production? *(please tick all applicable boxes)*

[a] Nothing, still maximising production
[b] Short of cash to buy fertiliser
[c] Short of cash to irrigate
[d] Cash flow is too low
[e] Uncertain about industry future
[f] Off-farm work takes too much time
[g] Weed problems
[h] Pest problems
[i] Disease problems
[j] Industry position has reduced motivation
[k] Maximum production is higher than most profitable production

2. Total farm size: ..... ha **or** acres
(please circle applicable units)

3. Cane area in 2003: ..... ha **or** acres

4. Number of ratoons you aim to have: .....

5. Do you use any of the following in cane?
(please tick all applicable boxes):
[a] ploughout-replant
[b] fallowing
[c] crop rotations with cane

6. Your cane yield in 2003:
..... t/ha **or** t/A ..... CCS

7. Irrigated cane in 2003: ..... ha **or** acres

8. What % of water allocation you tend to use?
[a] less than 50% [b] more than 50%

9. Do you still irrigate if you have to borrow to pay for water? [a] yes [b] no

10. Number of full-time workers (including family members) in cane in 2003:
unpaid: ..... paid: .....

11. Did you use contractors in cane in 2003 for: [a] planting [b] harvesting [c] none

12. Did you have income from cane contract work in 2003: [a] planting [b] harvesting [c] hauling [d] none

13. Non-cane agricultural activity on farm:
[a] grain crops [b] horticulture
[c] beef [d] baling cane trash
[e] other agriculture

14. Did your sugar business (growing and/or harvesting, contracting, etc.) turn a profit in 2002/03? [a] yes [b] no

15. Farm operator's highest education level:
[a] primary [c] trade
[b] secondary [d] tertiary
[e] other: .....

16. Farm operator's year of birth: .....

17. Operator same as owner? [a] yes [b] no

18. Number of working family members including farm operator:
on-farm: ..... off-farm: .....

19. Number of non-working family members dependent on the farm income: .....

20. How would you use an extra free day every week?
[a] more work for money
[b] more time off work

21. Does cane farming mean more to you than the income?
[a] very much [b] somewhat [c] no

22. Approximate share of household income in 2003:
from cane: .....% from off-farm: .....%

23. Farm debt::
[a] less than $50,000
[b] $50,000 - $150,000
[c] more than $150,0