THE UNIVERSITY OF ADELAIDE AUSTRALIA

The Environment Institute, University of Adelaide

Developing Landholder Capacity to adapt to Climate Risks and Variable Resource Availability in the Bookpurnong and Pyap to Kingston On Murray Regions of the Riverland South Australia.

Australian Government Department of Agriculture, Fisheries and Forestry
FarmReady Industry Grant R1#92

FINAL REPORT

February 2012

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Project partners:

Australian Government
Department of Agriculture, Fisheries and Forestry

Government of South Australia
South Australian Murray-Darling Basin Natural Resources Management Board

CSIRO

Loxton to Bookpurnong Local Action Planning

THE UNIVERSITY of ADELAIDE

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Authors contributing to the report were: Bart Kellett (Environment Institute, University of Adelaide); Onil Banerjee (CSIRO Sustainable Ecosystems) and Ian Laughlin (FieldObs).

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Finally but most importantly, we are particularly grateful to the growers of the Bookpurnong and the Pyap to Kingston irrigation regions for their valuable 'hands-on' input into this project.

Project Outcomes

The objective of this project was to develop landholder capacity to adapt to the variability and uncertainty associated with climate and water and agricultural production. The context and motivation for the project is set out in the first section of this report. The project team embarked on a fairly extensive engagement and consultation process, the purpose of which was to gain a more detailed understanding of the attitudes and options that landholders were considering as part of their adaptation strategies. This was also a time for exchanging information about the latest understanding of climate change and about changes in the availability of water, both during the drought and beyond.

While many common themes emerged from the consultation process, it remained unclear as to how best to use much of the existing information on adaptation options and the flow on consequences. This uncertainty revolved mostly around the most useful level or scale that the option development and assessment tool should address. The key to deciding the most appropriate scale was to consider who would most likely continue to use the tool beyond the current raised awareness state i.e. the landholders and those who most commonly advise them. Hence the ILSA (Interactive Land use Strategic Assessment) tool foreshadowed in the project proposal is directed at allowing the landholder to explore adaptation options and the consequences in a range of water availability, climate conditions, crop mixes and commodity prices.

The consultation process was made up of three components, telephone interviews with 43 respondents to a well designed survey (Appendix 1), followed by four workshops within the region attended by irrigators from the Bookpurnong and Pyap to Kingston areas and subsequently in-depth interviews with 11 local landholders. A brief example of workshop interaction is given in Appendix 2. Not surprisingly, there was a high degree of commonality among respondents with respect to concerns about water availability and options for adaptation. Common themes that emerged were doubts about the reality of climate change, concern at the rapid changes in water regulation and trading and concern about the security of water availability. Many landholders were well aware of the global market context that influences the price and markets of their primary products. They acknowledged that the water market was helpful in providing flexibility in times of limited water and many had already thought about options and strategies that would help them adapt. There was concern that the existing adjustment packages would result in disaggregation of the irrigation areas making it more difficult for maintaining “common-unity” water distribution system and also for loss of people in the locality. A listing of the many options suggested by landholders is given in the report of Appendix 3.

Following this consultation and collation phase work began on designing the Interactive Land use Strategic Assessment (ILSA) tool. At first, this took the perspective that adaptation would be assisted if the two irrigation districts were reconfigured in a way that maximised the net present value of the production of goods and services, including environmental services (Appendix 4). A decision hierarchy associated with different investment options was devised and then discussed with the LAP group and interested landholders (Appendix 5). Results from this consideration indicated that, while this district and regional scale consideration were important for decision making at the regional NRM Board level, it was less relevant to individual irrigators and landholders.

The decision was made to focus the ILSA tool on providing adaptation option assessment at the individual landholder or individual enterprise level. Hence the ILSA tool is a computer based, user interface for enterprise scale planning with combined scientific and individual production circumstance information in an easy to use and practical way. The development, scientific and information basis and the format of the ILSA is described in the accompanying report "Interactive Land Use Strategic Assessment (ILSA) Tool: Scientific Methods and Tool Design" by King, Connor, Laughlin and Meyer (2012).

To make use of the ILSA tool, the user is first provided with information about historic and future climate in decadal sequences. As perennial crop and capital decisions are longer term investments, it is important to consider the longer term influences as well as the annual ones. Irrigators often suggest that they are able to cope with the odd dry year but extended droughts are tough. They are presented with the likely impacts of each scenario and decade on water available to them in the form of allocations and water prices likely to result given those allocation levels. This information is presented both graphically and numerically in a simplified format for ease of understanding. The user is shown a time series of water that would have been available on average by decade over the past 11 decades, had current development and water sharing rules been in place for the entire period. They are also shown how allocation would have varied by year within decades and likely implications for water price. This information is also presented for a climate change scenario.

Each climate change scenario is represented as a 110 year timeline in decadal sequences. Each decade is then classified according the expected/predicted level of allocations. Years with allocations of 95% or greater are not expected to have any impact in irrigation, years with 80-95% allocation are expected to have very little impact on irrigation, years with 60-80% allocation are expected to exert some stress possibly forcing radical change, while years with 25-60% allocation represents extreme drought conditions similar to those experienced in the millennium drought. Any less than 25% allocations and irrigated agriculture at or near current levels would be considered unviable.

Based on this information the user chooses a climate decade as the basis for their planning. A risk adverse farmer might choose a very dry decade under a future with climate change, whereas an optimist might choose an average or wet decade from the historic climate series. The point of the model is to allow exploration of alternative wet to dry decade impacts.

Next, the user provides details about their total entitlement, the area by crop(s), and irrigation system that they would like to consider. The model provides default starting values for crop production budgets, water prices, water allocations based on widely accepted regional sources including Primary Industries and Resources South Australia (PIRSA), the Australian Bureau of Statistics (ABS) and, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) . The scientific basis for this information is described in the detailed accompanying report. The user can choose to accept these default values or adjust them to suit more farm specific data.

The model output is a graphic and tabular presentation of modelled outcomes that could be expected over the chosen planning decade. This includes expected: costs, returns, water use, opportunities to sell water or need to buy water to meet a gap between available allocations and planned application rates. The information is presented for different types of allocation years (wet normal, dry normal, dry, and very dry), the probabilities of each type of year are also presented as is the expected economic returns (or losses) over the decade as a whole.

The model generates results for the whole farm enterprise as well as for each individual irrigation activity described. For farms with just one activity the whole farm and individual crop will both be the same.

A rapid assessment survey of the potential use of the ILSA tool has been done that indicates that landholders will value having access to more detailed analysis of possible options in the future. The appealing part is that this “what if” exploration can be done with no risk, and provided there is sufficient trust in the validity of the inputs and plausibility of the outputs there is a good chance of having better informed landholders. An ongoing awareness raising program is planned to promote the availability of the tool as well as directed workshops using the tool as a focus for option development and adaptation discussion.

Origin and description of the project

The following description was extracted from the original CSIRO project plan and signed by the Project Leader/Proposer on 16/02/2009. It subsequently received approval to undertake a scoping/proof of concept study at an estimated cost of $160,000 on 15/06/2009.

Motivation

- Climate change appears to be leading to severe reduction in water allocation for irrigation in the SA Riverland
- Whilst climate, water and adaptation possibilities have been studied and are widely communicated to scientific and NRM management agencies, communities most impacted have received less attention and have not fully benefitted from a dialogue with scientists and NRM mangers. Yet these communities face critical choices about how to adapt and manage at individual farm scale at irrigation district scale and at regional economy scale.
- These communities also hold detailed knowledge of their local circumstances that scientist and NRM managers don't.

There is an opportunity to help these communities to explore options for their future in a way that combines best scientific and detailed local knowledge in a highly collaborative and interactive learning framework

Overview

Facing climate change threats requires a collaborative framework to be established in order to be able to define the most realistic management and adaptation strategies considering the three levels of interest of this project (i.e. farm, district and regional economy) *see Figure 1*.

The following diagram *(figure 1)*, describes the design of the collaborative framework; CSIRO scientists have investigated climate change impact on a regional scale and its socio-economic impacts. This regional information and the results of these investigations, such as reduced water allocation, allocation reliability, sharing, adaptation strategies and usage for irrigation purposes and regional economy will be communicated to South Australian Murray Darling Natural Resource Management Board.

The South Australian Murray Darling Natural Resource Management Board is able to digest and convert this information for use by NRM managers (i.e. Loxton Local Action Planning Committee), who are in turn working very closely with local growers groups.

It has been established that local growers have a detailed local knowledge regarding progressive climate related impacts on their individual businesses. The collaborative framework will allow the assembling and sharing of all the scientific information and local knowledge captured, via an integrated learning tool which will assist growers in their decision making.

The outcome of this will be that a better understanding of the consequences of individual decision making will be enabled, which will in turn have flow on effects at the district and regional economy scale and vice versa. Also, the tool will facilitate and close the communication gap between both scientists, NRM Managers and growers. The details of the work required to build and use the interactive learning and scenario analysis tool is discussed at the end of this section.

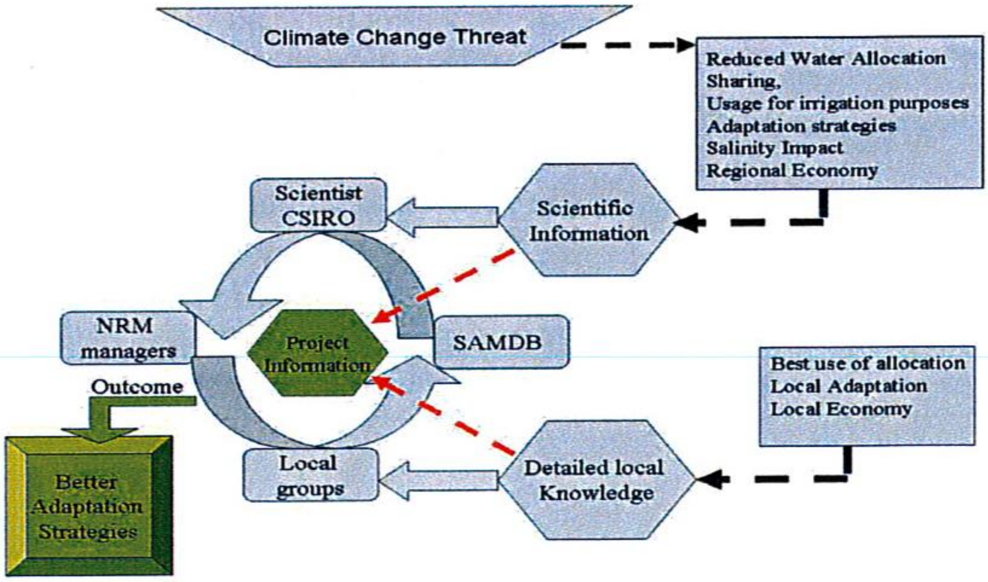

Figure 1 – The collaborative framework for evaluation and decision making

The project will build on a regional futures project recently completed by CSIRO for the Lower Murray region. The Lower Murray Landscape Futures Project (Landscape Futures for the River Corridor) was a comprehensive futures scenario analysis. It evaluated impacts on water supply, irrigation sector adaptation and regional economy of four climate scenarios, ranging from baseline conditions through to severe climate change using a best practice science triple bottom line approach.

The results of this study focus both on assessing how modelled climate futures will affect the viability and profitability of regional irrigation and economy considering potential adaptation strategies, as well as addressing potential environmental impacts.

Here the study proposes to:

- Adapt and downscale this regional level analysis to more localised conditions.
- Develop another set of scenarios to evaluate, but this time based on close collaboration with local irrigation groups and drawing on their specialised knowledge
- Explore alternative land, water, farm, and irrigation district adaptation strategies with the in a series of interactive workshops

Summary of Project activity and planned output

The table below sets out the breakdown of activities and the responsible agency as the project progressed.

Activity	FarmReady allocated Budget	Activity completed – Yes/No/underway (Include date details)	Activity completed by (CSIRO or Adel Uni)	Activity payment - Invoice details (no., date paid etc) by Loxton
B1. Desk top study and stakeholder consultation to develop active scientific knowledge building presentations to regional community groups	$5,000	Yes	CSIRO - Amgad Elmahdi. Based on interviews reported in "Farmers' perception on adaptation to climate change: A case study of irrigators in the Riverland, South Australia" by A.E. de Jonge	
B2. Conduct 4 workshops- 2 workshops with each of the 2 LWMP groups	$10,000	Yes	CSIRO - Amgad Elmahdi 28 Sep2009 Pyap, New Residence, Bookpurnong;29Sep2009 Moorook, Kingston-on-Murray	$24,000 paid to CSIRO
B3. Develop and report on a list of adaptation options of interest to each of the two groups for further evaluation	$5,000	Yes	CSIRO - Amgad Elmahdi	
B4. one meeting with each group to interact between NRM board and mangers, CSIRO and local group leadership to pick 2 to 3 scenarios for further exploration	$5,000	Yes	CSIRO - Initiated by Amgad Elmahdi - subsequently picked up by Bart Kellet and included in Summary Report B5.	
B5. Develop and report on 2 to 3 agreed local scenarios for each group (two LWMP), representing the consensus on what is of greatest interest and evidently feasible, given data availability	$15,000	Yes	Uni of Adelaide: Executive Summary Report "Reconfiguration scenarios and data needs" Sep2010. Bart Kellett & Onil Banerjee	
B6. Design and development of ILSA tool with expert and community consultation	$20,000	Yes	Uni of Adelaide: Meetings 16Nov10 Loxton, 17Nov10 Pyap; Project community update brochure Oct10	$40,000 paid to Uni of Adelaide Nov 2010

B7. Localised Modelling: Downscaling the models from regional scale to LWMP and farm scale to estimate economic responses to policy and external water availability, irrigation water salinity and water and crop price changes	$20,000	Yes	Uni of Adelaide through CSIRO, Oct 2011(Onil Banerjee and Darran King)	
B8.Deliver preliminary ILSA outcomes and analysis of the potential impacts (cost, benefits and risks) of the chosen scenarios for NRM Board consultation	$20,000	Yes	Uni of Adelaide through CSIRO Nov 2011(Darran King and Jeff Connor)	$30,000 paid to Uni of Adelaide Jun2011
B9.Refining ILSA after NRM board and community consultation	$15,000	Yes	Uni of Adelaide through CSIRO Nov 2011(Darran King, Jeff Connor) with user interface by Ian Laughlin	
B10.Refine and re-run the chosen scenario of new land uses with expert consultation	$10,000	Yes	Completed January, 2012 (CSIRO and Contractor)	
B11.Deliver the final version of ILSA with evaluation of ILSA outputs with NRM managers and local community using triple bottom line analysis	$5,000	Yes	Completed January, 2012 (CSIRO and Contractor)	
B12.Report on the scenario analysis of the two LWMP areas	$10,000	Yes	Completed January, 2012 (CSIRO and Contractor)	
B13.Deliver and discuss the results of the chosen scenario by re-engaging with the community group (2 workshops)	$10,000	Yes	Completed February, 2012 (CSIRO and Contractor)	
B14.Report on outcomes of each case study and the potential strategies to deal with farm, district and region economic threat	$10,000	Yes	Completed February, 2012 (CSIRO)	

The project milestones (B1 – B14) are summarised in the table above. In essence, the first five milestones (B1-B5) involved workshops and surveys to gain an appreciation of the key issues in farm business planning under more variable and scarce water availability under climate change. This was also a process that conveyed new information on climate variability, climate change, water policy and market analysis.

This then led to consideration of the form and scope of the proposed ILSA tool (milestone B6). At this point there was uncertainty as to the most helpful level that the tool could be designed for. Work was developed that identified a potential system for assessing reconfiguration options at a district scale. This would involve assessing the viability of different adaptation options for each farm within an irrigation district (see Appendix 4).

After much consideration and consultation with the community project leader, it was decided that the ILSA tool should be more directed at the individual irrigation farm.

Subsequently Milestones B7 through B11 involved development and refinement of the interactive software tool for use with community in assessing possible farm management strategies and economic outcomes that could be expected under varying climate circumstances. Milestones B12 – B14 involved actual application of the software to case study analysis working with farmers to provide them insights into implications of varying their farm business strategy and economic implications under alternative climate scenarios. The outputs from these Milestones and the description of the ILSA software tool are given in the accompanying report by King, Connor, Laughlin and Meyer.

Project Outputs:

Outputs from the activities in the project have been developed and circulated during the course of the project. Most of these have been directed towards informing the farmer and advisor stakeholders on the general context of understanding climate risk and variable water availability. In turn, this information and the interaction with the LAP group representatives have been used to inform the development of the ILSA tool.

In the following appendix section output from Activities B1, B2 and B4, B5 and B6 are given in full or in part as an example.

APPENDIX 1

Farmers' perception on adaptation to climate change:
A case study of irrigators in the Riverland, South Australia

By A.E. de Jonge

Master thesis Land Degradation and Development Group submitted in partial fulfilment
of the degree of Master of Science in International Land and Water Management at
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MSc International Land and Water Management (MIL)

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Wageningen University, Land Degradation
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Dr. Amgad Elmahdi CSIRO, land and water Adelaide

Examinator:
Dr. Ir. Leo Stroosnijder

Date: 26 February 2010

Abstract

Climate projections for the Lower Murray catchment estimate elevated temperatures and a decline in rainfall and runoff (Connor et al.,2008), which is very likely to affect agricultural systems. The negative impacts can be mitigated through adaptation, which requires involvement of the local community (Klein et al., 2007), and hence, it is important to gain a better understanding of farmers' perceptions to climate change, the adaptation options to the current drought circumstances and what limits their actions upon droughts and climate change. The data is collected through a phone-survey in which 43 farmers participated. Although the number of participated farmers is not sufficient to generalize the results beyond this sample population, general trends were identified for further evaluation. The interviewed farmers are aware of variations in climatic conditions, but are inclined to connect these to the natural climatic variability, rather than to human-induced climate change. Adaptation to the current drought exists mainly of purchasing extra water rights and/or improving irrigation efficiency. Factors which influencing farmers perceptions toward climate change and their ability to adapt, are their age, education level and the district where they are living in. Younger farmers tend to be aware of climate change and the impacts on their farm business, while older farmers appear to link this to natural climatic variability. Farmers who have been to university or TAFE are more likely to respond than farmers who have been only to primary school. In addition, farmers who are living in Kingston OM are more likely to adapt to climate change. The main barriers for adaptation to climate change considered by farmers are the lack of financial incentives, their strong dependency on commodity prices and the lack of knowledge on future water availability and adaptation options. This study suggests that the adoption of climate change adaptation measures can be accelerated by financial incentives that reduce the financial risks of the individual farmers and by providing more information about the future climate change impacts and adaptation possibilities.

Keywords: climate change, adaptation, perceptions, barriers, Lower Murray catchment

APPENDIX 2

Loxton to Bookpurnong Local Action Planning

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Loxton to Bookpurnong — Action for our environment...

Government of South Australia — South Australian Murray-Darling Basin Natural Resources Management Board

National Research FLAGSHIPS — Water for a Healthy Country — CSIRO

The LBLAP, CSIRO and SAMDBNRM Board invite you to share your ideas at one of 3 workshops being held in Moorook, Pyap and Loxton. The workshops aim to record and explore community opinions about variable climate and rainfall in the region. Community workshops will cover the following issues:

- Opportunities for adaptation of irrigation systems and technologies
- Opportunities for new crop types and varieties
- Challenges for irrigation into the future
- Challenges for improved irrigation management

Discussion will include the following topics:

- What is 'our' region's future vision for irrigated production
- At farm level how can individual growers remain viable facing a range of future climate scenarios
- Are growers considering changing crop selection and rotation
- Explore options at a district level for cost efficient delivery of irrigation water

Workshop dates, time and location for you region:

Monday 28th September

Pyap / New Residence residents	7:30-9:30am (breakfast provided)	McGuigan Shed at Pyap
Bookpurnong residents	6:30 – 8:30pm (evening nibbles provided)	Loxton Hotel- Upstairs Pyap Room

Tuesday 29th September

Moorook / Kingston on Murray residents	7:30-9:30pm (breakfast provided)	Moorook Club

RSVP is essential by the 23rd of September to the following people

Craig Ferber	Lauren Burdett
0429 913 508	0408 813 508
craig@lblap.org.au	lauren@lblap.org.au

This project is supported by funding from the *Australian Department of Agriculture, Fisheries and Forestry* under its *FarmReady Industry Grants* program

INTERVIEW TRANSCRIPT (example 1st page only)
(Job 9193) Pyap Workshop Q&A
(M1:Moderator, M2: Moderator 2, P: Participant)

M1: I don't know. Does anyone want to ask, anybody got any questions before we move into, this is gonna be a bit more of an open discussion kind of part of the meeting. Did anybody have any questions?

P: With some of your figures there like, you say 50 years and 50 years, how much, do they take into account the 50 years okay coincides with the main part of the Snowy Mountain Scheme when they started diverting all the water down the river? And see another big drop off too in 2002 is when they diverted 300 gigalitres back down the Snowy River so, how much ..?

M2: No the figures shows that 50% adjusted at annual flow receiving for the whole basin. By taking those ...

P: Before the Murray Darling that would've, it wouldn't have included the rivers on the other side of the mountain, but when they diverted the river, did they extend the catchment of the Murray Darling in those days? 'Cause once it was going to be going this side of the range and then they diverted the river to the other side of the range ...

M2: No with that number they are actually using 0:01:02.5 information during this historical time. This actually for what the 0:01:09.7 is right now. Just to compare for the same and what's going on and that story.

P: How come Victoria can do better than we can?

M2: Oh yes. This is an interesting one because actually if you see the Murray the actual ground water so they were able to study such 0:01:30.7 ground last year by pumping water on water.

P: Which in effect is gonna affect the river anyway because a lot of the ground ...

M2: Of course yeah. That's way the NTV tries to develop sustainable diversion of that which would try to figure out 0:01:50.2 if you take this much of surface water this should be as much you can take from ground water and the vice versa. Based on the other conditions yeah, like how much of the water is for storage, how much deep drainage going to the ground water has like recharge from the ground water system, what's the planting conditions and of course all this sustainable diversion then it will come without any compromise for the 0:02:16.4 acids along the river and this is why it's likely to be less damage than water kept than for what you already getting every year now because we are going to give the environment 0:02:29.3 we give this much water for the environment, the rest will start to be distributed for other irrigators along, other irrigation industry.

(Job 9190) Bookpurnong Workshop Q&A (example 1st page only)
(I: Interviewer AE: A Elmahdi P:Participant)

I: Alright, we had a session over at Highett this morning and had an open discussion session on a number of issues and we will just go into these now. Firstly I guess before we go into this, is there any question, I get the sense there's probably a few questions that people would have about the presentation we just saw and about the project and where it's going and what it's out to achieve, do you want to just go through those quickly now?

P: The overall question I would probably have would be the judgement of the climate change effect over the last 100 years, because we've only got 100 years of data so how do we really know in 20 years time we're not going to have that [0:01:19.2] come back for a certain period of time? And I am sure you will get that from a lot of growers as well who doubt the climate change theory, but I am just trying to get it through my head how will I analyse the data to make a judgment call that we're going to get either a one degree or a four degree variation in temperature over the long term.

P: I guess could that be possibly answered in same way by okay we've only got 100 years of data here but elsewhere in the world we've got longer.

I: I guess at the end of the day we can only go on the historical data that we've got and we've got 117 years of recording keeping [0:02:03.7], so that's our best guide and the projections are …

AE: The projections as well are developed through [0:02:12.9] issues behind actually developed through 14 different models, like these are the main 14 international models you are using, even for the whole global scale, or on a country scale, even for the whole continent or regional scale, so we applied these 14 models to get this projection and like the average for the whole 14 models. We just, it's like our future is uncertain. We either don't know what will happen or really we don't know, is it going to continue for just one year, ten years or fifty years, so we try to work with and assuming if it is true what will happen and how we can deal with it, if you prepare yourself for the worst case scenario, and then you get better condition so you are already survived, but if you prepare yourself for okay, no I will not get this, I will receive a very good year, so you stuck at the end of the page that you will be surprised at the end because you start facing worst conditions that you prepared for.

APPENDIX 3

DEVELOPING LANDHOLDER CAPACITY TO ADAPT TO CLIMATE RISKS AND VARIABLE RESOURCE AVAILABILITY IN THE BOOKPURNONG AND PYAP TO KINGSTON ON MURRAY REGIONS OF THE RIVERLAND SOUTH AUSTRALIA

OPTIONS FOR FARMERS TO ADAPT TO CHANGE IN THE RIVERLAND OF SOUTH AUSTRALIA

EXECUTIVE SUMMARY REPORT

MAY 2010

Bart M Kellett

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OPTIONS FOR ADAPTING TO CHANGE

This report summarises information collected from farmers from the Riverland of South Australia. Three data collection activities were undertaken including workshops, phone surveys and in-depth interviews. More details on these activities are given in the following sections. From the research undertaken so far I have identified a number of options for adapting to changes, including those associated with a changing climate. These options are summarised in Table 1 below.

Table 1. Options for farmers in the Riverland of South Australia to adapt to changes in climate, commodity prices and water allocations

Options for adapting to change
Increase water availability by buying more temporary water each season or by buying more permanent water. Having the financial resources to do this is limited by available capital and commodity prices.
Increase water availability (announced volumes as a proportion of licensed volumes) by reducing all licence holders' allocations.
Increase resilience to changing water prices by owning properties in different states and trading water between them.
Increase water use efficiency through technology change (e.g. subsurface drip, real time soil moisture monitoring), change in practice (e.g. apply more mulch to decrease evaporation, applying water to the root zone only) or plant a different crop variety that uses less water. A technology change may involve applying for Commonwealth Government funding.
Water less and sacrifice the health of crop, pruning or removing the fruit or nuts early in the season, reducing canopy size or removing some areas of the crop.
Influence all levels of government to ensure financial and other forms are support are fair. This could involve agency representatives doing on-site inspections to get a better understanding of on ground circumstances and by considering the level of investment already made by individuals.
Stop farming. This may involve selling the farm, with or without a farm exit grant. Permanent water could be leased out or sold.
Increase revenue by replanting with crop varieties that attract higher prices.
Increase market resilience by diversifying crop types or crop varieties and timing harvests through-out the year.
Increase revenue by diversifying or adding complementary businesses, e.g. rearing honey-bees, growing mid-row vegetation, growing carp in farm dams.
Increase revenue by buying more farm land and expanding production.
Improve crop quality and revenue by growing fruit in the middle and at the sides of trees, protecting the crop with shade cloth, increasing humidity with mid-row vegetation, growing and applying mulches and monitoring soil moisture in real time.
Increase revenue and increase resilience to fluctuating commodity prices by finding off-farm work or other off-farm income streams.

Increase revenue and cut costs by working with the organisations along the supply chain. Costs could be cut by economising transport and revenue could be increased by adding service elements (e.g. processing, delivery, crop quality).

Increase revenue by working with scientists to employ the latest technology.

Increase revenue by differentiating your product and marketing.

Decrease costs by doing work yourself or sharing services such as farm worker teams and equipment such as tractors.

WORKSHOPS

Workshops were held to introduce the project, to promote awareness and adoption of options for dealing with climate change, to clarify community goals and to explore consequences of a range of decisions. Growers from Bookpurnong and the Pyap to Kingston on Murray areas took part in three workshops. CSIRO staff presented information on climate change, water allocations and other scenario studies. Workshop discussions were recorded and transcribed and important points are described below.

1. *UNCERTAINTY REGARDING THE CLIMATE CHANGE CONCEPT*

Participants expressed doubts about the concept of climate change. For example, is it just a dry period that we are experiencing now or is the dry period actually evidence of a changing climate? Participants doubted the figures and graphs presented by the researchers. Also raised was the idea that we don't really know where we are with respect to long term changes and change cycles. Also, if farmers were not sceptical, then given scientists' predictions, farmers would not be farming.

2. *COMMODITY PRICES ARE CRITICAL*

Crop selection and commodity price cycles have a big influence on profitability and resilience of farm enterprises to drought and low water allocations. Farmers struggle when low commodity prices are combined with high prices for temporary water.

3. *GLOBALISATION IS COMPROMISING BUSINESS VIABILITY*

Globalisation of technology and information reduces barriers and favours international competition in commodity markets. International competition and mechanisation of local production is reducing production options for smaller farmers. Niche and market specialisation are one strategy to ensure that profitability can be maintained. However, there have to be significant barriers to entry for a niche market to be sustained and not be swamped with new competitors.

4. *WATER ALLOCATIONS SHOULD BE REDUCED TO INCREASE RESILIENCE*

A participant proposed that water allocations should be reduced to levels where licence holders are at least reasonably confident of following years' allocations. This will ensure the well being of everyone, not just some with the capacity to purchase temporary water. With the water supply system having such a small buffer to small inflow years, and multiple allocation decisions throughout each year (i.e. monthly), farm planning is difficult and farmers are forced to adapt frequently. Frequent response to allocation announcements and allocation decision-making is leading to decision-making weariness.

5. First structural adjustments were effective

The first adaptation to low water allocations was rapid and effective. Farmers changed infrastructure or trialled new management approaches to increase water use efficiency. Further improvements beyond this will have a relatively small impact on increasing water use efficiency.

6. Optimising production through efficiency reduces resilience

Capacity to adapt is compromised by improvements in water use efficiency and the tendency when operating in an economic system to optimise productivity. Following water efficiency improvements, farmers planted more crops, but with reduced water allocations, some areas or parts of production enterprises were sacrificed. Having a buffer or extra amount of water helps farmers adapt to low allocations.

7. Government adjustment grants could be better targeted and delivered

Farmers are currently finding it very difficult to survive financially, and some are biding their time (e.g. 12 months) to see if commodity prices will improve before making a decision to stay or leave farming. Farm exit packages are facilitating adaptation, but the administration process is slow. Also the exit packages result in stranded infrastructure, as the land cannot be used for 5 years, which means other farmers are not likely to invest in this land. It is also an aesthetic issue; before the areas was almost all cropping, now it is a mosaic of green and brown.

Government-sponsored adaptation can favour operators who did not make the investments that others made. For example, the irrigation improvement grants were open only to farmers with older systems, whereas farmers who had already invested were, by default treated unfairly. This becomes an incentive that awards those least able to adapt.

The Commonwealth Government's grants aimed at improving water use efficiency have little relevance in the Riverland, where private investment has already been made. There is more opportunity to improve in NSW and VIC, which suggests that funding packages could be better tailored to regions and states. One way to improve these schemes and make government more responsive to on ground needs is for government representatives to visit and assess farms.

It can be difficult to influence government, because the region has only one federal seat. Local government could assist by coordinating their efforts to influence high levels of government and shape policy and support packages so they are tailored to on ground circumstances.

8. *Adapting to drought is tough mentally and financially*

It is a blow to one's dignity taking a government grant to leave a farm. Farmers can spiral into debt with high inputs costs, because some crop area may have to be sacrificed, which then degrades the capital value of the farm.

9. *Education and learning for adaptation*

There is less research, development and educational support for the farming sector. The issue of mental health in society, and in regional areas in particular, is gaining increasing recognition. Over time, there are fewer schools that have Agriculture as a senior high school subject now, fewer agricultural extension officers and less money spent on research and development. Delivery of these services had been passed from agricultural agencies to industry groups.

10. *Coordinating efforts and resources*

A well organised industry can facilitate short-term adaptations. For example, the rice industry board suggests crop variety and assists in monitoring potential yield to help farmers with decisions on crop management and harvest.
Growers would benefit from a better understanding of the market for their commodities. This covers trends in local, regional and international supply and trends in consumer demand. Knowing only what buyers want is not enough, because demand changes and a product can be quickly oversupplied. For example, at one stage buyers wanted more chardonnay, but then there was there was an oversupply. A challenge for growers is that local products are increasingly replaceable, because international competitors use the same varieties and technologies.
Growers can turn this challenge into opportunity by taking greater control over commodity prices and working together to develop and market products with special or different features (e.g. organic, certification, carbon neutral). Products can be further enhanced by including service (e.g. delivery, processing).
Another facet of coordination is sharing of resources, for example picker teams and farm equipment. Coordinating resources can help. Sharing pickers ensure they have more work and are therefore likely to return, while sharing equipment reduces costs.

11. *Diversify business or source other forms of income*

Another option for adaptation is to diversity business or income streams. One way is to develop complimentary forms of production (e.g. bees). Another is for the farming family to find employment with another company or business. However, there are limited off-farm employment opportunities, especially since some of the corporate farms and processing plants have closed.

12. *Changing crops is capital intensive*

Changing crops that are permanent plantings (e.g. grapes, almonds, citrus) is very costly not only because of the cost of crop establishment, but also because it takes several years before a crop can be harvested. This is a challenge to farmers when demand shifts, for different varieties of wine grapes for example, and demand for old varieties diminishes or stops altogether. Different varieties may also be needed if there are not enough chill hours per year (e.g. for stone fruit).

Phone surveys

43 farmers from the Riverland were contacted. The case study covered five districts, including Bookpurnong, Pyap, Moorook, New Residence and Kingston on Murray. The survey was conducted by phone and comprised forty multiple choice questions. The survey was designed to identify personal characteristics (e.g. family, financial), farm characteristics (e.g. size, crops), attitudes to climate change, if farm management is being altered in response to climate change and barriers to adaptation. CSIRO staff designed the survey, which was then implemented by staff from the Berri office of the South Australia Murray Darling Basin Natural Resource Management Board. Results of the survey were analysed with three statistical models and presented in a Masters thesis by A.E. de Jong from Wageningen University of in The Netherlands. Some important points from the survey are detailed below.

1. *The results should not be generalised*

The number of farmers surveyed is not large enough to generalise results to the Riverland region.

2. *Farmers doubt climate change*

Overall, farmers are aware of variations in climate, but are inclined to connect these to the natural variability, rather than to human-induced climate change. Younger farmers tend to be aware of climate change and its effects on business. Older farmers tend to favour the notion of natural climate variability over climate change.

3. *Some groups of farmers are more likely to adapt*

Farmers who have attended university or TAFE are more likely to adapt farm planning and management to climate change than farmers who have attended only primary school. Also, farmers from Kingston-on-Murray are also more likely to adapt than farmers from other districts.

4. *Farmers are adapting to the current drought*

Farmers are adapting to the current drought by purchasing extra water and improving the efficiency of irrigation.

5. *Barriers to adapting to climate change*

Farmers think that the main barriers to adapting to climate change are a lack of financial incentives, a strong dependency of farm businesses on commodity prices, uncertainty regarding future water availability and uncertainty about adaptation options.

6. *Risks can be reduced with financial incentives and more information*

Risks to farms can be reduced with financial incentives and with more information about future climate change impacts and adaptation possibilities.

In-depth interviews

Eleven farmers were interviewed, nine from the Bookpurnong and Pyap areas and two from the broader Riverland region. Farmers were asked if they would like to participate at the completion of each of the three workshops. Interview participants were encouraged to respond to five visual prompts including photos showing a decline in water level at Meningie wetland between 2007 and 2009, Riverland water allocations from 2000 to 2009, a graph showing rainfall over the last 100 years with the first 50 years being wet and second 50 years being dry, a drought update article and photo released by the Murray-Darling Basin Authority in November 2009, and lastly a table showing the impact of different climate change scenarios on water allocations to South Australia. The interviewer allowed the discussions to cover many topics, but began by focussing on the issue of climate change and the idea of farmers adapting to climate change. These interviews were recorded, transcribed and analysed into themes with NVIVO software.

1. *Doubt about climate change*

Farmers doubted the concept of climate change and commented on the difficulty of distinguishing between climate variability and climate change. For example, 'we have had dry periods before too and wet periods and so whether it's cyclical or not is still very open for debate as far as I am concerned' (pg. 4, Interview Transcript 2). Media information from around the world also contributes to farmers beliefs. For example, one farmer commented about people seeing Mt Kilimanjaro without snow for the first time.

2. *Navigating a series of natural resource management issues*

Prior to the era of low water allocations in the Lower Murray, salinity was one of the most significant natural resource management issues for farmers. A series of works were undertaken to reduce the amount of salt passing to the river. This involved removal of dams and open channels and the installation of pipes and conversion of flood irrigation and furrow irrigation systems to sprinkler and drip. Water use efficiency was significantly improved, but the risk of soil salinity was inadvertently raised and as a consequence farmers are increasingly relying on high rainfall events to leach salts. These events are irregular because they are caused by monsoonal weather systems that move down from northern Australia. More variable weather patterns and by inference water allocations will mean that farming will become more opportunistic, where for example annual croppers (e.g. rice farmers) will only plant crops in some years.

3. *Rapid change associated with the water market has costs*

Farmers questioned whether the market is helping to achieve water management objectives. Past water allocation decisions were geared to a situation with numerous sleeper licences and unused portions of licences. The introduction of the water market resulted in the use of water that was previously not used. Water resources became quickly over-extracted and the ecological effects on the lower lakes became very noticeable. This situation also put significant financial pressure on water licence holders as competition for water became fierce in 2008. For example, one farmer reported a case where the government lifted allocations from 18% to 32% after irrigators from the local area spent $90 million on temporary water. Prior to the purchase of temporary water, price increased from $250/ML to $1200/ML.

4. *Farmers are learning how to buy and sell water*

With fluctuating prices in water and monthly allocation announcements, farmers put a lot of effort into monitoring market conditions and thinking about how to protect their investments, increase returns or at the least minimise costs. Some simple questions that farmers ask each year are:

- Should I buy water?
- How much water should I buy?
- When should I buy it?

5. *The Riverland is vulnerable to water allocation decisions made upstream*

The decisions made in QLD, NSW and VIC all influence water allocations to South Australia. This means there is high level of political uncertainty, which complicates long term farm planning. A high level of political uncertainty has contributed to some Riverland farmers perhaps being some of the most advanced irrigators in Australia.

6. *Regional adaptation, exit grants and costs*

Exit grants are having significant social impacts. To receive a grant of $150,000 a farmer has to remove existing plantings and remove all irrigation infrastructure.

Also, the land cannot be farmed for five years and the plantings must be removed by a licensed contractor. The result is that remaining farms will be isolated, surrounding areas will be unsightly, and a sense of community will be degraded. It also means that neighbouring farmers cannot purchase these farms, which is working against regional adaptation, because smaller farms are becoming less viable. Costs to clear a property and remove infrastructure can be significant (e.g. $110,000). Costs in lost capital value can be even greater (e.g. $2 million) and such estimates under-value the efforts made by individuals for periods of time that can span several decades. Falling community spirit is also hampering regional adaptation, "if you've just sold your water off and looked for an exit grant and trying to battle your way through that system the last thing you want to do is think about where you're going" (pg. 15, Interview transcript 3).There are apparently 176 farmers taking the farm exit grant so the impact on the region is significant. Some corporate farms have also closed, which has taken away some off-farm employment opportunities as well as an important source of innovation and training.

7. New International Markets and Regional Economies

Australia's currency became strong as a result of the global financial crisis and this contributed to low demand for wine grapes and other primary produce. Farmers who have remained in operation are hoping that commodity prices will improve with less competition, but this is optimistic given Australia produces only a fraction of the world's supply of wine grapes and citrus. At the moment farmers are in survival mode and are just doing the basics, which means not investing in new techniques or infrastructure. In areas serviced by an irrigation trust or cooperative, farmers expect water service fees to increase.

Australia imports a significant amount of primary produce from countries including China, India, Indonesia and Thailand due to good prices. Australia is potentially vulnerable, and therein opportunity lies, should the supply of some primary produce from overseas be drastically cut, for example as a result of disease outbreak or even war.

8. Implementing and Updating Management Strategies

A strategy is important for adapting to climate change, drought, salinity and variable water allocations. Each farmer has a strategy and may update this according to latest scientific knowledge, results of field trials and trial and error. Accessing information from diverse sources and being open minded to change is important for adaptation. Evaluating and updating strategy is also critical.

9. Reducing Input Costs Through Technology

Costs for pumping water can be reduced with solar or wind energy. However, these systems have high set up costs, and in the case of solar energy, may not have the power to operate some irrigation systems.

10. Reconciling community values and changing conditions in lower lakes

The lower lakes were originally tidal, but became fresh with the construction of barges. We have developed and become accustomed to freshwater in the lakes and so it is difficult to go back to salty lakes. Now with less water flowing down the River Murray, the lakes will change whether salt water is allowed to enter once more or not.

APPENDIX 4

Developing landholder capacity to adapt to climate risks and variable resource availability in the Loxton to Bookpurnong and Pyap to Kingston on Murray Regions of the Riverland SA

Executive Summary Report

Reconfiguration scenarios and data needs

Bart Kellett

Onil Banerjee

Summary

This report sets out the methods and data required to develop the Interactive Land use Strategic Assessment (ILSA) Tool. Appropriate methods and data have been selected through discussion with the Local Action Planning Group, the NRM Board and community representatives. We expect the reconfiguration options and data needs to evolve as the ILSA tool is developed and applied.

1. Methods

1.1 Overview

The two irrigation districts will be reconfigured in a way that maximizes the net present value of the production of goods and services, including environmental services, subject to a series of binding environmental and other constraints to be discussed below. In determining the optimal configuration of the landscape, the following five land use interventions were developed. A different set may be decided on as the project progresses.

Green option- diversify crops including consideration of crops that use less water, organic produce and agroforestry.
Blue option- invest in upgrading irrigation infrastructure, including conversion from overhead or spray to drip irrigation.
Brown option- conservation management involving carbon sequestration with mallee. Consider connectivity between patches of remnant vegetation and biodiversity corridors.
Red option- exit irrigated agriculture (sell all water and receive exit grant). Convert to dryland farming.
Grey option – exit irrigated agriculture (sell all water and receive exit grant). Convert to residential development.

The irrigation district reconfiguration follows three steps:

1. Use spatial socioeconomic and biophysical criteria to choose which option to select for each farm across the two irrigation districts.
2. Quantify the change in ecosystem services resulting from the reconfiguration
3. For each land unit (green/blue/brown/red/grey), maximize profit by changing input variables. This involves the application of PIRSA's Drought Business Skilling Tool.

1.2 Develop a decision-tree to choose an option for each farm

Socioeconomic and biophysical criteria are being developed and organised into a decision tree. The decision-tree model formalises the process by which alternative land uses will be assessed for each property. Table 1 defines the criteria, which are then presented in the decision-tree in Figure 1.

Table 1. Draft decision criteria to assist in choosing a reconfiguration option for each farm

ORDER	QUESTION	INDICATOR	OUTCOMES
1	Near high value environmental asset?	>75% of property within 500m of high value environmental asset	Yes – Brown No – (2)
2	Connected to the floodplain?	>75% of property in the floodplain	Yes – Brown No – (3)
3	Connected to residential or environmental amenity areas?	>75% of property within 500m of residential or environmental amenity area	Yes – Brown No – (4)
4	High downstream salinity impact?	In high salinity impact zone (or >0.2 EC reduction at Morgan per 1000ML irrigation ceased)	Yes – (7) No – (5)
5	Soil suitable for irrigation?	>9 suitability score	Yes – (6) No – (7)
6	Is it a low value commodity crop?	Grapes price <$500/t Citrus price <$40/carton	Yes – Green No – Blue
7	Located in a residential zone?	Located in residential zone identified in relevant local government strategic plans.	Yes – Grey No – (8)
8	Bordering an existing dryland farm?	Bordering an existing dryland farm?	Yes – Red No – Brown

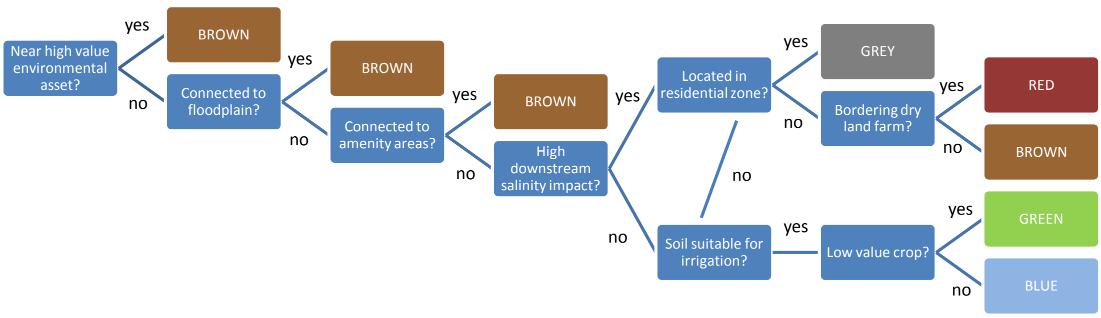

Figure 1. Decision tree for choosing a reconfiguration option for each farm

1.3 Calculate change in ecosystem services

The change in the value of ecosystem services resulting from the district reconfiguration is calculated. Table 2 identifies a number of ecosystem services and important information and references for calculating these services.

Table 2. Indicative information and methods for calculating ecosystem service values

Ecosystem services	**Indicators**	**Rationale**	**How to calculate & Models**	**Data needs**	**Sources**
Agricultural productivity land suitability	$ per hectare (Net present value over 30 years)	The production of agricultural commodities for human consumption is significant. Value of additional agriculture (dryland and irrigated) possible under reconfigured landscape.	PFE = (Price * Yield) – (Variable Costs + Fixed Costs)	Grapes, Citrus, Almonds Prices Yield Variable costs Fixed costs Cadastral and land use	ABS Agricultural Commodities Data Gross margin handbooks (Bryan, Hajkowicz et al. 2009)
River salinity risk	$ / ML present value	Irrigation contributes to downstream river salinity which imposes a cost on downstream ecosystems and users through damage to infrastructure and reduced crop yields. Conversion to dryland agriculture or conservation plantings will reduce these impacts.	Use existing model to quantify relationship between irrigation practice and river salinity. See Connor (2008) $2-4 million per EC reduced measured at Morgan through change of land use to dryland / conservation plantings.	Water application rates SA water allocations Soil permeability Hydraulic conductivity Hyrdaulic gradient Groundwater levels Landuse	(Connor, Schwabe et al. 2008) Existing CSIRO model.

Stable climate	$/ha (net present value over 30 years)	Trees capture and store carbon and assist to stabilise and regulate the climate. The benefit of climate regulation can be assessed by determining the voluntary carbon market value of tree plantings.	Area of tree planting multiplied by carbon dioxide equivalents per ha multiplied by the dollar benefit per tonne of CO2 reduction. 3PG model Voluntary market price for carbon Regional soil maps ESOCLIM model Digital elevation model Carbon sequestration potential model	Soil texture Water holding capacity Monthly climate surfaces (max temp, min temp, precip, solar radiation)	VIC DPI (2007)
Environmental flows	$/ML (net present value over 30 years)	Freshwater flows maintain and enhance the diversity and abundance of aquatic ecosystem species. We can value environmental flows through	ML * $500-2200 * 20 years * 6% discount rate	ML returned to river from reconfiguration.	(Bennett, Dumbsday et al. 2008)
Recreation and amenity	$/ha (present value)	Reforested areas have a higher cultural and aesthetic value over farming land. We can value amenity value by using data of the public's stated preferences, which are collected through surveys.	Model presented in Crossman et al. (2010)	Hectares converted to areas restored for carbon and biodiversity.	(Crossman, Connor et al. 2010) (van Bueren and Bennett 2004)

1.4 Calculate change in costs for irrigation district

The reconfiguration will also result in a change in the costs for the operation of the irrigation districts. These costs will be identified and calculated. Table 3 shows information relevant to calculating water delivery cost savings.

Table 3. Indicative information and methods for calculating district cost savings

Ecosystem services	**Indicators**	**Rationale**	**How to calculate & Models**	**Data needs**	**Sources**
Water delivery cost savings	$ per megalitre (net present value over 30 years)	Retiring of irrigation will result in water delivery cost savings. Set up, pumping and maintenance costs will be saved.	See Torrumbarry example.	Grapes, citrus, almonds Water use	(Morse-McNabb 2006)

1.4 Calculate and compare profit margins

PIRSA's Drought Business Skilling Tool will be modified and used to calculate profit margins for a series of case study properties in each land and water management planning area. Profit margins from existing land use will be compared with profits from the land use suggested as a result of the district reconfiguration study.

APPENDIX 5

Project Update – October 2010

Bart Kellett (The Univeristy of Adelaide)
Onil Banerjee (CSIRO)

PROJECT AIM AND PROGRESS

We are working with natural resource managers and farmers to identify and evaluate management options for the future. Variability in climate, reduced water allocations, fluctuating commodity prices and the emerging carbon market are important for this study, because they affect farm viability and catchment health.

In discussions so far, we have developed a number of management options. These options range from changing on-farm practices to changing land use completely.

MANAGEMENT OPTIONS

Green option – diversify crops to use less water or increase profit (e.g. organic).

Blue option – upgrade infrastructure to increase water use efficiency.

Brown option – plant trees for carbon sequestration.

Red option – sell land and water and convert to dry land farming or agro-forestry.

Grey option – sell land and water and convert to residential development.

CRITERIA

Criteria will be used to choose an alternative management option for each farm. When a set of criteria are used, farms in different locations and with different circumstances will suit particular options. Hence, there will be a scattering of options around the two districts.

Criteria to consider include water delivery costs, river salinity, town zoning and connection to floodplain. A threshold will be established for each criteria (e.g. > 75% of property in floodplain).

DECISION TREE

The criteria will then be organised into a decision tree like the one shown on the next page. This will help to streamline the selection of an alternative management option for each farm.

MAPPING

We will produce maps that show the distribution of management options.

WORKSHOPS

In November we will hold workshops with farmers, natural resource managers and policy makers. Project outputs will be discussed and evaluated. Further information will be collected to focus and improve the project.

FARM VIABILITY ASSESSMENT

This step will involve a comparison of existing business operations with the management options suggested by this study. PIRSA's Drought Business Skilling Tool may be used with farmers to explore challenges and opportunities for managing change.