

**SOURCES AND MANAGEMENT OF RISK IN LARGE-SCALE
SUGARCANE FARMING IN KWAZULU-NATAL,
SOUTH AFRICA**

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ABSTRACT

The South African (SA) sugar industry supports approximately 50,940 small and large-scale producers who collectively produce 22 million tons of sugarcane seasonally, on average. SA farmers face many challenges that lead to an uncertain decision making environment. Despite a general consensus among agricultural economists that risk constitutes a prevalent feature of the production and marketing environment, various authors have recently stated that risk-related research has failed to provide a convincing argument that risk matters in farmers' decisions. The various shortcomings of previous research have been identified and recommendations for the future proposed. Recommendations include that the focus of future risk research should be on holistic risk management.

This study firstly identified the perceived importance of 14 separate sources of risk for a sample of 76 large-scale commercial sugarcane farmers in KwaZulu-Natal. Once a sufficient understanding of the risk perceptions of respondents had been attained, their use of 12 risk-related management strategies was determined. Principal components analysis (PCA) was used to investigate how individual management instruments are grouped together by respondents into choice brackets in order to make use of complementary and substitution effects. The study then proposed and demonstrated a technique that may be used in future research to isolate the effects of risk on individual risk-related management responses by modelling the management strategies contained within individual choice brackets with two-stage least squares regression analysis (2SLS).

The most important risk sources were found to be the threats posed by land reform, minimum wage legislation and the variability of the sugar price, in that order. PCA identified seven risk dimensions, collectively explaining 78% of the variance in all 14 risk sources considered. These dimensions were: the “Crop Gross Income Index”, “Macroeconomic and Political Index”, “Legislation Index”, “Labour and Inputs Index”, “Human Capital and Credit Access Index”, “Management Index” and the “Water Rights Index”. Respondents were also asked questions regarding risk-related management strategies, including diversification of on-farm enterprises, investments and management time. PCA identified six management response brackets, collectively explaining 77% of the variance in the 12 responses considered. These response indexes were: the “Mechanisation and Management Bracket”, “Enterprise and Time Diversification Bracket”, “Insurance and Credit Reserve Bracket”, “Geographic and Investment Diversification Bracket”, “Land Trade Bracket” and the “Labour Bracket”.

Lastly, the study proposed a methodology for investigating the role of individuals’ risk preferences in decision making. The recommended technique involves the simultaneous modelling of the major risk-related management strategies within each management response bracket, using 2SLS. A measure of risk preference was included in the 2SLS analysis to establish the influence of risk on decision making. By applying this methodology to the data obtained in this study, respondents were shown to be taking advantage of various complementary and substitution effects that exist between management responses. This was evident from the PCA and confirmed for the first previously identified management response bracket using 2SLS regression analysis. Risk attitude was shown to be a significant determinant of management decisions regarding the extent to which back-up management is kept in reserve.

Important policy recommendations stemming from this study include that government review restrictive labour legislation and decrease the uncertainty surrounding new land redistribution legislation. Farmers need to make better use of available information by considering the effects of any single management decision on separate decisions, enabling them to take further advantage of substitution and complementary effects that may exist between management strategies previously considered in separate decision brackets. The fact that mechanisation and labour use occur in separate risk-related management response brackets in this study is an example of one such substitution effect that farmers do not seem to be utilising in terms of their management decision making.

Future research using time series data is important in order to identify how risk perceptions and management portfolios change over time. Also, further research using the methodology proposed in this study may prove to be a useful means of more adequately addressing the question “Does risk matter in farmers’ decisions?”

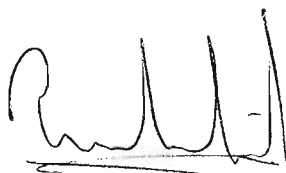
PREFACE

The research described in this dissertation was carried out in the School of Agricultural Sciences and Agribusiness, University of KwaZulu-Natal, Pietermaritzburg, from January 2005 to June 2007, under the supervision of Professor Gerald Ortmann and Dr Stuart Ferrer.

This study represents original work by the author and has not otherwise been submitted in any form for any degree or diploma to any University. Where use has been made of the work of others it is duly acknowledged in the text.

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INTRODUCTION

The South African (SA) sugarcane industry supports approximately 50,940 small and large-scale producers who collectively farm an estimated area of 426,861 hectares (SACGA, 2006). On average, 22 million tons of sugarcane are produced seasonally in 14 mill-supply areas, extending from Northern Pondoland in the Eastern Cape, through the coastal belt and midlands of KwaZulu-Natal (KZN), and into the lowveld of Mpumalanga (SASA, 2006). Sugarcane contributes approximately 82% of the income from field crops in KZN (STATSSA, 2002), with 72% of the crop planted by large-scale growers compared with 19% by small-scale growers (SACGA, 2006). The remaining nine percent is planted by millers. According to a 2002 census of commercial agriculture conducted by Statistics South Africa (STATSSA, 2002), approximately 87% of the gross farming income earned from sugarcane in South Africa is by producers in KZN.

SA farmers are faced with many challenges that lead to an uncertain decision making environment. In addition to dealing with the deregulation of domestic agricultural markets in the 1990s and thus more variable product prices, SA farmers also have to adapt to a dynamic global economic and trade environment, and a dynamic political environment. More specifically, other challenges that SA farmers are continuing to face include land reform, AgriBEE (Agricultural Black Economic Empowerment in Agriculture), new labour legislation and minimum wages, property (rural land) taxes, skills levies, uncertain water rights, HIV/Aids, a volatile exchange rate, and high transport and communication costs (Ortmann and Machethe, 2003; Ortmann, 2005). SA sugarcane farmers also had to deal with a highly variable sugar price in recent years (Illovo Sugar, 2006). Between January and March 2006 the International Sugar Agreement (ISA) daily price averaged

37.43 US cents per kilogram, 91% higher than in the same period in 2005 (FAO, 2006). Following a rise to almost 44 US cents per kilogram in early 2006, the price declined to about 26 US cents per kilogram by November 2006. European Union sugar policy reforms are a major market driver and are expected to continue to reduce world exports and contribute to strengthening prices, together with demand growth in China and India (FAO, 2006). Sugar production in Brazil is another major market driver, with projected growth in supply and the relative proportions of their crop split between sucrose and ethanol production being important market forces (FAO, 2006). Eighty percent of South Africa's anticipated export raw sugar sales for the 2006-2007 season has been sold at 33.58 US cents per kilogram, a price that is significantly higher than in the previous year (Illovo Sugar, 2006).

SA studies where farm-level data sets were used to identify the perceived importance of multiple risk sources include those by Swanepoel and Ortmann (1993), Bullock *et al.* (1994), Woodburn *et al.* (1995), Stockil and Ortmann (1997) and Hardman *et al.* (2002). The study by Woodburn *et al.* (1995) was conducted among commercial farmers in KZN, with 55% of respondents reporting a sugarcane enterprise. Similar studies conducted in the USA include those by Boggess *et al.* (1985), Patrick *et al.* (1985) and Ortmann *et al.* (1992). These studies identified mainly price and production risks as the most important perceived risk sources, although there was a trend towards the increasing importance of government legislation risks by the late 1990s. This is evident in the study by Stockil and Ortmann (1997) where changing labour laws and land reform policies were found to be the fourth and sixth most important risk sources, respectively. This study complements the research conducted by Swanepoel and Ortmann (1993), Bullock *et al.* (1993), Woodburn *et al.* (1995), Stockil and Ortmann (1997) and Hardman *et al.* (2002) by identifying risk

aversion amongst farmers and by investigating the dimensions that exist between risk sources using principal component analysis (PCA). Results are compared to previous studies in South Africa and KZN to analyse farmers' changing risk perceptions.

Despite a general consensus amongst agricultural economists that risk constitutes a prevalent feature of agricultural production (Moshini and Hennessey, 2001), Antle (1983) concluded that risk-related research in the discipline had failed to provide useful information for farm management. Twenty years later, Just (2003) convincingly argued that despite the large volume of research on the topic, agricultural economists had still not adequately addressed the question "Does risk matter in farmers' decisions?" In particular, he criticised risk-related research in agricultural economics for typically using aggregate instead of farm-level data, failing to account for heterogeneity in farmers' risk preferences, and for analysing specific production decisions without giving due consideration to holistic risk management (Just, 2003).

Holistic risk management recognises that various management decisions may act as substitutes or complements in risk management. For example, a farm business that has a high degree of enterprise diversification due to variation in physical characteristics of the land and climate across the farm, may be less likely to engage in income risk reducing strategies such as forward contracting, *ceteris paribus*. It is important to understand the choice bracketing behaviour of farmers to establish the levels at which they utilise the various beneficial substitution or complementary relationships that exist between many individual management instruments. Choice bracketing refers to the grouping of individual choices into sets, where sets of choices are bracketed together by considering the effect of each choice on all other choices in the set, but not those outside the set (Pennings *et al.*,

2005). This study uses PCA based on the levels of use of 12 risk-related management strategies to identify to what extent commercial sugarcane farmers in KZN bracket their management decisions. Based on the choice brackets identified, the study then proposes a useful approach to investigating the influence of risk aversion and other factors such as socioeconomic variables on the use of individual management decisions. It is argued that if risk preference is a determinant of the extent to which a management practice is used, then that management practice is a risk management practice; otherwise not.

The dissertation is organised as follows: Chapter 1 involves a review of the relevant literature for this study. Chapter 2 outlines the research methodology to be used. Chapter 3 explains the data collection process, the choice of study area and provides a summary of survey respondents' general characteristics. Chapter 4 deals with sources of risk, firstly identifying the perceived importance of 14 sources of risk and then using PCA to identify any dimensions that may exist between these risk sources. Chapter 5 investigates various managerial responses, commonly associated with risk management, and uses PCA to establish whether these responses may be grouped into choice brackets. Chapter 6 uses a measure of survey respondents' risk preferences, together with various other socioeconomic variables, to determine possible determinants of the choice bracketing behaviour revealed in the previous chapter using the simultaneous equations method. The dissertation concludes with a discussion and policy recommendations.

CHAPTER 1

LITERATURE REVIEW

This chapter presents a review of literature relevant to the study. The first section deals with whether or not risk should be included as an important consideration in agricultural economics research. This is followed by sections describing the various sources of risk and responses to risk identified in previous research. The chapter concludes with two sections identifying the limitations of previous research and proposed recommendations for future research, respectively.

1.1 Risk as an important consideration in agricultural economics research

“Risk and uncertainty are inescapable factors in agriculture” (Hardaker *et al.*, 2004: 4). Risk refers to uncertainty that may adversely affect a decision-maker’s welfare. Uncertainty refers to a situation in which knowledge pertaining to the possible outcomes is imperfect (Robison and Barry, 1987; Harwood *et al.*, 1999; Hardaker *et al.*, 2004). Although the distinction between risk and uncertainty is frequently made in risk-related literature, the terms will be used interchangeably in this study because both contribute to risk perceived by decision-makers. What is important is that risk constitutes an essential feature of the production environment and cannot be escaped when addressing most agricultural economic problems (Moshini and Hennessy, 2001). Virtually all decisions that farm managers are involved in are subject to risk, and their responses to the risk that they perceive will continue to influence the efficiency, structure and performance of agriculture (Jolly, 1983).

The importance of risk as a consideration in agricultural economic research is evident in the large volume of related work that has been conducted, both locally and internationally, over many years. Studies emphasising the importance of risk include those where risk has been shown to be an important component in supply response models (Aradhyula and Holt, 1989; Antonovitz and Green, 1990), and in acreage allocation decisions (Chavas and Holt, 1990). Foster and Rausser (1991) and Chavas (1994) also showed that risk is an important consideration in agriculture where sunk costs associated with the asset fixity of capital items and human capital exist.

Approaches to risk research are historically either parametric or normative in nature. Just (2003) identified the dualistic approach as one of the most commonly used methodologies in past research, and identified its various shortcomings. Criticisms of dual methodology include the fact that a sufficiently generalised representation of the producers' problem for the case of risk aversion has not yet been obtained, and that duality has limitations depending on the form in which disturbances enter the production model (Just, 2003). Other approaches such as non-parametric techniques, including mathematical programming, are becoming increasingly relevant to agricultural risk-related research (Just, 2003). Following a large body of financial risk-related literature, mathematical programming models, including linear programming solvable models, have started to be more widely used by researchers in an agricultural context (Ogryczak and Krzemienowski, 2003). Most models of this type follow the original Markowitz formulation and attempt to optimise an investment portfolio (Mansini *et al.*, 2003). Although this approach seems to have high potential for identifying the influence that risk has on decision making, it does have various restrictive requirements such as the availability of reliable farm-level panel data (Just, 2003).

Much past work has also tried to identify sources of, and management responses to, risks in agriculture. Studies conducted in the United States of America (USA) on commercial crop and livestock farms include those by Boggess *et al.* (1985), Patrick *et al.* (1985), Eidman (1990) and Ortmann *et al.* (1992). In a South African context, Swanepoel and Ortmann (1993) and Bullock *et al.* (1994) conducted similar studies on livestock and vegetable farms respectively. Woodburn *et al.* (1995) and Stockil and Ortmann (1997) conducted further research on commercial farmers in KZN. More recently Darroch (2001) conducted a study of risk management amongst game-based tourism operators in KZN, and Mohammed *et al.* (2006) studied perceptions and management of risk amongst small-scale commercial farmers in Eritrea. Many of these past studies have used multivariate analysis (specifically PCA) to identify the main sources of risk and management responses to risk that are prevalent in their respective study samples.

Following the notion that decision makers vary in the extent to which they take the consequences of their decisions into account, and that many individual risk responses may behave as substitutes or complements within a risk management portfolio, choice bracketing was introduced by Read *et al.* (1999). Choice bracketing refers to the grouping of individual choices into sets, where sets of choices are bracketed together by considering the effect of each choice on all other choices in the set, but not those outside the set (Pennings *et al.*, 2005: 5). In their study of US corn, cotton, soybean and wheat producers, Pennings *et al.* (2005) used this method to take into account combinations of risk management instruments and the interaction of the outcomes of using these instruments. Their study is useful in that it separates producers by means of their bracketing level and thus their combinations of risk management instruments, and uses producer characteristics such as age and risk attitude to explain why certain producers may be associated with a

particular bracketing level. Farmers who consider their decisions separately from one another are said to bracket their decisions at a narrow level. Farmers who consider two or more separate decisions to be interdependent and, therefore, consider these decisions simultaneously are said to bracket their decisions at a broad level. The more individual management decisions contained within a single choice bracket, the higher the bracketing level. The extent to which any individual risk management tool constituting part of a risk management portfolio is used within the choice bracketing framework is, however, not accounted for using the method proposed by Pennings *et al.* (2005). This is due to all risk management instruments being dealt with as binary variables, therefore somewhat limiting the explanatory power of models of this sort. The choice bracketing framework is, however, helpful in terms of aiding the conceptualisation of models where multiple sources of and responses to risk are incorporated.

1.2 Sources of risk in agriculture

A comprehensive review of risk-related literature revealed that considerable effort has been directed at identifying the sources of risk that affect agricultural producers. Based on this research, risk may be separated into two broad categories, namely business and financial risk. Business risk is often defined as being that risk which is inherent in the farming operation, and which is independent of the way in which the farm business is financed (Eidman, 1990; Hardaker *et al.*, 2004). Financial risk can be defined as the added variability of net returns to owner's equity that results from financial obligations associated with debt financing (Eidman, 1990; Hardaker *et al.*, 2004).

Several different methods of separating business and financial risks into sub-categories have been proposed. Eidman (1990) identified five dimensions of risk and uncertainty,

which included changes in the technological, climatic, social, political and economic environments. Hardaker *et al.* (2004) identify business and financial risk, and further categorised business risk into four sub-categories, namely production risk, price or market risk, institutional risk and personal or human risk. Institutional risk comprises political risk, sovereign risk and relationship risk. Moschini and Hennessy (2001) propose a similar categorisation but include technological risk as a component of business risk. Sources of risk (especially business risk) will differ in importance depending on the type of farming operation, and on the country in which a farm business operates, amongst other factors. The identification and ranking of risk sources within a specific sample will also depend on the modelling approach used and the way in which data are collected. Six past studies that identified the various sources of risk that were perceived as important by farmers are summarised in Table 1.1.

The range of various risk sources and their respective rankings that have been revealed by previous studies are evident from Table 1.1. The earliest of these studies was that of Patrick *et al.* (1985), followed by Ortmann *et al.* (1992), Swanepoel and Ortmann (1993), Bullock *et al.* (1994), Woodburn *et al.* (1995) and Stockil and Ortmann (1997). The four latest studies were conducted in South Africa with the remaining two performed in the USA. A large part of the variation in risk sources and their relative importance in each study may be attributed to differences between each analysis in terms of farm type, farm size, the prevailing economic and political environment, timing of the study and other factors such as geographical location.

Table 1.1: Ranking of risk sources by commercial farmers as identified in previous research conducted in South Africa and the USA.

AUTHOR	Stockil & Ortmann (1997)	Woodburn <i>et al.</i> (1995)	Bullock <i>et al.</i> (1994)	Swanepoel & Ortmann (1993)	Ortmann <i>et al.</i> (1992)	Patrick <i>et al.</i> (1985)
REGION	South Africa	South Africa	South Africa	South Africa	USA	USA
Risk Source: Variation in;						
Cost of inputs	1	1	4	5	6	3
Tax Legislation	2	11	11			
Government regulations	10	16	14		5	12
Crop yield	8	2	3	13	2	
Crop price	7	3	1	16	1	2
Livestock production	14	8		1	15	
Livestock price	2	4,5		3	12	
Cost of capital items	9	6	8	9	7	8
Interest rates	11	7	6	7	9	9
Illness or death of operator		10	10	6	3	7
Labour force		14	7		14	11
Rand exchange rate	5					
Weather			2	2		1
Labour laws	4	12	5	11		17
Land reform	6	9	9	4		
Marketing boards	13	18	16	15	4	10
Diseases and pests						5
Inflation (deflation) rate						3
World events						6
Use of leverage						13
Technology		15	13	12	8	15
Land rents			15	14	11	16
Credit availability	16	13	12	19	13	13
Family relationships		17		18	10	
Unionization of labour				22		
Political environment				10		
Marketing costs				8		

Note: Values represent the rankings of risk sources in order of perceived importance in each study.

Woodburn *et al.* (1995) and Stockil and Ortmann (1997) identified changes in costs of farm inputs as the source of risk that commercial farmers in KZN perceived to be most important. In Stockil and Ortmann's (1997) study this was followed by changes in tax legislation and variability in livestock prices, changes in labour legislation, changes in the Rand exchange rate, further land redistribution by government, variation in crop prices and variation in crop yields. According to Woodburn *et al.* (1995), the next most important sources of risk were perceived to be variability in crop yield, crop price, livestock price,

changes in capital item costs, changes in interest rates, livestock production variability and changes in land policies. Bullock *et al.* (1994) and Ortmann *et al.* (1992) found crop price variability to be the most important perceived source of risk amongst commercial vegetable farmers in KZN and leading Cornbelt farmers in the USA respectively. Bullock *et al.* (1994) found, in order of diminishing variability in rating, climatic variability, yield variation, changes in input costs, changes in labour legislation, interest rate variability, changes in the labour force, changes in the cost of capital items, and changes in land policy to be important. The ranking of climatic variability as high as second was attributed to the study area having been recently affected by drought.

Ortmann *et al.* (1992) found sources of risk for large US Cornbelt farmers other than crop price variability to be important, namely injury, illness or death of the farm operator, changes in government commodity programs, changes in government environmental regulations, and changes in costs of inputs and capital items. Swanepoel and Ortmann (1993) ranked livestock production variability, rainfall variability, livestock price variability, the threat of land reform and changes in input costs as the five most important sources of risk amongst livestock farmers in the NW Transvaal bushveld. Patrick *et al.* (1985) identified weather variability, crop price variability, costs of inputs and variation in the inflation (deflation) rate, and changing disease and pest pressure as those sources of risk perceived as most important for the average farmer in their 1983 survey. Robison and Barry (1987) propose storage cost fluctuations and uncertain futures prices as additional sources of risk. Darroch (2001) found crime to be the most highly rated cause for concern amongst game-based tourism operators in KZN.

1.3 Responses to risk in agriculture

“Risk management is the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risk” (Hardaker *et al.*, 2004: 13). As with identifying the important sources of risk, much has been accomplished in risk-related research to identify the possible responses that a farm operator may make to manage these risks. Possible risk responses are most often grouped into three broad categories. These include production, marketing and financial responses to risk (Patrick *et al.*, 1985; Ortmann *et al.*, 1992). Eidman (1990) distinguishes public responses as a separate category.

Another way in which to categorise risk responses is into those responses that reduce risk exposure, that transfer a part of the risk onto another party, and that improve a farm operation’s capacity to bear risk (USDA, 2000). Separating risk responses into these distinct categories may be difficult in the context of a specific study sample given its unique characteristics. Many managerial responses to risk may also overlap into more than one of these categories. The problem of isolating the effects of any individual risk response from others within a risk management portfolio is compounded by the fact that many risk management instruments may act as substitutes or complements. These phenomena are considered within a choice bracketing framework such as that used by Pennings *et al.* (2005), where within a set of bracketed risk management choices, non-profitable choices may enhance one another’s profitability if considered together within the same bracket. This is known as the adding-up effect and adds to the difficulty of attributing risk mitigating effects to individual risk management instruments. Table 1.2 shows the various risk responses and their respective rankings identified in studies by Ortmann *et al.* (1992), Swanepoel and Ortmann (1993), Bullock *et al.* (1994) and Woodburn *et al.* (1995).

Table 1.2: Risk responses, their categorisation and their perceived importance as identified in previous research conducted amongst commercial farmers in South Africa and the USA.

AUTHOR		Woodburn <i>et al.</i> (1995)	Bullock <i>et al.</i> (1994)	Swanepoel & Ortman (1993)	Ortmann <i>et al.</i> (1992)
REGION	(a)	South Africa	South Africa	South Africa	USA
PRODUCTION RESPONSES	Category				
Keeping production records	R, RBC	1(b)		4	
Making timely use of machinery	R	2	2		
Choice of production system	R, RBC	3		2	1
Being a low-cost producer	R, RBC	4	3	1	2
Decreasing use of capital items	R,RBC	5	11	10	
Diversification of enterprises	R,RBC	6	4	5	3
Reducing labour force	R	7	7	7	
Increasing farm size	RBC	8	6	8	
Having back-up management	RBC	9	9		4
Geographic dispersion	R, RBC	10	10	6	5
Having back-up labour	RBC	11			
Increasing use of capital items	R	12	5	11	
Increasing labour force	RBC	13	8	12	
Decreasing farm size	R	14	12	9	
Irrigation	R		1		
Increasing livestock numbers	R			3	
MARKETING RESPONSES					
Selling on free market	R	1	1		
Use of market information	R, RBC	2	2	3	
Direct marketing to consumers	R	3	3	2	
Keeping marketing records	R, RBC	4		3	
Vertical integration	R	5	4		
Forward contracting	RT	6	5	4	1
Selling through co-operative	RT	7	6		
Selling through marketing board	RT	8		1	5
FINANCIAL RESPONSES					
Keeping financial records	R, RBC	1	1	1	
Debt management	RBC	2	2	2	2
Maintaining credit reserves	RBC	3	4	3	2
Insurance of assets	RT	4	3	5	
Liability insurance	RT	5	5		1
Off-farm investments	R, RBC	6	8	7	6
Life assurance for partners	RT	7	6	4	4
Hail and crop insurance	RT	8	7	8	5
Off-farm employment	R	9	9	6	8

Note: (a) Category represents the categorisation of production, marketing and financial risk management responses into those that reduce exposure (R), transfer risk exposure (RT) and those which increase risk-bearing capacity (RBC).

(b) Values represent ranking of risk responses in order of perceived importance in each study.

Table 1.2 shows that the ranking of important risk responses identified in the studies of Bullock *et al.* (1994) and Woodburn *et al.* (1995) were similar. This may be because both studies were conducted among commercial farmers in KZN via postal surveys within a year of one another. The findings of Ortmann *et al.* (1992) and Swanepoel *et al.* (1993) differ, both between one another and between the two more recent studies, in terms of those risk responses that are identified as being relatively more important. Differences between the findings of Swanepoel *et al.* (1993) and the other three studies are most likely due to the fact that theirs was an earlier analysis that dealt specifically with extensive livestock farmers in the NW Transvaal bushveld. Similar conclusions may be made about the differences between the study of Ortmann *et al.* (1992) and the other three studies, as theirs dealt with Cornbelt farmers in the USA.

As suggested by the USDA (2000), risk management responses may be categorised into those that reduce the exposure of the farm business to risk, those that transfer risk onto another party, and those that improve the farm business' capacity to bear risk. Each of these categories are constituted by the various production, marketing and financial risk responses that have been identified in previous studies such as those by Patrick *et al.* (1985), Ortmann *et al.* (1992) Swanepoel and Ortmann (1993), Bullock *et al.* (1994), Woodburn *et al.* (1995) and Mohammed *et al.* (2006). Of the studies included in Table 1.2, those of Bullock *et al.* (1994) and Woodburn *et al.* (1995) were based on KZN surveys. The Woodburn *et al.* (1995) study also included a proportion of commercial sugarcane farmers amongst the respondents, and identified the most complete selection of risk responses. For these reasons the rankings of risk responses by respondents in the Woodburn *et al.* (1995) study are most relevant to this study.

1.3.1 Management responses that reduce risk exposure

Woodburn *et al.* (1995) found that the most important *production* response that reduces the exposure of a farm business to risk was perceived to be the keeping of production records. This was followed by making timely use of machinery, choice of production system, being a low-cost producer, decreasing use of capital items, diversification of farm enterprises, and reducing the size of the labour force. Bullock *et al.* (1994) and Swanepoel and Ortmann (1993) identified the use of irrigation and the increasing of livestock numbers as important risk responses in their respective studies.

According to Woodburn *et al.* (1995) and Bullock *et al.* (1994), the most important risk-reducing *marketing* responses to risk were perceived to be the selling of product on the free market, the use of market information, and direct marketing to consumers. The fact that marketing control boards were scrapped during the mid-1990s may also explain why respondents from these two studies rated the free market as their most important risk-reducing marketing strategy, contrary to the findings of Swanepoel *et al.* (1992). This was followed in the study by Woodburn *et al.* (1995) by keeping marketing records and vertical integration. Ortmann *et al.* (1992) included the purchase of commodity options as an important marketing response to risk in their study. The most important risk-reducing *financial* response of respondents was found to be the keeping of financial records by Swanepoel and Ortmann (1993), Bullock *et al.* (1994) and Woodburn *et al.* (1995). This was followed, in the study of Woodburn *et al.* (1995), by having off-farm investments and off-farm employment.

1.3.2 Management responses that transfer risk to other parties

Marketing responses that transfer risk to other parties identified in the study by Woodburn *et al.* (1995) included forward contracting, selling through co-operatives, and selling through marketing boards. In addition, Ortmann *et al.* (1992) identified forward contracting, government program participation and hedging the selling price as being of importance in the USA. Bullock *et al.* (1994) and Woodburn *et al.* (1995) identified the insurance of assets, liability insurance, life assurance for partners, and hail and crop insurance as important *financial* responses that transfer risk to other parties. Ortmann *et al.* (1992) identified multiple peril crop insurance as an additional risk-transferring financial response in their USA study.

1.3.3 Management responses affecting the farm business' ability to bear risk

There are a number of risk responses that may affect the ability of the farm business to bear risk. Some of the managerial responses to risk exposure may simultaneously increase the business' risk-bearing capacity and serve to reduce risk exposure. Bullock *et al.* (1994) and Woodburn *et al.* (1995) identified choice of production system, diversification of enterprises, increasing farm size, and having back-up management as *production* responses to risk that may improve the business' risk-bearing capacity. This was followed by geographic dispersion, having back-up labour, and increasing the labour force. The *financial* responses to risk exposure that may increase the business' risk-bearing capacity identified by Bullock *et al.* (1994) and Woodburn *et al.* (1995) include debt management, maintaining credit reserves and having off-farm investments.

1.3.4 Important socio-economic factors and risk preferences

Several key socio-economic factors may affect the availability, applicability, practicality, and the degree of utilisation of the various risk management responses by the principal decision-maker of a farm business. Some of these factors have been commonly used in past research, with others being included depending on their relevance to a particular study and its objectives. In studies on the sources and managerial responses to risk by Ortmann *et al.* (1992) and Bullock *et al.* (1994), data pertaining to a number of these socio-economic aspects were collected. Farmer's age, education and experience, type of business arrangement, hectares owned and rented, enterprise types, gross income, and the number of permanent labourers employed were found to affect managerial responses to risk exposure. Later studies by Goodwin and Mishra (2004) and Mohammed and Ortmann (2005) included variations of these factors and included family size and debt-asset ratios. Mohammed and Ortmann (2005) further considered off-farm investments and access to information as important socio-economic factors affecting the adoption of insurance as a risk response amongst Eritrean farmers. In addition, Sherrick *et al.* (2004) included level of business risk (reflected in insurance premiums) and expected yield as important factors influencing farmers' crop insurance decisions.

Most models involving management responses to risk exposure require knowledge of decision-makers' risk preferences (Ferrer *et al.*, 1997). Different approaches to eliciting farmers' risk preferences have been proposed in past research. Based on the seminal work by Pratt (1964) and Arrow (1965) the Arrow-Pratt absolute risk aversion coefficient (AP) and the Arrow-Pratt relative risk aversion coefficient (RR) were developed. Menzes and Hansen (1970) developed a third measure, namely the partial risk aversion coefficient (PR). In addition to the important socio-economic factors affecting managerial response to

risk, several past studies have included some measure of principal decision-makers' risk preferences. Examples of these studies include those by Bullock *et al.* (1994), Goodwin and Schroeder (1994) and Ortmann *et al.* (1992). Risk aversion is expected to be negatively related to the wealth of the principal decision maker but positively related to the use of risk-management instruments such as diversification (Barry *et al.*, 1995).

1.4 Limitations of existing research

Although much work has been conducted on risk research in the past, this work has failed to convince many of its importance in agricultural economics research (Just, 2003). Antle (1983) states that risk-related research has failed to provide useful information for farm management. This has mainly been due to the fact that the information presented has been pitched at a level that is difficult for farm managers to translate into practical solutions. Just (2003) has attributed this failure to a number of aspects of past research. He states that this has been largely due to the focus of researchers on risk in situations where risk is likely to be less important in terms of its influence on risk management strategies. This is due to data availability having restricted past studies to the use of aggregate data sets, and to focusing on short-run problems with temporal and spatial aggregation bias (Just, 2003; Just and Pope, 2003). Just (2003) lists some of his research as being included in the body of literature at fault in this regard (Just, 1974; Just and Pope, 1979). He also lists a study by Bar-Shira *et al.* (1997) among a limited number of notable exceptions, where analysis has been based on micro-level farm data. The studies of Swanepoel and Ortmann (1993), Bullock *et al.* (1994), Woodburn *et al.* (1995) and Stockil and Ortmann (1997) could be added to the list of notable exceptions in which analysis has been based on micro-level farm data.

The findings of Moschini and Hennessy (2001) are consistent with the opinions of Just (2003), and they state that a major problem in past research has been its reliance on aggregate data leading to aggregation bias. Just (2003) explains how temporal aggregation bias arises due to intra-seasonal variations in areas such as input-allocation being overlooked when using aggregated data sets. Another concern arising from the aggregation of data relates to the fact that risk attitudes play an important role in models incorporating risk, and given that such preferences are inherently an individual attribute, an agent's heterogeneity is an important consideration (Moschini and Hennessy, 2001). The findings of an earlier study by Just and Pope (1999) are consistent with this view, and lead the authors to emphasise the need for micro-level rather than aggregated databases that better represent farm and farmer heterogeneity, and in particular, farmer wealth, and that take into account factors such as intra-seasonal variability.

Another limitation of past research is that most of the literature involves the modelling of very specific areas within risk management, rather than the simultaneous treatment of multiple sources of and responses to risk (Just, 2003; Chambers and Quiggin, 2004). This poses a major problem by failing to account for the effects of the many risk management instruments that may substitute for or complement one another. By dealing specifically with a single risk management instrument or a small number of instruments rather than using a holistic approach, these relationships may be ignored resulting in findings and recommendations that could be misleading to producers, particularly to those who bracket their risk management choices broadly. Producers have at their disposal an array of risk management tools that increase the strategies available to them with which to manage risk (Chambers and Quiggin, 2004). Just (2003) identifies 11 specific areas of problem focus in agricultural risk research in the preceding 25 years. These areas include land and

technology allocation and diversification, risk management through the use of risk-reducing inputs, crop insurance and revenue insurance, and diversification using off-farm income opportunities, amongst others.

The understanding of why risk response occurs is very limited, with alternative explanations existing for most of the areas identified by Just (2003). For example, land technology allocation and diversification, the use of risk-reducing inputs, and crop and revenue insurance have explanations where risk management is a less important consideration than, say, profit maximisation. The justification of forward selling and use of futures markets as risk responses to deal with price risk is also questionable based on farmers' reluctance to employ such responses. Expectations formation and information management, contracting and vertical integration, mechanisms for income stabilisation, and diversification using off-farm income opportunities as risk responses can also be explained based on expected profit motivations rather than risk motivations (Just, 2003). Difficulties in separating risk responses between those due to expected profit motivations and those due to risk motivations are also identified by Musser and Patrick (2002). Chavas and Bouamra-Mechemache (2002), however, suggest that the failure to account for imperfect risk markets with high transaction and information costs may have limited the efficiency of risk allocation.

Recent emphasis in risk-related research has been on duality and non-parametric approaches, which has led to major self-imposed constraints within models. Just (2003) suggests that both of these approaches have been counterproductive because they ignore risk aversion. This raises the question of model mis-specification arising from the omission of important variables. Just (2003) finds that specification biases in past models stem from

omitting important variables such as human capital. Studies by Foster and Rausser (1991), Bar-Shira *et al.* (1997) and Just and Peterson (2003) support this finding and state that human capital explains a significant proportion of risk-averse behaviour. Generally, risk studies have failed to empirically identify risk behaviour clearly enough or in the context of broad enough models to provide a convincing argument that risk is an important consideration in policy issues (Just, 2003). The result of this failure is the divergence of results between experimental studies of risk and real-world empirical problems (Buschena, 2003). Goodwin (2003) suggests that more attention must be given to achieving a valid representation of the producers' problem.

1.5 Recommendations for further research

Just (1974) stated that a quantitative knowledge of farmers' reactions to risk is of considerable importance. More recently, Just (2003) suggested that models that capture the interactions of risk somewhat imperfectly yet lend themselves to the efficient use of available data, and characterisations that transcend individual models will be important in future research. 'Research is needed to determine what matters to decision-makers, how the correlation of outcomes occurring across time matters, and about when it matters' (Just, 2003: 135). Jolly (1983), supported by Chambers (1983), advocate a more holistic approach that provides information that is both understandable and useful to farmers. Just and Pope (2002) agree that factors such as human abilities of identification, comprehension and information processing are important considerations that need to be included in studies involving risk. They also identify other important difficulties that need to be addressed in risk-related research such as the fact that basic risks are endogenous depending on information and other farmer choices. Pennings *et al.* (2005) suggest within their choice bracketing framework, that research is needed that allows the factors associated with risk

management strategies to have different influence across producers and choice brackets. A shortcoming of their study is that farmers' use of management strategies are captured using binary variables, and do not reflect the extent to which a management strategy is applied.

1.6 Discussion

This section reviewed research involving risk and risk management. Specifically, studies dealing with sources of risk and their perceived importance and studies involving the perceived importance of various risk management strategies were reviewed. Different opinions regarding the question of whether or not risk matters to decision makers in an agricultural context were also investigated. Various authors have suggested that the failure of previous research to adequately answer this question is due to certain shortcomings in methodologies used. Just (2003) has proposed some solutions to these problems. These include the use of farm-level data, the simultaneous modelling of more than one risk management strategy and the inclusion of variables that suitably represent farm and farmer heterogeneity, including a measure for an individual's risk preference. The next chapter proceeds to describe the research methodology to be used in this study.

CHAPTER 2

RESEARCH METHODOLOGY

The purpose of this chapter is to describe the methodology to be used in answering the question “Does risk matter in farmers’ management decisions?” The first section outlines the study objectives and is followed by a section describing the estimating procedure. This is followed by two sections presenting the mathematical models used in this study. The final section explains how an individual’s risk preference will be estimated for the purposes of inclusion in the analysis.

2.1 Study objectives

The literature review revealed that farmers face a variety of risk sources and have a range of responses with which to manage their risk exposure. There have been numerous studies that have either identified the perceived importance of risk responses, or estimated the extent to which farmers employ a specific risk response. Just (2003) recently stated that, despite previous efforts, more comprehensive proof is required that risk is actually an important consideration in the decision making process. A more holistic approach involving all of the risk responses constituting farmers’ risk management portfolios has been recommended by various authors. This study proposes to use farm-level data to obtain quantitative estimates of the levels of actual use of multiple managerial responses and to investigate the extent to which these responses are combined into choice brackets by respondents. The study then proposes a method of investigating the influence of individual risk preferences and other socioeconomic variables on the use of particular risk-related management instruments, using the choice brackets identified, for future research. Finally,

examples of exactly how this method may be applied in future research are presented using the available data set.

The first logical step in this study is to obtain a full understanding of the perceptions of risk by survey respondents. Therefore, this study initially identifies the perceived importance of various risk sources facing large-scale commercial sugarcane farmers in KZN. Principal component analysis (PCA) is then used to investigate any dimensions that exist within these risk sources (Chapter 4). Once a sufficient understanding of the risks facing farmers within the study sample has been attained, the various managerial responses available to respondents will be quantified. PCA will then be used to investigate the extent to which respondents combine individual managerial responses into management strategies or choice brackets (Chapter 5). Because the levels of actual use of risk-related management strategies are used in this analysis, the principal components (PCs) represent choice brackets, where each bracket contains only those management instruments considered simultaneously by decision makers. With this in mind, a method that may be used to determine the effects of risk attitude and various other socioeconomic variables on individual management decisions will be presented in Chapter 6. The proposed method uses simultaneous-equations to model those management decisions responsible for the majority of the variation within each choice bracket and identify the important determinants of each individual management instrument. By including a measure of risk preference as an explanatory variable in these models, it may be possible to separate the true risk responses from those that are influenced mainly by factors other than risk and considered purely good farming practice.

2.2 Estimating procedure

The first model in this study is applied in Chapter 4 and involves a PCA of risk sources. Similarly, the second model applied in Chapter 5, involves a PCA of risk-related managerial responses. The one significant difference between these two models is that the PCA used in Chapter 4 is based on the covariance matrix compared to the PCA used in Chapter 5 which is based on the correlation matrix. This is because the units and magnitudes of measure of risk sources are the same, compared to those of the managerial responses, which are different. When differences in the units of measure exist in the data, the use of the covariance matrix would have negative implications for the direct comparability of the results of analyses for different sets of random variables (Jolliffe, 1986: 16-17). The final model in this study is applied in Chapter 6 and involves a two-stage least squares regression analysis (2SLS) of various socioeconomic variables on the management instruments that fall within an individual bracket, and that are therefore endogenously determined. A measure of risk attitude is also included as an endogenous variable in the 2SLS regression models due to its expected correlation with certain exogenous variables, such as age, education and farm size. PCA and 2SLS regression models are estimated using SPSS software (SPSS, 2004).

2.2.1 Principal Component Analysis (PCA)

The main aim of PCA is to reduce the dimensionality of a data set, while retaining as much of the variation present in the data set as possible. This reduction is achieved by transforming data to a new set of variables, the principal components (PCs), which are orthogonal and ordered so that successive PCs contain diminishing proportions of the total variation present in the original data (Jolliffe, 1986: 1). If any individual variables are almost independent of all other variables, then there will be a PC corresponding to each

such variable, and the PC will be almost equivalent to the corresponding variable. Some authors have suggested that PCA should only be used with continuous variables. Jolliffe (1986) argues that correlations on which PCs are based are still valid for discrete variables, as long as the values of discrete variables are binary and have genuine interpretations. Based on a covariance matrix in Chapter 4 and a correlation matrix in Chapter 5, and according to Jolliffe (1986), the principal components (\mathbf{Z}) are defined as:

$$\mathbf{Z} = \mathbf{A}'\mathbf{x}^* \quad \dots(1)$$

Where \mathbf{A} has columns consisting of the eigenvectors of the correlation matrix (covariance matrix in Chapter 4), and \mathbf{x}^* consists of standardised variables.

2.2.2 Simultaneous-equation (two-stage least squares) method

The simultaneous-equation method is used when there is a two-way, or simultaneous, relationship between the dependent variable in an equation and one or more of its explanatory variables. In such models the parameters of a single equation may not be estimated without taking into account information provided by other equations in the system (Gujarati, 2003). The application of ordinary least squares regression (OLS) on such a model would result in inconsistent estimators due to simultaneous-equation bias (Gujarati, 2003). “The method of 2SLS is especially designed for overidentified equations, although it can also be applied to exactly identified equations” (Gujarati, 2003: 785). For an equation to be exactly identified it should be possible to obtain unique numerical estimates of the structural coefficients from the estimated reduced-form coefficients. An equation is said to be overidentified when there may be more than one value for one or

more structural coefficients (Gujarati, 2003). “The basic idea behind 2SLS is to replace the (stochastic) endogenous explanatory variable by a linear combination of the predetermined variables in the model and use this combination as the explanatory variable in lieu of the original endogenous variable” (Gujarati, 2003: 785). Endogenous variables are defined as jointly determined variables compared to predetermined variables which are defined as truly nonstochastic (Gujarati, 2003). “The 2SLS method thus resembles the instrumental variable method of estimation in that the linear combination of the predetermined variables serves as an instrument, or proxy, for the endogenous regressor” (Gujarati, 2003: 785). The simultaneous-equation models in this study are of the following general form:

$$Y_{1i} = \beta_{10} + \beta_{12}Y_{2i} + \gamma_{11}X_{1i} + u_{1i} \quad \text{.....(2)}$$

$$Y_{2i} = \beta_{20} + \beta_{21}Y_{1i} + \gamma_{21}X_{1i} + u_{2i} \quad \text{.....(3)}$$

Where Y_1 and Y_2 are mutually dependent, or endogenous, variables and X_1 is an exogenous variable; u_1 and u_2 are stochastic disturbance terms. β and γ represent parameters.

The level of use of the risk-related management responses considered in this study is expected to be influenced by various farm (physical and financial) and farmer characteristics (e.g. human capital and psychological variables such as risk preference) and also by any other management responses considered within the same choice bracket. Important determinants identified in previous studies include farmer age, education level, experience, farm business arrangement, farm size, enterprise type, gross income and the number of permanent labourers (Ortmann *et al.*, 1992). Others include levels of off-farm investment (Mohammed *et al.*, 2006) and farmer’s perceptions regarding factors like

expected yields (Sherrick *et al.*, 2004). In order to analyse the role of risk in decision making some measure of risk attitude must also be included.

2.2.3 Risk preference

A direct elicitation of utility (DEU) through preset choices approach was used to elicit the risk preferences of principal decision makers. Monetary incentives were hypothetical due to budgetary constraints and respondents were not expected to encounter any difficulty in understanding the elicitation of certainty equivalent procedure. Elicitation through preset choices was used as only a single round of questioning was practical given time constraints and that lotteries were to be kept consistent across respondents to facilitate the comparison of risk preferences. The certainty equivalents were elicited separately for two consecutive hypothetical lotteries of the form (x_{\max}, x_{\min}, p) , offering a monetary prize of x_{\max} with probability p , or x_{\min} with probability $1-p$. The probability of a win or loss was described as being based on the toss of an unbiased coin in order to overcome probability preference.

The first lottery question had an expected value of R50,000, with a potential gain of R80,000 and a potential loss of R20,000. The second lottery question had an expected value of R10,000 with zero downside risk and the possibility of a R20,000 gain (Appendix B). Following Ferrer *et al.* (1997), Arrow-Pratt risk aversion coefficients adjusted for the range and scale of the data were estimated for all respondents and both lotteries by fitting the respective functions:

$$f = 0.5 + 0.5 \exp(-\lambda^*(x_{\max} - x_{\min})) - \exp(-\lambda^*(x^* - x_{\min})) \quad \dots(4)$$

In this analysis equation (4) reduces to:

$$f = 0.5 + 0.5 \exp(-\lambda^*) - \exp(-\lambda^*x^*) \quad \dots(5)$$

Utility functions of the form $U_1(x^*) = -\exp\{-\lambda_1 x^*\}$ were assumed, normalizing the x^* range from 0 to 1, as per Ferrer *et al.* (1997). Arrow-Pratt absolute risk aversion coefficients were adjusted to facilitate comparison with those obtained by Ferrer *et al.* (1997). The mean adjusted Arrow-Pratt absolute risk aversion coefficients over both lottery questions were used as a measure of risk preference in this study. The coefficients for the two lottery questions were expected to differ slightly, as the second question involved no downside risk. Levels of risk aversion for the second question were, therefore, expected to be lower than those for the first lottery question. It was expected *a priori* that principal decision makers in this study would be, on average, risk averse. The spectrum of risk preferences for commercial farmers was, however, expected to range from risk preferring to slightly risk averse.

CHAPTER 3

THE KWAZULU-NATAL SURVEY AND CHARACTERISTICS OF RESPONDENTS

3.1 Identification of the study area, selection of respondents and response to the survey

The sample for this study was drawn from a list of commercial sugarcane farmers in KwaZulu-Natal (KZN) compiled by the South African Cane Growers' Association (SACGA). Respondents were drawn from two separate mill-supply areas in KZN, namely the Noodsberg mill-supply area in the KZN Midlands and the Umfolozi mill-supply area on the Zululand Coast. This split was considered necessary in order to account for regional differences (e.g. climatic and soil characteristics) that may exist between inland and coastal-belt producers.

The SACGA regional managers responsible for the study areas were contacted and agreed to provide contact details for all large-scale commercial sugarcane operations in their respective areas. In consultation with SACGA representatives, large-scale operations were defined in this study as those responsible for annual sugarcane deliveries exceeding 10,000 tons. The decision to focus on large-scale producers was made because these farmers account for 72% of the area planted to sugarcane (contributing over 88% of production), compared with 19% by small-scale growers (Eweg, 2005; SACGA, 2006). The remaining nine percent is planted by millers. Large-scale farmers usually have a broader range of options available to manage risk and are better suited to the objectives of this study. These differences are due mainly to size economies and higher education levels (Barry, 2003). Additionally, land restitution and land redistribution as sources of uncertainty affect mainly

large-scale farmers, with most small-scale sugarcane growers in KZN being previously disadvantaged and therefore less vulnerable to land reform and exempt from paying land taxes for a period of 10 years (Department of Provincial and Local Government, 2004). According to Thomson (2007), 80% of sugarcane farms in KZN are currently subject to restitution claims.

Due to the relatively high cost of the personal interview approach compared to a postal survey method, budgetary constraints limited the maximum size of the sample to about 100 respondents. Based on consultations with SACGA regional managers, and on the results of a pilot survey, it was decided that an initial sample size of 110 farming operations would be used to compensate for possible non-responses. Fifty-five farming operations were randomly selected from a complete list of large-scale growers in each mill-supply area. The principal decision-makers for each business were contacted telephonically in order to arrange interviews. Every effort was made to encourage the participation of those decision-makers contacted (Appendix A). Of the 110 principal decision-makers contacted overall, a total of 76 usable responses were obtained (69%). Equal numbers of usable responses (38) were obtained from both study areas after four responses from the Zululand region were deemed to be non-representative, and were excluded. These respondents operate extensive beef and game enterprises (with 8,100, 7,400, 5,800 and 4,800 hectares of land owned respectively), with sugarcane contributing less than 30% of their gross farm income.

The overall response rate of 69% is lower than that obtained by Ferrer *et al.* (1997) of 82%, but higher than those obtained in studies using the postal survey approach. This is evident from the usable response rates of eight percent, 37%, 35% and 19% obtained by

Swanepoel and Ortmann (1993), Bullock *et al.* (1994), Woodburn *et al.* (1995), and Stockil and Ortmann (1997), respectively, using postal surveys.

3.2 Characteristics of respondents

Table 3.1 summarises the characteristics of the KZN sugarcane survey respondents. Included in this table is information pertaining to general farm and farmer characteristics, enterprise mix, labour force characteristics and off-farm economic activities. Respondents from both study regions were on average 47 years of age, with 22 years of sugarcane growing experience and have been involved with their current farming businesses for an average of 18 years. Respondents from the Zululand region are significantly older than those from the KZN Midlands, by about four years, at the 10% level of probability. Means comparisons in this study were conducted using a two-tailed t-test for independent samples, with equal variances not assumed (Steel and Torrie, 1980: 106). Formal education levels of respondents are similar for the two survey regions except for matrices and diplomas – 18% of respondents from Zululand have no more than a matric qualification compared with three percent of respondents from the Midlands, a difference statistically significant at the five percent level of probability.

Overall, the highest proportion of respondents operate their businesses as sole proprietorships (47%). This is followed by respondents whose businesses are identified as partnerships (19%), trusts (17%), close corporations (12%) and companies (five percent). The farm businesses operate an average of 417 hectares of land. In the Midlands region farm size is on average 599 hectares, of which an average of 66 hectares is rented in by respondents. No respondents from this region indicated that any portion of their land is rented out. In the Zululand region farm businesses operate an average of 236 hectares with no respondents indicating that land is rented in or out. The average area of land owned by

respondents in the two regions is statistically significantly different at the one percent level of probability.

Table 3.1: Mean values of characteristics of large-scale sugarcane respondents, KwaZulu-Natal, 2006 (n=76).

Characteristics of respondents		Overall (n=76)	Zululand (n=38)	Midlands (n=38)	Mean comparison t (assume \neq variances)
Age (years)		47	49	45	0.061*
Years experience:	Growing sugarcane	22	22	22	0.915
Formal education: (% respondents)	University degree	42	47	37	0.359
	Diploma	42	32	52	0.064*
	Trade	5.5	3	8	0.311
	Matric	10.5	18	3	0.025**
Business Arrangement: (% respondents)	Sole proprietorship	47	39	55	0.173
	Partnership	19	8	29	0.018**
	Trust	17	21	13	0.368
	Close corporation	12	21	3	0.014**
	Company	5	11	0	0.044**
Farm size:	Total farm area (Ha)	417	236	599	0.000***
	Gross farm income (R million)	3,45	3,02	3,88	0.004***
Enterprise mix: (% contribution To GFI)	Sugarcane	77	88	70	0.000***
	Timber	12	1	22	0.000***
	Beef	3	1	5	0.001***
	Citrus	2	4	0	0.047**
	Vegetables	1	2	0	0.092*
Labour force:	Permanent labourers	31	23	40	0.000***
	Proportion skilled labour (%)	25	26	23	0.080*
Off-farm economic activities:	Off-farm employment (% respondents)	47	55	39	0.173
	Spouse off-farm employment (% respondents)	30	47	13	0.001***
	Farm business interests in other areas (% respondents)	24	26	21	0.595
	Possession of material off-farm investments (% respondents)	84	82	87	0.536
	Percentage of asset value off-farm	22	16	28	0.012**
Risk attitude:	Mean, adjusted Arrow- Pratt absolute risk aversion coefficients	0.650	0.205	1.100	0.030**

Note: (a) ***, **, * indicate means statistically significantly different at the one, five and ten percent levels, respectively.

The gross income figures in Table 3.1 are assumed to be representative of an average season as respondents were asked by what percentage gross farm income (GFI) for the 2005-2006 season was above or below average for their farm business, and the GFI's adjusted accordingly. On average, GFI for the farmers in this study is R3,45 million, of which R2,64 million is contributed by sugarcane (77%). Mean GFI's for the two regions are statistically significantly different at the one percent level of probability.

Sugarcane constitutes the major enterprise in both regions, contributing on average 77% to GFI overall. The average proportion of GFI stemming from sugarcane is significantly higher for respondents in Zululand (88%) compared to the KZN Midlands (70%). This indicates higher average levels of farm enterprise diversification for sugar producing farm businesses in the Midlands. The second largest enterprise on average is timber, although the regional average for the Midlands (22% of GFI) is statistically significantly greater than that for Zululand (one percent of GFI). Overall, timber is followed by beef, citrus and vegetables. Other enterprises, such as macadamias, maize, bananas, contract harvesting, flowers, pigs and wildlife (game) are reported by some respondents in the overall sample but, on average, contribute less than one percent to GFI. Since the KZN Midlands and Zululand differ in terms of location (inland versus coastal regions respectively), certain enterprises that are viable in one region may not be so in the other. In Zululand the second largest enterprise is citrus contributing 4.4% to GFI on average.

Respondents were asked to provide information regarding both the permanent and casual components of the labour force involved in the operation of their farm businesses. In order to gauge the proportion of skilled labour amongst their permanent labour force, respondents were asked how many of their permanent staff possessed the skills necessary for the positions of foreman, supervisor and tractor driver. The proportion of skilled labour

was subsequently calculated as the ratio of skilled permanent to total permanent labourers. On average, 31 permanent labourers are employed, 25% of whom are skilled. Midlands respondents employ significantly more permanent labour, while Zululand respondents, on average, have a significantly higher proportion of skilled labour among their permanent labour. Respondents were also asked to rate their use of casual labour relative to other farmers in their area on a Likert-type scale where a response of 1, 2 or 3 indicated much less, similar and much more casual labour use, respectively. Respondents from both the Midlands and Zululand reported that they make use of similar proportions of casual labour (mean value of 2.0) compared to other farmers in their areas. This indicates that the study sample for both regions (and overall) is representative.

Forty-seven percent of respondents engage in off-farm employment of some kind. Of these, 55% of respondents from Zululand are employed off-farm, compared to 39% of respondents from the KZN Midlands. Thirty percent of all respondents indicated that their spouses are employed off-farm. Forty-seven percent of respondents from Zululand and 13% from the Midlands reported that their spouses engage in off-farm employment, a difference statistically significant at the one percent level of probability. Twenty-four percent of all respondents indicated that they have farm business interests in other areas (26% of Zululand respondents compared to 21% of KZN Midlands respondents). Eighty-four percent of principal decision makers indicated that they possess material off-farm investments. KZN Midlands respondents have, on average, a statistically significantly greater proportion of their asset value invested off-farm (28%) compared to Zululand respondents (16%).

On average, respondents were found to be risk averse, confirming *a priori* expectations, with a mean value for the adjusted Arrow-Pratt absolute risk aversion coefficient for both lottery questions and all survey respondents of 0.650. Midlands respondents were found to be statistically significantly more risk averse than those from Zululand (at the 5% level of probability). Figure 3.1 shows the distribution of the mean, adjusted Arrow-Pratt absolute risk aversion coefficients for all survey respondents.

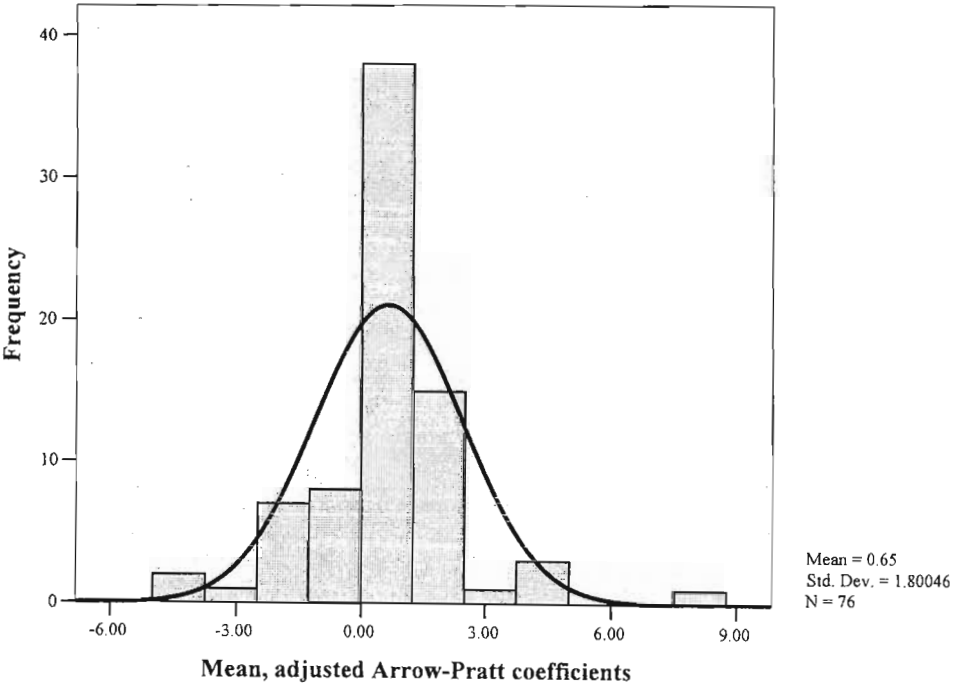


Figure 3.1: Mean, adjusted Arrow-Pratt coefficients for combined lottery questions for large-scale sugarcane respondents KwaZulu-Natal, 2006 (n=76)

As shown in Figure 3.1, the mean, adjusted Arrow-Pratt risk aversion coefficients are distributed fairly normally with the majority of respondents being slightly to moderately risk averse. The mean value of 0.650 shown in Table 3.1 is similar in order of magnitude to those reported by Ferrer *et al.* (1997).

CHAPTER 4

SOURCES OF RISK AS PERCEIVED BY SURVEY RESPONDENTS

The purpose of this chapter is to investigate respondents' perceptions of various sources of risk facing their farm businesses. Dimensions that exist within these sources of risk are also investigated using PCA. Respondents were asked to rate sources of risk for their farm businesses, from a list of 14 potential sources, on a Likert-type scale of one to five – where five and one indicate “highly important” or “not particularly important”, respectively. Mean ratings of risk sources are shown in Table 4.1. Respondents could include additional risk sources (e.g., crime) that they deemed to be important; however, no additional risk sources were included. Respondents were also asked to rank their top five most important risk sources from the list. The table indicates the frequency with which risk sources were included in the respondents' top-five list.

The three most important sources of risk as rated by respondents were land reform, minimum wage labour legislation and crop price variability. These had mean overall ratings on the Likert-type scale of 4.31, 4.14 and 3.68, respectively. The risk sources that were perceived to be the next most important were: changes in input costs (3.56), crop yield variability (3.43), the threat of HIV/AIDS (3.41), changes in the cost of capital items (3.33) and changes in land tax legislation (3.24). Compared to previous SA and KZN studies, these findings confirm that government legislation risks (particularly relating to agrarian reform) have become increasingly important, relative to price and production risks. The remaining sources of risk included in the survey questionnaire (unionisation of labour, variability in interest rates, changing water rights, changing credit availability, farm operator illness or death, and changes in family relationships) received mean overall

ratings of less than three, indicating that most respondents regarded them as less than moderately important.

Table 4.1: Rating and ranking of risk sources by large-scale sugarcane respondents, KwaZulu-Natal, 2006 (n=76).

Risk Source	Overall (n=76)			Zululand (n=38)			Midlands (n=38)		
	Mean Rating (a)	Rank (b)	(c)	Mean Rating (a)	Rank (b)	(c)	Mean Rating (a)	Rank (b)	(c)
Land reform	4.31	(1)	78.8	4.02	(1)	78.6	4.63	(1)	78.9
Labour legislation (specifically minimum wages)	4.14	(2)	75.0	3.90	(2)	66.7	4.39	(2)	84.2
Crop price variability	3.68	(3)	45.0	3.76	(3)	52.4	3.58	(3)	36.8
Changes in input costs	3.56	(4)	52.5	3.64	(4)	66.7	3.47	(6)	36.8
Crop yield variability	3.43	(5)	36.3	3.38	(6)	35.7	3.47	(6)	36.8
HIV / AIDS	3.41	(6)	41.3	3.40	(5)	50.0	3.42	(8)	31.6
Changes in capital item costs	3.33	(7)	40.0	3.12	(7)	38.1	3.55	(4)	42.1
Changes in land tax legislation	3.24		35.0	2.95		26.2	3.55	(4)	44.7
Unionisation of labour	2.89		31.3	2.40		16.7	3.42	(8)	47.4
Variability in interest rates	2.60		23.8	2.64		28.6	2.55		18.4
Changing water rights	2.26		10.0	2.48		14.3	2.03		5.3
Changing credit availability	2.13		5.0	2.07		2.4	2.18		7.9
Farm operator illness/death	1.98		6.3	1.9		7.1	2.05		5.3
Changing family relationships	1.79		6.3	1.95		7.1	1.61		5.3

Note: (a) Columns titled "Mean Rating" represent the mean perceived rating of risk sources based on a Likert-type scale of one to five, where a rating of five indicates a highly important risk source and a rating of one a risk source of relatively low importance.
 (b) Figures in parentheses show the ranking of risk sources according to their mean perceived rating by survey respondents.
 (c) These figures represent the percentage of respondents that ranked a particular risk source within a list of what they perceived to be the five most important.

Concerns among respondents regarding the land reform process in South Africa have become more pertinent leading up to the time of this survey, considering threats by the SA government to discard the willing seller, willing buyer principle due to the perceived slow pace of land reform (Farmers' Weekly, 2006; Democratic Alliance, 2006; Afrol News,

2006). The pace of land reform in KZN is slow relative to government's target of 30% redistribution of farmland by 2014 (2.6% per annum) (Lyne and Ferrer, 2004). Lyne and Ferrer (2004) showed that achieved rates in KZN had averaged only 0.54% between 1997 and 2003, due to slow progress with the land restitution process and problems with obtaining government grants, not due to problems with the willing seller, willing buyer principle. Subsequent to the survey, the Restitution of Land Rights Act 22 of 1994 has been changed to allow the Minister of Land Affairs to expropriate land, for the purpose of awarding it to a claimant who is entitled to the redistribution of a land right, on behalf of the state without being ordered to do so by the court. Effectively, should negotiations over a new market value for claimed land fail, the government will issue farmers with notices of appropriation allowing a period of 30 days for reconsideration, after which final letters of expropriation will be issued and farmers compensated at government-determined "market values" (Nailana and Gotte, 2006). This pro-active land reform policy will allow for the expropriation of land for land redistribution as well as land restitution.

Another source of risk facing respondents in this study was the threat posed by uncertainties regarding land tax legislation. Although the land rates policy had been formalised by the time of the survey, the rate at which land will be taxed remained uncertain. Lee (2007) showed that land taxes elsewhere in the world are typically less than one percent, yet municipalities in South Africa are proposing land taxes greater than one percent. Potential changes in land tax legislation were, therefore, considered to be an important source of uncertainty for respondents in this study. There was also considerable uncertainty regarding whether or not a farm business would qualify for tax rebates during the survey process.

The Sectoral Determination (an amendment to the Basic Conditions of Employment Act 75 of 1997) required farmers to meet new minimum-wage requirements from March 2003 (Department of Labour, 2006), creating uncertainty amongst sugarcane producers and increasing the costs of managing permanent labour (i.e., those who work more than 27 hours per week). Many survey respondents speculated during the interview process that minimum wage legislation could be extended to include casual or part-time labour. Considering the relatively high demand for this form of labour in the sugar industry (during planting and harvesting) (SACGA, 2006), respondents consider the potential higher costs involved to pose the second most important threat to their business' viability. Uncertainties, therefore, may be due to recent changes in land and labour legislation creating expectations that further changes are likely.

Overall, 79% and 75% of respondents included land reform and minimum wage legislation, respectively, in their top five list of risk sources most important to their farm businesses. These two risk sources were considered to pose the greatest threat to farm businesses in both areas. Compared to findings of previous studies (Swanepoel and Ortmann, 1993; Bullock *et al.*, 1994; Woodburn *et al.*, 1995; Stockil and Ortmann, 1997; Hardman *et al.*, 2002), these risk sources have become more prominent. Crop price variability was included in the top five list by 45% of all respondents. This may be explained by the high degree of fluctuation of the sugar price during the time leading up to the survey. Product price variability was previously found to be among the three most important perceived risk sources by Bullock *et al.* (1994) and Woodburn *et al.* (1995). Changes in input costs (53%) was the fourth most likely risk source to be included in the top five list. Compared to Midlands respondents, double the number of respondents from Zululand (67%) included changes in input costs as one of the five most important risks

faced by their farm businesses, whereas more than double the number of respondents from the Midlands (47%) included the risk of unionisation of labour in their top five. This is most likely due to respondents in the Midlands region facing threats of labour union strike action shortly prior to the interview process.

4.1 Principal component analysis of risk sources

All 14 sources of risk initially considered were included in a PCA incorporating all sample respondents. These variables are namely; the threats posed by land reform, changes in labour legislation, crop price variability, crop yield variability, changes in the cost of inputs, HIV/AIDS, changes in the cost of capital items, changes in land tax legislation, the threat of labour unionisation, variability in interest rates, changes in water rights, changing credit availability, farm operator illness/death and changes in family relationships. The magnitudes of the eigenvalues of the PCs (indexes) identified were used to determine the number of indexes to be included in the analysis. Indexes were extracted using the covariance matrix due to the units of measure for all 14 risk sources being the same. The first seven indexes had initial eigenvalues greater than one and collectively explained 78% of the variance in all 14 risk sources. Ten of the 14 risk sources had PC loadings exceeding 0.40 in absolute value in more than one index and therefore a varimax rotation with Kaiser Normalisation was used in order to obtain indexes that are easier to interpret. The rescaled communalities for risk sources all exceeded 0.62 with the exception of changes in the cost of capital items (0.565), indicating that most of the variance in the perceived importance of risk sources was accounted for by the first seven common indexes (Manly, 1986). These indexes are shown in Table 4.2 and are discussed in this section (risk sources with absolute index loadings <0.40 are excluded from the table and equations below).

Table 4.2: Rotated index loadings^(a) of risk sources and regional index scores for large-scale sugarcane respondents, KwaZulu-Natal, 2006 (n = 76).

Index		1	2	3	4	5	6	7
Initial eigenvalue		3.208	2.401	2.297	1.922	1.442	1.141	1.008
Percentage variance explained (cumulative)		14.01	26.32	37.97	49.31	59.23	68.94	77.93
Sources of risk	Rescaled Communalities (b)							
Land reform	0.681	-0.518	0.591					
Labour legislation (minimum wages)	0.787			0.681	0.526			
Crop price variability	0.666	0.781						
Changes in input costs	0.640				-0.450			-0.482
Crop yield variability	0.884	0.926						
HIV / AIDS	0.857					0.903		
Changes in capital item costs	0.565		0.655					
Changes in land tax legislation	0.863			0.916				
Unionisation of labour	0.945				0.929			
Variability in interest rates	0.629		0.542	0.432				
Changing water rights	0.895							0.931
Changing credit availability	0.780		0.710			0.469		
Farm operator illness/death	0.819					0.512	0.512	
Changing family relationships	0.899						0.921	
Zululand: mean index scores		0.146	-0.218	-0.245	-0.360	-0.047	0.090	0.113
KZN Midlands: mean index scores		-0.146	0.218	0.245	0.360	0.047	-0.090	-0.113
Means comparison: t-test (significance)		0.207	0.057*	0.033**	0.001***	0.688	0.435	0.329

Note: (a) Only index loadings with an absolute value greater than 0.4 are shown.

(b) That part of the variance of a risk source that is related to the common indexes.

*, **, *** indicate means statistically significantly different at the ten, five and one percent levels of probability, respectively.

Index 1: "Crop Gross Income Index" = (0.926) crop yield variability + (0.781) crop price variability – (0.518) land reform.

Index 1 indicates that the ratings for crop yield and price variability were positively correlated and displayed a high degree of variability. This index suggests that respondents who are concerned with price and yield variability are less concerned with the threat posed by land reform and *vice versa*. This may be due to farmers with significant liquidity stress

being less concerned about losing their farms to land reform. It may also suggest that some farmers have more confidence in the government's land reform policies than others. A comparison of group means for this index indicates that farmers in both regions are similarly concerned with Crop Gross Income variability. The reason that land reform seemed to be more of a concern for respondents from the Midlands (negative mean value) may be explained by a larger proportion of respondents from the Midlands (44.7%) facing land claims in line with the land restitution programme, as compared to respondents from Zululand (9.5%). Mean index scores for each region were estimated for each index and comparisons conducted using a two-tailed t-test for independent samples, with equal variances not assumed (Steel and Torrie, 1980).

Index 2: "Macroeconomic and Political Index" = (0.710) changing credit availability + (0.655) changing capital item costs + (0.591) land reform + (0.542) interest rate variability. Mean index scores show that Midlands respondents are more concerned with the four "Macroeconomic and Political" risk sources. This can be explained by the larger number of land claims lodged for farmland in this area, and Midlands respondents had relatively more capital investment (e.g., for forestry enterprises) than respondents from Zululand. Forestry enterprises contribute, on average, 22% of gross farm income (GFI) in the Midlands compared to 0.5% in Zululand. Mean index scores for the two regions are statistically significantly different at the 10% level of probability.

Index 3: "Legislation Index" = (0.916) changes in land tax legislation + (0.681) minimum wage legislation + (0.432) interest rate variability.

Mean index scores for the two regions in this index (which are statistically significantly different at the five percent level of probability) show that the three risk sources with the

highest index loadings are more important to Midlands respondents. This could be due to these respondents employing larger labour forces on average, using extra labour capacity mainly for their timber enterprises. The fact that respondents in this area considered the threat of a land tax to be relatively more important than respondents from Zululand could be due to increased familiarity of this issue among Midlands respondents. The higher level of information on land tax issues by Midlands respondents can be attributed to legal precedents involving the initial implementation of this legislation in the region.

Index 4: “Labour and Inputs Index” = (0.929) labour unionisation + (0.526) minimum wage legislation – (0.450) changing input costs.

The negative loading attached to changes in input costs suggests that respondents who are concerned with labour unionisation and minimum wage legislation are less concerned with changes in input costs and *vice versa*. This may be due to substitution between labour and other inputs. Zululand respondents are more concerned with changing input costs due to the more intensive nature of sugarcane farming in the coastal region. Sugarcane is normally harvested annually in the Zululand region compared to every 20 months in the Midlands. Midlands respondents consider minimum wage legislation and the threat of labour unionisation to be relatively more important. This can be attributed to respondents in the Midlands employing larger labour forces on average. Mean index scores are statistically significantly different at the one percent level of probability.

Index 5: “Human Capital and Credit Access Index” = (0.903) HIV/AIDS + (0.512) illness or death of farm operator + (0.469) changes in credit availability.

The fact that illness or death of the farm operator and changes in credit availability occur together in this index may be due to the effects of the death of the farm operator on

borrowing capacity. Mean index scores were similar for the two study regions. The threat of HIV/AIDS, illness or death of the farm operator and changing credit availability are, therefore, considered equally important by respondents from both areas.

Index 6: “Management Index” = (0.921) changes in family relationships + (0.512) illness or death of farm operator.

Respondents from both regions are equally concerned with the threats posed by changes in family relationships and the illness or death of the farm operator in this index.

Index 7: “Water Rights Index” = (0.931) changes in water rights – (0.482) changes in input costs.

Mean index scores for the two regions in this index show that respondents from both areas are concerned with changes in water rights and, to a lesser extent, changing input costs. Although the mean index scores are not statistically significantly different, there is a suggestion that Zululand respondents are slightly more concerned with changes in water rights, probably due to them using more irrigation than Midlands respondents. On average, Zululand respondents irrigated 60% of their sugarcane area compared to 11% by Midlands respondents, a difference statistically significant at the one percent level of probability.

4.2 Discussion

This chapter investigated respondents’ perceptions of 14 risk sources facing large-scale sugarcane farmers in KZN. Each source of risk considered was rated and the five most important risk sources identified for all respondents. PCA was then used to identify seven dimensions that exist among risk sources. The perceptions identified in this chapter may aid in the explanation of the risk-related management decisions of survey respondents.

Hence, the following chapter investigates the use of various risk-related management strategies, bearing the findings of this chapter in mind.

CHAPTER 5

MANAGEMENT STRATEGIES OF SURVEY RESPONDENTS

This chapter identifies means of estimating the use of various management strategies commonly associated with risk management and uses PCA to investigate the choice bracketing of these strategies by respondents in KZN. The objective is to identify how respondents use individual risk-related management responses and combinations of these responses to manage their risk exposure. The findings of the previous two chapters are used to aid in the explanation of the manner in which these risk-related management strategies are used by respondents.

5.1 Quantifying managerial responses of survey respondents

Respondents to the survey questionnaire were asked a number of questions regarding various risk-related management strategies or instruments that they may have at their disposal and use actively in their farm businesses. Certain management responses commonly associated with risk management, such as marketing responses and the use of irrigation, were excluded from the analysis. Marketing of sugarcane in South Africa is done at an industry level so that there is no potential for farmers to use the marketing of their crop as a management response to risk. Similarly, respondents from both study areas noted during a pilot survey process that water rights are mostly non-tradable. This implies that farmers have a limited potential to change the proportion of their crop that is irrigated in response to risk. What follows is a summary of this information.

The level of mechanisation as a management response (Roka, 2000) was based on a question in which farmers were asked whether their sugarcane operations are relatively

more or less mechanised than other farmers in their area (not including mechanical harvesters). This variable was measured on a Likert-type scale (1-3), with values of one and three representing relatively less and relatively more mechanisation respectively. There was no significant difference in levels of mechanisation between the two regions with a mean overall value of 2.21 on the Likert-type scale. This may be due to the decision to focus on large-scale producers in this study and due to the representativeness of the sample. Similarly, the use of casual labour as a management response (Roka, 2000) was measured on a Likert-type scale (1-3) with values of one and three representing a relatively smaller or relatively larger proportion of casual labour respectively. The mean overall rating was found to be 2.01. The extent to which a farmer uses on-farm diversification as a management instrument was measured using an “enterprise diversification index”, calculated as the sum of the squared proportions of the GFI stemming from each enterprise. Index values of zero and one represent farms that are highly diversified and highly specialised in terms of their enterprises, respectively. Respondents from the KZN Midlands were found to be significantly more diversified than those in Zululand, with mean diversification indexes of 0.58 and 0.83, respectively. This may be attributable to a larger proportion of farmland in the Midlands being unsuitable for sugarcane cultivation. This suggests that on-farm diversification is influenced mainly by land characteristics rather than by risk management considerations.

Principal decision makers were asked two separate questions in an attempt to estimate their propensities to both purchase and sell land. Respondents were asked dichotomous choice questions to determine if they would be willing to trade agricultural land, should either neighbouring land become available at a market-related price, or should they be offered a market-related price for a portion of their existing land. Eighty-seven percent of all

respondents indicated that they would consider buying an adjacent piece of land, should one become available at a market-related price. Only 24% of respondents indicated a willingness to sell a portion of their land should they be offered a market-related price. Both regions were similar in terms of respondents' propensities to purchase and sell farmland. These two variables were then transformed into a variable to be used in the factor analysis, the "propensity to trade land" variable. This variable was obtained by subtracting respondents' propensity to sell land from their propensity to purchase land. Values of -1.0 and 1.0 for the propensity to trade land variable therefore represent respondents who are more willing to sell land or more willing to buy land, respectively. A value of zero for this variable represents respondents that are indifferent to buying or selling land. This variable measures the ability of a farmer to respond to factors such as rising cost structures by adjusting the scale of the sugarcane operation.

A measure of the extent to which back-up management is kept as a response is whether or not additional management would have to be hired by the business should the farmer become unexpectedly incapacitated for a period of six months. Responses from both areas are similar with 46% of respondents indicating a need for back-up management. Another management response is having back-up skilled labour available on the farm. The extent to which a manager keeps skilled labour in reserve is defined as the proportion of permanent labour employed as tractor drivers or assigned alternative responsibilities requiring an equivalent level of skill. Zululand respondents, on average, have significantly higher proportions of skilled labour (26%) among their permanent staff than Midlands respondents (23%). This may be due to Midlands respondents having to retain relatively more permanent labourers to service timber enterprises.

The extent of geographical dispersion of farming operations as a management response is measured by a question in which farmers were asked whether or not they have farm business interests in other areas. Respondents from both areas are similar in this regard with 24% of all respondents indicating that they had farm businesses in other areas. Another management response measured is the use of contract machinery, specifically contract mechanical harvesters. Respondents from both areas reported similar usage of contract mechanical harvesters with an overall average of 12% of cane land being mechanically harvested by contractors.

The extent to which credit is kept in reserve is measured by the proportion of the businesses' overdraft facility used, on average, during the previous season. Zululand respondents maintained relatively lower credit reserves in the previous season as compared to respondents from the Midlands, with 43% versus 25% of available overdraft being used on average, respectively, a difference significant at the one percent level of probability. Zululand respondents also utilise significantly higher total levels of insurance, namely 3.6% of GFI spent on insurance versus 1.8% in the Midlands.

Midlands respondents have significantly higher proportions of their wealth invested off-farm as compared to respondents from Zululand (28% versus 16%). This was captured in an "investment diversification index" that is calculated by summing the squared proportions of asset value invested on and off-farm. Index values of 0.5 and one represent an investment portfolio that is highly diversified and highly specialised, respectively. This index shows that Midlands respondents, on average, have a significantly higher proportion of asset value invested off-farm than Zululand respondents, with mean index values of 0.72 and 0.79, respectively.

Finally, respondents were asked whether they engage in off-farm employment and, if so, what proportion of their time is spent involved in this activity. The results show that respondents from both areas are similar in this regard with an overall average of 15% of a principal decision maker's time being spent engaged in off-farm employment activity. This management response is captured in the form of a "time diversification index", calculated by summing the squared proportions of time spent on and off-farm. Index values of $0 < 0.5$ and $0.5 < 1$ represent a principal decision maker whose time is shared between many sources of employment and highly specialised towards a single source of employment, respectively. The mean index value for respondents is 0.83.

5.2 Principal component analysis of risk-related management strategies

The 12 risk-related management responses defined in the preceding section were included in a PCA incorporating all sample respondents. These variables are: the proportion of the permanent labour force that is skilled, a time diversification index, whether other farm business interests are owned in other regions, an investment diversification index, the use of casual labour, propensity to trade land, the use of a mechanical harvester, the proportion of gross farm income (GFI) spent on insurance, the need for back-up management, the degree of mechanisation and an enterprise diversification index. The magnitudes of the eigenvalues of the indexes identified in a PCA were used to determine the number of indexes to include in the analysis. Indexes were extracted using the correlation matrix due to variables having different units of measure. The first six indexes had initial eigenvalues greater than one and collectively explained 77% of the variance in all 12 risk responses. Eight of the 12 management responses had index loadings exceeding 0.40 in absolute value in more than one index and therefore a varimax rotation with Kaiser Normalisation was used in order to obtain indexes that are easier to interpret. The extraction communalities

for risk responses all exceeded 0.68. This is another indication that most of the variance in management responses was accounted for by the first six common indexes (Manly, 1986). The results are summarised in Table 5.1. Because indexes were extracted from the correlation matrix and risk-related management responses were mostly measured using continuous variables, indexes reveal the extent to which those management responses considered simultaneously within a choice bracket act as substitutes or complements. For this reason results differ from those of Pennings *et al.* (2005) in that the actual level of use of the various management responses is shown rather than simply whether or not a response is considered. Differences in the bracketing level of respondents are, however, not revealed using this method.

Index 1: “Mechanisation and Management Bracket” = (0.871) degree of mechanisation + (0.804) proportion of sugar mechanically harvested on contract + (0.650) level of backup management.

This is a logical grouping of management responses because as the proportion of the crop that is mechanically harvested by contractors increases, so would the degree of mechanisation be expected to increase. This is due to the quicker supply of cut cane obtained through mechanical harvesting compared to manual harvesting. The increase in supply rate means that greater demands are placed on other machines such as mechanical loaders and tractor haulers. These spikes in supply rate also result in an increased demand for management time and, therefore, an increased pool of backup management is expected. An alternative to the hiring of additional staff to meet this increased demand is the use of contract mechanical harvesters although most respondents reported the absence of such contractors in their areas. Mean index scores indicate that the two survey areas are similar in terms of the use of the three main management responses contributing to the variance in this factor. This is to be expected as there is no statistically significant difference between

the proportions of sugarcane mechanically harvested between respondents from the two regions.

Table 5.1: Rotated index loadings^(a) of risk-related management strategies and regional index scores for large-scale sugarcane respondents, KwaZulu-Natal, 2006.

Index		1	2	3	4	5	6
Initial eigenvalue		2.336	1.909	1.543	1.292	1.082	1.054
Percentage variance explained (cumulative)		19.47	35.37	48.23	59.00	68.02	76.80
Management Strategies	Communalities (b)						
Proportion skilled labour (PSL)	0.764						.820
Time diversification index (TDIV)	0.751		-.846				
Farm businesses in other areas (BUSINT)	0.887				.888		
Investment diversification index (IDIV)	0.773				-.671		
Use of casual labour (CASLAB)	0.680					.488	.515
Propensity to trade land (PTL)	0.798					.855	
Mechanical harvesting (MH)	0.754	.804					
Proportion of GFI spent on insurance (GFII)	0.770			.776			
Use of an overdraft facility (CRED)	0.783			.853			
Need for back-up management (BUM)	0.681	.650					
Degree of mechanisation (MECH)	0.885	.871					
Enterprise diversification index (EDIV)	0.721		.784				
Zululand	Mean index scores	0.042	0.067	0.061	-0.343	0.001	0.464
KZN Midlands	Mean index scores	-0.042	-0.067	-0.061	0.343	-0.001	-0.464
Means comparison	t-test (significance)	0.719	0.563	0.600	0.002***	0.995	0.000***

Note: (a) Only index loadings with an absolute value greater than 0.4 are shown.

(b) That part of the variance of a management response that is related to the common indexes.

*** Indicates means statistically significantly different at the one percent level of probability.

Index 2: “Enterprise and Time Diversification Bracket” = $-(0.846)$ time diversification index + (0.784) enterprise diversification index.

The composition of this index may be explained by the decrease in time available for off-farm employment as on-farm enterprise diversification increases (McNamara and Weiss, 2001; Goodwin and Mishra, 2004; Windle and Rolfe, 2005). It may be expected that a farm highly specialised towards sugarcane production demands less management time than a farm that is diversified in terms of its enterprises. A farm that is specialised toward sugar production would, therefore, free relatively more management time for alternative, off-farm, employment. Mean index scores for the two regions were not statistically significantly different, however, in spite of Midlands respondents reporting statistically significantly higher levels of enterprise diversification than those from Zululand. This would suggest expected higher levels of time diversification among Zululand respondents. Results show that this is the case, although the difference between off-farm employment for Zululand and Midlands respondents is only statistically significant at the 17% level of probability. Off-farm employment by the spouses of the principal decision makers is, however, statistically significantly higher for respondents from Zululand. This suggests that respondents and their spouses may be collectively involved in decision making processes (Davis, 1976).

Index 3: “Insurance and Credit Reserve Bracket” = (0.853) average proportion of an overdraft facility used in the 2005-2006 season + (0.776) proportion of gross farm income spent on insurance.

This index shows that as proportion of income spent on insurance increases, so the extent of overdraft use increases, which is synonymous with decreased liquidity. This relationship may be explained by the increased mitigation of risk through increased insurance cover

enabling a farmer to operate with lower credit reserves (Harwood *et al.*, 1999). This is evident in Zululand where respondents spend significantly higher proportions of total farm income on insurance and maintain significantly lower credit reserves compared to Midlands respondents. Despite this, mean index scores for the two study areas are not statistically significantly different. This may be due to the larger average farm size in the Midlands, as the proportion of total farm income spent on insurance is expected to be negatively related to farm size (Sherrick *et al.*, 2004). This is due mainly to scale economies; for example, an increased ability to efficiently utilise insurable assets such as buildings and machinery as output increases. The potential for decreased credit availability is expected to be negatively related to this index.

Index 4: “Geographic and Investment Diversification Bracket” = (0.888) owning farm business interests in other areas – (0.671) investment diversification index.

This index indicates that farmers with a higher proportion of asset value invested off-farm are more likely to also have farm business interests in other regions. Mean index scores indicate that Zululand respondents have significantly less off-farm investments and that Midlands respondents have significantly more farm business interests in other regions. Results confirm that Midlands respondents have, on average, significantly higher proportions of asset value invested off-farm; however, geographical diversification of farm business interests is similar for both areas. This anomaly may be due to higher levels of enterprise diversification among Midlands respondents compensating for the need to diversify geographically. A possible explanation for this complementary effect is that both forms of diversification serve to mitigate certain common risk sources such as the influence of climatic variability on crop yield (Pope and Prescott, 1980; Norte and Barry, 1994).

Index 5: “Land Trade Bracket” = (0.855) propensity to trade agricultural land + (0.488) level of use of casual labour.

This index suggests that respondents who are relatively more able to purchase land also consider themselves to be employing relatively more casual labour than other farmers in their areas. A possible explanation of this finding is that respondents, who have responded to restrictive labour legislation by replacing permanent staff with relatively greater proportions of casual labour, are more confident in terms of expanding their current farm sizes without incurring the risks associated with a larger permanent workforce. Conversely, this index may indicate that farmers with relatively higher proportions of permanent labour are less willing to sell existing sugarcane land. This may be due to the costs involved in the retrenchment of permanent staff.

Index 6: “Labour Bracket” = (0.820) proportion of permanent labour that is skilled + (0.515) level of use of casual labour.

Mean index loadings suggest that as average skill levels increase among the permanent labour force, so does the extent to which casual labour is employed. This may be explained by respondents having consolidated their permanent labour forces due to restrictive government labour policies, retaining those with relatively higher skills, and substituting the less skilled with casual labour (Simbi and Aliber, 2000; Sparrow *et al.*, 2006; Vink, 2004; Valodia *et al.*, 2006). Mean index scores for the two study regions are statistically significantly different at the one percent level of probability. This suggests that Zululand respondents have substituted significantly larger proportions of their permanent staff for casual labour. One plausible explanation is that Midlands respondents, on average, are forced to retain higher proportions of permanent staff due to the higher levels of enterprise diversification in this area.

5.3 Discussion

This chapter has measured the use of 12 management strategies commonly associated with risk management by large-scale sugarcane respondents in KZN. PCA has revealed that respondents combine some of these strategies in order to make use of various substitution and complementary relationships that exist between management strategies. The following chapter uses the choice brackets identified in this chapter, together with various socioeconomic variables, including a measure of an individual's risk preference, to distinguish between risk management strategies and those management strategies where risk does not have a significant influence.

CHAPTER 6

A PROPOSED METHOD TO INVESTIGATE THE ROLE OF FARMERS' RISK ATTITUDES IN DECISION MAKING

Farmers who bracket two or more risk-related management choices together consider those decisions to be related (e.g. they may be partial substitutes or complements). The previous chapter used PCA to identify the typical choice bracketing behaviour of the study group of farmers (it is acknowledged that some farmers in the sample may bracket their decisions at broader or narrower levels than the typical level identified in the PCA). Risk may have a significant influence on some, but not all, of these management strategies. Hence, the purpose of this chapter is to propose a methodology that may be used to identify the important determinants of individual management decisions, taking into consideration the typical choice bracketing behaviour of the large-scale KZN sugarcane respondents surveyed in this study. By including a measure of risk attitude, such as an estimate of the mean, adjusted Arrow-Pratt absolute risk aversion coefficient obtained in this study in a two-stage least squares (2SLS) analysis, it is possible to distinguish between individual management responses in terms of whether or not they are truly risk management strategies.

The proposed method involves the modelling of those inter-related management instruments found within a particular choice bracket and various explanatory variables, such as risk preference and other socioeconomic variables, using the 2SLS method. The variable representing risk preference is treated endogenously due to likely correlations with certain explanatory variables such as age, education and farm size. It is important to note at this juncture that such an approach was not the primary focus of this study and that the

proposed methodology is offered purely as a recommendation for future research. Although theoretical specification of these models is possible, many of the proposed models are practically impossible to specify for this study, given the available data, which do not contain a complete set of socioeconomic variables. For example, various authors have identified the importance of financial data such as financial ratios representing factors such as wealth, leverage and liquidity as important considerations when investigating risk management decisions. Such data were not collected during the survey process in this study owing to concerns over interview duration and confidentiality issues. Due to the resulting specification bias, 2SLS models for the “Enterprise and Time Diversification”, “Insurance and Credit Reserve”, “Geographic and Investment Diversification”, “Labour” and “Land Trade” indexes or brackets (see Table 5.1) yielded unsatisfactory results with very low adjusted R^2 statistics and parameter coefficients that, in many instances, contradicted expectations or were statistically insignificant. However, the “Mechanisation and Management Bracket” (Table 5.1) yielded a model that is, to a large extent, accurately specified and provides interpretable results. This model is presented in the following section as an illustrative tool to demonstrate the possible benefits of applying such a methodology to suitable data in future research.

6.1 Application of 2SLS methodology to management strategies contained in the “Mechanisation and Management Bracket” (Index 1 in Table 5.1)

The postulated 2SLS regression model is as follows:

$$MH = f(MECH, BUM, AP, REG, SHAREMH)$$

$$MECH = f(MH, BUM, AP, AGE, EXP, MIN, AVOF)$$

$$BUM = f(MH, MECH, AP, BUSINT, DIV5)$$

$$AP = f(\text{AGE, SIZE, ED})$$

MH, MECH and BUM represent the three endogenous risk-related management responses contributing the majority of variation in the “Mechanisation and Management Index”. MH measures the proportion (%) of the sugarcane crop that is harvested mechanically, MECH the relative degree of mechanisation (Likert-type scale of 1 - 3: values of 1, 2, 3 represent relatively less, similarly and relatively more mechanised than other farmers, respectively) and BUM the need for *further* back-up management (0, 1 represent no and yes, respectively). AP represents the mean, adjusted Arrow-Pratt absolute risk aversion coefficient (< 0 , $= 0$, > 0 represent risk preferring, risk neutral and risk averse individuals, respectively). The remaining variables included in the postulated model are socioeconomic variables. REG represents a regional dummy (0 – KZN Midlands; 1 – Zululand) and SHAREMH represents whether or not shares in a mechanical harvester are owned by a respondent (0, 1 indicate no and yes, respectively). AGE is a measure of a respondent’s age in years, EXP a measure of a respondent’s experience growing sugarcane in years and MIN represents whether a respondent prefers to minimise costs rather than strive for optimum yield (0, 1 indicate a preference to optimise yield versus a preference to minimise cost, respectively). AVOF represents the proportion of a respondent’s asset value that is invested off-farm (%), BUSINT whether or not farm business interests are owned in other regions (0, 1 indicate no and yes, respectively) and DIV5 whether or not a respondent intends on diversifying his enterprises within the next five years (0, 1 indicate no and yes, respectively). ED represents a respondent’s level of education in years (where values of 12, 13, 14, and 15 represent matric, a trade, diploma and university degree, respectively) and SIZE represents total farm size (in hectares).

Mechanical harvesters are expected to be used relatively more in the KZN Midlands because there are a larger number of contract mechanical harvesting machines in this area. The need for back-up management is also expected to be positively related to the use of a mechanical harvester due to the spikes in supply created by using this type of harvesting technique. Also, farmers who own shares in a harvester are expected to harvest a greater proportion of their crop mechanically than those who do not. In terms of risk aversion, a positive relationship is expected with the use of a mechanical harvester. This is due to the increased potential for losses through events such as fire, hail, water-logging, frost, lodging due to strong winds, and decreased sucrose content during the period between crop maturity and transport to the mill. The use of a mechanical harvester allows this period to be minimised and, therefore, offers a risk mitigating effect.

Due to spikes in supply of cut sugarcane that result from the use of a mechanical harvester, there is a resultant increased demand placed on other forms of machinery such as mechanical loaders and tractors. A positive relationship is therefore expected between MECH and MH. Most farm businesses already own (or have inherited) these forms of machinery because they are needed irrespective of whether the crop is cut mechanically or manually. For this reason the level of mechanisation is not considered to be a risk response in this case. Younger farmers are expected to be relatively more mechanised as they may be more familiar with recent technological advancements in terms of loading and hauling equipment whilst older farmers may be faced with high switching costs involved in upgrading from relatively obsolete machinery. Farmers who are more interested in optimising yields rather than minimising operating costs - through allowing longer periods before replanting - are also expected to be more likely to make use of mechanical harvesters. This is due to the need to spread the fixed costs associated with a mechanical

harvester over greater outputs. As with the use of a mechanical harvester, a positive relationship is expected between MECH and AP. Finally, farmers who use mechanical harvesters (and therefore those who are more likely to be heavily mechanised) are expected to have a relatively greater proportion of their asset value invested on-farm. This is compared to farmers who do not have large proportions of their capital tied up in on-farm assets such as machinery.

The need for back-up management is expected to be positively related to both MH and MECH owing to the increased demands placed on management time by the peaks in supply of cut cane created by using a mechanical harvester and the associated support machinery. Risk aversion (AP) is expected to be negatively related to BUM as risk averse individuals are expected to have relatively greater reserves of back-up management to allow for unforeseen circumstances. Also, respondents with business interests in other areas are expected to have management personnel that may be transferred between operations based demand meaning that they are expected to be less likely to have to hire additional management should they become incapacitated for any reason, compared to respondents with only one farming operation. Respondents who plan to increase their level of enterprise diversification are expected to have a greater need for back-up management, as the demands for management time are greater for a farm that is highly diversified. Finally, AP is expected to be related to AGE, ED and SIZE. However, *a priori* expectations regarding the coefficients of these variables are open to debate and are therefore not stated at this point (Grisley and Kellog, 1987).

The following regression results were obtained:

Simultaneous-equation model for the “Mechanisation and Management Bracket”:

$$\text{MH} = -16.58^* + (0.22^*)\text{MECH} + (0.41^*)\text{BUM} + (0.21)\text{AP} - (0.13^*)\text{REG} + (0.76^{***})\text{SHAREMH} \quad \text{Adjusted } R^2 = 67\% \quad \dots(6.1)$$

$$\text{MECH} = 2.77^{***} + (0.37^{***})\text{MH} + (0.41^*)\text{BUM} + (0.18)\text{AP} - (0.32^{**})\text{AGE} + (0.27^{**})\text{EXP} - (0.29^{**})\text{MIN} - (0.17^*)\text{AVOF} \quad \text{Adjusted } R^2 = 41\% \quad \dots(6.2)$$

$$\text{BUM} = 0.54 - (0.03)\text{MH} + (0.06)\text{MECH} - (0.66^{**})\text{AP} - (0.31^*)\text{BUSINT} + (0.09)\text{DIV5} \quad \text{Adjusted } R^2 = 24\% \quad \dots(6.3)$$

Where: *, **, *** represent statistical significance of parameters at the 10, 5 and 1% levels of probability, respectively.

As shown in equations (6.1), (6.2) and (6.3) the use of mechanical harvesters (MH), the level of back-up management kept in reserve (BUM) and the relative level of mechanisation (MECH) clearly act as complements within the “Mechanisation and Management Bracket”. This is evident from the positive parameter estimates for MECH, MH and BUM in all three equations with the exception of MH in equation (6.3). These parameter coefficients are statistically significant for the respective management instruments in the first two equations. The non-significance of this parameter coefficient is probably due to the fact that most mechanical harvesting is contracted out, placing minimum extra demand on the management time of the farm operator. AP was found to be an important determinant of BUM (statistically significant at the five percent level of

probability), consistent with *a priori* expectations. Furthermore, AP was found to be an indirect determinant of MH and MECH owing to its influence on BUM. Due to inadequacies in the data, however, it was impossible to fully specify the equation for AP. This was evident from a low adjusted R^2 of about 10%. As a result, the model for AP was not presented. The results of this 2SLS model, therefore, support those of the PCA (Table 5.1) in terms of including MECH, MH and BUM in the same choice bracket and suggest that the use of back-up management is a true risk management response.

6.4 Discussion

Although the application of the proposed method for identifying the influence of risk on individual management strategies was limited owing to data inadequacies in this study, the methodology does show potential for future use. PCA effectively determines important substitution and complementary relationships that exist between management strategies. Another advantage of using PCA in this manner is that the levels of use of the various management strategies are modelled rather than simply describing use or non-use of a particular response. Applying 2SLS to the choice brackets identified by the PCA enables the researcher to better specify models that can be used to estimate the important determinants of individual management responses. This improved specification is facilitated through an understanding of exactly which management instruments have an influence over one another (those bracketed together), allowing the necessary instrumental variables to be identified and included for each equation within the 2SLS framework. When viewed holistically by, firstly, understanding the bracketing of management instruments, it is easier to identify those variables that have an indirect effect (instrumental variables), but an effect nonetheless, on the use of a particular instrument. Models improved in this manner enhance the researcher's ability to detect the influence of risk on

individual management decisions and, therefore, to separate true risk management decisions from those where risk plays an insignificant role.

POLICY IMPLICATIONS AND CONCLUSIONS

This study shows that the most important risk sources as perceived by large-scale commercial sugarcane farmers in KwaZulu-Natal are the threat of land reform, the uncertainty involved with minimum wage labour legislation and the variability of the sugarcane price, in that order. With the exception of crop price variability, the relative ranking of risk factors differs from those of previous studies. Clearly, this is due to farmers now facing a new set of challenges such as continued land reform, property rates legislation and minimum wage legislation, which did not feature prominently in the past. The fact that the perceived importance of risk sources has changed compared to previous studies indicates that current government land and labour legislation in particular are raising levels of uncertainty amongst commercial sugarcane producers. Similar dimensions of risk to those identified in previous studies were found, although these categories were not identical. This may be attributed to the use of a different study population in this study and changes in the risk environment.

The study also identified some of the important risk-related management strategies available to commercial sugarcane farmers in KwaZulu-Natal. The PCA of risk-related management strategies provided evidence that farmers respond to changes in the risk environment using both individual risk responses and combinations of these responses, taking advantage of substitution and complementary relationships. Findings are consistent with those of Pennings *et al.* (2005) and tend to suggest the bracketing of management decisions at fairly narrow levels. This is evident from the six management dimensions or choice brackets identified in the PCA, where the majority of the variation in each dimension is attributable to one or two individual management responses. Regional

differences in the levels of adoption of individual risk-related management strategies are identified and explained based on farm, farmer and various other socioeconomic characteristics.

The study also proposed and demonstrated a new approach that may be used in future research to effectively, and holistically, model the role of risk in agricultural decision making. The technique used involves the separation of individual management strategies into choice brackets using PCA and the subsequent modelling of the strategies considered within each bracket simultaneously using 2SLS regression analysis. By combining PCA and 2SLS analysis, models aimed at identifying the influence of risk on decision making may be specified with greater accuracy, considering that many of the determinants of risk management behaviour may have an indirect influence that is otherwise difficult to detect. Using this technique, this study showed that risk attitude plays a significant role in management decisions regarding the extent to which management is kept in reserve by survey respondents. This study builds on the work of Pennings *et al.* (2003) by modelling most management responses based on actual levels of use rather than on dichotomous (non-continuous) choice variables. It addresses some of the concerns highlighted by Just (2003) by using micro-level data, the simultaneous modelling of more than one managerial response and the inclusion of an individual's risk attitude in the analysis.

Policy recommendations that stem from the findings of this study include that government should review restrictive labour legislation such as minimum wages to reduce the costs associated with permanent labour and slow the labour casualisation process, thereby promoting permanent employment rates and job security. An indication by government as to the long-term targets for minimum wage levels would serve to decrease some of the

uncertainty surrounding this legislation. Although recent developments regarding the land redistribution process have offered farmers some certainty regarding the willing seller, willing buyer principle, further uncertainty has been created amongst farmers in terms of the accuracy and reliability of the government's land valuation process. This is due to the Act introducing subjective criteria into the valuation process, creating uncertainty regarding compensation paid for land that has been successfully claimed. Government should question the wisdom of a process whereby an inadequately-resourced Land Claims Commission is able to shift the responsibility of disproving dubious claims to the farmer. The result of such uncertainties is that many farmers would rather opt for uncertain compensation than contend with high legal costs and an unpredictable court decision. Government, therefore, needs to decrease uncertainty surrounding the land redistribution process by providing farmers with detailed information regarding the process of land valuation and informing farmers whose land is subject to claim. For the SA sugarcane industry to remain competitive in a continually globalising market environment, policy makers need to create an enabling business environment that will help to reduce risk and uncertainty for producers. Farmers also need to develop management strategies that reduce the barriers to efficiency. For this to be realised, detailed knowledge of the prevailing risk environment is required which incorporates the various dimensions that exist between sources of risk. To achieve this, farmers require relevant and reliable information; for example, by engaging third parties such as SACGA extension officers and other private consultants and by using published information.

Farmers may also need to make better use of available information by considering the effects of any single management decision on separate decisions. Improved information processing by decision makers will allow relevant decisions to be made, taking into

account not only the effects of those decisions on all other decisions included in the existing choice bracket, but also on decisions previously restricted to other brackets. This would enable the improved anticipation of the outcomes of a management decision and, therefore, the ability to bracket these decisions at broader levels. This improved cognitive capacity will enable decision makers to take advantage of further substitution and complementary effects that may exist between management strategies previously considered in separate decision brackets. The fact that mechanisation and labour use occur in separate brackets in this study is an example of one such substitution effect that farmers do not seem to be utilising in terms of their management decision making.

Future research based on time series data is important in order to identify how risk perceptions and management portfolios change over time. Further research using the holistic methodology proposed in this study may prove to be a useful means of effectively identifying the effects of risk attitude on management decisions and, therefore, help to more adequately address the question “Does risk matter in farmers’ decisions?”. This would be facilitated through the use of a more comprehensive data set, including information regarding factors such as wealth, liquidity and leverage.

SUMMARY

The South African (SA) sugar industry supports approximately 50,940 small and large-scale producers who collectively farm an estimated area of 426,861 hectares. SA farmers face an uncertain decision making environment characterised by factors such as land reform, new labour legislation and minimum wages, AgriBEE, property taxes, high transport and communication costs, HIV/AIDS and a volatile exchange rate, amongst others. Studies have been conducted, both in South Africa and abroad, identifying the perceived importance of various risk sources and managerial responses to risk. Local studies identified price and production risks as the most important perceived sources of risk, although there was a trend towards the increasing importance of government legislation risks by the late 1990s. Despite a general consensus amongst agricultural economists that risk constitutes a prevalent feature of agricultural production, various authors have concluded that the majority of previous risk-related research has failed to provide a convincing argument that risk matters in the decision making of agricultural producers. Various criticisms of previous research have been made as well as recommendations for the future. These include that risk management be investigated more holistically and make use of farm-level data, accounting for heterogeneity in farmers' risk preferences. Holistic risk management recognises that various management decisions may act as complements or substitutes within a risk management portfolio. The method of choice bracketing is one means available with which to investigate these phenomena.

This study first identifies the risk aversion of a sample of large-scale commercial sugarcane farmers in KwaZulu-Natal (KZN) and uses principal component analysis (PCA) to investigate the dimensions that exist between 14 risk sources. Once an understanding of

the risk perceptions of respondents is obtained, the study goes further to quantify 12 managerial responses that respondents have at their disposal to manage their risk exposure. PCA is then conducted including all 12 responses in order to identify how respondents group their management decisions within choice brackets. Individual management responses occurring within the same choice bracket may act as either complements or substitutes but are interdependent and are, therefore, considered simultaneously by decision makers. With this in mind, the study proposes a methodology for future research that involves modelling those management responses occurring in the same choice bracket using the simultaneous-equations method to identify determinants of individual decision making. The use of simultaneous-equations is necessary to account for the fact that responses considered in the same choice bracket are endogenously determined.

The sample for this study was randomly drawn from a list of large-scale commercial sugarcane growers in two separate mill-supply areas of KZN, namely the Midlands and Zululand. Principal decision makers were contacted telephonically to arrange personal interviews and an overall, usable response rate of 76 respondents (69%) was obtained. Respondents were on average 47 years of age with 22 years of sugarcane growing experience. The prevalent business arrangement was a sole proprietorship, and the mean gross farm income (GFI) overall was R3,45 million. Sugarcane constitutes the major enterprise in both regions, although Midlands respondents reported significantly higher levels of enterprise diversification. On average, respondents were found to be risk averse, confirming a priori expectations, with a mean value for the adjusted Arrow-Pratt absolute risk aversion coefficient of 0.65.

The three most important sources of risk as reported by respondents were land reform, minimum wage legislation and crop price variability with mean overall ratings on the Likert-type scale of 4.31, 4.14, and 3.68, respectively. Overall, 79% and 75% of respondents included land reform and minimum wage legislation, respectively, in their top five list of risk sources most important to their farm businesses. PCA of risk sources revealed seven dimensions or indices, namely: the “Crop Gross Income Index”, “Macroeconomic and Political Index”, “Legislation Index”, “Labour and Inputs Index”, “Human Capital and Credit Access Index”, “Management Index” and the “Water Rights Index”.

Respondents were asked a number of questions regarding 12 risk-related management strategies that they may have at their disposal and use actively in their farm businesses. Certain management responses commonly associated with risk management yet not relevant to this study were excluded from this list of strategies. An example of the type of management responses used is the extent to which a farmer uses on-farm diversification as a management instrument. This variable was estimated in the form of an “enterprise diversification index”, calculated as the sum of the squared proportions of GFI stemming from each enterprise. PCA was then conducted including all 12 management instruments with the resultant indexes representing those management responses considered within the same choice bracket. Six choice brackets were revealed from the PCA, namely: the “Mechanisation and Management Bracket”, “Enterprise and Time Diversification Bracket”, “Insurance and Credit Reserve Bracket”, “Geographic and Investment Diversification Bracket”, “Land Trade Bracket” and the “Labour Bracket”. Because choice brackets were extracted using the correlation matrix, individual management instruments

falling within the same bracket are interdependent and act as either complements or substitutes and are considered simultaneously by the decision maker.

Following the section on choice bracketing of management responses, a model is proposed and demonstrated that may be used to investigate the determinants of individual management decisions occurring in the same risk bracket, taking into account the effects of all decisions within that bracket on one another. The proposed methodology uses a combination of PCA and two-stage least squares (2SLS) regression analysis. This methodology is useful in that it facilitates the accurate specification of risk management decision making models. This is due to the indirect effects of instrumental variables, used as proxies for any endogenous variables in the equation system, being incorporated into the model allowing improved overall model specification. Applied to the data in this study, the proposed methodology proved a useful tool in identifying whether certain management responses are influenced significantly by risk attitude. Although, due to inadequacies in the data, suitably specified models could not be obtained for all 12 management responses included in this study, the methodology was effectively used to show that risk is a significant determinant in management decisions regarding the extent to which management is kept in reserve by respondents. Future research applying the methodology proposed in the latter part of this study on a more comprehensive data set that includes information on variables such as wealth, liquidity and leverage may prove to be an efficient means of separating true risk responses from those merely considered to be good farming practice. Research based on panel data could also be important to allow researchers to identify how risk management portfolios change over time.

Important policy recommendations stemming from this study include that government review restrictive labour legislation in order to slow the casualisation process and promote permanent employment levels. Government also needs to decrease the uncertainty surrounding new land redistribution legislation by providing farmers with specific information pertaining to objectives and timeframes. Farmers need to make better use of available information by considering the effects of any single management decision on separate decisions. Improved information processing by decision makers will allow relevant decisions to be made, taking into account not only the effects of those decisions on all other decisions included in the existing choice bracket, but also on decisions previously restricted to other brackets. This improved cognitive capacity will enable decision makers to take further advantage of substitution and complementary effects that may exist between management strategies previously considered in separate decision brackets. The fact that mechanisation and labour use occur in separate brackets in this study is an example of one such substitution effect that farmers do not seem to be utilising in terms of their management decision making.

Future research using time series data is important in order to identify how risk aversion and management portfolios change over time. Also, further research using the methodology proposed in this study may prove to be a useful means of more adequately addressing the question “Does risk matter in farmers’ decisions?”

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APPENDICES

APPENDIX A: MEANS USED TO ENCOURAGE THE PARTICIPATION OF RESPONDENTS IN THE SURVEY

- a) SACGA will be approached for their endorsement of the study. An attempt will be made to obtain a covering letter from them stating that this research may be beneficial to commercial sugarcane farmers in KZN by providing a better understanding of their risk environment.
- b) Interviews will be conducted during appointments previously arranged telephonically with sample farmers.
- c) Before interviewing each farmer, the author will provide a brief introduction to the study, its importance and its relevance to farmers.
- d) Every attempt will be made to ensure that the interviewing process is conducted in a polite and mutually beneficial manner.
- e) Confidentiality will be guaranteed to each respondent by the author.
- f) All questionnaire documents will bear the name of the University of KwaZulu-Natal to relate the study to a recognised institution.
- g) It will be stated that results will be made available to those farmers who participate.
- h) Prompt thank you letters will be sent to respondents subsequent to their participation.

APPENDIX B: THE SURVEY QUESTIONNAIRE



UNIVERSITY OF KWAZULU-NATAL SCHOOL OF AGRICULTURAL SCIENCES AND AGRIBUSINESS DISCIPLINE OF AGRICULTURAL ECONOMICS

QUESTIONNAIRE: RISK MANAGEMENT BY KWAZULU-NATAL COMMERCIAL SUGARCANE FARMERS

TO BE ANSWERED BY THE **PRINCIPAL** DECISION MAKER OF THE FARM BUSINESS

What practices constitute your risk management portfolio? How does this portfolio compare to that of other farmers? Which sources of risk do you consider to be most important? We know that individuals differ in their attitudes towards risk, and that businesses differ in terms of their capacity to bear risk. We think that these two factors, amongst others, influence the makeup of a farm business' risk management portfolio. This questionnaire attempts to elicit data for a study on the effects of KwaZulu-Natal commercial sugarcane farm and farmer characteristics on the composition of a risk management strategy. Results of this study may be useful for identifying the effects of current policies on risk management strategies and in recommending future policies that may better suit the needs of commercial sugarcane farmers in KwaZulu-Natal. This study is undertaken by the Discipline of Agricultural Economics, University of KwaZulu-Natal, and has been sanctioned by the South African Cane Grower's Association. Each participant in this survey was randomly selected from a list of sugarcane farmers in the Noodsberg and Zululand mill-supply areas. I will require approximately 30 minutes of your time and will be happy to answer any questions that you may have regarding the study. Individual responses will not be reported.

ALL SURVEY RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL

Interview record: (to be completed by the interviewer)

CODE	DATE

SECTION A:

1. FARM AND FARM OPERATOR INFORMATION

1.1 Age: _____

1.2 Formal education. (tick where appropriate)

None	
Grade 7 (Std 5) and below	
Grade 8 to 11 (Std 6 to 9)	
Matric	
Diploma	
Degree	

1.3 How many years experience do you have at:

1.3.1 Managing a farm? _____

1.3.2 Managing your current farm? _____

1.3.3 Growing sugarcane? _____

1.4 Which of the following best describes your relationship to the farm business?

(tick where appropriate)

Sole proprietor	Partnership	Trust	Corporation

1.5 Please complete the following table regarding tenure of land.

	Owned	Rented In	Rented out	Other: (specify)
Cane Land (Ha)				

1.6 Indicators of farm size:

1.6.1 Please indicate the area (Ha) of land currently used for sugarcane: _____ (Ha)

1.6.2 Please provide an estimate of Gross Farm Income (Turnover) for the 2005/2006 financial year:

R _____

1.6.3 In your opinion was the 2005/2006 production season fairly representative (Y/N)? _____

1.7 What is the approximate distance to the nearest mill? _____ (km)

1.8 Labour force characteristics:

1.8.1 Approximately how many permanent labourers do you employ? _____

1.8.2 Of these permanent labourers, how many are trained to operate a tractor? _____

1.9 Do you have off-farm employment (eg: as a consultant or contractor)(Y/N)? _____

Does your spouse have off-farm employment (Y/N)? _____

What proportion of your time is spent engaged in off-farm employment? _____

1.10 Is any portion of your farm business' land subject to a land claim (Y/N)? _____

3. RISK RESPONSES

3.1 Keeping of records:

- 3.1.1 Do you actively use physical production records (e.g., field records) for enterprise and farm planning purposes (Y/N)? _____
- 3.1.2 Do you actively use financial records (e.g., balance sheet, income statement, cash flow statement) for enterprise and farm planning purposes (Y/N)? _____

3.2 Operating as a low cost producer:

- 3.2.1 Do you associate allowing a larger number of ratoons, relative to other farmers in your area, with reducing operating costs (Y/N)? _____
- 3.2.1 On average, how many ratoons do you allow before replanting? _____

3.3 Diversification:

3.3.1 Diversification of on-farm enterprises.

Please complete the following table by listing the various enterprises that you operate on your farm and by indicating the proportion of gross farm income derived from each respective enterprise.

Enterprise	Proportion of Income
1: Sugarcane	
2:	
3:	
4:	
5:	
6:	
7:	
8:	
9:	
10:	

- 3.3.2 As an indicator of geographical diversification of production please specify whether or not you have farm business interests in other areas (Y/N)? _____
- 3.3.3 To indicate your level of off-farm diversification please specify whether or not you have significant off-farm investments (Y/N)? _____
- 3.3.4 What proportion of your wealth is invested off-farm? _____

3.4 Do you employ a greater or smaller proportion of casual (seasonal) labourers relative to other farmers in your area (Please circle your response)?

Much less	Slightly less	Similar	Slightly more	Much more
1	2	3	4	5

3.5 The use of information:

3.5.1 Do you own a computer (Y/N)? _____

If so, do you use the computer for;

- business correspondence (Y/N)? _____
- access to on-line business information (Y/N)? _____
- business e-mail (Y/N)? _____
- organisation of records (Y/N)? _____
- other (please specify) _____

3.5.2 Approximately how many hours per week do you spend collecting and analysing external sources of information (eg: Internet, other farmers, magazines etc)? _____(hrs/week)

3.5.3 Please indicate your three most important sources of information, beginning with the most important (e.g., other farmers, consultants, the Internet).

- 1: _____
- 2: _____
- 3: _____

3.6 Propensity to purchase land:

3.6.1 If an adjacent piece of land, suitable for sugarcane production, were to become available at a fair price would you purchase that land (Y/N)? _____

3.6.2 Propensity to sell land:

If offered a fair price for a proportion of your potential or existing sugarcane land would you sell that land (Y/N)? _____

3.7 What proportion of your sugarcane land is irrigated? _____

3.8 The use of capital items:

3.8.1 Are you relatively more or less mechanised in terms of sugarcane production than other farmers in your area (Please circle your response in the following table)?

Much less	Slightly less	Similar	Slightly more	Much more
1	2	3	4	5

3.8.2 How many tractors are owned by the farm business? _____

3.9 The use of machinery contractors:

- 3.9.1 - What proportion of your cane land could be mechanically harvested? _____
- Are there any mechanical harvesting contractors in your area (Y/N)? _____
- What is the proportion of your crop mechanically harvested? _____
- Do you own a sugarcane harvester (Y/N)? _____

3.10 Insurance:

3.10.1 What proportion of total farm income is spent on insurance? _____

3.10.2 Please list the various types of insurance that you use;

- Crop fire insurance (Y/N)? _____
- Hail insurance (Y/N)? _____
- Insurance of assets (Y/N)? _____
- Liability insurance (Y/N)? _____
- Farm operator life insurance (Y/N)? _____
- Other (Please specify) _____

3.11 Please indicate the level at which you maintain credit reserves by providing an estimate of the percentage of available credit on your overdraft facility that was used during the 2005/2006 production season: _____

3.12 If you were to become unexpectedly incapacitated for a period of six months would the business have to hire additional management (Y/N)? _____

4. RISK ATTITUDE

4.1 Please indicate, by circling the appropriate option in the following table, your willingness to take risks relative to other farmers in your area.

Much less willing	Slightly less willing	Similar	Slightly more willing	Much more willing
1	2	3	4	5

4.2 You are asked to consider the following two sets of hypothetical questions. In each question you are faced with a decision between two options, OPTION A being a gamble based on the toss of an unbiased coin, and OPTION B yielding a certain outcome. The object of this exercise is to determine that specific outcome where you are indifferent between the uncertain and certain amounts for each of the five questions. In each question you are asked, for various values of OPTION B, which option you prefer until a value is found where you are indifferent between the two options.

4.2.1 If you were faced with an option to take a gamble (OPTION A) and the option to receive a certain amount (OPTION B), which would you prefer?

OPTION A: A coin is tossed:

HEADS (50%): You win R80 000

TAILS (50%): You lose R20 000

OPTION B: You receive:

R5 000	R7 500	R10 000	R12 500	R15 000	R20 000	R25 000
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4.2.2 If you were faced with an option to take a gamble (OPTION A) and the option to receive a certain amount (OPTION B), which would you prefer?

OPTION A: A coin is tossed:

HEADS (50%): You win R20 000

TAILS (50%): You lose nothing

OPTION B: You receive:

R1 000	R2 500	R5 000	R7 500	R10 000	R12 500	R15 000
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- 5 Do you plan to still be farming sugarcane in:
- 5.1 Five years time (Y/N)? _____
- 5.2 Ten years time (Y/N)? _____
- 6 Would you be interested in the findings of this study (Y/N)? _____

THANK YOU FOR YOUR COOPERATION