Risk - An Opportunity or Threat for Entrepreneurial Farmers in the Global Food Market?

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Abstract

Operating in a deregulated economy that provides minimal support to agriculture, New Zealand dairy farmers are exposed to considerable uncertainty. However, this uncertainty provides both opportunities and threats for New Zealand dairy farms and often it is the capacity of the farm manager to interpret and respond to external (and internal) information that determines the extent of the advantage or disadvantage that is eventually realized. The research question in this study is to determine whether the perceptions of risk (importance and likelihood) differ according to time horizon and according to whether the risk is viewed as an opportunity or a threat. Subsequent to this question is whether presenting farmer perceptions in a format that better illustrates and informs on the relativity between the sources of risk can enhance the capacity of farm managers to either avoid or exploit the threat and opportunity respectively. This paper reports on the development and application of a methodology to answer these questions. The methodology is then tested on a selected group of farmers with the results analyzed and presented.

Keywords: uncertainty, farm management, opportunities, threats

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Introduction

Operating in a deregulated economy that provides minimal support to agriculture, New Zealand dairy farmers are exposed to considerable uncertainty. However, this uncertainty provides both opportunities and threats for New Zealand dairy farms and often it is the capacity of the farm manager to interpret and respond to external (and internal) information that determines the extent of the advantage or disadvantage that is eventually realized.

There is however an interesting bias in the literature on the definition of uncertainty and/or risk. There is also a distinction made between uncertainty and risk. The extent of available information partly contributes to the concepts of uncertainty and risk in literature. While the difference is of significance to some (Hardaker et al. 1997), the terms risk and uncertainty are more often described as interchangeable (Chavas 2004; Newbury and Stiglitz 1981; Sonka and Patrick 1984). This is based on the argument that subjective probabilities are usually formed by decision makers in which case the distinction between the two (uncertainties exist when the probability of outcomes are unknown and risk implies an imperfect knowledge of the actual outcome but the probabilities of the possible outcomes are known) become less relevant (Anderson et al.1977; Hardaker et al., 2004; Sonka and Patrick 1984).

The bias in the literature relates to whether risk is seen as a positive or negative influence on the business. While, for example, Chavas (2004) states that risk represents any situation where some events are not known with certainty and Robison & Barry (1987,13) maintain that " …*uncertain events are important when their outcomes alter a decision maker's material or social well being",* neither provide a negative or positive bias in their definitions. In contrast a more negative bias is found in Hardaker et al. (1997) who define uncertainty as imperfect knowledge and risk as uncertain consequences, particularly exposure to unfavorable consequences. For example, they include in human risk death of owner, prolonged illness, or carelessness of a hired employee.

Similarly Harwood et al., (1999), cited by OECD (2008) state "…*risk is uncertainty that matters and may involve the probability of losing money, possible harm to human health, repercussions that effect resources and other types of events that affect a person' welfare."*

The negative bias presented by Hardaker et al. (1997, 2004) relates to their observation that technical risk in agriculture is downside risk, since significant deviations from plan, either greater or smaller, are likely to have adverse consequences e.g. large deviations in rainfall either way will reduce yields, and thus income. Despite definitions to the contrary, this bias has been pervasive as many studies in this area focus only on the negative impact of risk.

Consider, for example, Pinochet-Chateau et al. (2005) who compared the risk perceptions of New Zealand dairy farmers in 1992 from the study by Martin (1994) with those in 2004. They found that farmers' perceptions of risk changed over time and that the mean scores for the majority of risk sources increased. The three highest ranked risk sources in 2004 were market risks. The highest ranked risk source in both 1992 and 2004 was changes in product prices. Interestingly, the second and third ranked risk sources in 2004, changes in world economic and political situation and changes in input prices were ranked lower in 1992 (3rd and 5th

respectively). They also noted that the overall perception of production risk had not changed over the twelve-year-period, there was a change in some of the components of production risk. For example, the perceived risk from rainfall variability declined between 1992 and 2004 whereas that from pests and diseases increased. Farmers' perceptions of risks from regulatory risks increased between 1992 and 2004.

The work of Martin (1994) and Pinochet-Chateau et al. (2005) helped identify changes in how farmers both perceive and manage risk. However in both instances only the negative side of risk was presented and the management strategies described were assumed to be minimising the uncertainty associated with those sources of risk. There was also no distinction made between whether the risk was being assessed within a season or over a longer time frame.

This bias has important implications for the study of farm management, and is highlighted when one considers farming entrepreneurs. For McElwee (2006), entrepreneurship is a good risk attitude measure because he found that those farmers who had ventured into new farm enterprises in his study scored highly in what he termed risk attitude. While entrepreneurship has various definitions, as identified by Shadbolt et al (2009), a common theme is that farming entrepreneurs have more growth orientation, risk taking, innovativeness and personal control characteristics than their conventional farmer counterparts (Vesala et al. 2007). They seek to exploit opportunities (de Lauwere's 2005). Alsos et al. (2003) also state that farm-based entrepreneurship is the result of alert farmers discovering and exploiting business opportunities related to their prior knowledge. Therefore any survey that does not provide for farmers' identification of the opportunities that uncertainty creates and does not analyze how farmers adopt strategies that capture those opportunities is only telling half of the story.

Both entrepreneurship and risk management are being promoted as areas requiring improvement on-farm (Shadbolt et al. 2009). For example, in Europe, Phillipson et al. (2004) state that market liberalization has led to drastic changes in government policies and the subsequent promotion of entrepreneurship and business skills in the farming sector. Similarly Detre et al. (2006) identify that changes in the industry are creating new and different uncertainties than the traditional operational and financial uncertainties agribusinesses have faced in the past. Risk management skills are all the more important now with the recent increased volatility in market prices (Rabobank 2010).

An exception to the bias noted above is the work reported by Detre et al. (2006). In their research, they recognized that uncertainty has upside potential as well as downside exposure citing (Pascale et al. 2000) and developed a tool to promote and generate discussion around key areas of uncertainty. They presented a methodology to understand, assess and evaluate, and manage strategic uncertainty. They are guided by Boehlje et al. (2005)'s definition of strategic uncertainty:

"strategic uncertainty is the sensitivity of the company's value to inappropriate strategic choices, ineffective strategy implementation, or uncertainties in the business climate"

This definition differs from those quoted above in that it implicitly identifies the role of the manager in both managing and creating uncertainty in the business. Not only can the business

climate be turbulent, but also the manager can make the wrong choice or implement strategy poorly. Detre et al. (2006,73) maintain that "*firms must evaluate and manage strategic uncertainty through proactive strategies that capture the potential benefits of the uncertainty and mitigate the exposures if they fail to act.*" Citing Talavera (2004) and Pascale *et al*, (2000) they identify how managing uncertainty can create long-term value and they caution that a focus only on "uncertainty avoidance" will cause a firm to overlook opportunities to create value. They tested their methodology with agribusiness executives working on a hypothetical seed company. The results suggest that the approach they had developed was useful, not only to understand the uncertainties from both a positive and a negative perspective, but also to communicate the impact of the uncertainties and discuss the various strategies open to the company – capitalize, share, transfer, reduce, avoid and monitor. So if managing uncertainty can create long-term value, how does it affect short-term value? Does the time horizon alter the effectiveness of, or requirement for, risk management due to outcomes being less certain?

The literature review failed to unearth other examples of farm or agribusiness management analysis in which both perspectives were explored. Most literature focused on risk mitigation to prevent an uncertainty from occurring. However a similar approach was found to be in use by the Government of Alberta, Department of Agriculture and Rural Development, with their Risk Choice Matrix tool (Millang et al. 2010). This tool helps to illustrate the uncertainties that are of greatest concern for a farm but it does not extend to the choice of strategy that either mitigates downside exposure or exploits upside potential.

Research Objectives

This research was part of a larger project designed to explore risk management on dairy farms in New Zealand, to review existing knowledge on farmer perceptions of risk in dairy farming and the risk management strategies they currently employ. The survey was initially undertaken to identify suitable case farmers for an in-depth multiple case study of the risk management strategies of New Zealand dairy farmers (Payne et al. 2009). The farmers in the survey were identified by the research team as operators who might provide useful insights into risk management across a range of regions in New Zealand. They had collaborated in previous studies and been used as case studies for students so were known to be receptive to enquiry. As such they are a biased and not a random sample.

The survey results were then further scrutinized to determine if it was a useful method to determine whether long- and short-term perceptions of risk differ from both a positive and a negative impact of risk perspective. Various methods were explored for describing these perceptions in an attempt to develop a tool of use to both farmers and the industry. The aim was to aid both farmer and industry understanding and prioritization of risks and hence guide the risk management and mitigation strategies they adopt or promote.

The research question in this study is to determine whether the perceptions of risk (importance and likelihood) differ according to time horizon and according to whether the risk is viewed as an opportunity or a threat. Subsequent to this question is whether presenting farmer perceptions in a format that better illustrates and informs on the relativity between the sources of risk can enhance the capacity of farm managers to either avoid or exploit the threat and opportunity

respectively. This paper reports on the development and application of a methodology to answer these questions. The methodology is then tested on a selected group of farmers with the results analyzed and presented.

Method

This study aimed to identify and assess strategic uncertainties in the New Zealand dairy industry using sample data from New Zealand dairy farmers and to develop a typical scale and importance index for the identified uncertainties. Such an index could then be used to help dairy farmers both exploit the opportunities created by uncertainty and mitigate the threats from those same uncertainties.

A questionnaire was completed by 27 dairy farmers from diverse locations across New Zealand. The sample size was small and biased as the farmers chosen were those who were being considered for an in-depth multiple-case study project. To get a better understanding of the characteristics of the selected group the first section of the questionnaire asked the respondents to assess their perceived ability to manage uncertainties within a season, and over the long-term, their attitude to planning, aptitude in decision making and degree of risk aversion.

Respondents were then asked to assess the potential for their businesses to benefit from a range of sources of uncertainty and state what they believed was the likelihood of this opportunity arising. They were then asked to assess the potential for their business to be disadvantaged from the same range of sources of uncertainty and state what they believed was the likelihood of this threat arising. This self-assessment was carried out twice, once from a within season perspective and then again from a longer term (5-10 year) perspective. The sources of uncertainty were taken from a combination of the studies of Pinochet-Chateau et al. (2005), Martin (1994) and Detre et al. (2006).

The sources of risk were then grouped into six categories and respondents were asked to assess their ability to respond to each category both within a season and over the long term. The respondents were then asked to assess, for both within season and the longer term, how well resourced they were to respond to the sources of risk with respect to land, labour, capital and management structure and ability.

A list of risk management techniques taken from Pinochet-Chateau et al. (2005) and Martin (1994) were provided to the respondents and they were asked to state their importance and whether they did or did not use that technique. The questionnaire finished with some questions about the respondents dairy farm and personal characteristics.

Apart from the last section, the questions were framed in a way that responses are captured as ordinal data on a scale of 1 to 5. Typical responses were constructed using median. Where the average median response was a fraction, the mode was used instead to represent the average response after considering extreme responses (outliers) by using standard deviation and skewness in responses. This scale allowed assigning of numbers to various levels of threat posed or opportunity created by an uncertainty, the likelihood of each uncertainty happening and other concepts measured.

The scale is similar to the popular Likert scaling technique which measures a respondent's degree of agreement or disagreement on an issue, opinion, or particular belief. Responses to a Likert scale can be considered to be interval level scores, thus allowing scores to be summed and treated statistically. Appropriate descriptive analyses were performed to complement the limited statistical analysis that Likert scale type or ordinal responses can allow. This helped to rate and score different uncertainty impacts and likelihood and other perceptions of the respondents required for the development of a number of tools.

Uncertainty scorecards, RiskChoice matrices and risk importance indices, as well as heat maps (extrapolation of exposure/likelihood graph on potential/likelihood map) were the tentative tools developed and tested on the data from the 27 dairy farmers' responses. In this study, the scorecards were integrated into a matrix developed by the Alberta Department of Agriculture and Rural Development (Millang et al. 2009).

The Uncertainty Scorecard

Detre et al. (2006, p. 72) identify that managers have a *"mental model that frames assessment of strategic uncertainty from both a potential and an exposure perspective"* and describe the assessment tools such as the scorecards and heat maps as ways to operationalise the mental model by providing quantitative rankings to communicate the impact of uncertainty on the business.

The response (qualitative ranking) from the farmers were coded into a scorecard showing the quantitative ranking (score) of each uncertainty source. On a separate scorecard for each of potential and exposure, the vertical axis is likelihood while the horizontal axis is the level of potential or exposure. To estimate or generate a scorecard from the graph and for a typical scorecard estimated from the respondents' response, a low score corresponds to a number less than 3 and a high score is a number greater than 3 using median score. Each graph is divided into four quadrants based on this summation, and the quadrants are color coded. As in Detre et al. (2006) symbols in the form of hand gestures can also be attached to each quadrant to aid visualization.

RiskChoice Matrix

The potential/likelihood graph (scorecard) is mirror-imaged and appended to the right edge of exposure/likelihood graph (scorecard) to create a RiskChoice matrix. The arrow of attention is drawn across the matrix from highest likelihood to lowest likelihood within the high to very high impact. The uncertainty scorecards can help farmers identify opportunities and threats, so that these can either be captured or avoided. When they are integrated into a risk choice matrix, they help to identify how each uncertainty may be both an opportunity and a threat. Simultaneous responses can then be conceptualized in a legend of generic uncertainty responses.
The RiskChoice matrix is a template that individual farmers can use to analyze specific sources of uncertainty. For each business, a particular uncertainty may be assessed as either a threat or an opportunity depending on a particular context and the outcome of a particular unknown.

Response Legend

It is proposed that the heat map, as described by Detre et al. (2006), be reconstructed as a legend of responses to different impacts and likelihood of uncertainty as read from the RiskChoice matrix. The Response legend can be created to serve as a filter for choosing a specific set of responses or activities to manage a strategic uncertainty. They can be based on the sixteen quadrants from the RiskChoice matrix. A combination of colors and hand gestures could be used to help visualization.

Risk Importance Index

Farmers have different perceptions about the impact and likelihood of each uncertainty source. This influences their rating or assessment of each uncertainty. It is difficult therefore to rank the uncertainties based on individual farmers' responses without normalizing (or weighting) the uncertainties to avoid distortions due to context, diversity (ranges from human capital to physical assets) or different measurement scales.
A risk importance index was constructed by assigning weights based on qualitative or subjective judgments from the respondents. Average uncertainty scores and proportion of respondents were used as weights to compute indices which were then ranked. The average uncertainty score was constructed from the impact score, the likelihood score and the proportion of respondents. This followed the approach used in Mclean-Meyinsse et al. (1994), Jose and Valluru (1997) and Alimi et al. (2006) where weights were constructed based on fewer factors - only impact and proportion of respondents.

In addition, in this study the median scores (each for impact and likelihood) were used rather than arithmetic mean scores as used in previous studies (Mclean-Meyinsse et. al., 1994; Jose and Valluru, 1997; Alimi et al., 2006). The approach goes further than using the proportion of respondents that ranked a source of uncertainty as the most important. The uncertainty scores were first calculated from the multiplication of impact scores and likelihood scores. Then we considered the proportion of respondents with a risk score of 15 and higher. This is the level at which management action such as uncertainty mitigation measures are required according to an extract by David Champion, from a discussion by five experts on the future of enterprise risk management in Harvard Business Review (2009). Yet, this is not exhaustive as there is still a need to consider a risk score of 5 (e.g. when there is a likelihood score of 1, but an impact score of 5) as although an uncertainty event is very unlikely to happen, when it happens, the impact is very high. Incidentally, none of the sources of uncertainties considered in this study had a typical impact score of 5 and a likelihood score of 1. Finally the proportion of respondents that assessed an uncertainty source at a level of 15 and above was used to multiply the uncertainty score to arrive at an importance index.

The index is then ranked in descending order. The rank of each index is its size relative to other indices in the list such that if sorted in descending order (i.e. order of less importance), the rank of each index is its position. This analysis was done using the RANK function in Microsoft Excel which gives duplicate numbers the same rank. This happens when there is a tie. However, the presence of a tie (i.e. duplicate numbers) affects the ranking of subsequent numbers such that for instance, in a list of index sorted, if an index of 10 appears twice and has a rank of 5, then 11 would have a rank of 7 (no index has a rank of 6).

Constructing a risk importance index for a group of farmers, weighted by the proportion of responses from respondents, allows the relative importance of uncertainties to be determined. This is aimed at capturing industry and institutional value as this information can help to create awareness of the major and most important sources of uncertainty and guide entry strategy (for new farm businesses), industry strategy and policy formulation.

Results and Discussions

The farmers surveyed had considerable experience in dairy farming with 73% aged 41 and older. About 35 % were single-farm owner operators and another 35 % were owner operator with multiple operations. More than half (57%) of the farmers were at the growth stage in the farm family life cycle while 40 % were in a consolidation phase, none were at the entry or exiting stage. See summary statistics for respondents in Table 1 located in Appendix 1.

Half of the farmers have a debt to asset ratio of between 40 and 60 %, 78% had a debt to asset ratio 40 % or greater. The national mean debt to asset ratio was 34.6% in that year (DairyNZ 2009) which means that this sample of farmers carries above average debt levels. Nearly 70% of the farmers had 20% or greater debt servicing as a proportion of gross income (including off-farm income) as at June 2008. The national mean debt servicing capacity measure ((interest + rent) divided by gross farm revenue) was 17.5% in that year (DairyNZ 2009). Again this shows that this sample carries a higher debt servicing commitment than average.

Within a season, 66% agreed or strongly agreed that they have the ability to manage almost all uncertainty and over the longer-term, 61% agreed or strongly agreed that they have the ability to manage almost all uncertainty. About 40% have a neutral attitude to risk while 31% reported risk seeking behavior and 19% were risk averse.

The high level of debt, many in the growth stage of their business their confidence and the small number identified as risk averse would suggest the selected group were similar to Vesala et al., (2007)'s description of farming entrepreneurs. They stated that entrepreneurs had more growth orientation, risk taking, innovativeness and personal control characteristics than their conventional farmer counterparts. The perceived ability to manage risk of the selected group is more typical of a entrepreneur given their sense of control, self-efficacy and self-belief. Given these observations the selected group is hitherto described/defined as 'entrepreneurial' as compared with average dairy farmers in New Zealand.

Distribution of Risk Management Techniques

In common with previous studies (Pinochet-Chateau et al. 2005) the most widely used risk management techniques (accorded very high importance) include maintaining feed reserves, having short term flexibility, irrigation, managing debt, using futures markets (where applicable), planning the timing of capital expenditure, insurance, and a range of business planning techniques. Few farmers adopted the strategies of diversification, not producing to full capacity, keeping debt low, and the farm operator working off the property to add to farm income. This commonality with previous studies suggests that despite the biased sample these farmers were not atypical in their risk management strategies although their scores were higher. The higher scores indicated that they placed greater importance on the techniques available and made more

use of them. There are also some differences in the strategic planning area, these farmers rated some of the strategic management strategies much more highly and a much greater proportion of them used the strategies. This observation also reinforces their description as entrepreneurial as it fits with Alsos et al. (2003)'s conclusion that farm-based entrepreneurship is the result of alert farmers discovering and exploiting business opportunities related to their prior knowledge.

Table 2. Distribution of risk management strategies among the respondent dairy farmers

Risk management strategies		Within season	
	# Responses	*# Using*	*Median Score*
1. Having more than one type of animal or other enterprises on your property	26	10	3
2. Maintaining feed reserves	26	25	**5**
3. Not producing to full capacity so there are reserves in the system	25	11	3
4. Having short term flexibility: adjusting quickly to weather, price & others	26	24	**5**
5. Monitoring programme for diseases and climate	26	20	4
6. Routine spraying or drenching as a preventive measure	24	21	4
7. Irrigation	20	13	**5**
8. Spreading sales (reducing seasonality in milk production)	25	13	4
9. Geographic diversity (having property in different areas)	21	10	4
10. Using futures markets	22	2	**5**
11. Forward contracting	25	15	4
12. Gathering market information	26	23	4
13. Arranging overdraft reserves	25	24	4
14. Maintaining financial services: having cash and easily converted	26	16	4
15. Main farm operator working off property to add to farm income	25	5	3
16. Managing debt: monitoring debt and working closely with lenders	26	26	**5**
17. Keeping debt low: reducing debt or maintaining a low level of debt	26	8	3
18. Planning of capital spending: pacing investments and expansion	26	26	**5**
19. Having personal or business insurance	25	23	**5**
20. Using of practical planning steps in your business	26	25	**5**
21. Assessing strengths, weaknesses, threats and opportunities	26	24	**5**
22. Having a clear and shared vision or strategic purpose for your operation	26	22	**5**
23. Using of financial ratios for decision making	25	18	4
24. Others*	6	6	**5**

Score: Scale: 1 = not very important,… 5 = very important
*maintaining good health, involving family in business growth, other investment off-farm, varied team of skilled advisor, keep in touch with what is happening, measure net worth gain, calving more than once per year, variety of feeds available.

Typical Assessment Scorecards for Strategic Uncertainty

Within season, the typical scorecards developed for each of the uncertainty sources show that the production, financial, marketing, R&D and human/relationships categories of uncertainty all have a high positive impact. Within those categories, interest rates, global demand for dairy products, product prices, business relationships and skills and knowledge of those in or associated with the business have a high likelihood of occurring. By contrast although unexpected weather conditions, global demand for dairy products, product prices, input costs and local body laws and regulation have high negative impact, the farmers perceived that they have a low likelihood of occurring. The juxtaposition of the positive and negative impacts are best illustrated on the RiskChoice matrices (Figures 1 and 2) as they enable an "arrow of attention" to be recognized that, in turn, can guide the focus of the decision maker.

Arrow of Attention

Threats

Opportunities

Likelihood										Likelihood
Very likely										Very likely
Likely					• Interest rates • Global demand for dairy products • Product prices • Business relationships • Skills and knowledge (business)					Likely
About as likely as not		• Pasture/crop/animal health • Interest rates • Credit availability • Government laws and policies	• Unexpected weather conditions • Global demand for dairy products • Product prices • Input costs • Local body laws and regulations		• Unexpected weather conditions • Purchased feed availability • Pasture/crop/animal health • Credit availability • Land prices • Input costs • On-farm Technology • Availability of labour	• Cooperative polices & producer requirements	• Government laws and policies		About as likely as not
Unlikely	• Purchased feed availability • Land prices • On-farm Technology • Family relationships	• Business relationships • Availability of labour • Skills and knowledge (business) • Cooperative polices & producer requirements					• Family relationships	Local body laws and regulations		Unlikely
Very unlikely										Very unlikely
	Very low	Low	Medium	High	Very High	Very High	High	Medium	Low	Very low

Negative Impact

Positive Impact

Figure 1: Typical RiskChoice matrix within season

Arrow of Attention

Threats

Opportunities

Very likely											Very likely
Likely				• Unexpected weather conditions • Local body laws and regulations			• Global demand for dairy products • Product prices • Business relationships • Availability of labour • Skills and knowledge (business)				Likely
About as likely as not	• Skills and knowledge (business)	• Purchased feed availability • Pasture/crop/animal health • Interest rates • Credit availability • Land prices • Global demand for dairy products • Product prices • Cooperative polices & producer requirements	• Input costs • Government laws and policies			• Unexpected weather conditions • Purchased feed availability • Pasture/crop/animal health • Interest rates • Credit availability • Land prices • Input costs • On-farm Technology		• Family relationships • Cooperative polices & producer requirements	• Government laws and policies • Local body laws and regulations		About as likely as not
Unlikely	• On-farm Technology • Family relationships • Business relationships	• Availability of labour									Unlikely
Very unlikely											Very unlikely
	Very low	Low	Medium	High	Very High	Very High	High	Medium	Low	Very low	

Negative Impact

Positive Impact
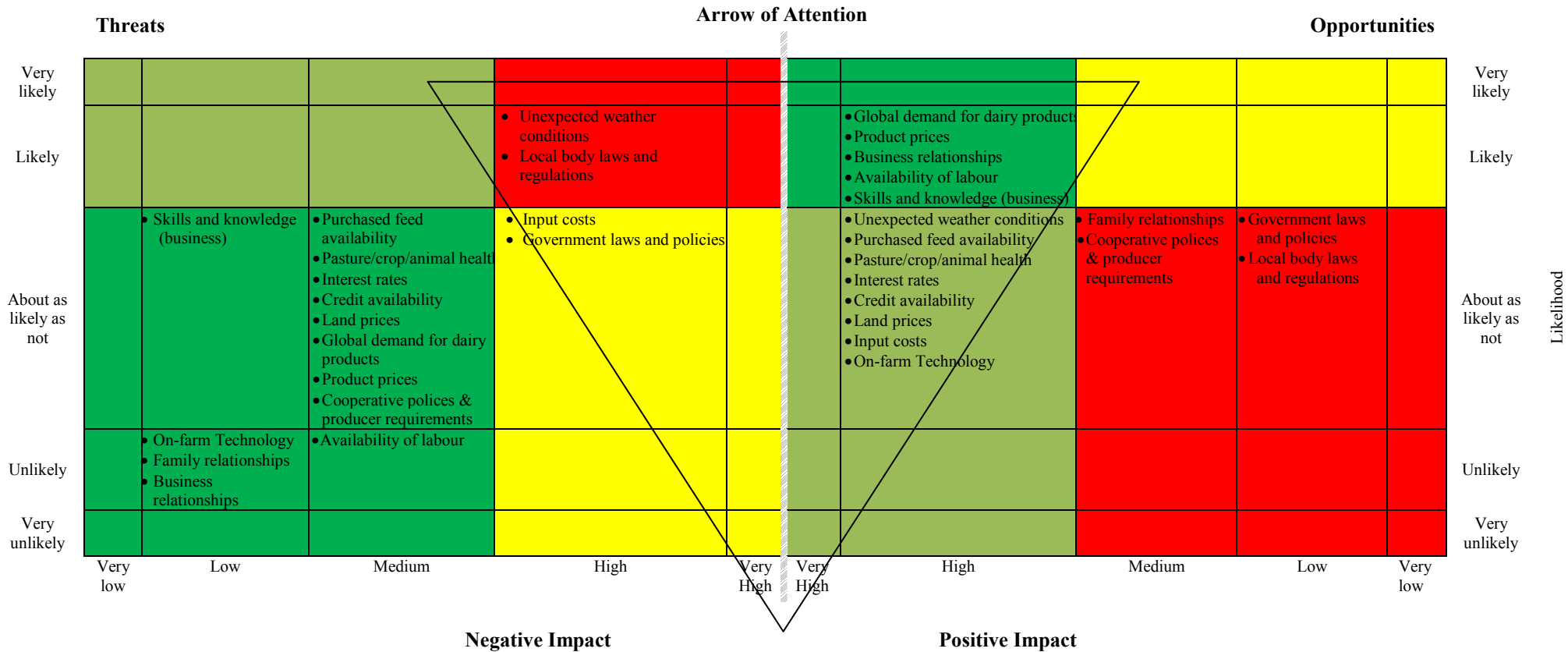
Likelihood

Likelihood

Figure 2. Typical RiskChoice matrix over 5 – 10 years

Table 3. Typical scorecards for strategic uncertainty within season as rated by the respondent dairy farmers

Sources of uncertainty	Opportunity		Threat	
	impact	*likelihood*	*impact*	*likelihood*
Production				
Unexpected weather conditions	4	3	4	3
Purchased feed availability	4	3	2	2
Pasture/crop/animal health	4	3	3	3
Financial				
Interest rates	4	4	3	3
Credit availability	4	3	3	3
Land prices	4	3	2	2
Market				
Global demand for dairy products	4	4	4	3
Product prices	4	4	4	3
Input costs	4	3	4	3
R&D				
On-farm technology (incl. Breeding)	4	3	2	2
Human/relationships				
Family relationships	3	2	2	2
Business relationships	4	4	3	2
Availability of labor (self, family, employees, contractors)	4	3	3	2
Skills and knowledge of those in or associated with the business	4	4	3	2
Policy & Regulation				
Government laws and policies	2	3	3	3
Local body laws and regulations	2	2	4	3
Cooperative policies and producer requirements	3	3	3	2

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely

Table 4. Typical scorecards for strategic uncertainty over 5-10 years as rated by the respondent dairy farmers

Sources of uncertainty	Opportunity		Threat	
	impact	*likelihood*	*impact*	*likelihood*
Production				
Unexpected weather conditions	4	3	4	3
Purchased feed availability	4	3	3	3
Pasture/crop/animal health	4	3	3	3
Financial				
Interest rates	4	3	3	3
Credit availability	4	3	3	3
Land prices	4	3	3	3
Market				
Global demand for dairy products	4	4	3	3
Product prices	4	4	3	3
Input costs	4	3	4	3
R&D				
On-farm technology (incl. Breeding)	4	3	2	2
Human/relationships				
Family relationships	3	3	2	2
Business relationships	4	4	2	2
Availability of labor (self, family, employees, contractors)	4	4	3	2
Skills and knowledge of those in or associated with the business	4	4	2	3
Policy & Regulation				
Government laws and policies	2	3	4	3
Local body laws and regulations	2	3	4	4
Cooperative policies and producer requirements	3	3	3	3

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely

Over a longer-term it is a different situation. Again there are a number of issues recognized as having a high positive impact on the farm business – the production, financial, marketing, R&D

and Human/Relationships categories of uncertainty. Within those categories, global demand for dairy products, product prices, business relationships, availability of labor and skills and knowledge of those in or associated with the business have a high likelihood of occurring. When looking long-term the farmers identified unexpected weather conditions, input costs, government laws and policies and local body laws and regulations as having a high negative impact. Of these, unexpected weather conditions and local body laws were perceived to have a high likelihood of occurring.

When contrasting the two RiskChoice matrices it is clear that, for these entrepreneurial farmers, they perceive many positive impacts from uncertainty within a season and few negative impacts. However over the long-term although there are still a number of high positive impacts from the various sources of uncertainty they now also perceive uncertainties that create high negative impacts.

The survey data can also be used to develop heat maps and a RiskChoice matrix for individual farmers. The heat maps can then be used to identify those factors most in need of risk mitigation initiatives to reduce the likelihood or severity of an event and those requiring most focus to capture the full potential of an opportunity.

Risk Importance Index

Another approach is to develop uncertainty scores by multiplying the score for the impact of a particular uncertainty with the score for the likelihood of it happening (Tables 5,6,7,8). Within a season the highest uncertainty scores for the different sources of uncertainty that were perceived to generate opportunities are business relationships, skills and knowledge of those in or associated with the business, and interest rates. The highest uncertainty scores for the different sources of uncertainty within a season that generated the greatest threats were input costs, then product prices and unexpected weather conditions to a lesser extent. The data suggests that the farmers not only perceived input costs within a season as an important threat in terms of its impact on the farm business, but they also believed that there was a high likelihood that the threat would eventuate.

Over a longer time frame, skills and knowledge of those in or associated with the business has the highest uncertainty score of the various sources of uncertainty that generates the greatest opportunities. This is followed by product prices and then interest rates to a lesser extent. Threats are generated from input costs with local body laws and regulations to a lesser extent. While these results are exploratory in nature, it is of interest to note how this approach identifies the risks that can be managed (business relationships, skills and knowledge of those in or associated with the business and interest rates) as those providing the greatest opportunity, while those less easy to manage provide the greatest threats. The results also possibly reflect the entrepreneurial characteristics of the farmers in the survey and their confidence in their ability to leverage skills and knowledge to best effect.

Within season, (Tables 5 and 6) the uncertainties associated with interest rates, global demand for dairy products, product prices, business relationships, skills and knowledge of those in typically likely (likelihood score 4) to happen with a high potential (impact score 4) to create

Table 5. Typical assessment scorecards and risk scores for strategic uncertainty that create opportunities within season as rated by the respondent dairy farmers

Sources of uncertainty	N	Potential	Likelihood	Risk Score	Proportion of Respondents	Importance	
		Score	*Score*		*(%)**	*Index*	*Rank*
Skills and knowledge of those in or associated with the business	27	4	4	16	70.37	1,125.93	1
Global demand for dairy products	26	4	4	16	61.54	984.62	2
Interest rates	27	4	4	16	55.56	888.89	3
Business relationships	27	4	4	16	55.56	888.89	3
Product prices	26	4	4	16	42.31	676.92	5
Pasture/crop/animal health	24	4	3	12	50	600	6
On-farm technology (incl. Breeding)	26	4	3	12	50	600	6
Purchased feed availability	27	4	3	12	44.44	533.33	8
Availability of labor (self, family, employees, contractors)	27	4	3	12	44.44	533.33	8
Unexpected weather conditions	27	4	3	12	40.74	488.89	10
Land prices	27	4	3	12	40.74	488.89	10
Input costs	26	4	3	12	30.77	369.23	12
Credit availability	27	4	3	12	29.63	355.56	13
Cooperative policies and producer requirements	27	3	3	9	33.33	300	14
Family relationships	27	3	2	6	25.93	155.56	15
Government laws and policies	27	2	3	6	7.41	44.44	16
Local body laws and regulations	27	2	2	4	3.7	14.81	17

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely
* proportion of respondents with risk score of 15 and higher

Table 6. Typical risk scores for strategic uncertainty that create threats within season as rated by the respondent dairy farmers

Sources of uncertainty	N	Potential	Likelihood	Risk Score	Proportion of Respondents	Importance	
		Score	*Score*		*(%)**	*Index*	*Rank*
Product prices	26	4	3	12	62.96	755.56	1
Unexpected weather conditions	27	4	3	12	51.85	622.22	2
Input costs	26	4	3	12	51.85	622.22	2
Global demand for dairy products	26	4	3	12	48.15	577.78	4
Local body laws and regulations	27	4	3	12	44.44	533.33	5
Government laws and policies	27	3	3	9	33.33	300	6
Pasture/crop/animal health	24	3	3	9	19.23	173.08	7
Skills and knowledge of those in or associated with the business	27	3	2	6	18.52	111.11	8
Interest rates	27	3	3	9	11.11	100	9
Credit availability	27	3	3	9	11.11	100	9
Availability of labor (self, family, employees, contractors)	27	3	2	6	14.81	88.89	11
Cooperative policies and producer requirements	27	3	2	6	14.81	88.89	11
Land prices	27	2	2	4	11.11	44.44	13
Business relationships	27	3	2	6	7.41	44.44	13
Purchased feed availability	27	2	2	4	7.41	29.63	15
Family relationships	27	2	2	4	7.41	29.63	15
On-farm technology (incl. Breeding)	26	2	2	4	3.7	14.81	17

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely
* proportion of respondents with risk score of 15 and higher

benefit. However, considering the proportion of respondents that ranked it with an uncertainty score of 15 or more, skills and knowledge of those in or associated with business has the highest relative importance or potential to gain benefit from. This is followed by global demand for dairy products, interest rates and business relationships in that order.

Interestingly none of the sources of uncertainty are typically assessed to create threats at a level requiring management attention as they all have average uncertainty scores of less than 15. It is worth noting that about 63% of the respondents individually assessed uncertainty related to product prices at a level of 15 and above, the point at which they should require management attention. This is followed by uncertainties associated with unexpected weather conditions and input costs and global demand for dairy products.

Over the long-term (Tables 7 and 8), although none of the sources of uncertainty generated high indices with regard to creating opportunities, it is equally worth noting that about 60% of the respondents individually assessed global demand for dairy products and skills and knowledge of people in or associated with business as sources of uncertainty that can create benefits. Similarly few of these sources of uncertainty generated high index values as threats to the business, but about 55% of the respondents assessed input costs as a concern. The source of uncertainty causing the most concern long-term is the local body laws and regulations. This has a risk score of 16 with an index value far exceeding other uncertainties.

Table 7. Typical assessment scorecards and risk scores for strategic uncertainty that create opportunities over the long term as rated by the respondent dairy farmers

Sources of uncertainty	N	Potential	Likelihood	Risk Score	Proportion of Respondents	Importance	
		Score	*Score*		(%)*	*Index*	*Rank*
Global demand for dairy products	27	4	3	12	59.26	948.15	1
Skills and knowledge of those in or associated with the business	27	3	2	6	59.26	948.15	1
Product prices	27	4	3	12	51.85	829.63	3
Business relationships	27	3	2	6	44.44	711.11	4
Availability of labor (self, family, employees, contractors)	27	3	2	6	44.44	711.11	4
On-farm technology (incl. Breeding)	26	2	2	4	38.46	461.54	6
Interest rates	27	3	3	9	37.04	444.44	7
Credit availability	27	3	3	9	37.04	444.44	7
Pasture/crop/animal health	27	3	3	9	25.93	311.11	9
Purchased feed availability	27	2	2	4	22.22	266.67	10
Land prices	27	2	2	4	22.22	266.67	10
Family relationships	27	2	2	4	29.63	266.67	10
Unexpected weather conditions	27	4	3	12	18.52	222.22	13
Input costs	27	4	3	12	18.52	222.22	13
Cooperative policies and producer requirements	27	3	2	6	22.22	200.00	15
Government laws and policies	27	3	3	9	18.52	111.11	16
Local body laws and regulations	27	4	3	12	18.52	111.11	16

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely
* proportion of respondents with risk score of 15 and higher

Table 8. Typical assessment scorecards and risk scores for strategic uncertainty that create threats over the long term as rated by the respondent dairy farmers

Sources of uncertainty	N	Potential	Likelihood	Risk Score	Proportion of Respondents	Importance	
		Score	*Score*		*(%)**	*Index*	*Rank*
Local body laws and regulations	27	4	4	16	51.85	829.63	1
Input costs	27	4	3	12	55.56	666.67	2
Unexpected weather conditions	27	4	3	12	40.74	488.89	3
Government laws and policies	27	4	3	12	40.74	488.89	3
Product prices	27	3	3	9	33.33	333.33	5
Interest rates	26	3	3	9	29.63	266.67	6
Purchased feed availability	27	3	3	9	25.93	233.33	7
Global demand for dairy products	27	3	3	9	25.93	233.33	7
Credit availability	27	3	3	9	22.22	200	9
Cooperative policies and producer requirements	27	3	3	9	22.22	200	9
Pasture/crop/animal health	27	3	3	9	15.38	138.46	11
Land prices	27	3	3	9	14.81	133.33	12
Availability of labor (self, family, employees, contractors)	27	3	2	6	14.81	88.89	13
Skills and knowledge of those in or associated with the business	27	2	3	6	11.54	69.23	14
Family relationships	27	2	2	4	11.11	44.44	15
On-farm technology (incl. Breeding)	27	2	2	4	7.41	29.63	16
Business relationships	27	2	2	4	3.7	14.81	17

Score: Impact: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Likelihood: 1 = very unlikely; 2 = unlikely; 3 = about as likely as not; 4 = likely; 5 = very likely
* proportion of respondents with risk score of 15 and higher

The risk importance index is an improvement on the risk scores as it ranks the sources of uncertainty and therefore provides a clearer direction on where to focus for a group, or population of farmers.

Conclusion, Recommendations and Limitations

The uncertainties of the business world provide as much opportunity for success as threat of failure. As such, when assessing farmers' risk perceptions, it is useful to enquire about both the positive and the negative implications from each source of uncertainty. It is acknowledged that various aspects of the business (including production, finance, marketing, R&D/technology, human relationships and policy and regulations) contribute to the success of the business as well as being part of the uncertainty factors that contribute to the failure of the business.

The methodology developed was able to illustrate differences in these entrepreneurial farmers' perceptions of risk both with respect to time horizon and whether the risk created opportunities or threats to their business. The time horizon effect on farmers' perception of risk provides a useful distinction between management and mitigation measures at the strategic level and the within season, tactical, level in a dairy farm business.

Of particular interest is the assessment by the respondents that there are more opportunities created by uncertainty within a season than threats. In the longer-term, there was more of a balance between the threats and the opportunities but, as the RiskChoice matrix illustrated well, the sources of uncertainty created more opportunities than threats for this sample of farmers. Although while acknowledging that the respondents are identified as entrepreneurial farmers given their perceptions of risk this provides a useful lead for further research and certainly questions the efficacy of focusing only on the negative aspect of uncertainty. Of interest would be to use the tools that have been developed to explore differences between farmers' ability to see risk as not just a threat. It would be useful to survey a larger number of farmers and then segment them according to physical and financial performance as well as personal characteristics. If and why differences in the respective segments ability to see risk as an opportunity, and not just a threat, were identified it would help determine what it takes to have that ability.

This conclusion was further reinforced by the risk index that not only ranked the sources of uncertainty, but also identified, for these farmers, more sources of risk providing opportunities than threats, particularly within the season. The index is designed to be of use in guiding industry and policy makers in their understanding of how farmers perceive risk. The next step in this research would be to calculate the index from a larger sample of farmers to determine the balance of perceptions between positive and negative impacts. The results will be able to guide the application of funds to extension and development of risk management strategies for the industry. The extent to which the results of the wider sample are similar to the selected group would shift funds from a focus on risk mitigation to one of working with farmers to develop strategies that capture opportunities. It would also guide extension work to better identify those with the ability to identify opportunities and determine what knowledge, information and skills are required by those who see mostly threats.

The limitations of this study were, firstly the sample size and its biased nature. This was an exploratory exercise that was initially designed to identify suitable case study farmers. The next step in this research is to further refine the technique and extend it to the wider population. The biased nature of this sample, where the majority of farmers were entrepreneurial, may have resulted in a much greater focus on opportunities than would have been found if the sample had been from a broad cross-section of the dairy farming population. The second limitation of the study was the limited assessment of the farmers' attitude to risk. This requires more research, particularly in regards to the link between attitudes and how risk is perceived.

Dairy farmers in New Zealand will assess the sources of uncertainty facing them, identify both opportunities to exploit and hazards to minimize, and respond as they see fit. The success or failure of their individual responses will not be observed for some time. The literature suggests that those who are more aware of both immediate and wider, long-term issues will make the most robust responses.

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Appendix 1

Table 1. Summary Statistics from Respondents

Characteristics	Number	Frequency	Percentage Frequency
Farmers' characteristics			
Number of years you have been farming	26		
Between 11 and 20		9	34.62
21 – 30		14	53.85
Above 30		3	11.54
Age	26		
Between 36 and 40		7	26.92
41 – 50		12	46.15
51 – 60		6	23.08
Above 60		1	3.85
No of staff (full time equivalents)	25		
1 – 2		5	20.00
2 – 5		6	25.00
More than 5		7	28.00
No. of family members available to assist with farm duties	24		
None		6	25.00
1 – 2		11	45.83
More than 2		7	29.17
Business characteristics			
The farmer's situation	29		
Herd owning Sharemilker/Lessee		1	3.45
Herd owning Sharemilker/Lessee with more than one herd		1	3.45
Owner Operator		10	34.48
Equity Partnership Managing partner		4	13.79
Owner Operator with multiple operations - farms, equity partnerships,		10	34.48
Other		3	10.34
Stage of farm business	30		
Growth		17	56.67
Consolidation		12	40.00
Entry of next generation		1	3.33
Total Debt as a proportion of Total Assets, June 2008	25		
0 – 30 %		5	20.00
30 – 40%		3	12.00
40 – 50%		8	32.00
50 – 60 %		5	20.00
60 – 70&		3	12.00
More than 70%		1	4.00
Debt servicing as a proportion of Gross Income, June 2008	23		
0 – 20%		7	30.43
20 - 30%		11	47.83
More than 30%		5	21.75
Perceived ability to manage risk			
Perceived ability to manage almost all uncertainty within season	27		
Strongly agree		7	25.93
Agree		11	40.74
Neutral		3	11.11
Disagree		5	18.52
Strongly disagree		1	3.73

Perceived ability to manage almost all uncertainty over a long term	26		
Strongly agree		5	19.23
Agree		11	42.30
Neutral		5	19.23
Disagree		3	11.54
Strongly disagree		2	7.69
Perceived difficulty to make a choice where there a number of solutions to a problem	26		
Strongly agree		0	0.00
Agree		3	11.54
Neutral		1	3.85
Disagree		15	57.69
Strongly disagree		7	26.92
When it comes to business, I like to play it safe	26		
Strongly agree		0	0.00
Agree		5	19.23
Neutral		11	42.31
Disagree		8	30.77
Strongly disagree		2	7.69