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DIVERSIFICATION IN THE SUGAR INDUSTRY: THE GROWERS' PERSPECTIVE IN CENTRAL QUEENSLAND, AUSTRALIA

Jill Windle
Centre for Environmental Management, Central Queensland University, Bruce Highway, Rockhampton, 4702
j.windle@cqu.edu.au

John Rolfe
Faculty of Business and Law, Central Queensland University, PO Box 197, Emerald Q.4720
j.rolfe@cqu.edu.au

Abstract
The future viability of the sugar industry has been questioned in several major reports. It is generally agreed that the industry will have to undergo some changes. One of the key issues in the most comprehensive of these reports, the Hildebrand report (Hildebrand 2002), is the need to improve economic efficiency in the industry. At the grower level, the report considers many farms to be economically unviable and advocates the need to increase farm size to achieve better economies of scale. Some growers will not be able to expand and a more viable economic option might be to diversify farm enterprise income. Generally, the main advice farmers receive about alternative crops is based on gross margins, but there are other components of crop diversification which may influence growers' decisions, eg, changes in management effort required or changes in the level of risk associated with a new crop. This paper outlines a study that used the Choice Modelling technique to explore the trade-offs growers make between different components of diversification, when deciding on possible diversification options. The influence of socio-economic characteristics on choice is also explored.

Introduction
Growers in the sugar cane industry have been struggling under financial pressure for several years. Sugar prices have been low, and adverse weather conditions have spoiled crops. In addition, some areas have also experienced crop losses from different pests and diseases. In particular, the Central Queensland region has suffered the impacts of orange rust in one of their popular new and productive varieties. The difficulties in the sugar industry have generated substantial debate about the need and potential levels of government support. To assess those arguments, an independent review (Hildebrand 2002) was commissioned by the Federal Government. While current conditions are particularly difficult, Hildebrand (2002) suggests that pressure from low sugar prices, increasing costs of production and debt levels will remain and continue to impact adversely on the viability of many farms.

At the grower level, Hildebrand (2002) considers many farms to be economically unviable and advocates the need to increase farm size to achieve better economies of scale. Some growers will not be able to expand, and a more viable economic option might be to diversify farm enterprise income. However, little information exists to identify the willingness of sugarcane growers to explore diversification opportunities. The study discussed in this paper was designed to explore factors that may influence growers' choice of particular diversification options. Choice Modelling, an economic valuation technique, was used to explore the trade-offs growers make between different aspects of diversification, and how their choices may be related to certain socio-economic factors. Application of the technique involved surveys of cane growers in the Central Queensland region.

Survey details

Sugarcane growers in the Mackay and Sarina area were surveyed in late November /early December 2002 and growers in the Proserpine area were surveyed in January 2003. All three areas are located in central Queensland, with a distance of 36kms from Sarina to Mackay, and 126kms from Mackay north to Proserpine. The same collection technique was applied in all areas. Contact information for growers was supplied by CANEGROWERS organization and related to Cane Production Areas, rather than individual growers. Information was edited for multiple entries and current telephone numbers. First, attempts were made to contact all growers by telephone and establish whether or not they were willing to complete a questionnaire survey. Several attempts were made to contact growers at a various appropriate times. Surveys were then delivered to the homes of those willing to participate and later collected from them – a drop-off/ pick-up collection technique. A very high response rate of 67% was obtained in both areas (see Table 1 for details).

Table 1 Survey Response Rates in Mackay, Sarina and Proserpine Areas

	Mackay/Sarina	Proserpine
Callable listings	990	218
Contact made	588	145
Agreed to participate	458	118
Surveys collected	391	99
Response rate	**67%**	**68%**

The survey design and content was developed in discussion with various experts, and was amended on the advice of two grower focus groups held in Walkerton and Farleigh in the Mackay area. All technical details and information presented in the section on crop diversification was based on information provided by relevant experts in the Central Queensland region.

A Choice Modelling Case Study of Diversification Options

Choice Modelling (CM) is a non-market valuation technique that has become popular for eliciting values for environmental goods with multiple attributes (Adamowicz *et al.* 1998, Blamey *et al.* 1999). It is a technique in which respondents are asked to state their preference or choice when presented with a series of options. In this study, the method is used in relation to different options for diversification in the sugar industry. CM is used to determine how growers value different components of diversification, and how such values may be related to particular socio-economic characteristics of the respondents, and to particular opinions they may have.

Survey respondents were asked to make a series of choices about alternative options for diversification. Each choice set involves a number of options describing the alternatives on offer. In this study, the first option was to keep growing sugarcane and not to diversify. This option remained constant between the choice sets. Six other options were presented in each choice set – beef cattle, tree crops, horticulture (annual), horticulture (non-annual), field crops and forestry. Each option was labelled and the labels remained the same in each choice set. Each option was described in terms of five attributes or components:

- start-up costs

- production costs
- risk
- management effort
- net annual income

The attribute levels associated with each option was based on specific examples suitable for the central Queensland region. Attribute levels varied in each choice set (see Appendix 1 for details), so that respondents were being asked to make a series of similar, but different choices. Respondents were presented with three pages of choices or choice sets (see Appendix 2 for an example choice set). Information about each of the options was provided to the respondents in the questionnaire, prior to their being asked to complete the choice sets. An experimental design was used to generate 81 profiles for the choice sets. Each survey had three choice sets and there were 27 different versions of the survey.

391 surveys were completed in Mackay/Sarina and 99 surveys were completed in Proserpine. The results from the two areas were combined providing a total of 1470 completed choice sets. However, the majority of growers (65%) in both areas chose to remain in sugar production and were not inclined to select one of the diversification options – they chose the "keep growing sugarcane" option in all three choice sets. As the aim of this section of the survey was to explore the way in which respondents valued the different diversification components, all these responses were removed. This left a total of 536 choice sets remaining for analysis.

The choice information is analysed using a logistic regression model (the LIMDEP software program was used). The main focus of interest lies is whether respondents choose a diversification option or if they choose to retain the status quo and "keep growing sugarcane". The probability that a respondent would choose a particular option can be related to the levels of each attribute making up the option profile (and the alternative options on offer), the socio-economic characteristics of the respondent, and other factors. The latter might include the ways in which the choices are framed to respondents through background information and structure of the survey, and the way in which the surveys are collected (Bennett and Blamey 2001, Rolfe, Bennett and Louviere 2002).

Each of the variables used in the models are specified in Table 2 and the results are presented in Table 3.

Table 2. Variables Used in the CM Application

Diversification attributes	
Start-up costs	Costs associated with establishing a new enterprise - $/hectare
Production costs	Costs of producing the crop - $/hectare
Risk	Years out of 10 income is at or below the cost of production
Management effort	Management skills required to grow the crop - % change from the **standard** – that required to grow sugar.
Net annual income	Income minus production costs. Estimated over a 30 year period and accounts for delays until first harvest.

Socio-economic attributes	
Age	Age of respondent (in years)
Education	Education (ranges from 1=never went to school to 6=tertiary degree)
Off-farm income	Household has off farm income, Yes(1) or No (2)
Debt	Farm debt as % of assets – from zero
Children	Respondent has children, Yes (1) or No (2)
Family workers	No of family members inc respondent working on farm
Experience	Farm management experience (in years)
Farm size	Total farm size 1=100ha or less, 2=101-200ha, 3=201ha or more
Sugar farm size	Sugarcane Area 1=50 ha or less, 2=51-100ha, 3=101-200ha, 4=201ha or more
Other crops grown	Current farming system includes other crop/cattle Yes(1) – No (0)
Tried other crops	Tried other crops Yes (1) No (2)
Constant values	
ASC_2(beef cattle)	Constant value which reflects the influence of all other factors on choice of the beef cattle option
ASC_3 (tree crops)	Constant value which reflects the influence of all other factors on choice of the tree crop option
ASC_4 (horticulture annual)	Constant value which reflects the influence of all other factors on choice of the annual horticulture option
ASC_5 (horticult–non annual)	Constant value which reflects the influence of all other factors on choice of the non-annual horticulture option
ASC_6 (field crops)	Constant value which reflects the influence of all other factors on choice of the field crop option
ASC_7 (forestry)	Constant value which reflects the influence of all other factors on choice of the forestry option

Table 3. Results of Multinomial Logit Model for Sarina, Mackay and Proserpine

DIVERSIFICATION ATTRIBUTES			**MODEL STATISTICS**	
Variable	*Coefficient*	*Stand Err*		
Start up costs	-0.0000	0.0000	No of choice sets	536 (15 skipped)
Production costs	-0.0000	0.0000	Log likelihood	-851.8080
Risk	-0.0135*	0.0073	Adjusted R squared	0.1506
Management effort	0.0014	0.0071	Chi-square (d of f)	155.9193 (28)
Net annual income	0.0001***	0.0000		

SOCIO-ECONOMIC CHARACTERISTICS

Option 2 – beef
Based on breeding and fattening

Variable	*Coefficient*	*Stand Err*
ASC_2	0.7416	0.6074
Debt	-0.0062	0.0046
Age	-0.0285***	0.0107
Other crops grown	0.9303***	0.2221
Family workers	0.1528**	0.0690

Option 3 – tree crops
Based on lychee and mango

Variable	*Coefficient*	*Stand Err*
ASC_3	-1.4825	1.0832
Experience	-0.0485***	0.0132
Farm size	1.2276***	0.3115
Sugar farm size	-0.4008*	0.2149
Other crops grown	-0.7196*	0.3761

Option 4 – horticulture (annual)
Based on pumpkin and watermelon

Variable	*Coefficient*	*Stand Err*
ASC_4	0.6288	1.1870
Age	-0.0339**	0.0157
Education	0.1829	0.1470

Option 5 – horticulture (non-annual)
Based on banana and paw paw

Variable	*Coefficient*	*Stand Err*
ASC_5	-1.7401	1.8871
Debt	0.0271***	0.0077
Age	0.0501*	0.0284
Children	-1.2067*	0.6514
Family workers	-0.6262**	0.2826
Tried other crops	-0.9769**	0.4982

Option 6 – field crops
Based on maize and mung bean

Variable	*Coefficient*	*Stand Err*
ASC_6	-0.0010	1.0746
Age	0.0330	0.0219
Off-farm income	0.8068**	0.3262
Children	-1.1676***	0.4043
Experience	-0.0269*	0.0151
Tried other crops	-0.7499**	0.3017

Option7 - forestry
Based on wood chip and sawlogs

Variable	*Coefficient*	*Stand Err*
ASC_7	-1.4808	1.2490
Age	-0.0387**	0.0162
Education	0.3558**	0.1417
Tried other crops	0.6039*	0.3089

"Net annual income" and "risk" were significant attributes in choosing between alternatives, including the alternative of "keep growing sugarcane". The socio-economic characteristics were modelled in relation to the specific options, to determine which characteristics were relevant to a particular option. None of the ASC values were significant which demonstrates that there were not any factors other than those included in the model which influenced the selection of any particular option.

The "beef "option tended to be selected by those who had other crops/cattle in their farming enterprise (presumably in this case most had cattle), and those who had more family members working on the farm. This option was not favoured by older people.

The only characteristic that influenced the selection of the "tree crop" option was larger farm size. All other significant factors were signed negatively, indicating that the option was not favoured in preference to maintaining the status quo option, "keep growing sugarcane". Those with more years experience, larger sugarcane farm size (in contrast to those with larger farm sizes), and those who were growing other crops/cattle were all less likely to select this option.

Age was the only significant factor in relation to the "annual horticulture" option, but it was a negative association, which meant that older people were less likely to select this option.

There were five significant factors in relation to "non-annual horticulture". Older respondents and those with higher debt levels favoured selection of this option, while those with no children, with more family workers on the farm, and those who had not tried other crops/cattle, were less likely to select the option.

Selection of the "field crop" option was favoured by older respondents and those without off-farm income, and not favoured by those without children, those with more years of farming experience and those who had not tried other crops/cattle.

The "forestry" option was selected by those with higher education levels and those who had not tried other crops and cattle, and it was not selected by older respondents.

Discussion

The results indicate that the net annual income (or gross margins) of a crop, together with the risk of generating a return, are the key attributes that growers focus on in choosing which crop option they prefer. In contrast, the costs of start up and production, and the management effort required, were not nearly as important. These results indicate that access to capital or different management skills are not perceived by growers as major barriers to diversification.

The choices between different diversification options were also driven by a range of other factors. It appears that different groups of farmers (as distinguished by factors such as age, education, farm size, debt levels, children) are interested in the different diversification options. This suggests that, unless one option is dominant in terms of net returns and low risk, there is potential for substantial variation in the region in the development of diversification options.

Many growers reported current or previous experience with growing other crops. In both areas, 29% of respondents grew something apart from sugar. The majority of these, 86%, had cattle as another farm enterprise. Overall, accounting for past and present experience, 43% of all respondents had some experience with crops, including cattle, other than sugarcane. A third of all respondents (33%) had some experience with cattle and 20% had experience with other crops. However, many growers reported bad experiences with diversification and had not continued production of alternative crops. So, they had some, but limited experience with managing other crops. In general, growers have a poor perception of the viability of alternative crop production in their area (Windle 2003).

However, the survey data also revealed how reluctant growers were to consider diversification options. 65% of growers only chose the "keep growing sugarcane" option across all choice sets, while this option was chosen in 1090 (74%) out of the total 1470 completed choice sets. Despite the current downturn, the potential for interest in diversification appears to be low.

Conclusion

Respondents were focused on growing sugarcane and it would appear that interest in crop diversification amongst sugarcane farmers in the central Queensland region is limited, particularly while knowledge and experience of alternative production systems remains low.

There are two attributes of diversification which pose significant barriers to change for sugarcane growers, gross margins and risk. As most growers have limited financial knowledge of their own and/or alternative crop production systems, their attention is focused on their basic returns for a crop. However, after several years of poor returns from sugarcane, one of the lower risk crops, growers were cautious and risk adverse in considering diversification options.

Although the majority of growers were not inclined to consider a diversification option in the survey, those who did consider the options were influenced by a range of socio-economic characteristics. The choice sets were relatively complicated, but realistic enough as people are often faced with a complex set of choices in their lives and people will learn their own way of making such choices. Different people will make choices in different ways, hence the range of socio-economic attributes that were significant in determining choice in this study.

Author details

Dr Jill Windle is a socio-economist and is currently involved in several research projects that explore the use of Choice Modelling, a non-market valuation technique, in natural resource management. She has previously worked in the sugar industry in North Queensland.

Associate Professor John Rolfe is a resource economist and teaches in the areas of economics, statistics and environmental management. His main research areas are dealing with environmental, resource management and regional development issues in Queensland. He also owns and operates a large cattle property.

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Appendix 1. Attribute Levels for Choice Sets*

	Start-up cost ($/ha)	**Production costs** $/ha	**Risk** (Years out of 10 at or below cost)	**Management effort** (% above standard)	**Net annual income** ($/ha)
Sugar - base	0	1500	2	standard	700
Beef cattle Based on breeding and fattening	300 450 600	35 60 85	1,2,3	-20 -30 -40	100 180 260
Tree crops Based on lychee and mango	10,000 20, 000 30,000	15,000 20, 000 25,000	4,5,6	40, 50, 60	5,000 11,000 17,000
Horticulture annual Based on pumpkin and watermelon	1,000, 2,000, 3,000	6,000 8, 000 10,000	5,6,7	20, 30, 40	1,000 2, 000 3,000
Horticu non annual Based on banana and pawapw	200 400 600	30,000 32, 000 34,000	4,5,6	30, 40, 50	1,000 10, 000 19,000
Field crops Based on maize and mung bean	100, 200. 300	400, 600, 800	4,5,6	40, 50, 60	400, 500, 600

Forestry	2,000	500			1,000
Based wood chip	2,500	1,000	2,3,4	20, 30, 40	4,500
and sawlog	3,000	1,500			8,000

* Information is appropriate for the region and was determined in consultation with local experts

Appendix 2. Example Choice Set

Question 19a: Carefully consider each of the following 7 options. They relate to ONLY A PART of your farm. Suppose these were the ONLY options available, which would you choose?

Option 1 – keep growing sugarcane	
Start-up costs ($/ha)	**0**
Production costs ($/ha)	**1500**
Risk (yrs at/below costs)	**2 out of 10**
Management effort	**Standard**
Net annual income ($/ha)	**700**

Please indicate which option you prefer – Tick one box only

☐ Option 1 – keep growing sugarcane

☐ **Option 2 – beef cattle** ☐ **Option 3– tree crops**

☐ **Option 4 – horticulture (annual)** ☐ **Option 5 – horticulture (non**

☐ **Option 6 – field crops** ☐ **Option 7– forestry**

Option 2 – beef cattle	
Start-up costs ($/ha)	**450**
Production costs ($/ha)	**85**
Risk (yrs at/below costs)	**2 out of 10**
Management effort	**40% less**

Option 3 – tree crops	
Start-up costs ($/ha)	**20,000**
Production costs ($/ha)	**25,000**
Risk (yrs at/below costs)	**6 out of 10**
Management effort	**60% more**

Option 4 – horticulture (annual)	
Start-up costs ($/ha)	1,000
Production costs ($/ha)	**10,000**
Risk (yrs at/below costs)	**7 out of 10**
Management effort	**30% more**

Net annual income ($/ha)	**100**

	Option 5 – horticulture (non-annual)
Start-up costs ($/ha)	**400**
Production costs ($/ha)	**30,000**
Risk (yrs at/below costs)	**4 out of 10**
Management effort	**40% more**
Net annual income ($/ha)	**1,000**

Net annual income ($/ha)	**5,000**

	Option 6 – field crops
Start-up costs ($/ha)	**200**
Production costs ($/ha)	**600**
Risk (yrs at/below costs)	**6 out of 10**
Management effort	**60% more**
Net annual income ($/ha)	**400**

Net annual income ($/ha)	**3,000**

	Option 7 – forestry
Start-up costs ($/ha)	**2,500**
Production costs ($/ha)	**1,000**
Risk (yrs at/below costs)	**2 out of 10**
Management effort	**20% more**
Net annual income ($/ha)	**1,000**