Dairy farm owners, their resilience attributes, and how they relate to their perception and management of risk

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Abstract

Coping with risk will be a major challenge for farmers in the years to come. In this context, farmers must develop resilience. Resilience requires the ability to mitigate threats, capture opportunities, and adapt to change as required. However, little is known about what is required to become resilient, or if resilience is associated with different perceptions of risks or risk management behaviours. This research was set up to answer two questions. First, what are the attributes that define a resilient farmer and second, do different resilient farmer types differ in their perceptions of the farm business environment and their strategic risk management behaviour? Firstly, a literature review on resilience was used to identify the attributes that could be used to define a resilient farmer, risks and risk strategies. Secondly, a survey was designed and sent out to a random sample of New Zealand dairy farmers in order to measure the attributes of resilience identified in the literature and farmer perceptions of risks and risk management behaviour. Thirdly, principal components analysis and cluster analysis was performed in order to typify farmers according to their resilience attributes. Finally, differences between farmer types were linked to their perceptions of risk and their risk management behaviour. Five attributes of resilience (general self-efficacy, willingness to change, locus of control, social sense-making, and strategic thinking focus) differentiated two resilient farmer groups: high resilient and low resilient farmers. High resilient farmers perceived more opportunities in risk than low resilient farmers. They also made greater use of, and gave more importance to, strategies that were associated with visualising and positioning their business in the future, and with strategies associated with the prevention, mitigation, flexibility and diversity to risks, compared to low resilient farmers. These findings were consistent with resilience theory. The resilience profile and management strategies used by high resilient farmers identified in this research can be used by those in the industry to support farmers in building resilience and encouraging the use of management strategies associated with resilience.

Key words: resilience attributes, adaptive capacity, risk management, dairy farmers, New Zealand

Introduction

Over the last few years, there has been increasing concern about the instability of the business environment in which dairy farmers operate (Gray, Dooley, & Shadbolt, 2008; Shadbolt, Rusito, Gray, & Olubode-Awasola, 2011). A number of factors, such as the increased variability in milk and input prices, international trade policies, global policies on bio-fuels, increasing consumer awareness of sustainable food systems, government regulations on animal welfare and the environment, and the consolidation of the dairy industry, have been attributed to the instability in the business environment (Conforte, Garnevska, Kilgour, Locke, & Scrimgeour, 2008; Gray et al., 2008). This instability has brought about increased
variability in the financial performance of dairy farm businesses posing significant risk to the
survival of these businesses (Gray et al., 2008). Many farm management scholars (Boehlje,
Akridge, & Downey, 1995; Boehlje, Gray, & Detre, 2005; Boehlje & Roucan-Kane, 2009;
Gray et al., 2008; Parsonson-Ensor & Saunders, 2011) acknowledge an increase of risk in the
farm business environment and recognise that coping with risk is a major challenge for
farmers. Gray et al. (2008) suggest that New Zealand dairy farmers are entering a new era in
relation to risk, which is characterised by increased uncertainty in the farm business
environment; a description that fits that of the theoretical “turbulent” business environment
proposed by Emery and Trist (1965, p. 26). Gray et al. (2008) also noted that operating in this
type of environment poses an important question: how best can New Zealand dairy farmers
manage in a turbulent environment?

Several authors (Crawford, McCall, Mason, & Paine, 2007; Darnhofer, 2014; Darnhofer,
Bellon, Dedieu, & Milestad, 2010a; Gray et al., 2008; Shadbolt et al., 2011) concur that in
order to cope with a turbulent environment, farmers must build resilient farm systems. In
dairy farming, resilient farm systems have been described as “those with the capacity to not
only adapt to change in the environment, but also take advantage of opportunities created by
a disturbance while maintaining productive capacity in the face of variability in production,
financial and market related factors” (Shadbolt et al., 2011, p. 8). This definition, which is the
definition used in this paper, emphasises the idea that in order to build resilient farm systems,
management should focus not just on achieving robustness and stability through their ability
to buffer threatening disturbances (i.e. buffer capacity), but also focus on being able to adapt
to changes in the environment (i.e. adaptive capacity). More importantly, Shadbolt et al.’s
(2011) definition of resilient farm systems suggests that disturbances may also represent
opportunities that these businesses can take advantage of. Despite growing interest in
resilience in the farm management literature (Crawford et al., 2007; Darnhofer, 2014;
Shadbolt et al., 2011), little empirical research has been undertaken. Indeed, many farm
management scholars (Darnhofer, 2014; Darnhofer, Gibbon, & Dedieu, 2012; Love, Sharma,
Boxelaar, & Paine, 2008; Miller, Dobbins, Pritchett, Boehlje, & Ehmke, 2004) suggest that
farm management research has primarily focused on efficiency and optimizing system
performance during short-term periods of stability, rather than focusing on the development
of long-term adaptive capacity. As such, the discipline struggles to provide practical theory
that helps farmers cope effectively with a turbulent environment (Darnhofer, 2014;
Darnhofer, Bellon, Dedieu, & Milestad, 2008).

Although resilience has been identified as a necessary property of farm systems to cope with
a turbulent environment, a milestone for the development of practical theory for farm systems
resilience is its measurement (Crawford et al., 2007; Darnhofer et al., 2012; Shadbolt et al.,
2011). Despite the fact that measuring resilience as a whole is probably an impossible task,
the measurement of resilience can be approached by measuring its elements (buffer capacity,
adaptive capacity, and transformability) individually. Recently, Shadbolt et al. (2011)
identified resilient dairy farms in New Zealand through the indirect measurement of their buffer capacity. In order to gain more knowledge about how resilience works, further research is required to develop a measurement, or indicator, of adaptive capacity.

Adaptive capacity is linked to an individual’s attributes. Folke, Carpenter, Walker, Scheffer, Elmqvist, Gunderson, and Holling (2004) describe adaptive capacity as “the ability of actors in a system to influence resilience” (p. 5). Therefore, understanding adaptive capacity of farm businesses is about knowing how a farmer deliberately adapts their business in response to changes in the environment so that the business is well positioned to capture opportunities without relegating the mitigation of threats also present in the environment. Indeed, farmers have a crucial role in building the resilience of farm systems through their roles as decision-makers with regard to the choices they make regarding their risk management strategies in order to achieve their goals (Darnhofer, Fairweather, & Moller, 2010b). Little is known about the adaptive capacity of dairy farmers in New Zealand. Likewise, little is known about how farmers with different degrees of resilience, and therefore adaptive capacity, can be identified, and whether different resilient farmer types differ in their perceptions of risk in the farm business environment and their risk management behaviour. Identifying, farmers based on the attributes that confer resilience, with a focus in their adaptive capacity, would provide a milestone in the quest to build resilience in dairy farm businesses.

Six attributes are relevant for individual resilience: self-efficacy; locus of control; willingness to accept uncertainty and change; open-mindedness; sense-making; and strategic management.

**Self-efficacy**

Much of the literature on psychological resilience indicates that resilient people have a strong sense of self-efficacy (Reich, Zautra, & Hall, 2010; Schwarzer & Warner, 2013), which is defined by Bandura (2000) as “the belief in one’s capabilities to organise and execute the courses of action required to produce given levels of attainments” (p. 18). Schwarzer and Warner (2013) and Reich et al. (2010) state that people with a strong belief in their capacity to overcome stressful situations are more able to bounce back than people with weak self-efficacy beliefs. Likewise, strong self-efficacy beliefs about the ability to successfully adapt are an indicator of adaptive capacity (Grothmann & Patt, 2005). Self-efficacy is linked to decision-making by regulating goal setting (Bandura, 2010; Gist, 1987). In this respect, people with strong self-efficacy beliefs are more likely to set more challenging goals. Moreover, self-efficacy beliefs affect the way risk is perceived: people with strong self-efficacy beliefs are more likely to perceive a source of risk as an opportunity rather a threat (Bandura, 2010; Gist, 1987).

**Locus of control**
Resilient people have what has been named an “internal locus of control” (Skodol, 2010, p. 114). Locus of control theory classifies individuals in one of two categories, internal or external, based on their general expectancy of where control over events and outcomes is located (Rotter, 1966). People with an internal locus of control believe that they have considerable control over external events and, therefore, their behaviour is the main factor responsible for their situation. In contrast, people with an external locus of control usually believe that they have little control over external events, and therefore external factors such as “fate” or “bad luck” are responsible for their situation (Skodol, 2010, p. 114). An internal locus of control is associated with skills which are useful for coping with uncertain environmental events (Skodol, 2010). People with an internal locus of control are often more motivated and committed to finding solutions, or learning about unexpected problems than people with an external locus of control (Skodol, 2010). Moreover, Van Kooten, Schoney, and Hayward (1986) and Tanewski, Romano, and Smyrnios (2000) suggested that farmers with a strong internal locus of control place significant importance on planning during decision making. Van Kooten et al. (1986) argued that a farmer’s strong belief about their ability to control future events would give them the confidence to adopt planning in their decision making. In contrast, farmers with a strong external locus of control would be less likely to plan because of their negative belief about their ability to control external events.

Willingness to accept uncertainty and change

Boxelaar, Sharma, and Paine (2006) suggested that a dairy farmer’s degree of resilience is a construct of their ability to face reality, particularly when confronted with a situation of significant change. Boxelaar et al. (2006) argued that in the case of agriculture, where many of the changes are inherently uncertain, a farmer’s willingness to face the reality of uncertainty and ambiguity is an attribute that would indicate their level of resilience. Boxelaar et al. (2006) suggest that the willingness to accept uncertainty and ambiguity is linked to the ability of a person to learn, and hence it is related to their adaptive capacity. They argue that recognising that uncertainty and ambiguity are inevitable is a first step to learning about a situation in order to reduce the level of uncertainty in the environment.

Open-mindedness

Open-mindedness has been described as a defining attribute of resilient people (Webb, 2013). Darnhofer (2010) suggests that this attribute is relevant for farmers in the process of adapting to changes in the environment. Darnhofer (2010) argues that farmers with an open-minded attitude understand strategy as an unfolding process. That is, they acknowledge that a certain plan may be changed for a new and better one if the conditions require this. An open minded person tends to be accepting of, and values the opinion of others. Likewise, open-minded people tend to mirror themselves on others and see them as learning partners rather than competitors or experts. They consider this mutual behaviour as beneficial to both parties.
(Rogers, Luton, Biggs, Biggs, Blignaut, Choles, Palmer, & Tangwe, 2013). Darnhofer (2010) argues that although open-mindedness seems to be an attribute of most people, it is less usual in the case of farmers, since many farmers tend to hold on to traditional farm management practices or social norms of how a farm should be.

**Sense-making**

Another attribute of resilient farm managers is their ability to understand, and to put into perspective, situations that are new to them and to be aware of changes that occur in the farm business environment (Shadbolt et al., 2011). Sense-making is described as a process that is triggered by extracting and bracketing of “cues” (Weick, Sutcliffe, & Obstfeld, 2005). According to Weick et al. (2005), “environments are talked into existence” (p. 409) and it is during this process of talking that cues are extracted from narratives or stories (Mantere, 2000; Weick et al., 2005). The process of making sense also involves retrospection, and an ongoing effort of making connections in order to create order and understand a situation. Likewise, the ability of making sense favours plausibility over accuracy, and involves a range of social activities where stories and narratives that contain information for sense-making, are stored, preserved and shared (Weick, 1995; Weick et al., 2005). Sense-making involves scanning and interpreting large amounts of diverse information that is then used to form hypotheses or mental models about emerging conditions. As such, sense-making is a relevant process for the planning aspect of decision-making in situations of change and in identifying business opportunities (McCann, Selsky, & Lee, 2009). However, in order to be effective in adaptation, sense-making should be followed by a quick reaction from management aimed to implement a suitable strategy to capture an opportunity or adapt to a change (McCann et al., 2009). Sense-making is an important ability for management because the lack of this ability can result in the loss of a business opportunity or in the overexposure of a business to a threat, which ultimately might lead to the failure of the business (McCann, 2004; McCann et al., 2009).

**Strategic management**

Much of the literature on resilience (Carmeli, Friedman, & Tishler, 2013; Darnhofer et al., 2010b; Fazey, 2010; Folke, Stephen, Brian, Marten, Terry, & Johan, 2010; Walker & Salt, 2006) suggests that, in order to adapt, individuals must develop holistic thinking and to the ability to develop strategic foresight by exploring all possible futures so as to implement the most appropriate course of action relative to their goals. These characteristics match the capabilities described for strategic thinking (Graetz, 2002; Liedtka, 1998a) and those of successful leaders with a strategic mind-set (Pisapia, Reyes-Guerra, & Coukos-Semmel, 2005). The link between strategic thinking and resilience was proposed by Sloan (2013) who associated strategic thinking with the adaptive capacity of individuals. Similarly, Sorgenfrei...
and Wrigley (2005) indicated that strategic thinking was a facilitator of adaptive capacity in organisations facing turbulent environments.

Heracleous (1998) suggests that strategic thinking is a thought process that is interrelated and complementary to the strategic planning process, which refers to a formal and analytical means of forming strategy. Graetz (2002) proposed that good strategic management practice requires balanced strategic thinking and strategic planning.

Most of the work describing the attributes of a person with strategic thinking capabilities (e.g. Bonn, 2005; Kamangar, Rohani, Salavati, & Karimi, 2013; Moon, 2013; van der Laan, 2010) is based on the work of Liedtka (1998b), who believes that strategic thinking has five main elements: a systems perspective; intent-focused; thinking in time; hypothesis driven; and intelligent opportunism. Bonn (2005) suggested that these five attributes can be reduced to three categories (systems thinking, creativity and vision) which, in essence, integrate the elements described by Liedtka (1998a; 1998b).

**Research questions and objectives**

This research set out to answer two research questions: First, what are the attributes that define a resilient farmer? And second, do different resilient farmer types differ in their overall perceptions of the farm business environment and their risk management behaviour? Given these questions, the objectives were: to define the attributes that would differentiate farmers based on the resilience attributes of a farm manager; to identify different farmer types based on the resilience attributes previously defined; and to investigate any differences between resilient farmer types regarding their use of, and importance given to, strategies for managing risks in their farm businesses and to explore their overall perceptions of sources of risks in the farm business environment.

**Methodology**

The resilience attributes identified in the literature review were used to design a survey which was conducted on 1559 randomly selected dairy farmers in New Zealand. 89% of these dairy farmers were farm owners and the remaining 11% were herd-owning sharemilkers.

Resilience attributes were assessed by using 20 Likert scale type questions, where respondents were asked to evaluate using a scale which ranged from “strongly disagree” to “strongly agree”. The questions were adapted from similar questions obtained mainly in the business literature (refer to table 1A in the appendix for the questions used and their references).
Farmer perceptions of risk in the farm business environment were assessed by asking farmers if they believed that common sources of risk present in the farm business environment presented an opportunity, a threat, or both an opportunity and a threat for their farm business in the last 10 years. The sources of risk were drawn from previous studies on risk perception undertaken in New Zealand (Martin, 1994; Pinochet-Chateau, Shadbolt, Holmes, & Lopez-Villalobos, 2005; Pinochet Chateau, 2005; Shadbolt & Olubode-Awosola, 2013) (refer to Table 2A in the appendix for the list of risk sources used in this survey). Then, overall indices for risk perception were developed as follows:

A. Overall opportunity index$_i$ = \( \frac{\text{Number of risk sources perceived as an opportunity}_i}{\text{Total number of risk sources}_i} \)

B. Overall threat index$_i$ = \( \frac{\text{Number of risk sources perceived as a threat}_i}{\text{Total number of risk sources}_i} \)

C. Overall opportunity/threat index$_i$ = \( \frac{\text{Number of risk sources perceived as an opportunity and a threat}_i}{\text{Total number of risk sources}_i} \)

Where \( i \) represented an individual response.

In order to assess farmer risk management behaviour, farmers were questioned on 27 risk management strategies drawn from previous studies on risk management undertaken in New Zealand (Martin, 1994; Pinochet-Chateau, Shadbolt, Holmes, & Lopez-Villalobos, 2005; Pinochet Chateau, 2005; Shadbolt & Olubode-Awosola, 2013) (refer to Table 3A in the appendix for the list of risk management strategies used in this survey). For each risk management strategy, participants were asked whether they had used the strategy or not, or if it was applicable for its use in their farm business. In addition, farmers were asked to assess the importance of the risk management strategy for managing risk using a 5 point Likert-type scale ranging from “very low importance” to “very high importance”.

The design of the survey was pre-tested with three farmers. After amendments, the survey was sent out by post and online on 25 July 2014. Farmers returned 364 complete usable responses that were used for data analysis. Principal components analysis (PCA) was used to identify and derive underlying attributes from the answers to the resilience attributes questions grouped by attribute.

PCA also weighted the importance of the questions for defining attributes according to the variance in the responses to each question. Two-step cluster analysis was used to segregate farmers with respect to the principal components scores obtained from the derived attributes obtained during PCA. A resilient farmer typology was developed based on the findings of the cluster analysis. Finally, Chi-square tests, and Mann-Whitney U tests were performed to determine whether there were differences between resilient farmer types, farmer perceptions.
of risk in the overall indexes, and farmer use of, and importance given to strategies for managing risk in their farm businesses.

**Results and discussion**

*Derived resilient attributes and resilient farmer typology*

Results from the principal components analyses indicated that one or two principal components (PCs) explained most of the variance in farmer responses to the resilience attributes questions (Table 1).

Table 1. Relationships between resilience attribute questions and principal components, and the resilience attributes that derived from PCA results

<table>
<thead>
<tr>
<th>Attribute in the literature</th>
<th>Resilience attribute question from the survey</th>
<th>Component loadings</th>
<th>Derived attribute from PCA results†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PC1</td>
<td>PC2</td>
</tr>
<tr>
<td>Willingness to accept uncertainty and to change</td>
<td>I intend to make time to implement changes required in my farm business.</td>
<td>-0.204</td>
<td>-0.734*</td>
</tr>
<tr>
<td></td>
<td>I am willing to make changes to my farm business.</td>
<td>-0.115</td>
<td>-0.639*</td>
</tr>
<tr>
<td></td>
<td>I am willing to accept uncertainty in my farm business</td>
<td>-0.972*</td>
<td>0.230</td>
</tr>
<tr>
<td>Open-mindedness</td>
<td>I value the knowledge of others from inside and outside the farm business.</td>
<td>-0.240</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I consider everyone in the dairy industry learns from each other.</td>
<td>-0.971*</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>It is easy for me to stick to my aims and accomplish my goals.</td>
<td>-0.605*</td>
<td>0.426*</td>
</tr>
<tr>
<td></td>
<td>No matter how hard I try, I struggle to solve difficult problems.</td>
<td>-0.673*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am confident that I can deal efficiently with unexpected events.</td>
<td>0.909*</td>
<td></td>
</tr>
<tr>
<td>Locus of control</td>
<td>The success of my farm business is mostly determined by factors outside of my control.</td>
<td>-0.416*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The weather and commodity prices can knock the business around in the short term, but in the long term, there is still a lot I can do to stay ahead of the game.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sense-making</td>
<td>I am not good at making sense of ambiguous and uncertain situations.</td>
<td>0.274</td>
<td>0.836*</td>
</tr>
<tr>
<td></td>
<td>I do not pay close attention to conditions outside the dairy industry.</td>
<td>0.384</td>
<td>0.357</td>
</tr>
<tr>
<td></td>
<td>I have regular contact with other farmers where we discuss trends in the industry.</td>
<td>-0.647*</td>
<td>0.297</td>
</tr>
<tr>
<td></td>
<td>I have regular contact with other members of the industry to acquire knowledge.</td>
<td>-0.572*</td>
<td>0.284</td>
</tr>
<tr>
<td></td>
<td>When confronted with a new situation, I review past experiences to assess the situation.</td>
<td>-0.177</td>
<td>0.063</td>
</tr>
<tr>
<td>Strategic management</td>
<td>My decision-making is driven by my vision for my farm business.</td>
<td>-0.554*</td>
<td>0.437*</td>
</tr>
<tr>
<td></td>
<td>I do not search for patterns when confronted with rich information.</td>
<td>0.697*</td>
<td>0.339</td>
</tr>
<tr>
<td></td>
<td>I consider how different parts of the farm system impact on each other.</td>
<td>-0.401*</td>
<td>0.237</td>
</tr>
<tr>
<td></td>
<td>When resolving a strategic problem, I consider a range of possibilities.</td>
<td>-0.195</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>No matter what happens, I always stick to my original plans.</td>
<td>0.130</td>
<td>0.798*</td>
</tr>
</tbody>
</table>

* Resilience attribute question which explain most of the variance in the responses contributing to the PC (component loading ≥0.4)
† Questions associated with the derived resilience attributes between brackets
Table 1 shows the component loadings that indicate how much of the variation in farmer responses to a question was explained by a principal component. The Table also shows the nine derived resilience attributes (willingness to change, willingness to accept uncertainty, open mindedness, general self-efficacy, locus of control, individual sense-making, social sense-making, strategic thinking focus, and strategic planning focus) that resulted from the interpretation of the principal components and their relationship with the resilience attributes questions.

The cluster analysis performed on the set of PC scores for the derived resilience attributes resulted in two clusters of farmers. Based on the profiles to be discussed, the farmers in each cluster were named as follows:

- Cluster 1, which grouped 245 farmers (67.3%) who were typified as the “low resilient farmer”.
- Cluster 2, which grouped 119 farmers (32.7%) who were typified as the “high resilient farmer”.

The average Silhouette coefficient obtained for the cluster model was 0.21, which reflects weak to moderate significant evidence of cluster structure (Kaufman & Rousseeuw, 1990). Five derived resilience attributes were particularly important in defining the two clusters: general self-efficacy, willingness to change, locus of control, social sense-making, and strategic thinking focus (Figure 1). Because farmers in cluster 1 had lower values for the attributes that were used to define the resilient farmer type than farmers in cluster 2, farmers in cluster 1 were termed “low resilient farmers” and farmers in cluster 2 were termed “high resilient farmers”.

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1 The Silhouette coefficient is a measurement of the degree of cohesion and separation of clusters (Kaufman & Rousseeuw, 1990). This coefficient ranges from -1 to 1; the closer the measurement is to 1, the more different the clusters are from each other.
Figure 1. Comparison between resilient farmer clusters 1 and 2.

Figure 1 shows the variability in the PC scores for each of the attributes for the farmers in clusters 1 and 2, and in overall responses. The variability in overall farmer response is displayed as background boxplots showing the overall median and the interquartile range. The variability in response for farmers in each cluster is displayed as overlaid boxplots in which square point markers and horizontal lines indicate the median value and the interquartile range, respectively. Farmers in cluster 2 had higher median PC scores for all of the attributes compared to farmers in cluster 1. The median PC scores for most important attributes: general self-efficacy, willingness to change, locus of control, social sense-making,
and strategic thinking focus were 1.12, 0.46, 0.81, 0.72, and 0.53, respectively, for farmers in
cluster 2, and 0.10, -0.19, -0.10, -0.28, and -0.48, respectively, for farmers in cluster 1 (Figure
1). Although there were differences between clusters in their median PC scores for the
remaining attributes (strategic planning focus, individual sense-making, open-mindedness
(shared learning), and willingness to accept uncertainty), their interquartile ranges tended to
overlap, which indicated that farmers in both clusters were not significantly different one
from another with respect to these derived attributes (Figure 1).

The findings from this cluster analysis were consistent with the description of resilient people
provided by Coutu (2002), Reich et al. (2010), and Schwarzer and Warner (2013) who
identified a direct link between perceived self-efficacy and a resilient personality. Likewise,
these results were consistent with the findings described by Connor and Davidson (2003) and
Coutu (2002), who found a direct relationship between a resilient person and their willingness
to change, and Skodol (2010) who suggested that an internal locus of control is as an
important attribute of resilient individuals. Moreover, a resilient personality was also linked
to an enhanced networking ability due to its relationship with sense-making, as described by
Darnhofer (2010), Goldstein (2009) and Hahn, Schultz, Folke, and Olsson (2008). The results
from this research are also consistent with Fazey (2010) and Walker and Salt (2006) who
suggested that strategic thinking is an important prerequisite of resilience.

Resilient farmer types and their overall perceptions of risk

The median values for the overall opportunity/threat index were .39 and .41 for high resilient
farmers and low resilient farmers, respectively. This difference was non-significant ($U=\sum_{336}^{341} 13598.5, p>.05, r=-.04$). There was a significant difference between the median values for the
overall opportunity index between high and low resilient farmer types, .28 and .24,
respectively ($U=\sum_{336}^{341} 12115.5, p<.05, r=-.12$). This higher proportion of risk sources being seen as
“opportunities” by high resilient farmers was counter to their perceptions of “threats” in the
environment. In this regard, high resilient farmers had a lower overall threat index .28 (28% of
risk sources) compared to low resilient farmers .33 (33%), $U=\sum_{336}^{341} 12522, p<.05, r = -1$. The
results are consistent with Cooper, Estes, and Allen (2004) and Manzano-García, Calvo, and
Carlos (2013) who described resilient people as often seeing opportunities where others see
threats. Manzano-García et al. (2013) linked this characteristic to a particular type of resilient
personality, which they termed the “resilient entrepreneurs”.

Resilient farmer types and their risk management strategies

Figure 2 shows the difference between high resilient and low resilient farmers with respect to
the use of strategies and the importance given by these farmers to each strategy for managing
risk in their farm businesses. Results identified that there were three groups of strategies as
shown in Figure 2 below. Only strategies that were significantly different ($p<.05$) in their use
and importance between high and low resilient farmers are shown; levels of adoption and importance for each of the strategies for both groups: high and low resilient farmers, are shown between brackets.

1) Strategies **adopted differently** but of **similar importance** to high and low resilient farmers

- **Strategies more likely to be used by high resilient farmers**
  - Geographic diversity (low adoption/low importance)
  - Future markets (low adoption/low importance)
- **Strategies more likely to be used by low resilient farmers**
  - Main operator working off-farm (low adoption/low importance)

2) Strategies **adopted similarly** but of **different importance** to high and low resilient farmers

- **Strategies of relatively more importance to high resilient farmers**
  - Managing debt (high adoption/high importance)
  - Planning of capital spending (high adoption/high importance)
  - Using practical planning steps in your business (high adoption/high importance)
  - Short term flexibility (high adoption/high importance)
  - Having personal or business insurance
- **Strategies of relatively more importance to low resilient farmers**
  - Not producing to full capacity (low adoption/moderate importance)
  - Keeping debt low (moderate adoption/high importance)

3) Strategies **adopted differently** but of **different importance** to high and low resilient farmers

- **Strategies more likely to be used by and of more relative importance to high resilient farmers**
  - Gathering market information (moderate adoption/moderate importance)
  - Long term flexibility (high adoption/high importance)
  - SWOT analysis (high adoption/high importance)
  - Having a clear and shared vision or strategic purpose for your operation (high adoption/high importance)
- **Using financial ratios for assisting with decision making (moderate adoption/high importance)**
  - Implementing technological innovations (high adoption/moderate importance)

Figure 2. Main differences between high and low resilient farmers in the use of, and importance given to, strategies for managing risk.
The strategies in group 1 were among the least important for managing risk for both high resilient and low resilient farmers (Figure 2). High resilient farmers were more likely to adopt the strategy of geographic diversity than low resilient farmers. This is consistent with resilience theory that suggests that diversity, on its many forms, is a key strategy for spreading risks and creating buffers against variability, and thus strengthening systems resilience (Folke et al., 2010, Darnhofer et al. 2010a).

The second group of strategies is important because it shows the difference in the focus that the two resilient farmer types placed on strategies they used interchangeably. This finding can be used in further research to identify differences in the implementation of these strategies between high and low resilient farmer types.

The differences identified across the three groups of strategies showed that high resilient farmers used, and placed more importance on, strategies that coped with risk in a more proactive way than low resilient farmers (Figure 2). High resilient farmers placed relatively higher importance on strategies for coping with risks from a strategic management perspective compared to low resilient farmers. These strategies are related to planning where the business is heading and why. This is explained by the greater strategic thinking focus of high resilient farmers compared to low resilient farmers. These findings are consistent with Miller et al. (2004) who suggested that having a strategic purpose or implementing SWOT analysis were proxies for the capability of a farm business to recognise when strategic adjustments are necessary, and thus a reflection of their adaptive capacity. Likewise, high resilient farmers used and identified flexibility as an important strategy for coping with risks in the long term; once again, this may have been explained by high resilient farmers’ high strategic thinking focus. A high strategic focus may be related to recognising that positioning the farm business for flexibility is important for coping with downside and upside risks (Darnhofer et al., 2008, 2010a; Miller et al., 2004). Darnhofer et al. (2010a) and Miller et al. (2004) suggested that positioning a firm for flexibility was an important strategy for responding to changing circumstances, and thus is a strategy related to adaptive capacity.

High resilient farmers were likely to use, and give more importance to, the strategy of gathering market information than low resilient farmers. This may have been a reflection of their higher social sense-making skills and, therefore greater farmer learning about the environment, in this case related to the market. The gathering of any kind of information for decision making is also described as an important strategy that ensures adaptive capacity through learning (Darnhofer et al., 2008; Folke et al., 2010)

Another important characteristic of high resilient farmers was that they used, and placed relatively high importance on, managing debt and planning capital spending, which meant that these farmers were less concerned about having debt. Instead, they were more concerned about doing something “useful” with that debt. This was consistent with Parsonson-Ensor and
Saunders (2011) who described that as farming in New Zealand has become more intensive over time, acquiring debt is a strategy that has been adopted by most farms in New Zealand (70%), and is an important means of overcoming periods of economic hardship. Therefore, farmers may have been relying on debt as a strategy for financing investments or expenses. This finding challenges Darnhofer (2010) who described keeping debt low, rather than having and managing debt, as a sign of resilient farms. However, it is important to note that Darnhofer (2010) described keeping debt low strategy as being important for building resilience in farms in Austria where farmers are less exposed to the external environment because their agricultural policy subsidises farms so that farm businesses can remain operating regardless of the environment. New Zealand farmers, however, operate in a non-subsidised environment in which finance may be needed.

High resilient farmers were also more likely to adopt, and give more importance to, implementing technological innovations. This may be related to these farmers’ willingness to change, and thus results in adaptation in the form of new techniques or approaches to cope with risk in the form of either threats or opportunities. However, the idea that these innovations result in a resilient farm business can be debated because it depends on how useful or successful the implementation of the innovation is. Parsonson-Ensor and Saunders (2011) identified that being innovative and adopting new technologies was a source of farms’ adaptive capacity. However, they also argued that innovations can also present a source of risk if farmers are not able to implement them properly, and that quickly changing trends means that technology can also become obsolete rapidly and result in loss of markets and revenue.

Low resilient farmers placed relatively more importance on strategies which were more reactive and targeted to buffering the negative effect of risks such as not producing to full capacity and keeping debt low, strategies that aimed to reduce the threats to production and financial risks, respectively. These results suggest that low resilient farmers were not seeking opportunities; rather, they felt more comfortable in managing what they knew. This is consistent with resilience theory which suggests that although buffer capacity is a key aspect of resilience, resilience goes beyond being simply a buffer for retaining and maintaining the status quo, but that it is also about being able to adapt to new situations (Folke et al., 2010). Moreover, the results from this study were consistent with Darnhofer et al. (2010a) and Miller et al. (2004) who identified that not producing to full capacity and keeping debt low were suitable strategies for coping with threats in the short-term and, therefore were a reflection of a farm’s buffer capacity. Shadbolt and Olubode-Awosola (2013) also found that these two strategies were thought to be of relatively high importance to farmers who they termed “experienced but cautious” and of relatively lower importance to those they termed “entrepreneurs”; the former being more a successful farmer type than the latter, which suggested that the “experienced but cautious” identified by Shadbolt et al. (2011) might be related to the high resilient farmer types identified in this study.
**Conclusions**

This research identified two farmer types (high and low resilient farmers) based on five different attributes. Moreover, the findings in this research highlighted the greater orientation of high resilient farmers to prevent, react to, and adapt to risks, which was consistent with resilience theory that suggests that since uncertainty is an inherent part of managing systems, managers should be ready to prevent, react to and adapt to risks (Darnhofer et al., 2010b; Folke et al., 2004; Folke et al., 2010).

In order to build resilience, farmers should be encouraged to develop soft skills that help foster the resilience attributes that were identified as being more important to high resilient farmers: general self-efficacy, willingness to change, internal locus of control, social sense-making, and a strategic thinking focus. Activities that may be undertaken could be to encourage: participation of farmers in discussion groups, encouraging farmer networking, encourage farmers to interact with other actors from inside and outside the industry, and promote opportunities for learning. Finally, farmers should be encouraged to consider a range of choices to address a problem.

The typology developed in this research can be used in further empirical research, aiming to understand the processes that high resilient farmers go through in order to build resilience.

**Acknowledgements**

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## Table 1A. Resilience attributes questions.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Item in the survey*</th>
<th>Original item</th>
<th>Original context</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to accept uncertainty and change</td>
<td>I intend to make time to implement changes required in my farm business. (+)</td>
<td>Intention to make time to implement the change</td>
<td>Organisations</td>
<td>Metselaar (1997)</td>
</tr>
<tr>
<td></td>
<td>I am willing to make changes to my farm business. (+)</td>
<td>Our organisation is open to change</td>
<td>Business</td>
<td>McCann et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>I am willing to face uncertainty in my business. (+)</td>
<td>Derived from the question above</td>
<td>Business</td>
<td>McCann et al. (2009)</td>
</tr>
<tr>
<td>Open-mindedness</td>
<td>I value the knowledge of others from inside and outside the farm business. (+)</td>
<td>Encounter every person with equal respect, listen for their specific needs, knowledge, and ways of knowing</td>
<td>Social ecological systems</td>
<td>Rogers et al. (2013)</td>
</tr>
<tr>
<td></td>
<td>I consider everyone in the dairy industry learns from each other. (+)</td>
<td>Accept everyone as colearners, not experts or competitors</td>
<td>Social ecological systems</td>
<td>Rogers et al. (2013)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>It is easy for me to stick to my aims and accomplish my goals. (+)</td>
<td>It is easy for me to stick to my aims and accomplish my goals.</td>
<td>Psychology</td>
<td>Schwarzer and Jerusalem (1995)</td>
</tr>
<tr>
<td></td>
<td>No matter how hard I try, I struggle to solve difficult problems. (-)</td>
<td>I can always manage to solve difficult problems if I try hard enough.</td>
<td>Psychology</td>
<td>Schwarzer and Jerusalem (1995)</td>
</tr>
<tr>
<td></td>
<td>I am confident that I can deal efficiently with unexpected events. (+)</td>
<td>I am confident that I could deal efficiently with unexpected events.</td>
<td>Psychology</td>
<td>Schwarzer and Jerusalem (1995)</td>
</tr>
<tr>
<td>Locus of control</td>
<td>The success of my farm business is mostly determined by factors outside of my control. (-)</td>
<td>The success of the farm is mostly determined by factors outside of my control</td>
<td>Agricultural systems</td>
<td>Price and Leviston (2014)</td>
</tr>
<tr>
<td></td>
<td>The weather and commodity prices can knock the business around in the short term but in the long term there is still a lot I can do to stay ahead of the game. (+)</td>
<td>The weather and commodity prices can knock you around in the short term, but in the long run there is still a lot you can do to stay</td>
<td>Agricultural systems</td>
<td>Price and Leviston (2014)</td>
</tr>
</tbody>
</table>

* The sign between brackets indicates the sense of the direction between farmer response to an item and their degree of skills in the related attribute. Thus, a (+) indicates that the higher a farmer agrees to the item, the greater their skills in the related attribute. In contrast, a (-) indicates that the higher a farmer agrees to the item, the lesser their skills in the related attribute.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Item in the survey*</th>
<th>Original item</th>
<th>Original context</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense-making</td>
<td>I am not good at making sense of ambiguous and uncertain situations. (-)</td>
<td>Our organisation is good at making sense of ambiguous, uncertain situations</td>
<td>Business</td>
<td>McCann et al. (2009)</td>
</tr>
<tr>
<td></td>
<td>I do not pay close attention to conditions outside the dairy industry. (-)</td>
<td>We pay close attention to conditions outside of our industry</td>
<td>Business</td>
<td>Neill, McKee, and Rose (2007)</td>
</tr>
<tr>
<td></td>
<td>I have regular contact with other farmers where we discuss trends in the industry. (+)</td>
<td>We have regular interdepartmental meetings to discuss market trends and developments.</td>
<td>Business</td>
<td>Neill, McKee, and Rose (2007)</td>
</tr>
<tr>
<td></td>
<td>I have regular contact with other members of the industry to acquire knowledge. (+)</td>
<td>Marketing personnel in our business spend time discussing customers’ future needs with other functional departments.</td>
<td>Business</td>
<td>Neill, McKee, and Rose (2007)</td>
</tr>
<tr>
<td></td>
<td>When confronted with a new situation, I revise past experiences to assess the situation. (+)</td>
<td>Consider your own experiences in applying your own knowledge to any problem</td>
<td>Organisations</td>
<td>Pisapia et al. (2005)</td>
</tr>
<tr>
<td>Strategic management</td>
<td>My decision-making is driven by my vision for my farm business. (+)</td>
<td>Overall, my company’s decision-making is vision-driven.</td>
<td>Business</td>
<td>Moon (2013)</td>
</tr>
<tr>
<td></td>
<td>I do not search for patterns when confronted with rich information. (-)</td>
<td>Search for patterns when confronted with rich information</td>
<td>Organisations</td>
<td>Pisapia et al. (2005)</td>
</tr>
<tr>
<td></td>
<td>I consider how different parts of the farm system impact on each other. (+)</td>
<td>Consider how different parts of the organization influence the way things are done</td>
<td>Organisations</td>
<td>Pisapia et al. (2005)</td>
</tr>
<tr>
<td></td>
<td>When resolving a strategic problem I consider a range of possibilities. (+)</td>
<td>Ask yourself and others to map out different strategies needed to map out the resolution of a problem</td>
<td>Organisations</td>
<td>Pisapia et al. (2005)</td>
</tr>
<tr>
<td></td>
<td>No matter what, I always stick to my original plans (+)</td>
<td></td>
<td>Business</td>
<td>Adapted from Graetz (2002)</td>
</tr>
</tbody>
</table>

* The sign between brackets indicates the sense of the direction between farmer response to an item and their degree of skills in the related attribute. Thus, a (+) indicates that the higher a farmer agrees to the item, the greater their skills in the related attribute. In contrast, a (-) indicates that the higher a farmer agrees to the item, the lesser their skills in the related attribute.
### Table 2A. Sources of risk listed in the survey and their classification in six risk categories.

<table>
<thead>
<tr>
<th>Source of risk in the survey*</th>
<th>Classification of risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk price</td>
<td>Market risk</td>
</tr>
<tr>
<td>Input prices and availability</td>
<td></td>
</tr>
<tr>
<td>Business relationships (within supply chain)</td>
<td></td>
</tr>
<tr>
<td>Dairy industry structure</td>
<td></td>
</tr>
<tr>
<td>The global economic and political situation</td>
<td></td>
</tr>
<tr>
<td>Global supply and demand for food</td>
<td></td>
</tr>
<tr>
<td>Global competitors &amp; competition</td>
<td></td>
</tr>
<tr>
<td>Reputation and image of the dairy industry</td>
<td></td>
</tr>
<tr>
<td>Interest rates</td>
<td></td>
</tr>
<tr>
<td>Land values</td>
<td></td>
</tr>
<tr>
<td>Availability of capital</td>
<td></td>
</tr>
<tr>
<td>Climate</td>
<td>Production risk</td>
</tr>
<tr>
<td>Pasture/crop/animal health</td>
<td></td>
</tr>
<tr>
<td>Government laws and policies</td>
<td>Regulatory risk</td>
</tr>
<tr>
<td>Local body laws and regulations</td>
<td></td>
</tr>
<tr>
<td>Availability of labour (self and family, employees, contractors)</td>
<td></td>
</tr>
<tr>
<td>Skills and knowledge of those associated with the business</td>
<td></td>
</tr>
<tr>
<td>Technological changes</td>
<td>Technology risk</td>
</tr>
</tbody>
</table>

* The list drew upon a number of risk sources used in other studies on risk management for farm business in New Zealand (Martin, 1994; Pinochet-Chateau et al., 2005a; Pinochet-Chateau et al., 2005b; Shadbolt & Olubode-Awosola, 2013).

### Table 3A. Risk management strategies and the type of risk the strategy aims to manage.

<table>
<thead>
<tr>
<th>Risk management strategy*</th>
<th>Type of risk the strategy aims to manage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintaining feed reserves</td>
<td>Production risk</td>
</tr>
<tr>
<td>Monitoring programme for pest and diseases</td>
<td></td>
</tr>
<tr>
<td>Routine spraying and/or drenching</td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
</tr>
<tr>
<td>Geographic diversity through having properties in different areas</td>
<td></td>
</tr>
<tr>
<td>Using futures markets</td>
<td>Market risk</td>
</tr>
<tr>
<td>Forward contracting</td>
<td></td>
</tr>
<tr>
<td>Gathering market information</td>
<td></td>
</tr>
<tr>
<td>Spreading sales (reducing seasonality in milk production)</td>
<td></td>
</tr>
<tr>
<td>Arranging overdraft reserves</td>
<td>Financial risk</td>
</tr>
<tr>
<td>Maintaining financial reserves: having cash and easily converted financial assets</td>
<td></td>
</tr>
<tr>
<td>Main farm operator or family working off property</td>
<td></td>
</tr>
<tr>
<td>Managing debt</td>
<td></td>
</tr>
<tr>
<td>Keeping debt low</td>
<td></td>
</tr>
<tr>
<td>Planning of capital spending</td>
<td></td>
</tr>
<tr>
<td>Having personal and/or business insurance</td>
<td>Human risk</td>
</tr>
<tr>
<td>Having short term flexibility to adjust quickly to weather, price and other factors</td>
<td></td>
</tr>
<tr>
<td>Having long term flexibility</td>
<td></td>
</tr>
<tr>
<td>Having more than one type of animal or other enterprises on your property</td>
<td></td>
</tr>
<tr>
<td>Using practical planning steps in your business</td>
<td></td>
</tr>
<tr>
<td>Assessing strengths, weaknesses, threats and opportunities</td>
<td>Overall risk</td>
</tr>
<tr>
<td>Having a clear and shared vision or strategic purpose for your operation</td>
<td></td>
</tr>
<tr>
<td>Using financial ratios for decision making</td>
<td></td>
</tr>
<tr>
<td>Not producing to full capacity so there are reserves in the system</td>
<td></td>
</tr>
<tr>
<td>Implementing technological innovation(s)</td>
<td>Technology risk</td>
</tr>
<tr>
<td>Adjusting production methods/system to comply with laws and policies</td>
<td>Regulatory risk</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>

* The list of risk management strategies drew upon a number of strategies used in other studies on risk management for farm business in New Zealand (Martin, 1994; Pinochet-Chateau et al., 2005a; Pinochet-Chateau et al., 2005b; Shadbolt & Olubode-Awosola, 2013).