

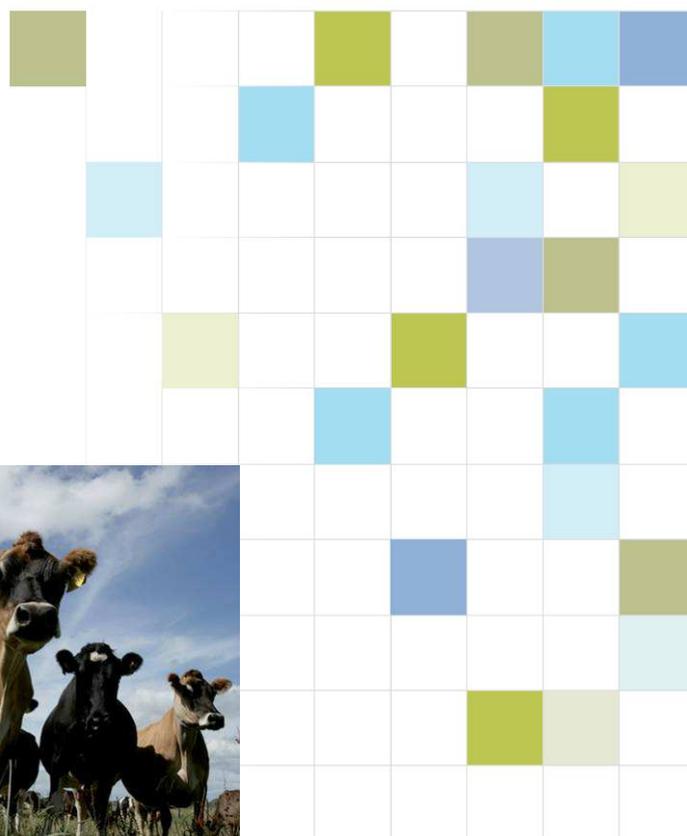
Learning from past adaptations to extreme climatic events:

A case study of drought Part A: Summary Report

June 2008

2020
SCIENCE

New Zealand's science. New Zealand's future.



MAF Policy – Climate Change

CC MAF- POL 2008 – 17 (124-3)

**Climate Change ‘Plan of Action’ Research Programme
2007/2008**

Learning from Past Adaptation to Extreme Climatic Events: A Case Study of Drought.

Part A: Summary Report

June 2008

Dr. Rob Burton and Dr. Sue Peoples

DISCLAIMER: While all reasonable endeavours have been made to ensure the accuracy of the investigations and the information contained in this report, AgResearch expressly disclaims any and all liabilities contingent or otherwise that may arise from the use of the information.

COPYRIGHT: "This report has been produced by AgResearch Ltd for The Ministry of Agriculture and Forestry. All copyright is the property of the Crown and any unauthorised publication, reproduction, or adaptation of this report is strictly prohibited without prior permission."

.

Contents

Contents	3
1. Introduction	4
1.1 Rationale	4
1.2 Questions addressed.....	5
2. Methodology.....	5
2.1 The use of qualitative methodologies.....	5
2.2 The questionnaire schedule.....	6
2.3 The study.....	7
3. Drought adaptation strategies – an analysis of the experiences of farmers in North Otago/South Canterbury.....	7
3.1 Conclusions.....	14
4. The importance of contextual issues in historical drought adaptation in New Zealand – an analysis of the 1980s, 1990s and 2000s.	15
4.1 Contextual factors in farmers’ experiences of drought in the 1980s, 1990s and 2000s.....	16
4.1.1 The importance of the political and economic context during the 1980s drought	16
4.2 The 1990s drought: a relative non-event?.....	17
4.3 Drought in the 2000s?	18
4.4 Other contextual considerations for drought – new entrants and experience	19
4.5 Conclusion.....	20
5. Assessment of the methodology.....	21
5.1 Was the methodology useful?.....	21
5.2 Future applications	23
6. Conclusions.....	24
7. References.....	26

1. Introduction

Adaptation to climate change is likely to benefit from experience gained in reaction to extreme climate events, specifically by implementing proactive climate change risk management adaptation plans (IPCC, 2007).

This study addresses this observation by the IPCC by exploring farmers' experiences of extreme climate events in North Otago/South Canterbury – a drought prone area of New Zealand. In particular, it focuses on historical adaptation to two of the most serious droughts in the region in the periods of 1988-89 and 1997-99 (He, 2000).

Climate models have predicted that under global warming drought conditions will extend northwards to cover the entire east coast of New Zealand (IPCC, 2001)¹ and droughts that were 1 in 20 year events could soon become 1 in 5 year events (Fitzharris, 2007). As a result, developing strategies to cope with agricultural drought is likely to become a critical part of New Zealand agriculture and agricultural policy in the coming decades.

The focus of this study is the exploration of farmers' "tacit knowledge" of drought adaptation. Polanyi (1966) argued that knowledge could be divided into two types – tacit and codified. Codified knowledge represents scientific knowledge which is "explicit, standardised and easily transferable" whereas tacit knowledge is *personal, often experience based, and context dependent*. As such, tacit knowledge is "difficult, if not impossible to communicate other than through personal interaction in a context of shared experiences" (Morgan & Munton, 2000: 161). Ironically, given that much information has in the past been gathered in a codified manner (for example, quantitative surveys and psychometric measures) it is widely believed that tacit knowledge is more important in determining behaviour (Gao et al., 2003).

1.1 Rationale

Exploring farmers' "tacit knowledge" of adaptation to climate change is important for four key reasons.

1. The breadth of knowledge farmers have for responding to climate change is likely to be far greater than anything research could deliver within the medium term. Thus we can greatly accelerate our understanding of climate adaptation and use this as a base to build future research programmes.

¹ The presence of an agricultural drought in the Hawkes Bay in 2007 (Hawkes Bay Regional Drought Committee, 2007) may be the forerunner of more to come.

2. As observed by the IPCC (2007), knowledge gained from past experience can be critical in implementing proactive climate change risk management adaptation plans, and, importantly, can aid new farmers who have no previous experience with climatic hazards.
3. Adaptive measures based on existing systems and beliefs are likely to be directly compatible with existing systems and thus cause minimum disruption to implement. (Burton et al., 2007).
4. Understanding how farmers currently respond to climatic change will assist in the development of models that predict the financial and environmental impacts of climate changes on the agricultural industry.

1.2 Questions addressed

The report addresses two main questions concerning farmers' experiences of drought adaptation to drought, namely:

1. How have farmers in the study area historically adapted their farms to cope with the extreme drought events of the 1980s and 1990s and how did the context of the drought influence their response?
2. What adaptive strategies do farmers need to follow to best cope with any increase in drought events in the future?

In addition, there is a brief analysis of the value of using a similar methodology to explore other aspects of climate change, for example, increased flooding or an increase in the frequency of cyclones.

2. Methodology

2.1 The use of qualitative methodologies

The study employed qualitative methodologies to explore tacit knowledge. While some researchers suggest that quantitative research methods are passé as they represent "mindless quantification and measurement" (e.g. Hamnett, 2003) others have argued that this is not the case, and that quantitative research approaches in social research can still be valid (e.g. Johnston et al., 2003). While we concur with Johnston et al. (2003), we used qualitative methods for two main reasons:

First, we wished to understand how farmers construct a complex system to cope with drought (at the farm, individual, family and community level) and, furthermore, how this system is then adjusted to cope with external pressures such as changes in the value of livestock, economic conditions, or numerous other potential external influences. Positivist quantitative research makes certain assumptions concerning the regularity of relationships within the social world (i.e. that people behave in the same stimulus/response manner as objects in the natural environment), but, in

reality, social worlds do not follow simple mechanistic rules but are chaotic, uncertain, unstable, complex and even contradictory. In this environment quantitative assessments are not effective (Borch, 2007).

Second, quantitative techniques have been criticised for failing to produce results of relevance to the real world as they reduce the world to a series of statements for assessment – rather than allowing people to describe the processes of decision-making or the feelings that may accompany the act. As a result, they are seen by many to “provide ‘idealised’ accounts of attitudes and behaviour which, because they are rationalisations, have an uncertain relation to actual situations” (Silverman, 1985: 15). In effect, quantitative studies remove the act from the complex, confused everyday life context in which it takes place. Qualitative research, on the other hand, involves seeking a detailed appreciation of human behaviour, embracing lived experience through a reflection on, and interpretation of, the understandings, experiences and shared meanings of peoples within their everyday realities (Dwyer and Limb, 2001).

2.2 The questionnaire schedule

In keeping with the application of a qualitative methodology, our fieldwork employed open-ended interviews based on a loose interview schedule (where questions can be asked in any order, questions may or may not be asked, and questions can be added as more is learnt about the situation of the interviewees). This approach has three main advantages over scheduled questionnaires (Silverman, 1985):

- 1) It allows the respondents to explain their unique way of seeing the world. In the case of this study, we learn not only what the farmer is doing, but their rationale behind it, historical acts that led to this position, the influence of other family members, and so on.
- 2) It assumes that no fixed sequence of questions is suitable to all respondents. Because of the differing structures of their farms and economic situations, farmers are in a myriad of different situations – and this enables the researcher to follow questions relevant to the farmer’s position rather than ask generic questions which may or may not be relevant.
- 3) It allows respondents to raise important issues not contained in the questionnaire. Scheduled questionnaires limit the number, nature and type of responses the interviewee can make – rather than allowing the respondent to present new issues that he/she may consider important.

2.3 The study

In keeping with the intensive nature of qualitative investigations (and greater time required for the conducting of fieldwork and analysis of discourse) we sampled twenty farmers and one drought advisor from the Rural Trust. Details of the final sample are presented below Table 1 of the main report. The pastoral farms ranged in size from 160 to 15,000 hectares. The minimum age of the farmers involved was 45 years (this farmer would have been 25 at the time of the 1988 drought). In total the farmers represent over 500 years of experience in dealing with farming in dry conditions with an average of 29 years general farming experience, and 22 years farming on their current farms. Farm produce included dairy, sheep, beef, deer and cropping production (depending on the farm) and farms were spread across the geographical area.

While the validity of qualitative studies cannot be assessed in the same manner as quantitative studies, we followed the appropriate methods for assuring the results covered the key categories for investigation (principally through the construction of a sampling matrix) and, in addition, the research was analysed by two researchers independently to ensure that the interpretation was valid (i.e. not just based on one person's perspective). The 'adaptation strategies' arrived at are a good match to those from literature on adaptation in Canada, the US, Australia and New Zealand with almost all of the adaptation strategies listed being detected in this study (see tables 3.1 and 3.2 in the literature review for a list of tactical and strategic adaptations). Thus, although the sample is small, we can be confident that the results concur with the general literature (including quantitative studies) on drought adaptation.

The interviews were recorded verbatim and the results analysed using the qualitative analysis software package: NVIVO[®].

3. Drought adaptation strategies – an analysis of the experiences of farmers in North Otago/South Canterbury.

This chapter produced a categorisation and typology of historical drought adaptive strategies (Objective 1 in the research proposal). In addition, it explored the optimal drought adaptation strategies farmers have developed in the region (to achieve one of the aims in Objective 2). From the analysis of the farmer interviews, we surmised

that there are three key areas the farmer has to adapt to in order to develop a drought resistant system.

- 1) Farmers need to develop the farm such that it is able to resist drought (should it occur) as well as build up and maintain resources that may be needed to fight drought in future years.
- 2) Farmers need to develop a farming system that provides them with some flexibility to deal with drought when it occurs (i.e. on recognition of a drought to act immediately and effectively)
- 3) Once the drought is perceived the farmer must have strategies capable of dealing directly with the drought situation and minimising the impact of the drought on livestock, capital and family

We thus constructed a categorisation of drought response based on these three needs. Note that this differs from the common approach of dividing responses into tactical and strategic (e.g. Risbey et al., 1999; Smit & Skinner, 2002; Bradshaw, 2004). The change in the categories was made on the basis that creating a flexible farming system falls between a tactical and strategic response (as noted in the literature review).

The key objectives, approaches and strategies used by farmers can be outlined as:

Objective 1: Make the farm drought resistant

Approach 1.1: Structure the farm for drought conditions

Distribute land over different areas or climate zones: A feature of droughts and 'drys' is that they are often distributed in an irregular fashion on a horizontal plane as even low rainfalls at the right time can make a big difference to pasture availability. Rainfall is also variable vertically with higher altitude areas almost invariably receiving more rainfall than lower areas. Farmers can enhance drought resistance by constructing their farms so that they own both high country and lowland and/or distribute their farm holdings over a wider geographical area.

Select vegetation and livestock to suit drought and the farm: Selecting varieties of vegetation and livestock that are suited for drought conditions (both in terms of their ability to survive in low moisture conditions and how well they fit in with the farmer's system for drought response) is essential for drought survival. In the literature review, numerous authors suggested this as a common strategic response to drought (e.g. Smit et al., 1996; Topp & Shafron, 2006; McLeman et al., 2007).

Plant shelter belts: Farmers are able to plant shelter belts to help structure the farm for drought. This may be a particularly useful strategy for properties where wind is a major factor in drying the land.

Invest in irrigation and/or water storage: Irrigating land is an obvious solution to drought. By irrigating the land is immediately made immune to meteorological drought. Two key advantages to irrigation is that (a) it provides farmers with a much greater ability to plan ahead and, (b) when a drought occurs the farmer does not act the same as other droughted farmers (i.e. put stock to the works when prices are low and purchase replacements when prices are high). Problems with irrigation include the cost, the difficulty in getting irrigation rights and the fact that it does not guarantee immunity to hydrological drought (as happened in the recent Australian drought – Topp & Shaffron, 2006). Another means of coping with water shortages in the area was through the construction of dams to provide water for stock.

Approach 1.2: Build up reserves during good years

Ensure there is sufficient stored feed: Growing and storing feed for livestock appears to be the most important single drought adaptation strategy for farmers in the North Otago/South Canterbury area. The figure often quoted by farmers for storage is 2 years worth: sufficient to get through two dry years and a bad winter. While some farmers suggest that they will store as much feed as they possibly can, others are reluctant to store too much because of the cost of storage. One farmer (78) who prefers to store as much as possible argues “*I know it’s expensive to make, but droughts are expensive.*”

Use capital wisely during good years: In the 1980s a key factor in worsening the impact of drought was the lack of working capital available to farmers. Being careful about spending during the good years and building up capital (or access to capital) provides farmers with more options for drought response.

Objective 2: Make the farming system drought resistant

Approach 2.1: Develop and implement flexible farming strategies

Diversify production types on the farm: A key difference between drought in the 1980s and the current situation is that, at the time of the 1980s drought, farmers were much more reliant on a single production system (for example, sheep or sheep/beef) and, as a consequence, when the price of sheep (in particular) fell there was no alternative source of income. In contrast to the 1980s, many farmers now run mixed

systems. Recently the growth of the dairy industry has provided some farmers (depending on the farm and location) with the opportunity to diversify into dairy service or grow feed for the dairy industry.

Develop a system with a pivot (decision) point for drought response: In drought it is beneficial if the farming system is flexible enough to rapidly change at the point where the farmer considers there is the likelihood of a drought – a pivot point around which the farmer can instantaneously switch from a normal farming system to a drought system. For example, farmer 72 describes his system:

We grow a lot of winter feed so we store them all on and then we use our spring flush which just about guaranteed because we're high rainfall and we get a good, really reliable rain normally between October to December so we use that flush ... er feed to get all our livestock up to hopefully cullable weights and then, if after Christmas it doesn't dry out, well then, good, they can just put on more weight. But if its drought, the drought is here and we haven't got any feed, they can go. And we do that with different classes – that's the bulls and we also do that with weaner deer.

Of key importance to the success of pivot points is that the decision to switch systems needs to have been made previously and, once the point is reached, action needs to be taken immediately.

Keep spare capacity to allow flexibility: Keeping spare capacity on the farm can be an important part of a drought resistance strategy. The advantage of this approach is twofold. First, it allows the farmer to keep stocking rates low and thus not overgraze the fields or put too much pressure on the feed reserves in case of drought. Second, it provides farmers with the flexibility to use the remaining capacity as they see fit – depending on the climatic and market conditions. Keeping a reasonable proportion of trading stock to capital stock is one way of dealing with this. Critical to the success of this strategy is that farmers resist the temptation to overstock during good years.

Objective 3: Follow strategies to survive in drought conditions

Approach 3.1: Respond quickly to drought

Make decisions fast and take action early: Whatever the farming system operated, a rapid response to drought requires decisions (such as prioritising the stock) to be taken rapidly. As noted above, systems that have pivot points in them encourage rapid decision-making – although there is no guarantee that the farmer will perceive the drought and act on it. The problem with leaving it late is, farmer 67 suggests “if

you leave it to late, you tend to then get into the fire sale situation where it actually really costs you and it's better perhaps to take a \$5 hit on a lamb, you know early than it is to take a \$20 hit three weeks late because it didn't rain and everyone else has had to bail out."

Wean lambs early: One key drought survival strategy that a number of sheep farmers have developed as a result of drought was to ensure that lambs were weaned as early as possible – enabling farmers more options for getting rid of livestock at a pivot point around Xmas time (to sell lambs before the prices drop).

Adjust stock grazing immediately depending on drought conditions: Farmers can also adjust to drought by changing their system of stock grazing, in particular the speed of the rotation.

Cull stock immediately: One way of relieving pressure on grazing is to cull stock that are surplus to requirements. Farmer 79 suggests that this is the first thing farmers should do after a drought is perceived.

Approach 3.2: Raise capital to survive drought

Sell land to raise capital: In a desperate situation a farmer may consider selling land to cope with drought response. With land prices high it may provide a reasonable option but, on the other hand, it is probably better to borrow against the equity held in the farm (which some farmers had done).

Sell stored feed to take advantage of high prices: In the current situation where the prices for feed are high and there is the possibility of drought, farmers may consider getting rid of sheep and selling the feed (silage or baleage). This solves two problems by reducing the grazing pressure on the land and, at the same time, providing farmers with a cash injection to maintain income flows. In the case of farmers who have no breeding stock and can get rid of stock immediately this may prove to be a successful strategy. Likewise, it is more likely to be effective if the farmer has trading stock that can be easily despatched.

Off-farm employment for farmer or spouse: While in the 1980s some farmers coped with the drought by finding work off the farm there is some question though as to whether this would be an effective solution under current conditions. As farmer 57, suggests, the ratio of costs in agriculture compared to the possible income made off the farm are now completely different. Whereas an off-farm income used to be sufficient to keep the farm ticking over, it is now more expensive to farm and the

income from the off-farm job would be relatively lower. Coping with the loss of labour from the farm presents another challenge.

Approach 3.3: Reduce costs

Reduce household and farm expenditure: Reducing expenditure at the time of drought is probably one of the most common strategies for responding to drought (be “tight fisted with the cheque book” farmer 65) – although it is not always an explicit part of a drought strategy. This strategy was particularly important in the 1980s drought where the economic position of many farms and low price for lamb meant that many farms were in a very poor economic position. A dilemma facing farmers in the current drought/dry was whether to cut back on fertiliser as a result of the high prices. Although they did not want to, 2 farmers had recently reduced their fertiliser use as they felt they had no other options.

Increase family workload (and decrease labour): Some farmers noted that in drought events they had reduced labour on the farm and undertaken the additional work themselves.

Approach 3.4: Find extra feed for stock

Coping with the need to feed the livestock can cause considerable problems for farmers. In the current situation where feed prices are high and many farmers have been left with excess stock because of a lack of space in the works, the search for feed can place considerable stress on farmers. Strategies for finding feed are well known to farmers and need little explanation.

Buy in feed: One farmer noted that in the drought of the 1990s this was an option as it was available at a competitive price. However, currently because of the extent of the dry conditions and the high prices paid by dairy farmers, buying feed is an expensive option. A number of farmers complained about the high price of feed.

Agist stock: Agistment features widely in the literature on potential adaptive strategies for drought (Topp & Shaffron, 2006; Marwick & Davies, 2006). In the drought of the 1990s agistment of stock to neighbouring regions was a viable option for farmers. In this current ‘dry’ only one farmer (farmer 79) had placed his hoggets on agistment. In this case it is very much a last choice scenario as although agistment is expensive in the current market the cost of baleage was even higher than the cost of agistment.

Put stock on the roadside: Some farmers use the roadsides as a source of extra feed for stock during drought.

Approach 3.5: Maintain learning and good relationships

Talk to other farmers and listen to what they are doing: The importance of other farmers for developing drought survival strategies cannot be underestimated. In particular, as micro-climatic conditions can vary over a relatively short area, talking to farmers in a local region or in a similar position can be particularly useful. Talking to others is also important for dealing with stress (see below).

Keep in close contact with industry: It is important for farmers to keep in regular contact with industry during a drought (i.e. freezing works, bankers, insurers, and so on). Personal relationships and social capital can be important for gaining a positive response when asking for some help with drought. Dairy farmer 64 advises that it is better to do this sooner than later as *“They’re better when you’re coming from a position of strength.”*

Approach 3.6: Strategies for dealing with stress during drought

While they do not lead directly to changes in economic performance, strategies for dealing with the psychological stress of a drought can be critical to ensure that decision-making can be done with a clear head. That farmers suffer considerable stress during drought periods is well established in the literature (Stehlik, 2003b; Ziervogel et al., 2006; Alston, 2007). Farmers interviewed in the survey had a number of key ways of dealing with stress during drought.

Getting away from the farm: The main means of stress relief for farmers in the survey was to get away from the farm for a holiday. This can have huge benefits not simply for the psychological health of the farmer, but also for the business as it provides farmers with a fresh perspective on the drought. For example, farmer 58 describes how holidays allow him to think clearly again:

When you’ve got real pressure on, sometimes a few days away, you actually see it a hell of a lot clearer from outside than you do when you’re in there but at the time you can’t go away because there’s so much pressure on. Can’t is something that shouldn’t be accepted. You know, it’s easier to go away for a few and see if clearly then come back in.

The problem with getting people to take holidays is that once in a drought condition people are under pressure and less likely to want to leave their farms.

Playing sport: Playing sport is a strategy some farmers used to relieve the drought stress during past droughts. Changes in the social structure of rural communities though may have influenced the viability of this as an option as farmers observed that a number of sports clubs have closed since the 1980s.

Keep taking decisions (be positive): A number of farmers observe that a key to reducing stress is to keep a positive approach to the drought by (a) keeping on making decisions, and (b) keep doing positive things on the farm that represent progress. Farmer 79 observes:

You know, go prune some trees or do something, you know, that's still going to be of benefit in the long run. Rather than just choosing to mope or put the blinkers on, shut up shop and you know, there's still an awful lot of things you can do on the farm that don't cost a lot of money but need your time. You know the farm would still be better off and it's just your time and you can do some of those things and I always say they give you a positive feeling.

Talk to people: One farmer currently experiencing a severe drought said that one of the reasons he agreed to partake in the survey was "even just discussing it with people helps. That you know that people are aware that things are not too good."

3.1 Conclusions

What we have presented here is not a single 'best strategy' for drought response, but a collection of strategies that dryland farmers in North Otago/South Canterbury have developed over many years in response to drought events. Selecting the best strategies for any individual farm requires that the farmer consider the context of his/her own farm (climate, soils, labour supply, and so on), the market he/she is targeting and the wider economic context of the drought. However, one of the key suggestions emerging from this chapter was that farmers should maintain strategies from across the three key areas.

- 1) Strategies to make the farm drought resistant,
- 2) Strategies to make the farm system drought resistant,
- 3) Strategies for dealing with the drought once it has been perceived

The drought adaptation strategies that fall into these categories are summarised in the below table (Table 1): Farms can be made more drought resistant by taking measures to ensure water supplies or purchasing holdings in different climatic zones. Actions such as creating pivot points in the farm system and keeping options flexible for part of the farming system (e.g. maintaining only 75% capital stock) can also produce considerable dividends when coping with drought. Finally, if a drought

strikes, having “a suite of appropriate risk-management measures” (Wilhite, 2002 – also see Bryant et al., 2000) is necessary to ensure the direct stressors of drought are coped with.

1. Make the farm drought resistant	Structure the farm for drought	Distribute land over different areas or climate zones Select vegetation and livestock to suit drought and farm Plant shelter belts Invest in irrigation and/or water storage
	Build up reserves	Ensure there is sufficient stored feed Use capital wisely during good years
2. Make the farming system drought resistant	Implement flexible Farming systems	Diversify production types on farm Develop a system with a pivot point for drought Keep spare capacity to allow flexibility
3. Have strategies to survive drought	Respond quickly to drought	Make decisions fast and take action early Wean lambs early Adjust stock grazing depending on drought conditions Cull surplus stock immediately
	Raise capital to survive drought	Use land to raise capital for farm Sell stored feed to take advantage of high prices Off-farm employment for farmer or spouse
	Reduce costs	Reduce household and farm expenditure Increase family workload (and decrease labour)
	Find extra feed for stock	Buying in feed Adjustment of stock Putting stock on the roadside
	Dealing with people	Talk to other farmers and listen to what they are doing Keep in close contact with industry
	Strategies for dealing with stress	Getting away from the farm Playing sport Keep taking decisions (be positive) Talk to people

Table 1: Drought adaptation strategies

4. The importance of contextual issues in historical drought adaptation in New Zealand – an analysis of the 1980s, 1990s and 2000s.

In the literature review it was noted that the context within which the drought occurs is of key importance in determining the extent and severity of the drought. This chapter looked at the contextual features surrounding the 1980s, 1990s and current (2000s) droughts in North Otago/South Canterbury. The objective was to assess the impact of external drivers is on farmers’ experience of drought. While the focus of the

study was initially on the historical droughts of the 1980s and 1990s many farmers related their experiences not to past droughts, but to the current dry conditions – thus the recent drought/dry is also included in the analysis.

4.1 Contextual factors in farmers' experiences of drought in the 1980s, 1990s and 2000s.

4.1.1 The importance of the political and economic context during the 1980s drought

Drought in the 1980s took part in a unique context for agriculture in North Otago/South Canterbury (and the whole of New Zealand). Farming in New Zealand prior to the 1980s had been based on a system of supplementary minimum prices (SMPs) – a subsidy approach that guaranteed farmers income for their produce. This, in combination with a history of sheep farming in the region, meant that many farms were heavily dependent on sheep (and wool) production at the time of the 1980s drought.

Two other economic conditions were present at the same time. Farmers recall that the removal of the SMPs had had a major effect on land prices with the equity held in the farm being very low and, where farmers had borrowed money to purchase the farm, high inflation and high interest rates made servicing mortgages difficult. At the same time, the removal of SMPs left sheep prices open to fluctuations in the market and, in the late 1980s the price plummeted. In better years farmers may have had the money available to agist their stock or to purchase feed for the livestock but the severe lack of capital meant that there was simply not the income available to spend on feeding livestock. With many strategies for dealing with drought closed to them, some farmers dealt with it by reducing almost all expenditure during the drought as a last option *“you were quite ruthless with how you went about spending and stuff. If it didn't fit, it didn't ft.”* (farmer 65). Another strategy used by a couple of farmers was to work off the farm to survive the drought.

The drought of the 1980s had a lasting impact on farming in the region. While most farmers were not able to state specifically what they changed on their farm in response to the drought, some farmers suggest that it created a new 'tough' attitude to farming in the region.

The key contextual factors that made the 1980s drought so bad were thus:

- a) Inflation and interest rates were high making it difficult for farmers to service debts.
- b) Equity in land prices was low – meaning that banks were less willing to lend money to farmers to service debts.
- c) The decline of lamb prices mean that, as well as costs increasing, incomes received for produce were declining.
- d) Farmers had less diversification on their farms and therefore were heavily hit by the decline in lamb prices.

What made the 1980s drought so bad was thus not only the hydrological/ meteorological drought itself but the lack of preparedness of farmers and, critically, the dire condition of the farming industry at the time.

4.2 The 1990s drought: a relative non-event?

One interesting feature of the survey was that, whereas farmers referred to the 1980s drought as a stressful event, little mention was made of the 1990s drought despite the fact that the hydrological and meteorological conditions of the time were as bad as in the 1980s (He, 2000). There are a few features which could account for this.

First, by the 1990s interest rates had declined significantly, land prices had increased (possibly as a result of greater confidence in the agricultural industry) and, importantly, in the late 1990s prices for lamb had recovered significantly. As a result, farmers were financially in a better financial position and able to cope better with the drought. Lower interest rates, higher equity in their farms and higher prices meant that in the 1990s food could be purchased or stock agisted. Thus a lot of the stress and concern associated with drought was absent. Second, as noted above, the 1980s drought may have created a different ‘tougher’ attitude in farmers to drought, leading farmers to adopting better strategies for coping with drought. Third, it is possible that the institutional arrangements for dealing with drought were better in the 1990s than the 1980s. The drought advisor interviewed observed that the 1999 drought had “effected everybody and it didn’t matter if you did have money or you didn’t have money” and that this led to “*really great community support*”.

The key lesson to learn from the difference between the 1980s and 1990s drought is the role of economics in agricultural drought. Farmer 57 observes that the drought of the 1980s “was a financial thing” as “People were unable to feed their stock but I think ... the farming side of it ... actually farmers could handle that”. In contrast, with

no financial pressure on the farmers in the 1990s farmers perceived a very dry period – but without any of the stress present that accompanied the 1980s drought, a serious drought was not widely perceived.

4.3 Drought in the 2000s?

The main purpose of this study was to examine historical droughts from the 1980s and 1990s. However, in the period between the submission of the proposal and the undertaking of the research it became apparent that a new drought may be upon us – with farmers experiencing dry conditions right across the country. As a result of this ‘dry’ farmers are beginning again to think about the possibility of drought in the next year – the timing of which allows us to address the issue of what are the main contextual issues that farmers face at present?

One of the key changes in agriculture since the drought in the 1990s is the rapid growth of the dairy industry and its current high level of prosperity relative to sheep, wool and beef production (which were all low). This had a strong influence on farmers’ experience of the current drought/dry.

High land values: In the drought in the 1980s farmers observed that low land prices were an important cause of stress for farmers who risked losing everything if the farm failed. Currently, however, the value of farm land is very high – in part as a result of demand for dairy conversions. These high land prices have two major impacts on farmers’ drought response. First, if they wish to borrow money against the farm (or even sell part of the farm) they are able to as the value of the farm as collateral is high. Second, farmers wishing to leave farming during the drought can do so with a considerable lump sum for establishing themselves elsewhere.

Market for dairy services: The growth of the dairy industry provides an opportunity for farmers in terms of the diversifying into the dairy service industry (providing grazing and feed for dairy farmers). Dairy service appears to be a good option for farmers in drought areas as, as well as diversifying income, it enables farmers to lower the stocking level of their capital stock.

Increasing cost of buying in feed during a drought: For some of the sheep and beef farmers themselves, there was concern that the high dairy prices has left them unable to compete for feed with the dairy industry – thus one of the key strategies for drought adaptation was made more difficult for farmers. While the high price of feed

was creating problems for some farmers, for others it was creating financial opportunities in the dairy service sector.

Inability to get stock slaughtered to relieve drought pressure: Increases in the cost of feed may be having a knock-on effect in the current dry conditions. With dairy farmers paying big money for feed, the costs to sheep/beef farmers have doubled. As a result, the drought advisor suggests *“this year basically they’ve really got to make the stock decisions and sell off”* – leaving the works flooded with stock. This is a case where a number of contextual aspects have come together to create a problem – the high value of dairy products, the low value of stock, continued dairy conversion in sheep areas, and, on top of everything, the dry conditions leading farmers to try to get rid of stock. The inability to get stock slaughtered is causing farmers problems and increasing the likelihood of food shortages.

The impact of dairy on rural communities: A further way in which the dairy industry may influence drought response is through its impact on communities. While there was little animosity towards dairy farmers, there was an underlying concern that the rural communities are being changed through the arrival of dairy farms and dairy workers, in particular because dairy farmers were often too busy to get involved in the local community. This could become a problem in the future because communities are important for coping with drought (Stehlik, 2003a). On the positive side, the dairy industry does create opportunities for farmers’ children to find employment in rural areas and has *“actually brought some of those back for our kids to do in the community”* (farmer 57).

The geographical extent of the drought: A non-dairy related feature of this current drought is its geographical extent – covering much of the country. A geographically widespread drought creates far more problems for farmers than a local drought of the same intensity because of the additional pressure on feed and agistment, lack of market for sheep, clogging up of the works, and its impact on prices. The result is to place farmers in an economically weaker position than they would be in a regional drought. If droughts become more widespread (as is forecast under climate change conditions) this kind of issue is likely to become even more problematic.

4.4 Other contextual considerations for drought – new entrants and experience

One of the most difficult times in drought can be when it coincides with changes in management. As noted earlier, a key strategy for adaptation to drought is to build up

feed and economic reserves during good periods to survive during dryer spells. One of the farmers interviewed had taken ownership of the farm 4 years ago with “a fairly big mortgage” and was immediately faced by 3 years of dry weather conditions causing him to place the farm in “*survival mode*” as “*We were not able to make hay and silage because of the dry weather*” (farmer 79). Again, this has been influenced by the detrimental conditions for sheep farming at the moment as, currently he is being forced to hold onto 700 ewes because of the current overload of the freezing works. New entrants into agriculture have similar problems. Farmers related their own experiences with starting off farming in drought conditions and how the additional debt burden accentuated the impact of the drought event. Developing a drought strategy is something that many farmers admit is down to experience and there are differences between the economic position, level of experience and even psychological state of young farmers.

4.5 Conclusion

Assessing drought in the 1980s, 1990s and 2000s has revealed how important the context of the drought is on farmers’ experience of drought. In the 1980s the farming industry had been recently set free on the market, interest rates and debts were high, equity in land was low, and prices for stock were low (although wool prices were still high). As a consequence many farmers suffered considerably when the drought arrived. On the other hand, those that survived learnt a lot from the drought. Their experience and the development of more drought resistant systems may be in part responsible for their survival of the 1990s drought. In contrast to the 1980s farmers in the 1990s had experienced some very good years prior to the drought and, as a result, debts were lower. Coupled with good prices for lamb, farmers had many more options for feeding their livestock – being able to either graze them outside the area (as one did for two years) or purchase food to make up for any shortfall.

The current ‘dry’ in the 2000s is a different situation again with the dairy industry having a major impact on the drought response of farmers. Some of the impacts such as the increase in prices of feed and grazing, difficulty getting stock into the works and the impact on the structure of rural communities can be negative. However, on the other hand the role of the dairy industry in maintaining high rural land prices (and therefore providing farmers with equity to use to survive the drought) and the new market for dairy services means that the overall impact could be positive in the long term. Dairy services, in particular, could fit in well with a long term drought system as it provides farmers with a simple flexible option for land management (around a lower

core of capital stock) – something that was not as evident in the droughts in the 1980s and 1990s.

As this analysis of farmers' experiences of drought has revealed, 'agricultural drought' is about more than simply a combination of the hydrological and meteorological conditions. Rather, experiencing drought is more probable when a combination of contextual issues emerge at the same time, with the impact on farmers dependent on a huge variety of factors ranging from the geographical extent of the drought to the economic condition of other industries. Dry conditions in a region make farming difficult – but it is the contextual factors that can make it almost impossible.

5. Assessment of the methodology

One of the objectives of the study was to develop methodology for exploring farmers' adaptation to climate change events. As suggested by the IPCC (2007) we focused on adaptation to extreme events – namely two specific drought events in North Otago/South Canterbury from the 1980s and 1990s. We used a qualitative methodology, face-to-face interviewing and a semi-structured question schedule in order to explore the complexity of farmers' drought adaptation systems. In particular, we were focusing on farmers' tacit knowledge of the events – knowledge that is personal, often experience based, and context dependent rather than being explicit, standardised and easily transferable

5.1 Was the methodology useful?

At the beginning of the summary report we suggested there were four key reasons why an exploration of tacit knowledge of drought adaptation strategies may be important.

We surmised that the methodology would be useful for gathering knowledge about climate adaptation strategies in New Zealand and thus we could accelerate our understanding of climate adaptation. One of the key criticisms of qualitative research is that the number of interviews means that they do not cover the range of respondents to provide the full spectrum of responses (Herbert, 2000) so one obvious question is: Were the results comprehensive enough? One indication that suggests this is the case is the fact that the 21 interviewees identified at least 27 different adaptive strategies to drought. In contrast (as an indicator as results are not directly comparable), Austen et al.'s (2002) quantitative questionnaire survey of 62

Australian farmers returned 33 different adaptive strategies to climatic events; a similar result with only a third of the interviewees.

Has the research “accelerated our understanding of climate adaptation” as we hoped? One area not discussed much in the literature is the impact of the context of the drought on perception of and response to drought. Yet, as we demonstrated through our analysis of historic droughts, the environmental, economic and even political contexts of the drought plays a key role in how serious it is and how farmers respond. Hydrological and meteorological drought alone does not necessarily lead to an agricultural drought. In the 1980s farmers were severely affected by the drought because of a lack of capital, but the drought in the 1990s of similar magnitude had little impact largely because farmers could afford to agist stock or buy in feed.

The flexible nature of the methodology directly led to another important finding. As we note in the report, at the time of the interviews farmers were on the verge of another drought (and a couple of farms were already experiencing drought). As farmers were already considering the possibility of a new drought, we were able to explore contextual factors existing at the current time (i.e. the impact of changing rural communities, increased land values, ability to provide dairy services, the geographical extent, inability to get stock into the works, and the increased cost of feed). From this we learned the importance of considering structural changes in the farming industry and how that may influence drought adaptation in the future. The impact of the dairy industry growth on drought adaptation of sheep and beef farmers is an interesting issue for future study – but would not have emerged using structured techniques.

The results may also aid farmers with little previous experience with drought. As we note in the analysis chapters, a key mistake of young farmers in droughted areas is a tendency to be too enthusiastic and maintain high stocking levels (some farmers even admitted this of themselves in earlier droughts) – whereas experienced farmers (without irrigation) often operate flexible farming systems and/or pivot points to enable rapid response to dry conditions. This may become an issue in future if climate change causes more widespread drought and, at the same time prices for better land increase. This could force new entrants increasingly onto poorer land such as that affected by drought or lacking in irrigation – meaning that knowledge of how to approach drought may become more important in the future and support for younger/ less experienced farmers more necessary.

We also suggested that the understanding developed here can assist in future climate change modelling by developing a greater understanding of how farmers are likely to respond to increased drought. Perhaps the most important lesson for modellers here is the importance of incorporating more than climate data into models of agricultural drought, but to consider the high impact of drought context on the response of farmers. In all three periods of drought (10 years apart), the key contextual drivers for droughted farmers have been different and the response different accordingly. In an extreme case, we could have extended droughts in New Zealand but if the price for produce is high enough and the industry in good enough condition, farmers may be able to import the feed they need to get through dry periods.

5.2 Future applications

This methodology can also be applied to other climate events expected to increase in frequency under climate change. However, given that farmers barely mentioned one of the historic drought events examined here (from only 10 years ago), it is doubtful whether it would be useful for exploring short term events unless they were very extreme. An extreme cyclone, flood or snow event may warrant study but in general, these are short term events and do not require the level of adaptation (or cause the level of stress) that droughts may.

There are three areas where more work of this kind would be useful:

- 1) The impact of the growth of the dairy industry on drought adaptation in the sheep/beef industry suggests that the relationships between the industries are important for drought survival. Because of problems getting interviews our study involved only 2 dairy farmers (both irrigated). A study specifically on drought adaptation in the dairy industry (in non-irrigated areas particularly) would provide a more complete picture of how the NZ agricultural industry will respond to drought events in the future.
- 2) Our research focused on the drought adaptation of farmers but not on rural communities as a whole (e.g. other industries in the agricultural sector). As (a) some researchers have suggested community response is critical to drought adaptation (Stehlik, 2003a), and (b) communication between farmers and other farmers/industry was identified as a key adaptation strategy, work focusing on the role of the broader community may also be beneficial.

- 3) This study has clearly shown the importance of the geography of the farm and the location for the experience of drought. For example, some farms in the survey had access to high country land with higher rainfall that they could incorporate into their drought resistance strategy, or the location of the North Otago/South Canterbury area close to the Southland plains (a formerly predominantly sheep growing area with different climatic conditions but within easy transport distance) have shaped farmers' options and responses in the past. While we are certain that the core strategies as regards adaptation have been explored here, understanding the spread of drought into other regions of New Zealand will require a greater understanding of the geographical and economic context of different farming regions. In this case a more extensive (and representative) survey of farms across the East Coast of NZ would aid our understanding of the context of drought adaptation on a regional basis.

6. Conclusions

This study has investigated farmers' tacit knowledge of drought adaptation – in particular, exploring the types of decisions farmers make and the importance of context on drought adaptation. In the original proposal we suggested it may be possible to outline optimal drought adaptation strategies for the region. In reality, however, we can conclude that because of the strong impact of context there is no optimal strategy for drought adaptation. Instead, there are issues for which farmers must find solutions – but these issues are dependent on the contextual situation of both the drought and the farm itself and consequently, not all farms will adopt all options and not all options will be open to all farmers. As noted above, farmers need (a) strategies to make the farm resilient to drought, (b) strategies to ensure that the farming system is resilient to drought, and (c) strategies for coping with a drought once it has occurred.

For farmers in areas increasingly experiencing drought it would be wise to consider these three categories of adaptation. We have also suggested some possible strategies drawn from the experience of farmers who have been coping with drought for decades, but there may be other solutions that fit in well with the local situation. Asking neighbouring farmers who are experiencing similar conditions is a good way of gathering information on these. In addition, farmers need to be aware of the changing context of drought. In the decade between each of the droughts the structural conditions of the farming industry changed, meaning that, when the drought occurred the conditions farmers experienced were radically different.

Keeping in touch with the changing world outside the farm is likely to be an important feature of drought response in the future.

7. References

- Alston, M. (2007): 'I'd Like to Just Walk Out of Here': Australian Women's Experience of Drought. *Sociologia Ruralis* 46 (2): 154-170.
- Austen, E.A.; Sale, P.W.; Clark, S.G.; Graetz, B. (2002): A survey of farmers' attitudes, management strategies and use of weather and seasonal climate forecasts for coping with climate variability in the perennial pasture zone of south-east Australia. *Australian Journal of Experimental Agriculture* 42: 173–183.
- Borch, K. (2007): Emerging technologies in favour of sustainable agriculture. *Futures* 39: 1045–1066.
- Bradshaw, B.; Dolan, H.; Smit, B. (2004): Farm-level adaptation to climatic variability and change: crop diversification in the Canadian prairies. *Climatic Change* 67: 119–141.
- Burton, R.J.F., Dwyer, J., Blackstock, K., Ingram, J., Brown, K., Mills, J., Schwarz, G., Mathews, K. and B. Slee (2007). *Influencing positive environmental behaviour among farmers and landowners – a literature review*. Report for Defra. CCRU and Macaulay Institute, Gloucestershire and Aberdeen.
- Byrant, C.R.; Smit, B.; Brklacich, M.; Johnston, T.R.; Smithers, J.; Chottti, Q.; Singh, B. (2000): Adaptation in Canadian agriculture to climatic variability and change. *Climatic Change* 45: 181-201.
- Dwyer, C.; Limb, M. (2001): Introduction: Doing Qualitative Research in *Geography. Qualitative Methodologies for Geographers: Issues and Debates*. M. Limb and C. Dwyer. London, Arnold: 1-19.
- Fitzharris, B. (2007): How vulnerable is New Zealand to the impacts of climate change? *New Zealand Geographer* 63: 160-168.
- Gao, F.; Li, M.; Nakamori, Y. (2003): Critical Systems Thinking as a Way to Manage Knowledge. *Systems Research and Behavioral Science* (20): 3-19.
- Hamnett, C. (2003): Contemporary human geography: fiddling while Rome burns. *Geoforum* 34, 1–3.
- He, Z. (2000) The 1997-99 and historic droughts in North Otago. *Weather & Climate* 20: 29-46.
- Herbert, S. (2000): For ethnography. *Progress in Human Geography* 24(4): 550-568.
- IPCC (2001): *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. http://www.grida.no/climate/ipcc_tar/wg2/477.htm
- IPCC (2007): Summary for Policymakers. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.

- Johnston, R.; Hepple, L.; Hoare, T.; Jones, K.; Plummer, P. (2003): Contemporary fiddling in human geography while Rome burns: has quantitative analysis been largely abandoned—and should it be? *Geoforum* 34: 157–161
- MAF (2008): *Meeting the Challenges. Key Points for Getting Through Droughts*. <http://www.maf.govt.nz/mafnet/rural-nz/emergency-management/droughts/challenges/>
- McLeman, R.; Mayon, D.; Strebeck, E. & Smit, B. (2007): *Drought adaptation in rural eastern Oklahoma in the 1930s: lessons for climate change adaptation research*. Mitig Adapt Strat Glob Change DOI 10.1007/s11027-007-9118-1.
- Polanyi, M. (1966): *The Tacit Dimension*. Routledge, London.
- Risbey, J.; Kandlikar, M.; Dowlatabadi, H. (1999): Scale, context, and decision-making in agricultural adaptation to climate variability and drought. *Mitigation and Adaptation Strategies for Global Change* 4: 137–165.
- Silverman, D. (1985): *Qualitative Methods and Sociology*. Gower Publishing, Aldershot.
- Smit, B.; McNabb, D.; Smithers, J. (1996): Agricultural adaptation to climatic variation. *Climatic Change* 33: 7-29.
- Smit, B.; Skinner, M.W. (2002) Adaptation options in agriculture to climate change: a typology. *Mitigation and Adaptation Strategies for Global Change* 7: 85–114.
- Stehlik, D. (2003a): Australian drought as lived experience: Social and community impacts. In E. Butterill & M. Fisher (eds): *Beyond drought: People, policy and perspectives*. CSIRO Publishing, Collinwood (Aus). Pp. 87-108.
- Stehlik, D. (2003b): *Seeking solutions: Drought responses as capacity building: A research report to the National Rural Women's Coalition*. Curtin University of Technology, Australia <http://www.strongercommunities.curtin.edu.au/local/pdfs/Reports/Seeking%20solutions.pdf>
- Topp, V. and Shafron, W. (2006): *Managing Farm Risk: The Role of Preparing for Drought*, ABARE eReport 06.6 Prepared for the Department of Agriculture, Fisheries and Forestry, Canberra, April.
- Wilhite, D.A. (2002): Combating drought through preparedness. *Natural Resources Forum* 26: 275-285.
- Ziervogel, G.; Bharwani, S.; Downing, T.E. (2006): Adapting to climate variability: Pumpkins, people and policy. *Natural Resources Forum* 30: 294–305.