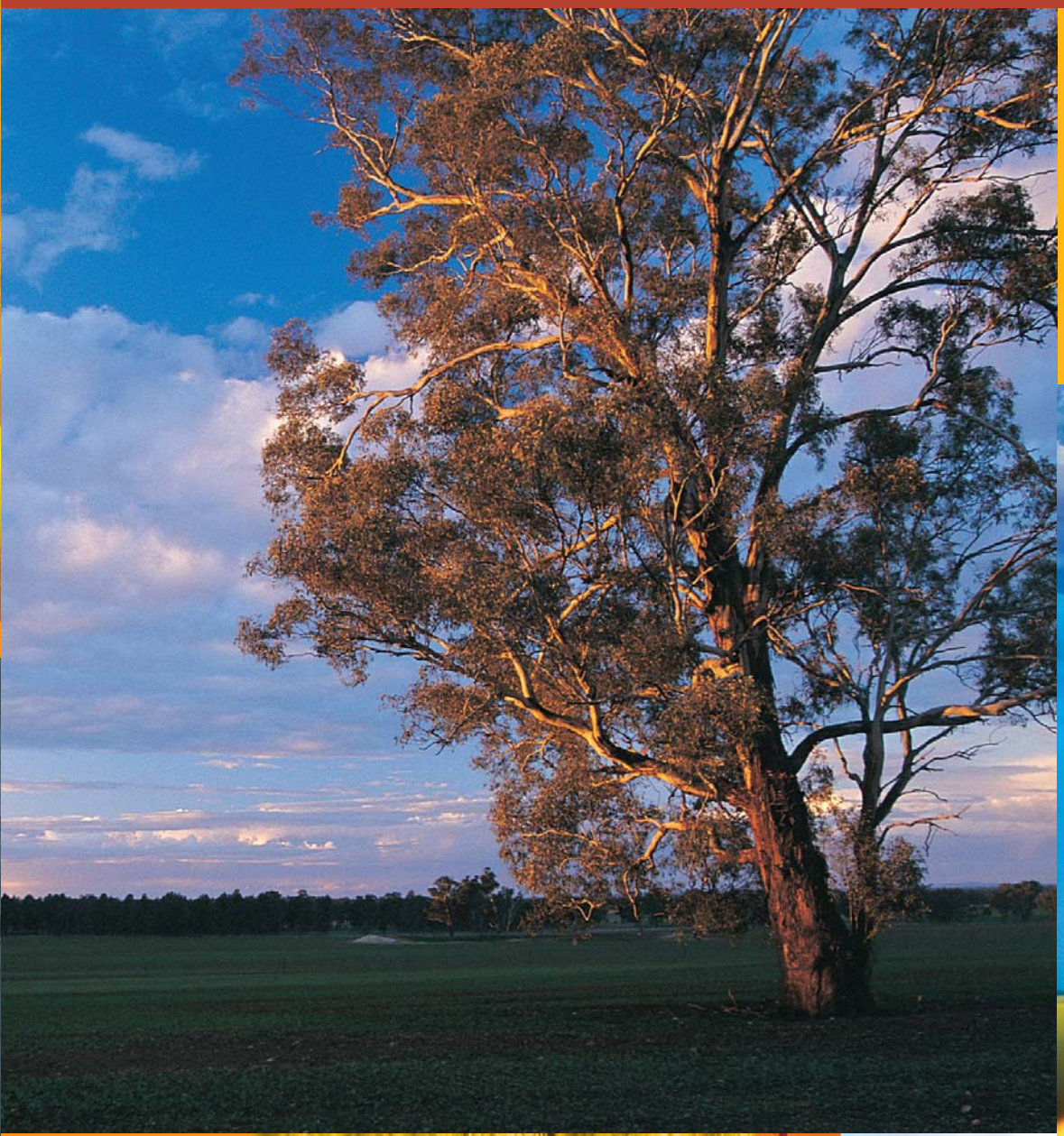
Masters of the Climate

INNOVATIVE FARMERS COMING THROUGH DROUGHT



MANAGING CLIMATE VARIABILITY R&D PROGRAM

SEPTEMBER 2005

MANAGING CLIMATE VARIABILITY
R & D PROGRAM

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Masters of the Climate Revisited is a research project funded through the Managing Climate Variability Program. This Program is a partnership between agricultural industries and the Australian Government involving several Rural Research and Development Corporations and the Australian Government Department of Agriculture, Fisheries and Forestry.

Foreword

Drought is a word that generates an emotional response based upon imagery of dying stock, wilting crops and dust storms engulfing cities. Within modern agriculture perceptions have changed and drought is predominately viewed as part of the variability that is inherent within the Australian landscape, a phenomenon that for the most part can be prepared for and managed. Leading this change are the Masters of the Climate, farmers that are investigating new approaches to manage for seasonal climate variability.

In 1999 farmers from different regions and industries across Australia were asked about how they were applying new climate forecasting tools and information. Five years later and many of these farmers have assisted us again to share the management techniques and the information sources and tools they used to cope with one of the worst droughts of the past 100 years. Their insights show that one size does not fit all but that solutions should be tailored to specific situations. At the heart of successful management is information, not only the latest scientific findings but also from the landscape itself.

The Masters of the Climate project is an example of the strength, flexibility and importance of the collaborative research partnership which is the Managing Climate Variability Program. Climate variability is an issue that we all face and must deal with. Through the Managing Climate Variability Program research organisations representing Australia's major agricultural industries are working smarter to learn from each other and maximise the value of their investments.

The Masters represented through the following pages are prime examples of people who are also working smarter, not harder, within the constraints of the climate rather than against it. In the process they are productive and sustainable. There are lessons here for us all.

Dale Baker
Chairman
Managing Climate Variability R&D Program

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Masters of the Climate revisited

Innovative farmers coming through drought

By Jesse Blackadder

From sugar cane to canola, from fine wine to feral goats – travelling to interview a group of farmers known as 'Masters of the Climate' has been as varied as the landscapes and climates in which they are farming.

In 1999 the Climate Variability in Agriculture Research and Development Program (CVAP) ran a project called Masters of the Climate. More than 80 landholders from around the country provided information to the project team about how they were using climate tools to better manage their land resources and farm businesses.

I was fortunate enough to visit and interview most of the 23 farmers who were chosen as outstanding examples of the innovative and profitable use of climate tools. The original case studies from this project are on the web at http://www.cvap.gov.au/mastersoftheclimate/.

CVAP has now been replaced by the Managing Climate Variability R&D Program, still administered and supported by Land & Water Australia. In 2004 this program agreed to fund a project for me to revisit the original 'Masters of the Climate' and see how they fared during an extreme drought.

My aim was to find out how farmers who were already working out ways to deal with climate variability managed in a drought of the magnitude of that experienced in 2002. I didn't only want to hear success stories – some of the best learning comes from failures and mistakes. I was keen to hear the full spectrum of experiences. What methods worked? What methods failed the road test? Which tools were still in use? And which had been abandoned?

Fourteen of the original 23 farmers were available and willing to participate again and I travelled from one end of the continent to the other to see first hand what they have been doing.

CLIMATE MANAGEMENT TOOLS

The case studies drew out a number of tools that participants are using to manage for climate variability.

TRACKING THE SOI

The Southern Oscillation Index (SOI) is calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin. Its movement from positive to negative can be used to predict the likelihood of rainfall, especially across eastern Australia. All of the farmers interviewed were aware of the SOI and applied it to some degree in predicting seasonal rainfall.

NO EASY ANSWERS

The theme that came up repeatedly was 'no easy answers'. Many of the climate forecasting tools that were showing promise in 1999 did not live up to farmers' expectations during the drought. While in 1999, many farmers had specific examples of improved profitability from applying climate tools to their farming systems, there were few examples in the aftermath of a major drought.

The divisions between weather (the short term events) and climate (longer term cycles) seemed to be less distinct and many farmers are taking opportunistic rather than long term approaches to farming decisions, watching weather patterns and forecasts closely and being ready to act in response to what happens on the ground. In general there was less confidence in long term forecasts – perhaps this showed a better understanding of the nature of probability forecasts and a tempering of expectations with reality.

Climate change was rarely discussed in 1999. In 2004 it's a different story – many farmers believe that climate change is the cause of increasing climate variability and they are evolving different ways of dealing with this uncertainty.

TRENDS OBSERVED IN 2004

Some trends that I observed included:

- Solid understanding of local climate history as the basis for greater understanding (which was apparent also in 1999);
- The use of American weather and climate websites for both long and short term forecasts (a new development since 1999);
- The application of sophisticated tools (such as software for tracking sub-soil moisture and wheat yields) for making full use of all available moisture;
- Shifts in the nature of crops and stock run on the properties, moving away from riskier varieties and activities;
- Opportunistic decision making – being ready to act on short notice to take advantage of weather conditions; and
- In a few cases, deciding to leave the enterprise altogether.

THE CASE STUDIES

The fourteen case studies in this booklet were written following personal interviews with each farmer in the latter part of 2004. Each one also refers back to comments made by that farmer during the original interview in 1999 to show changes over time.

It's important when reading these case studies to remember that they reflect the opinions and experiences of the people being interviewed, and their opinions may not be consistent with the latest research.

ABOUT THE AUTHOR

Jesse Blackadder (MAppSci) is a freelance writer and author based in northern NSW. She has worked for Landcare Australia since 1993 as a staff member and consultant and has also consulted to Land & Water Australia, Institute for Sustainable Futures and Environment Australia.

1. Jesse Blackadder interviewing Chris and Sarah Roche in Gulargambone New South Wales

2. Interviewing Bill and Anne Yates in Garah New South Wales.

3. Interviewing John Hamparsum near Tamworth in New South Wales.

ANALYSING HISTORIC RAINFALL RECORDS

Two farmers (Jeff Hoffman and Bill Yates) have carried out detailed analysis of rainfall records in their local districts, going back at least one hundred years, and several others refer to these records regularly.

USING FORECASTS

There are a number of professional forecasting services available in Australia, as well as the Bureau of Meteorology. Several of the farmers interviewed were able to make use of specific forecasts for their area and integrate the information into their farming practices.

USING COMPUTER MODELLING

John Ive, near Canberra, and Ian McLelland, in Birchip, both made extensive use of computer modelling on their farms. John uses his own water balance model to find out if he has enough sub soil moisture in order to plant deep rooted pastures, and Ian uses Yield Prophet software to model the influence of climatic factors on wheat yields. Many of the participants use Rainman software to assist in seasonal climate prediction.

APPLYING A SPECIFIC MANAGEMENT SYSTEM

James Gardiner from Cobar in NSW has applied Holistic Resource Management to his rangelands grazing property to maximise the benefit he receives from rainfall.

APPLYING NEW TECHNOLOGY

Several of the participants have answered the challenge of managing for climate variability by applying new technologies. Some examples include Neutron probe technology to measure sub-soil moisture and computerised irrigation systems.

CARRYING OUT ORIGINAL RESEARCH

Erl Happ, a grapegrower from Western Australia, has extensively modelled the effects of temperature on grape flavour – and has been rewarded by international recognition of his premium shiraz.

Drought isn't about rainfall

JEFF, LARRAINE AND OLIVER HOFFMANN

'Ceranya'

Lockhart New South Wales

470mm average rainfall

1,100 hectares

Producing canola, wheat, pulses, merino sheep and cattle

CLIMATE MANAGEMENT TOOLS USED ON CERANYA

- **More than 100 years of rainfall records entered into Excel and analysed.**
- **Understanding of what defines an autumn break and when it occurs based on historic records.**
- **Watching winter SOI movements to predict spring rainfall.**
- **Use of Rainman software.**
- **Bureau of Meteorology weather by fax service.**
- **Integrating climate information with other indicators to make profitable decisions.**
- **Building a robust system that expects and can withstand drought.**
- **Flexible decision making based on indicators for optimism or pessimism each season.**

Jesse Blackadder

BACKGROUND

When a farmer tells you that drought isn't about rainfall, it makes you sit up and listen. Especially when he is a farmer who has 'lived' through 117 seasons of rainfall.

Jeff Hoffman, his wife Larraine and their son Oliver run 'Ceranya' at Lockhart in the NSW wheatbelt. In 1999 Jeff was the NSW winner of the Masters of the Climate competition for his painstaking work analysing 112 years of rainfall records and developing a solid body of climate knowledge.

In my 1999 visit to Ceranya, Jeff told me about tracking down historic district rainfall records and taking the huge step of typing them into the spreadsheet program Excel. What could have been a long and tedious task for a slow typist became a fascinating re-living of every season.

As Jeff described at the time: 'It was like living through it – as I was going through a particular year I'd be experiencing how the rain came. It's dry. Now we have a shower of rain. Now another dry patch. We've had the pasture and we're losing it. Nine points comes down, it just might save the day. Then 16 points a couple of days later and half an inch a couple of days after that. We're OK.

'I knew what that would mean to the farmers who were going out and recording the rain. So I found myself living these seasons in my mind as I typed them in. While I can't easily present that information, it helped me understand.'

PINNING DOWN THE AUTUMN BREAK

Jeff used the records to work out the timing of the autumn break, an important factor in sowing and fertilising crops. Once he started looking through the records, he found it difficult to find any objective way of even defining the autumn break! Eventually he defined it subjectively as enough rain to germinate the winter pasture and allow it to survive.

Under this definition, Jeff worked through the rainfall records and found that the break normally happened at the end of April or early May. But one year in ten it didn't break till June. This led him to question the idea of a 'normal' year.

'You can't say something is abnormal if you can expect it every tenth year,' he said. 'There is a level of climate risk that a farmer must expect. "Abnormal" shouldn't occur any more than five times in 100 years. Anything more than that should probably be regarded as a normal climate variation. We farm in Australia so we had better get used to climate variability. It won't go away.'

FACING DROUGHT IN 2001/02

After the 1994 drought Jeff began using a number of software packages to help manage his farm, including Rainman. He developed a far greater understanding of how the SOI influenced the local area and this understanding was tested coming into the 2001 drought.

'My work on the SOI showed that on average we get low rainfall in a low SOI season, but we can also get some very good seasons in those conditions. Just because you have a low SOI doesn't mean you're assured of getting a drought,' said Jeff.

'The SOI didn't help predict this last drought. The indications really only started in mid winter, and by that time the crops were in and a lot of the decisions for the season were made. I started to get worried in June and July 2002, realising the SOI was low and we may be in for a drought.

'A forecast is only any good if you can make a decision based on it and most of the time you can't. It's no good telling me that I'm likely to get 55 percent chance of getting above the average rainfall. Unless a forecast can say there's a high probability of a coming drought, or a high probability of it being very wet, starting from now or in this spring, then it's of no use to me.

'Right now (July 2004) the forecast sounds as though they're predicting average rainfall, but in fact they're saying there are no indications either way. I think the forecasters are better off saying there are no indications.'

Having worked with the SOI for a number of years now, Jeff believes its value is as a tool in identifying and managing years that are very different from average and knowing whether to temper decisions with optimism or pessimism. He believes a high and rising winter SOI is a good indicator of spring rainfall and a cause for optimism in decision making. A lower and falling winter SOI reduces the chance of spring rainfall and is an indicator for pessimism.

'I try to understand the range of possibilities for a season. Most of the indications are on the ground in front of me. For example, today there's very little pasture growth and the soil is not very wet. Those are known things. I can also look at the hay stored in the hayshed, the price of livestock and integrate those things to make a decision and then I can then look at the possibilities for a rainfall forecast. If the forecast was really reliable, then it would be dominant, but at this stage it's just one factor.'

DROUGHT ISN'T ABOUT RAINFALL

As well as building a huge body of knowledge about local climate, Jeff has worked to integrate drought into all his management strategies.

'Drought isn't about climate or even about rainfall, it's about the way we choose to use the land,' he said. 'If I took my farming system to Broken Hill, I'd have a drought every year. If a Broken Hill farmer brought his system here he'd never have a drought. It's about our choices, not something inherent in the particular season.

'My work in the past has made me not frightened of drought. If you farm in the Australian environment then you have to be prepared for it. That means having a robust system that can handle the drought and also making the best of good seasons.

'You can't be really radical because the cost of being wrong in your prediction is very high. If I thought a drought was coming and said sell most of the livestock and don't fertilise the crops and pull the shutters down and then it turned out to be a good season, that would be a very high cost. Probably as costly as the drought would have been.'

FROM THE 1999 CASE STUDY...

'The end of July is a critical time for fertiliser on crops. I found that on average if the SOI at that time was less than ten and falling then the average rainfall for spring was 112mm. If the SOI was plus ten and rising then the average rainfall for spring was 226mm.'

'What it meant for this area was that significant differences in rainfall could be predicted by the SOI. The same sort of differences showed up in our crop yields.

'In 1997 I analysed the SOI with the help of Rainman and used the probability of having a low spring rainfall to make the decision not to apply nitrogen fertiliser and to sell stock early. These turned out to be good decisions.'

FROM THE 2004 CASE STUDY...

'You have to temper your optimism with the information that you have. It would be silly to be optimistic and say it will probably rain in the spring, when the SOI is low.

'It's really only in the extreme years that I can afford to use it. In most seasons when it is all happening around average, rainfall average, soil moisture somewhere around the middle of the range, you can't really make any predictions then. It's got to be a fairly strong indicator before I'd take much notice of it.' The big factor will always be what is on the ground in front of you.'

Web site
http://www.bom.gov.au/other/wbf/wbf.shtml
- is the part of the Bureau of Meteorology website where you can find out more about the weather by fax service.

High tech tools for risk management in the Wimmera Mallee

IAN AND WARWICK MCCLELLAND

'Cambrae'

Birchip, Victoria

250mm average rainfall

7,700 hectares

Producing wheat, barley, red lentils, canola and sheep for meat and wool.

CLIMATE MANAGEMENT TOOLS USED ON CAMBRAE

- **A culture of change, evaluation, discussion, trials and different opinions through the Birchip Cropping Group.**
- **Decision support software Yield Prophet that models wheat yields under different climate scenarios.**
- **Regular climate workshops for group members with the Bureau of Meteorology to improve understanding of local climate issues.**
- **Ongoing study of the 'Mean Southern Oscillation Index' as a predictive tool for rainfall in the Wimmera-Mallee district.**
- **An opportunistic approach to farm activities, responding quickly to actual weather conditions.**

Jesse Blackadder

BACKGROUND

In the past five years Ian and Warwick McClelland have gone from being sceptical about the use of the Southern Oscillation Index (SOI) as an indicator of rainfall, to being convinced that it is an important indicator for farmers in Victoria's Wimmera-Mallee district.

Ian McClelland has been chairman of the Birchip Cropping Group (BCG) since 1993, a group famous for trialling leading edge approaches to farm management. The group has 500 family members and a highly successful program of field days, expos, seminars and trials.

MANAGING RISK TO MAXIMISE PROFIT

'My farm management is based around developing a confidence factor in relation to risk management and probabilities. I put down on paper all my risks over a year and put a time schedule on them. As these risks pass, they either improve the confidence factor or not,' Ian said in 1999.

'For example, a late break for sowing will make my confidence factor decrease, because every day that I wait after the middle of May loses potential yield. Climate information fits into that confidence factor – I look at how it fits in with other things such as the effects of disease, prices, inputs and so on.'

HIGH TECH TOOLS FOR RISK MANAGEMENT

Five years down the track, Ian is trialling new software which reproduces his manual process and provides far more information for decision making. The program Yield Prophet uses the Agricultural Production System Simulator (APSIM) to model the influence of climatic factors on wheat yields.

'The APSIM production model gives a prediction of crop yields based on historical

climate data, current temperature data and agronomic information about the types of crops that we grow,' said Ian.

'We start by categorising our soil and its capacity to store and extract moisture. Then we put our own information into the model, including rainfall and nitrogen applications. It also takes into account rising and falling SOI. You can model all different possibilities. At any time during the growing season it will give us the probable yield of that crop and show what happens if you change inputs. It's a great opportunity to predict yield outcomes and change your management.

'All of us have different characteristics in the way we make decisions. Warwick and I are optimists and sometimes we need some wise counsel. Other people are pessimistic and they need a bit of a push along in. So we believe the APSIM model is a great help in making better decisions.'

Warwick added: 'A lot of your profit can come from taking risks. If you stick your neck out and grow the crop or keep the sheep even though there hasn't been much rain, then you can do very well if it comes good. The key is trying to manage the risks. You have to prepare very well.'

UNDERSTANDING THE SOURCE OF RAIN

The BCG has been running climate workshops for its members for the past two years, using scientists from the Bureau of Meteorology. Ian said they were motivated by wanting to understand the long term implications of climate change, as well as building better knowledge of local weather and climate.

'We thought that our rain came in fronts from Western Australia, and it was so disappointing when they would fade out at the South Australian border,' said Ian.

'But new research from the CSIRO Marine in Tasmania has shown that only 30 percent of our rainfall comes from West Australian fronts. More than 60 percent of it comes from cut off lows, which is when a cold mass of air gets surrounded by warm air. All the big rainfall events, the ones that really make the season or not, come from cut off lows.

'It means that when we see the fronts coming across from WA, we don't get our hopes raised and think they are going to be the saviour. You can be far more philosophical about it, knowing the reality.

'It also shows that predicting the weather in this part of the world is quite difficult. A good season in the Mallee is often the result of one or two fluky rains where you get 25 to 40 mm out of the blue. Now to be able to forecast one or two events in a year is very difficult. That's why we have adopted the attitude of reacting to what is happening.'

FORECASTING A DIFFERENT FUTURE

Ian believes that coming generations of farmers will reap the benefits of huge technological breakthroughs in dealing with problems that are disastrous for today's farmers.

'Genetic engineering is going to have a huge effect on the sustainability of farming. The possibility of being able to survive dry years in the future is far more optimistic,' said Ian.

'For instance, there are some farmers in this area who've had six frosts in a row, which has affected their income enormously. I believe in the future, frost resistant wheats will be a regular part of agriculture. For those farmers, that represents an enormous breakthrough.

'Crops are going to be far more resistant to lack of rainfall. They are already developing crops that can grow in half the rainfall and ones that produce twice the yield. It's just a matter of time before we incorporate these into our farming systems.'

Ian says that while technology has improved and there are new developments all the time, overall his philosophy hasn't changed much in the past five years. 'We still believe in opportunity cropping and taking advantage of what's actually happening as well as predicting the future,' he said.

FROM THE 1999 CASE STUDY...

As chairman of the BCG, Ian played a role in the appointment of Ian Holton of Holton Weather Forecasting to provide climate forecasts for all group members.

'Holton provided an alternative to El Nino/SOI based forecasts' said Ian.

'The last El Nino event in 1997 had minimal effect on rainfall in late winter and spring months in south-eastern Australia. Climate models that are based on the SOI simply don't work well down here.

'Ian Holton incorporates sea surface temperatures from this critical east Australian-New Zealand ocean area, which should be more accurate for the Wimmera/Mallee area of Victoria.
Climate forecasting is still in the experimental stage, but I believe that we should encourage it. There are huge benefits to be gained.'

FROM THE 2004 CASE STUDY...

'We've been sceptical about the SOI until the last couple of years,' said Ian. 'We've now had quite a few climate workshops up here and I've been influenced by the bureau people. I've taken a lot of convincing, but I now believe that the probability of SOI affecting us at Birchip is very similar to northern New South Wales. So I watch it far more closely than I used to.

'David Stevens is a forecaster using a different SOI model. Instead of the SOI being based on Tahiti and Darwin, he brings in Alice Springs, Mildura and a centre south of Tahiti. He adds them together to what he calls the Mean Southern Oscillation Index.

'In this new model, when the Mean SOI between October and June is above 20, there isn't a year when we haven't had very good rainfall. Whereas when the Mean SOI is below 20 then the variation in rainfall is far more dramatic – ranging from very good years to very bad years. I'm waiting for one of those years when it gets above 20 again and we can just go for it!'

Web site
www.bcg.org.au - *The website of the Birchip Cropping Group, a farmer-driven agricultural organisation that conducts agronomic research on cereal, pulse and oilseed crops grown in the Wimmera-Mallee region.*

'Some of the years we thought were drought years in the past are just lean years now,' said Warwick. 'New technology has helped us convert a dry year into a reasonable year.'

'The other thing we've learnt is you need to be adaptable and not be locked into a system that is too rigid. You need to be able to take advantage of changes in prices of commodities and seasonal variations. A flexible system which doesn't exclude anything has the opportunity of being more responsive and taking advantage of whatever turns up.'

From Grandad's records to the cutting edge climate forecasts

BILL, ANNE AND ANDREW YATES

'Amondale'

Garah, New South Wales

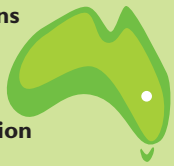
540mm average rainfall

11,000 hectares

Producing wool, beef cattle and rotated crops.

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON AMONDALE



- **Three generations of climate records used to build knowledge of climate variation over time.**
- **Close monitoring of short term forecasts and computer models for opportunistic decision making, using web sites with weather and climate interpretations.**
- **Weekly tracking of the Southern Oscillation Index with different scenarios planned to respond to changes.**
- **Pastures of perennial rather than annual grasses.**
- **Early de-stocking, especially of cattle, if conditions indicate low rainfall.**
- **The 'two teapot discussion' each morning to discuss and process information from different points of view.**

BACKGROUND

Bill Yates believes that many people – including farmers – base their understanding of climate on their most recent experiences. While this may be a natural human tendency, it can cause problems when making management decisions in a highly variable climate like that experienced at Amondale in north west NSW.

In 1999 Bill showed me the history of his family's activities on the properties Delvin and Amondale, including a history of the climate and how it impacted on 100 years of farming decisions. Bill discovered that the district had been settled during an unusually wet period in the late 19th century. Settlers believed properties like Delvin could maintain stocking rates of one sheep to the acre or better and the build up of sheep numbers at the turn of the century was huge. The 1902 drought had a devastating impact, especially because there was no outside source of fodder.

Bill's father took over the property in the thirties, during another dry cycle that lasted until 1947. Over time he moderated the stocking rate to reduce variations in income and promote better pasture productivity. During the sixties the family gradually moved into broadacre cropping, diversifying from its strong reliance on wool.

In his Masters of the Climate interview in 1999, Bill said he believed Amondale was in a generally wetter phase, as reflected by the winter rainfall dominance in the eighties.

'The seventies were dominated by wet summers with big floods. Prior to that there hadn't been a flood for 22 years,' he said.

'I had my father's advice in my head, who had come out of those long dry periods. He said: "This won't last, you can't just go and plough it all up". It was tempting at the time, but I'm glad I didn't.'

'The biggest danger is complacency. It's easy to forget climate history and the old records really help you keep an eye out for threats.'

In 1999 Bill was getting comfortable with technology that his father and grandfather could hardly imagine. He was checking the Southern Oscillation Index each week, and regularly using the Bureau of Meteorology web site. He combined short term information with a family tradition of taking a longer term view in decision making.

Tracking the SOI was useful for making cropping decisions and managing livestock – in fact several times Bill moved sheep to higher ground based on climate information. The decision turned out to be a cost effective one when pastures flooded and sheep could have died or required helicopter feeding.

FROM THE HISTORIC TO THE FUTURISTIC

By 2004, Bill and Anne were incorporating cutting edge forecasting into their management decisions. Bill relies less on looking at historic records because he's integrated the information from the past.

'We now watch the NOAA (National Oceanic and Atmospheric Administration) models to get a 15 day outlook on the weather. I would go into the COLAS (Centre for Ocean-Land-Atmosphere Studies) web site every day to see what's happening and try to make my own assessment,' said Bill.

'I go into the Long Paddock site once a week to check the SOI. If you look at it every day you can lose the plot, but if you leave too long, then you're not picking up the trend early enough.

'Occasionally I'll go back to the old data, but it's the observation being done by others that's increasingly accurate and complex. The obvious way to find climate information is on the internet. You can watch the markets and see how they react to the weather – today's weather, the 15-day forecast and the three-month forecast. You can learn to do your own analysis. You have to be responsible for your own decisions. When people ask me for information I can only say what I would do in the situation.

FACING DROUGHT IN 2001/02

By 2004, Bill and Anne had just come through several years of drought interspersed with some rain periods.

'It seems as though we might be heading back into a dryer cycle again,' said Bill. 'We are becoming more and more opportunity croppers. This year we had a good summer [03/04] and we capitalised on it. We had something growing when it did rain and sowed more afterwards.

'We've just taken that off and it's given us cash flow now. Otherwise we would have had to wait till the end of the year before we got cash flow from the winter crop. And gee, we were desperate for it and I'm sure everyone else is too.'

In the first year of the drought, Bill had enough information to make decisions for conservative management.

'The low SOI was established between March and May 2002 and it was consistent, so we sowed barley rather than wheat, limited the nitrogen inputs, and we started to offload the cattle. As the SOI entrenched, we realised we weren't going to get much crop. We kept dry sowing and using some of that for grazing. It wasn't big grazing but it was something,' said Bill.

Bill and Anne faced some loss of faith early in 2003 after climate forecasts suggested that the drought was over in their area. The SOI was positive, but not rapidly rising.

'What was coming out in the climate forecasts was that the drought was over. And to anyone just to the east of Moree, just 70 kilometres east from us, it was over. They had 16 inches for the summer. We had three or four inches. It was so close! I lost a bit of faith,' said Bill.

'Now that we've had a gentle break, we've got very good reestablishment of native grass. So we've reacted this year by bringing in a lot of agistment stock from the south. We couldn't afford to restock with prices the way they are. We'll do it gradually, but in the meantime we'll carry a lot of agistment stock without too much effect on our pastures for next 13 months.

'For all our records and interpretation, we realise how quickly the climate is changing particularly temperature. What was once several months frost danger period 100 years back is now only one month and shrinking fast.'

FROM THE 1999 CASE STUDY...

Bill has the advantage of modern technology over this father and grandfather. Each morning he checks the Bureau of Meteorology Internet site and he checks the Southern Oscillation Index at least once a week.

'If there are no big changes in the SOI then I will follow an average plan of attack. I will spread risk by sowing so that not everything ripens at the same time' said Bill. 'If it is changing, then I look back for analogous years. I would plan for the worst and then a bit more.
'If there's a rising SOI trend by March, I tend to think of higher level of inputs to target higher outputs.

'If the SOI is steady but we don't have much sub soil moisture, I would look at lower yield estimates or sow barley, which can use the moisture better. Our records show that we don't get much winter rain under those conditions and it's very hard to grow a big crop if we haven't got good moisture by March.

FROM THE 2004 CASE STUDY...

Bill and Anne also use climate and weather forecasts to help with marketing decisions.

'At the moment I've just completed the sorghum harvest. I've sold quite a lot quite quickly to get cash, but we've got some up our sleeves that we haven't had to sell. Given my assessment of the weather at the moment, I'm not in any hurry to sell that because I think the feed grain market is overestimating what they've got.

'But I'll be watching that weather like a hawk, and it's only going to take another really good rain down south to make them quite confident. It could change very quickly. You've got to be smart enough to stay ahead and analyse it.

'We're only talking a few hundred tonnes of grain but it could be worth another $100,000.'

Websites

http://grads.iges.org/cola.html - *the Centre for Ocean-Land-Atmosphere Studies, a US scientific research center established to improve understanding and prediction of Earth's climate variations.*

http://www.noaa.gov/wx.html - *the National Oceanic and Atmospheric Administration (NOAA) National Weather Service, the primary source of weather data, forecasts and warnings for the United States, run by the US Department of Commerce.*

http://www.longpaddock.qld.gov.au/ - *climate management information for rural Australia.*

Looking at the ground, not at the sheep.

JAMES AND LIBBY GARDINER

'Bulgoo'

Cobar, New South Wales

300mm average rainfall

20,000 hectares

Producing goats and white dorper sheep for meat

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON BULGOO

- **Holistic Management, which provides tools for decision making and improves ability of the enterprise to withstand drought.**
- **Rotational grazing rather than set stocking rates.**
- **Feed budgeting eight weeks in advance – decision to move stock to agistment made on the basis of measuring pasture growth, not condition of stock.**
- **Constant state of adaptation to conditions – diversifying if profitable, changing enterprise to work with what's making money.**
- **Regular 'eco-check' systematic monitoring of pasture growth, soil, insect activity, biodiversity for property health and sustainability.**

BACKGROUND

James and Libby Gardiner have been farming Bulgoo near Cobar in western New South Wales for more than 25 years.

When I visited the Gardiners in 1999, they were running sheep for meat and wool, goats for meat and had just moved into growing yabbies. Bulgoo was showing the results of three years of Holistic Management, with major increases in biodiversity and production values.

At the time James said 'Since applying Holistic Management over the past three years we've gone from a few kilograms per hectare of dry matter to 2.5 tonnes per hectare. We say that's a 400 percent increase in production.'

APPLYING HOLISTIC MANAGEMENT

Holistic Management (HM) is the name given to the Allan Savory method of rangelands grazing, which incorporates an entire shift in attitude to farm management. Along with the other members of Buckwaroon Catchment Landcare group, James and Libby joined an eight-day training in Holistic Management in 1996.

'Holistic Management is really about you and your wellbeing' said James. 'In simple terms, you look at anything you want to improve and use your animals as tools to do it.'

'In Holistic Management we aim to eat one third of the plant, trample one third and

leave one third to regenerate. We look at the pasture species that we want to keep and graze those to a specific height and then move on.

'In doing that we've stopped the runoff of water and we're making better use of the water in the ground.'

'Paddocks we locked up for a few years became quite crusted' said Libby. 'Without the action of grazing animals, the water can't penetrate the soil and the seeds have difficulty growing. This method increases water penetration. Since we rotated the sheep back in there, biodiversity has improved.'

In the first three years after adopting Holistic Management, the Gardiner's lambing percentages improved from 40 percent to 80 percent, wool production rose by 20 percent and other inputs were reduced. Diversification into goats and yabbies improved income variability.

'Our profit didn't improve because of the downturn in wool prices,' said James. 'But if it hadn't been for changing our management so that we could use the water cycle more effectively to grow grass, we may have been in very serious financial trouble.'

FACING DROUGHT IN 2001/02

The Gardiners had faced a run of bad years after 1999 and had to adjust their diversification decisions in the face of looming drought.

'We decided to chuck out the cattle and the merinos and settle for goats and dorpers,' said James. 'That's what we were told in Holistic Management – diversify with whatever you've got and get rid of what isn't a paying proposition.

'The yabbies were a paying proposition but because of government regulations we just couldn't have them. It wasn't viable.'

James and Libby faced the same challenges as every rangeland farmer, but they believe Holistic Management gave them additional tools that helped them make decisions. When the drought deepened in 2001/02, they made plans to scale back.

'The beauty of Holistic Management is that it taught us how to "feed budget" eight weeks in advance,' said James.

'We came to 2002 and ran out of feed. Peter Spencer from the Western Lands Department visited just as we were about to send the sheep away on agistment and they were all together in a small paddock. When he saw the sheep looking so good he thought we'd just got them back from agistment. He was dumbfounded. He said why would you send sheep away in that condition? And I said that's the problem, people look at the sheep and not at the ground.

'We had very good prices at the time so we came back from 9000 sheep equivalents back to about 4000 sheep equivalents, and went on agistment. We were left here with 100 sheep and 12 or 13 head of cattle and that was it on 50,000 acres!'

'A drought is really quite mind blowing. It creeps up on you,' said Libby. 'It's a gradual thing, the feed's disappearing, and then you have this emotional response when you go for a drive and all you see is red dirt. We had constant dust storms. James was away for a week every month managing the sheep on agistment so I'd be left here on my own to cope with the various stresses that occur.

'I did things I'd never had to do before in my life. I'd never had to shoot a cow before. I often wonder how long it takes you to get over that stress. Even though it's rained now, it's always still in the back of your mind that we could go back into that again, and we're not out of it yet.'

Fortunately for James and Libby stock prices remained high during the drought, with lambs and old ewes fetching $60 while on agistment and in 2004 averaging more than $70, which is considered a good price for the rangelands.

'We sent about 1500 ewes away to agistment with a 50 percent lambing and we got more than 3000 sheep back. It was very expensive, but I think it paid off,' said James.

'You've got to be ready to change in this business. Not just diversifying, but actually doing something different if things aren't looking right.'

FROM THE 1999 CASE STUDY...

'To us, day-to-day rainfall is a minor thing now' said James. 'We don't worry so much, because we know if we get even ten points of rain it's going to be magical. The system is set up so that we make the most of whatever rainfall we get.'

'The type of feed and diversity of feed has grown. We've got birds and reptiles and all the plants that everybody wants and some that no one's heard anything about. Everybody wanted tall oat grass, we've got it growing out here as high as my head. There's windmill grass and kangaroo grass by the mile. It's just magic. Our stock used to eat mineral supplements like children eating liquorice, but now they shun them. What we've got here is increasing biodiversity within a profitable enterprise.'

FROM THE 2004 CASE STUDY...

'I was talking to one of the educators the other day and I said it looks like we're going back into dry again and he said well you'll just have to put adaptive management into gear. And I thought yeah that's right, my adaptive management is to sell the farm and walk off,' said James.

'We're getting older and we can't do what we used to do and we think it's time to move on and let someone else have a go.

'But I would say to other farmers to stick to your guns and hang in there. I really think that the rangelands are the greatest future in Australia because we haven't been able to muck around with the environment too much. The reason we moved out here from Victoria was because it was low input. If we could get the rainfall we knew we could do things.

'The theory behind Holistic Management is that you can have more than a 50 percent increase in production, coupled with a 25 percent reduction in costs. Anyone who doesn't want to look at that in farming has got rocks in their heads. That's what really switched me on to it. We've tried our damnest to prove it to be wrong and we can't.'

Websites

www.holisticmanagement.org – *the site of the Alan Savoury Centre for Holistic Management in the United States.*

http://www.holisticresults.com.au/ - *the Australian site for Holistic Management training and information.*

Keeping faith with forecasts.

BRETT AND FRAN FRANCIS

'Rocky Glen'

Kimba, Eyre Peninsula
South Australia

2000 hectares

325mm average rainfall

Producing mainly wheat, with some barley, peas, canola and merino sheep.

CLIMATE MANAGEMENT TOOLS USED ON ROCKY GLEN

- **Long range (15 month) weather forecasts (commercial source).**
- **30 years of historic rainfall data and seasonal yields.**
- **Analysis of early season rainfall patterns and comparisons to past years.**
- **Choice of three cropping scenarios – for poor, average or good rainfall seasons.**
- **Decisions about crop types and amount of land cropped made by cut off dates relating to rainfall received.**

Cal MacKinnon

BACKGROUND

'Someone who forecasts weather professionally is bound to be better at it than I'll ever be by just having a look at night,' said Brett Francis.

In contrast to most Masters of the Climate farmers, Brett has chosen to put his faith in long term weather forecasts. He uses a 15 month outlook provided by a commercial forecaster, combined with his own rainfall and yield records, the knowledge of climate he's built up over several years, and trusting his intuition when making decisions.

Brett and Fran Francis are third generation farmers on one of Australia's driest cropping zones, in the Kimba district of the Eyre Peninsula in South Australia, with an average rainfall of 325mm. They produce mainly wheat, with barley, peas and canola in better years and they run some merino sheep.

CLIMATE STUDY IN THE NINETIES

During the nineties, Brett was involved in a farmers' group organised by the South Australian Research and Development Institute (SARDI). SARDI was investigating how early season information could be useful to farmers. For example, Brett would send in rainfall information for April and SARDI would fax back a range of potential yields that he could expect.

Through SARDI, Brett came across a software program called SOWHAT, a package designed for farms in low rainfall areas. It enables 30 years of rainfall and

wheat yield data to be analysed. He finds it a valuable tool in seeing what yields have been achieved under certain rainfall conditions – and a benchmark for measuring his improvement as a farmer.

When funding ran out and the farmers' group finished, Brett was still excited about the possibilities of incorporating climate information into his farm management. He attended a Climate Risk Workshop run by SARDI and the Kondinin Group and subscribed to the weekly fax provided by the Climate Risk Yield and Information Service.

'The dream is eventually to have a tool that will show you what kind of year it's going to be and hypothetically you can make all sorts of better decisions. We're not there yet, but in the last ten years there's been so much research, you can't dismiss it,' said Brett.

'The Southern Oscillation Index is of very little use to us when we need it most. We need better indicators for this region. I'm interested in what they're finding out about MJO [Madden Julian Oscillation, also called the 40-day wave, see glossary on page 29] and the Indian Ocean Dipol.'

MAKING THE LEAP TO FORECASTS

In 2003 Brett decided to invest in a commercial long range forecast.

'It's a 15 month forecast on a month by month basis,' said Brett. 'It includes the likely temperatures, wind speeds and rainfall in terms of below average, average, above average. That gives me a feel for what kind of season it's likely to be.

'I rely on it, but I don't want to be locked into just one approach in case the commercial forecast doesn't get it right, so I also look at the historic records and I go by my gut feel.

'Mostly I want to be seeding early in May, so I look at the rainfall in fortnightly blocks – from April 1st to April 15th, for example. That's quite a good indicator of what decile the season's rainfall is going to be in and what the likely yields are.

'I have cutoff dates, especially for a crop like canola. If it hasn't rained by the end of March, then I don't sow canola and it won't be grown that year.'

Brett makes major decisions early in the season, so the forecasts play an important role. In an average season, around two thirds of the property will be cropped. If a poor season is indicated, only one third will be used, eliminating the poorest paddocks and those with low water holding capacity. If a good season is indicated, the cropped area is increased.

'It's about a 30% change, and obviously that amount depends on grain prices at the time,' said Brett. 'Yields are only part of the equation. If you've got higher prices you can afford to make a lower yield and still get your profit.'

Currently in his second year of using the commercial forecast, Brett has found it accurate enough to help him make farm decisions.

'It's not always spot on and some months aren't right, but it's been close enough to keep me persevering. That's always been my approach with climate work – if you keep persevering, sooner or later you'll get more experienced and closer to being right.

'Holton also sends a fortnightly forecast each week and we use it to identify spraying windows and seeding opportunities.

'It cost about $500 for the long range forecast and it's not going to take too many right decisions to get that money back.'

A CAUTIOUS APPROACH

Brett says he takes a cautious approach and tends to be conservative. 'I'm simply using what I believe to be the best information I can get and applying it to helping my business.

'You can't dismiss climate information. I try and look for the positives and if someone can get a forecast half right, well then they're getting there. The more we know, the better we can manage.
My advice to other farmers is watch this space! And don't put too much weight on it until you're comfortable with it. You've got to be happy with what you're doing, because the buck stops with you,' he said.

'If I'm not comfortable, I won't do it. That's where the gut feeling comes in. In the end, a good night's sleep is worth more than anything else.'

FROM THE 1999 CASE STUDY...

In 1999 the Francis's prevented a loss of $150/ha. That's the saving Brett puts on a decision to give canola a miss when he reviewed indicators that put April rainfall on par with the lowest 10% on record, tipping the probability towards a bleak season.

By contrast, the year before (1998) Brett expanded the cropping program on the strength of early indicators, sowing wheat earlier than normal to reap an extra $90/ha. He also enjoyed a handsome profit on canola.

The peace of mind the Francis' have derived from using climate tools is evident as they recall savings in both 1994 and 1996 when they were swayed from sowing a potentially disastrous crop of lupins.

FROM THE 2004 CASE STUDY...

'I'm a better farmer than I was ten years ago. I can tell that from the growth we're able to get in dry years,' said Brett.

'Ten years ago I had knowledge but not experience. Now I've fine tuned it into a systems approach. The improvement is due to things like earlier sowing times, better weed control, using no till on most of our country, not wasting as much rain. We're growing far more robust and healthy wheat plants than we did ten years ago.

'It's self belief too – having the confidence that what you're doing is the right thing.

'The aim is to convert every millimetre of rain that falls in the growing season to 20kgs of grain per hectare. This year we've got about 160mm available. When you take out evaporation that leaves us only 50mm of available rain to convert – so that's our potential yield.

'I had examples of saving money last time. I don't have them to the same degree this time. I've gotten older, had kids and I try to take the simplest way now!'

Websites
http://users.senet.com.au/~holton7/contents.htm
- Ian Holton commercial forecasting services.

Getting sweet with climate technology

DOUG AND ANTONIETTA LEE

'Kelsey Creek'

Proserpine, Queensland

1800mm average rainfall

283 hectares

Producing sugar cane

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON KELSEY CREEK

- **Trash blankets (retained stubble) used to keep water in the soil.**
- **Applying technology to improve farm system efficiency.**
- **A water efficiency program involving overhead irrigation, readings of soil moisture and prioritising paddocks for irrigation when water is scarce.**
- **Use of Rainman software and keeping track of SOI readings.**
- **Four day weather outlook used for managing the Kelsey Creek irrigation system and minimising wastage.**

BACKGROUND

Doug Lee was involved in the original trials of Rainman software and he has always had a fascination with computers. Now he's using technology to help him get through an extremely dry few years.

'Back in 1999 we were fairly new at this climate stuff,' said Doug. 'We thought we were pretty good at it. In fact we thought we were pretty well invincible! At that time we were just coming out of a La Nina and the indications were a lot stronger.

'This year has been really difficult and I'm more cautious. We're not as confident, but we still use it. It's still the best indication we've got and we can't just throw it out.'

Doug was an early user of internet weather and climate services and software packages like Rainman. Back in 1999 he had attended two climate workshops, regularly consulted the Bureau of Meteorology web site, and relied heavily on a two-three month advance forecast when making decisions about leasing additional irrigation water. He kept a close eye on the Southern Oscillation Index (SOI) and the Madden-Julian Oscillation [or '40-day wave', see glossary on pages 29] as indicators of coming rainfall.

'The problem at the moment is that the indications aren't there. When it's like this, everyone can have a different opinion about what's happening. One person can read the weather chart and say it is going to rain in the next few weeks and I can read the same chart and say it's not,' he said.

TECHNOLOGY TO HELP WITH DROUGHT

In the absence of clear indicators for the climatic outlook at the end of the drought, Doug is relying more than ever on using

technology to increase efficiency in his farming system and make the best use of available water.

The Lees adopted 'trash-blanketing' long ago. Instead of burning the cane before harvesting, it is cut green and the stubble (or trash) is left to cover the soil, forming a blanket of mulch. Trash blanketing can help make major savings in water use.

'Only 20 years ago we were out on tractors day in, day out, working up the ground,' said Doug. 'Now we keep the trash down everywhere, even on our fallow paddocks. A couple of years ago we experimented with planting soybeans to put nitrogen back into the fallow paddocks. We built our own planter to plant the soy straight into the trash. We've done quite well out of it and now we hire the planter out to other farmers.

'The trash blankets are three or four inches deep and they're very good for the soil. I know some soils around can't handle the heavy trash and you get waterlogging underneath, but in our soil it works really well.

'Once we've finished planting, I don't touch the soil for four or five years. This farm used to employ two men, but now I only employ one and sometimes he's struggling to find enough work to do.'

Doug has built on the water-saving properties of trash blanketing by changing to overhead irrigation rather than furrow irrigation; setting up a roster system that prioritises which paddocks are irrigated; and using a tensiometer which measures ground moisture and links it to cane growth.

'In the nineties we were pumping a lot of water and we weren't getting the tonnes of cane in return. After 1999 we changed our irrigation system from furrow to overhead irrigation. The irrigator is computerised and we have variable speed pumps to give us better control over the amount of water we use,' he said.
'We now use a roster system, where we identify good paddocks that are guaranteed to grow the tonnes if we water them properly, and we make those category one paddocks. They're the first ones to get water when they need it. The lower quality paddocks might have to wait. That helps us keep production up.'

WATER USE EFFICIENCY BEYOND THE FARM

Doug believed that his water use efficiencies were nothing out of the ordinary. However his approach won him an award for water use efficiency on the farm. No doubt that's one reason the community trusts him as the chairman of the Kelsey Creek Water Board and an irrigation system coordinator, responsible for allocating water to a group of 10 neighbouring farmers.

'The water in Kelsey Creek is very, very expensive to apply and my job is to make sure that the scheme is really efficient. It's a tough time now because the dam is so low and farmers are riding us hard to improve efficiency and minimise the losses.

'I use Rainman, get on the internet and model on past history what I think might happen with rainfall. If it looked like rain next week, I'd ease back on the orders, lower the level in the channel and be more cautious,' said Doug.

'It takes 80 mega litres to fill the channel. If we fill it, and it rains a lot, then we've got to drop that water out of the channel and into the creeks and let it go. If we think rain is coming, sometimes we don't fill the channel – we just put a little bit in and the farmers have to take pot luck. If it rains and you're not prepared, you can lose two or three hundred mega litres, at $40 a mega litre – that's a lot of water and money.

'If it doesn't rain at the end of this year, and the dam hasn't filled up, we have to make sure we get our climate information right. The decreased water allocation from the dam means our losses are multiplied, because the water is measured on the dam wall. All losses are paid for by the farmers.'

FROM THE 1999 CASE STUDY...

'Last year we followed the SOI on the internet. Rainman showed it would be a wet year. So when the harvesters came we cut very wet blocks to start with. Come September, I was right. In the end I cut 92 percent of our cane. Most of the other people in this area only cut to 70 percent.

'We had some money left over and were ready to update our machinery. We had the choice of an irrigator or a tractor. Normally we would have bought the irrigator and it would have ended up just sitting there. Because of the indications of a wet year, we bought a tractor instead, which got great use,' Doug said.

FROM THE 2004 CASE STUDY...

'One of the things we were trying to do a few years back was predict climate a year ahead. That was a disaster. You just can't do it,' said Doug.

'Another thing I tried was using Rainman and the SOI to predict sugar prices. But you don't know whether it's going to be very wet or very dry in other places. For example, this year there's been talk of Brazil having a wet season and not being able to get the crop harvested. But it turns out they are getting their crop off, so the sugar price isn't going to go up as much as predicted. I gave up on that one too.

'The strongest climate tool that we've kept using is the SOI. Roger Stone from the Queensland Department of Primary Industry has become very accurate – in fact it's scary how accurate! He's the leader in Queensland. Most farmers will listen to him and he's helped a lot of farmers along the way with his workshops.'

Web sites

http://www.dpi.qld.gov.au/source/14117.html - *a glossary of climate definitions including the 40-day wave.*

http://www.apsru.gov.au/mjo/ - *analysis of the current phase of the Madden Julian Oscillation.*

http://www.weatherzone.com.au/charts/twcGrads.jsp - *the Australian Weatherzone website, which includes weather maps and computer models.*

http://www.solar.ifa.hawaii.edu/tropical/ - *tropical storms warning website from the University of Hawaii.*

Doug believes that one positive outcome of the drought is making farmers more aware of the need to understand climate.

'Back in 1999 we were ahead of the game, looking at things like the SOI and the 40-day wave. Now there's been so much publicity about it that lots of other farmers know a fair bit. There's nothing like a drought to make you more aware!'

No such thing as too much information

JOHN, ROBYN, STEVEN AND CAROLYNN IVE

'Talaheni'

Dicks Creek, New South Wales

740mm average rainfall

250 hectares

Producing superfine merino wool, Sharlea wethers and Angus beef cattle

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON TALAHENI

- **Simple computerised water balance model to track soil moisture profile for pasture management, tree planting and salinity risk.**
- **Customised software to identify the contribution of climate to productivity changes and measure productivity increases independent from climatic variations.**
- **Perennial pasture management that aims to increase bulk and vigour and make maximum use of rainfall.**
- **Decisions made within a triple bottom line framework – looking at environmental, social and economic impacts.**

BACKGROUND

CSIRO scientist and farmer John Ive and his family have spent almost every weekend since 1980 transforming a run-down, salty and bare property outside Canberra into an award-winning and highly productive farm.

When the Ives first purchased Talaheni it suffered from severe dryland salinity, loss of pasture, extensive sheet and gully erosion and low productivity. From the outset, John has applied scientific principles to improve the management of Talaheni and bring the farm back from the brink of environmental disaster, a necessary forerunner to achieving production gains.

Since 1999, the Ive's work and dedication to the triple bottom line at Talaheni has been widely recognised. In June 2004 they won United Nations Association of Australia World Environment Day Award in the Triple Bottom Line category – the first farmers to even reach the finals in this prestigious event. In 2003 they won the NSW Landcare Research Award and recently they won an Awards Australia Regional Achievers Award for their efforts in managing dryland salinity.

BENCHMARKING PRODUCTIVITY WITH CLIMATE INFORMATION

In 1999 John described how he painstakingly wrote his own software to monitor the links between climate and productivity increases on the property. The program relates production values to rainfall in the preceding 12 months to evaluate annual performance indicators against productivity benchmarks.

'Every year we do an analysis of how we've performed relative to the climatic conditions. Rainfall is a major limiting factor here and we obviously want to get maximum productivity from the rainfall we do get,' said John at the time.

'With the cattle, I discovered that our individual weaning weights increased by about 2kg for each additional 10mm of rain received in the 12 months prior to weaning.

'On top of that, over 18 years there has been a mean gain in individual weaning weight of around 2.5kg per year or nearly 45kg per head increase over the 18 years after allowing for rainfall variation.

'This figure reflects our productivity gain, separated from any gains relating to annual rainfall conditions. It means that overall we're making quite significant gains in terms of the amount of beef produced per unit of rainfall over the 18 year period.'

John used similar methods to examine productivity in superfine wool production. If the results for individual seasons were below what they should be, then rainfall wasn't efficiently utilised for wool production and he goes back to find the reason.

TRACKING EVERY DROP OF WATER

When I visited again in 2004, John had turned his attention to developing a simple computerised water balance model that he says any farmer could adapt to their own situation.

'The water balance model I've developed takes just 10 or 15 minutes to set up on an excel spreadsheet. It's a way of keeping track of the moisture that's available on the property,' said John.

'To start off, you've got to have some idea of the depth of soil capable of storing moisture. In our case we work on about 60 or 70cm. Then it's just a matter of putting in our own daily rainfall records, plus mean daily temperature and evaporation, which we get from the Bureau of Meteorology.

'After that it's just bookkeeping. You get rainfall, which is like money coming into your account, and just like money you get moisture going out, which is governed by temperature and evaporation. From that information you can calculate a moisture index – either in millimetres per 60 cm of soil depth, or as an index between zero and one – whichever way you so choose.

'I run the model perhaps every month, depending on the time of year and conditions. Less often if things are stable, such as in a drought! Or more often if critical operations are planned, such as pasture establishment. It gives me a fair idea of just how much soil moisture we've got stored and therefore what the pasture growth conditions are like. It also gives me information about the risk of recharge that potentially can add to our salinity situation.

'Anyone who is familiar with the web could do a search and find themselves a water balance model quite easily.'

FACING DROUGHT IN 2001

Having come through the 82/83 drought, the Ives believed they were well prepared to face another one. They had sufficient on-farm fodder stores to carry them through 18 months of drought and a solid understanding of the climate variability of the area. However, the 2001 drought lasted far longer than they'd anticipated.

'I thought that 18 months of fodder stores was a reasonable quantity, based on what had gone before. It certainly would have been enough to get us through the 82/83 drought, but this one just persisted much longer,' said John.

'We exhausted our on-farm fodder stores for the cattle in July 2003 and we had to buy in a small quantity of hay at an exorbitant price – about $14 a bale – to get us through.

'We were stuck in the situation of deciding do we sell the last of our breeding herd, which were about to calve in a flat market, or buy fodder at that price. But if you look at it over the whole fodder reserve, the average cost worked out at something like $4.50 a bale and that was the important thing.

'We got a little window of opportunity in spring and we actually rebuilt our fodder reserves at very good prices, in fact about $6 a bale for good quality lucerne hay. So we're now in a position where if we need to we can go another 12 months with the stock we're carrying.

'I don't like to let good breeding stock go, so we do try to feed them on the property. But also I don't want to overstock. If you have a look around at the paddocks here, given the seasonal conditions they're holding up pretty well. Certainly far better than in the 82/83 drought, even though this one has persisted much longer.'

FROM THE 1999 CASE STUDY...

John attributed his productivity improvements to several factors including: improved genetics, detailed monitoring and objective assessment of each individual animal, improved condition of the property and better understanding of local weather and climate conditions over time – all combined with a willingness and keenness to do better.

'Farming is very much at the vagaries of the climate and weather' said John. 'You can either cop it on the chin or be proactive.

'Even with the approach of using climate information I've made bad decisions, but I like to think I've made more good decisions than I would have otherwise.'

FROM THE 2004 CASE STUDY...

The Ives have decided to increase perennial pastures on the property with a mixture of native and exotic species to increase pasture bulk and vigour and gain the maximum benefit from rainfall. John uses his water balance model and seasonal forecasts to decide when to sow pasture.

'We did all the preparation for sowing this paddock back in spring 2001 but we didn't get enough rainfall. I knew from the water balance model we didn't have enough soil moisture,' said John.

'So then we planned to do it in autumn 2002, and again abandoned that. Then we looked at doing it in spring 2002, abandoned that, and then autumn 2003 and abandoned that, and finally did it in spring 2003. And as it happens it was the best pasture strike I've seen, it was just fantastic.

'That was just by understanding what the soil moisture was, what the climatic conditions had been and making the best judgement about what they were to be. And now there's a very successful perennial pasture established.'

Websites

www.talaheni.com.au - *the web site developed with assistance from Land & Water Australia's Community Fellowship, developed by John Ive.*

http://grads.iges.org/pix/prec7.html - *the 10-day precipitation outlook for Australia from the Centre for Ocean Land Atmosphere Studies.*

http://www.bom.gov.au/silo/ - *a collaborative project between state and federal agencies, providing meteorological and agricultural data.*

Staying positive when the dust is blowing

TOM AND MARGARET PORTER

'Te-Aro'

Hay, New South Wales

350mm average rainfall

5,500 hectares

Producing first cross merino lambs and cattle

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON TE-ARO

- **Invested in an irrigation bore to grow millet for drought feed.**
- **Tracking the Southern Oscillation Index (SOI) particularly through winter.**
- **Comparison of current SOI values with 100 years of SOI values to find similar years.**
- **Buying and selling cattle based on SOI data.**
- **Daily tracking of five and ten-day forecasts.**

BACKGROUND

Tom and Margaret Porter spent much of the 2002 drought barricaded indoors against howling dust storms that swept over the Hay Plains every few days. If it hadn't been for the opportunity to sink an irrigation bore before the worst of the drought ravaged the farm, they may not have survived.

'This is grass country, so once you get a severe drought and there's no vegetation or moisture to hold the topsoil, it just starts to blow,' said Tom. 'I've never seen anything like the 2002 drought. As well as the low rainfall we had record severe winds which continued for months. It was unbelievable. I hope I never see it again.'

Te-Aro, a dryland grazing property that straddles the wheat-sheep and pastoral zones in south western NSW, has been in the Porter family since 1884. The family's major business is breeding first-cross merino lambs, with buying and selling cattle an important sideline.

In 1999 when I first visited Te-Aro, Tom was at the forefront of using the internet for climate information. Not only had he tracked down climate and weather websites from all over the world, but he worked at night to build his own website with links to climate, weather and agricultural sites in many countries. Tom's site was so useful that many other farmers started using it in preference to search engines. The site www.bushlink.com.au is still active and used as a first port of call by other farmers.

These days Tom still uses the internet constantly, mainly looking up the Southern Oscillation Index over three to four months (particularly during autumn and winter) and the ten-day weather forecast. He is less confident about long range weather forecasts and does not rely on them as heavily when making decisions.

TRACKING THE SOI FOR CATTLE PURCHASE AND SALE

In 1999 Tom was confident about his use of the SOI as an indicator to help him make decisions about buying and selling cattle and he had examples to prove his case.

This time around, in spite of dramatic dust storms and the complete loss of vegetation on Te-Aro, Tom was still confident enough in his study of climate to purchase cattle for restocking before the 2002 drought officially broke [see box story].

However, Tom's ticket through the drought was investing in an irrigation bore. The bore allowed him to sow 300 acres of irrigated millet in October 2002 and then put the sheep on to it in December.

'By the time the millet was ready to graze it was nearly a metre high and the feeling of putting the sheep on there was just unbelievable after going through feeding them grain in virtually barren paddocks,' said Tom.

'The drought really finished for me when we opened the gate and put the sheep on the millet. We did lose a few sheep before that, but I knew I'd be able to keep water up to the millet and keep them going till the autumn, which is what happened.

'Having the sheep on a small area which was watered and green was very positive as far as the farm was concerned, because the rest of it was in a very delicate state. We still had a lot of degradation but it would have been worse if the sheep had stayed on the paddocks.

'Climate information helped predict the drought but I don't think anybody could have prepared for it. It was just so severe. It helped me a bit to know what was going on, but once you're in those extreme conditions it's just very hard to cope.'

LONG TERM CHANGE IN CLIMATE

Tom is concerned that long term climate change is already a reality in the district and that current farming systems won't survive in their current form.

'In this part of the world there's enormous concern about what's happening to our regular seasons. They've changed and it's pretty scary,' said Tom.

'Just in this area we've been in abnormally dry years since 1990, with the exception of 2000 which was a really good year. We don't seem to get the rain in the autumn and winter. In my lifetime that's been the main rain that gets the season established and all of a sudden it just doesn't happen anymore.

'I think that we're all slow to change because you tend to think that next year it will rain in the autumn but invariably it doesn't. If it continues we've got to look at our stock management, because we like to lamb when we've got feed! So I'm actually thinking of changing from a May/June lambing to an August/September lambing next year.

'It's potentially a very serious change to what actually grows on the farm in the long term. We're losing our annual grasses which used to be the mainstay of autumn and winter feed. If grass germinates but then dies, you don't get the seed. That's happened quite a lot in the last 10 years. The seed bank is becoming depleted and we're not getting the ground cover we used to.

'I don't think anyone knows what's going to happen, but we're in it now, I'm sure we are. As far as we're concerned, loss of grass in autumn and winter is the biggest problem.'

FROM THE 1999 CASE STUDY...

'From my own observations over time I've worked out some climate patterns in this area. The SOI seems to run in 12 – 18 month cycles. If its been a good season for 12 – 18 months and the SOI starts to head down, then look out!' said Tom.

'Often I find if we get rain before January, then it won't rain in the autumn. On the other hand, if it stays dry in summer, often we'll get an early rain in the autumn.

'There's another pattern I use a lot – if we've had a drought, a bad autumn through to Spring, the chances are very high that its going to rain in Autumn the following year. It's rare for a drought to go more than one year.'

Tom's trading of cattle is heavily dependent on seasonal factors and availability of feed, so his study of the SOI and the long-term indicators has an immediate and practical application.

'I've actually bought cattle when the dust has been blowing and they're virtually giving them away because of the drought and within a couple of months it's completely different outlook because it has rained' said Tom.

'I've done that several times. It takes a lot of courage though and it helps if they're cheap. I certainly wouldn't be buying dear ones! You have to be getting them at a very big discount.

FROM THE 2004 CASE STUDY...

'In 2002 I didn't have any cattle at all because they're the first things to feel the pinch if it's dry. But we'd lost stock in the drought and I didn't want to go into the next year having been right down in stock numbers because I knew that once it did rain that they'd be almost un-buyable,' said Tom.

'I was pretty confident the drought was going to break. There was no summer rain and the SOI had gone back into positive. It's not a very reliable time of year to look at the SOI but if you go back through the records there are very few droughts that last more than 18 months here.

'So I did buy cattle in April 2003 virtually before it rained. We bought very well bred Angus heifers for $430 in April and we sold them for $930 in December, so we did quite well out of them.'

Websites

www.bushlink.com.au - *Tom Porter's website with a myriad of useful links to weather, climate and agricultural sites around the world.*

One hundred percent business – the odds of success in outback South Australia

TONY BOYD

'Kalamurina Station'

Outback South Australia

142mm average rainfall

700,000 hectares

Producing beef cattle

Tony Boyd

CLIMATE MANAGEMENT TOOLS USED ON KALAMURINA

- **Study of the SOI to predict flooding in the river.**
- **Tracking Indian Ocean sea surface temperatures and weather patterns off the coasts of India and South Africa.**
- **Satellite feed maps plus on-ground calculations to work out available feed.**
- **Participation in the QLD DPI Aussie GRASS project to spatially map and track Australian grazing lands.**
- **Decision to sell the property when the odds of success showed it to be potentially unviable.**

BACKGROUND

'We sold the station in 2003,' Tony Boyd said, when I contacted him about participating again in Masters of the Climate. 'In fact, it was the climate outlook that helped me make the decision. The odds were changing and it was becoming too unpredictable.'

Tony's use of climate information to make a major decision fascinated me and I interviewed him for the project, even though he is now working in a different industry.

In 1999 Tony was one of the owners of Kalamurina Station, a 7000 square kilometre station in the middle of the Simpson Desert, backing on to Lake Eyre. In the midst of this harsh, sandy desert country runs the Warburton River bringing life-giving floods two years in every five; plus fast growing, desert vegetation that provides high-protein feed for the station's 3,500 cattle.

A BUSINESS-LIKE APPROACH

Tony has spent the past 25 years advising some of the world's casinos on the odds of making a profit from new games. Along with several other investors, he bought the station in 1994 after analysing the odds for its success, including looking at the climatic outlook and the opportunity for success versus risk in the venture.

'I wanted to see if a business model would work in a remote, harsh area of Australia,' said Tony. 'When I looked at the climate, I worked out that over a ten-year time-frame we could expect four very good years, two average years, two poor years and two that would probably be extreme drought.'

As it turned out, the weather conditions were kinder than predicted. Central Australia was in a severe drought at the time of purchase. However, two climatologists told Tony that sea surface

temperatures and precipitation indexes in the atmosphere over the Indian Ocean suggested a significant wet period on the way. Within days of signing the contract to purchase, the rain started falling and the investors were able to begin building stock numbers up again.

LOOKING FOR NEW SOURCES OF INFORMATION

Tony started by looking at the Southern Oscillation Index (SOI) to understand the weather and climate patterns in the district. He quickly concluded that in outback South Australia, it had a relatively small influence. He needed to widen his research and draw climate information from a variety of sources in order to predict seasonal conditions.

'In the early days I thought the SOI was important. But I've come to realise it only has a five to 10 percent effect on us. It's most useful in predicting rainfall in Queensland, which affects the likelihood of water coming to us down the river.

'The biggest influence on our weather comes from the Indian Ocean and the patterns that form off the coast of India and South Africa.'

Tony started using satellite vegetation index readings that provided an indication of the amount of feed available on a given area. He began with the vegetative indexes prepared by the American web site National Oceanic and Atmospheric Administration (NOAA) and went on to the more detailed 'feed maps' of Australia prepared by the Department of Primary Industries in Queensland.

'The information is detailed, down to the square kilometre,' said Tony. 'The greenness index indicates the amount of feed you've got. I combined it with measuring actual growth levels on the ground. So if rain fell in January, for example, we could work out how many kilograms of dry matter were available, and when it dried, how much dry feed on offer we were going to have. From 1000km away I could calculate how much stock we could carry.'

Combined with the hands-on local knowledge of the farm manager, it meant that Tony could make accurate decisions about stock levels. As he became more interested in tracking feed levels, Tony started using Aussie GRASS (Australian Grassland and Rangeland Assessment by Spatial Simulation), a project developed by the QLD Department of Primary Industries to integrate climate and natural resource data, remote sensing, historical agronomic research and simulation modeling. It aimed to develop a spatial model that allowed assessment of the condition of all Australia's grazing lands.

'When DPI started working on Aussie GRASS, we worked with them,' said Tony. 'If we had rain, I'd talk to them about our methods of working out dry matter on the ground and what we estimated it to be. They'd compare it to their own readings and see how they measured up.

'Western Australia has a similar system using satellite tracking to gauge the amount of wheat being cropped and there are even people like futures traders using it to look at crops around the world.'

TIME FOR A HARSH DECISION

With everything going well, why did Tony sell the property?

'Looking at the climate patterns I believed it was moving from a viable proposition to something that might not be viable. The patterns that are happening now are quite different to those of 20 or 30 years ago. They've even changed since 10 years ago.

'For example, there are changing monsoonal patterns around Indonesia, Fiji, the Solomon Islands and Vanuatu. The monsoon pattern has narrowed and become less intense. Rainfall is happening out of season. It might just be an anomaly, but you can't tell.

'Around 70 percent of the information out there says that there's a definite warming of the atmosphere. It makes everything unpredictable, because you can't tell if the next 10 year period will have the same odds as the last. You might have six bad years, two good years and two average years.

In the face of less and less predictability, Tony and his partners decided to sell.

'We weren't emotionally attached to the business, so the decision was easy. But for people who've been farming a property for 100 years, those decisions become very hard. I think there are a lot of people who should have got out a couple of years ago, but emotionally they couldn't make the decision to go.'

FROM THE 1999 CASE STUDY...

Tony believes many people underplay the significance of climate tools. He remembers 1997 as a year when the media had panicked farmers about a monster El Nino developing in the Pacific, but they had failed to notice the sea surface temperatures over the Indian Ocean. It turned out he was right – by the end of 1997 rain had picked up and 1998 turned out to be a wet season.

'From where we sit the El Nino only has a two percent effect on the rain we get. The patterns over the Indian Ocean as revealed through precipitation indexes and sea surface temperatures have a much greater bearing on our climate.'

FROM THE 2004 CASE STUDY...

'In 1996 the northern cloud bands were starting to form fairly early, drawing moist air down from the tropical equatorial area. The SOI was indicating a fairly wet period in Queensland, which meant we'd have the river flowing and probably a flood. At the same time the Indian Ocean was cooling off in its centre and getting warmer closer to the coast of Australia. All the indications were telling me that we would get precipitation sweeping through the central part of Australia.

'We decided to buy store cattle out of Alice Springs, which was going through a fairly dry period at that stage. Cattle prices were incredibly low so we bought quite a number of cattle over a period of time to start stocking the place up. And basically when the cattle started arriving it started raining.

'There was about a 60 percent chance that the rainfall would occur and the season would go as predicted, and a 40 percent chance of failure. We felt that was a good risk to take.'

Websites

http://www.noaa.gov/wx.html - *the National Oceanic and Atmospheric Administration web site.*

www.osdpd.noaa.gov/PSB/EPS/SST/climo.html - *sea surface temperature readings.*

http://agnet.com.au/wpreaus.html - *this site gives 10 day precipitation outlooks.*

www.longpaddock.qld.gov.au/AboutUs/ResearchProjects/AussieGRASS/ - *the Aussie Grass site.*

http://www.osdpd.noaa.gov/PSB/IMAGES/gvi.html - *the first site to have vegetation indexes available.*

Trash blankets and climate predictions

BILL, BETTY AND PAUL ATKINSON

'Windaroo'

Proserpine, Queensland

1500mm average rainfall

150 hectares

Producing sugar cane

Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON WINDAROO

- **Trash blankets (retained stubble) used to keep water in the soil.**
- **Assessing climate outlook at the start of the season and setting strategies accordingly.**
- **Adjusting the timing and order of harvest to ensure crops are successfully cut even in wet conditions.**
- **Making advance orders on additional irrigation water if the outlook is dry.**
- **Burning cane on heavy soils if the outlook is wet.**
- **Leaving land with heavier soils out of production in wet years.**

BACKGROUND

The Atkinson family have been in the Proserpine area for 35 years. They grow sugar cane, producing more than 15,000 tonnes of cane a year and aiming to increase that to 18,000 tonnes with the addition of son Paul's new block.

Bill remembers when the country they farm for sugar cane was covered in trees and used for grazing cattle. And both he and Betty recall what happened to their soil after several years of cane farming. It had degraded to a white powder that blew away in the wind. At the time they were also short of water. Bill and Betty knew that they had to re-assess their practices.

Deciding to change to harvesting the cane green and leaving the trash on the paddock, rather than burning cane prior to harvesting, signalled a change of approach for the Atkinson family. From there, it was a short step to working with climate information to make their farming system more sustainable.

ACCESSING CLIMATE INFORMATION

A workshop with Queensland climatologist Roger Stone in 1996 sparked Bill's interest in climate. Betty had studied climate at university and when she saw Bill becoming involved, she brushed up her own skills and joined in. As a result of the workshop, the Atkinsons began to apply climate information to their farming system.

The family looks at rural newspapers (particularly *Queensland Country Life*), magazines and the internet to find their climate information. They receive an email

report each month from the Queensland Department of Primary Industry that summarises most of what they've accessed in other places. Their previous extension officer Bill Webb set up a useful page of links to a variety of weather and climate web sites, which they use often.

The Atkinsons find the Southern Oscillation Index (SOI) a useful indicator of rainfall in the coming season. The strategies that Bill and Betty were following in 1999 have stood them in good stead and they now have a predictable routine for applying the information.

'Coming in to the start of a new season, we'd try to round up as much information as possible to get an idea of the probability of average, above average or below average conditions,' said Bill. 'Once we have that information we put together our strategy for the season.'

'The weather year starts changing in March and by June when the water year starts, you've got an idea of what's happening and can make a few decisions just after June.'

'The strategy varies from year to year,' said Betty. 'We are under a monsoonal influence and because of that there's always going to be huge variability in rainfall, because that's the nature of monsoons. When they come you get them full blast and when they miss, you get nothing. So while there might be similarities from year to year, overall there are different decisions made every time.'

'This year was an example of strategies for a dry year,' said Paul. 'The prognosis from the start was dry and we had to plant while there was moisture available. We planted one particular site much earlier than usual because we wanted to take advantage of the moisture in the soil.'

'In wetter years we could have relied on getting another 40 or 50mm of rain, but this year all the indications were that the ground was drying out and we had to go in early.'

'We also look at what blocks we are going to cut green, especially on heavier country. If it looked like rain – if the SOI was heading up instead of below neutral – we'd probably burn the crops that are on heavier country because otherwise it can become very wet under the trash and you can lose a lot of production. But we only burn when it's absolutely necessary. In a dry year like this, we don't do it.'

Bill also looks at the seasonal outlook before making decisions about leasing additional irrigation water that might become available, such as the allocation for local shires which may not be fully used. When he saw indications of a potential El Niño or neutral pattern in 2004, Bill made inquiries about additional water. At the time of this interview he was holding off on a final decision until he had a better idea of the season.

OBSERVING NATURE

While the Atkinsons take a scientific approach to gathering climate information, they maintain an active interest in observing the natural world and finding indicators for the climatic outlook.

'It's not uncommon to see the ants build up a high nest, in a volcano shape, on the roadways,' said Bill. 'That's usually an indication that rain's coming. They seem to be able to read something.

'Another common thing around here is looking at where the scrub turkeys build their nests. The oldies would say if they build them high up on the creek banks, then big floods are coming. Other times they'll build right down near the water and that means it's going to be dry. Sometimes they're right and sometimes they'll lose their nests!'

Paul said 'I spent 12 years in western Queensland. One thing that's evident this year is the emus. They're breeding full broods this year, five and six chicks following behind them. I heard a comment that during the droughts in the sixties there were very few around because they struggled to find a drink and when an emu can't find a drink things are pretty drastic on the land!

'I don't think the SOI can be taken as gospel truth. It's a bit like looking at nature to determine the weather. Although I think it's a bit clearer and easier to read than nature.'

Bill said 'It's more scientific than looking at the ants! If we've got a consistently positive SOI up here, I'd be wondering how many fine days we had coming up. But at this point in time, we might well have a lot of fine days to come. I suppose we see it as a useful guide more than anything.'

FROM THE 1999 CASE STUDY...

In 1998 the use of climate information was critical at the harvest time, when indications were for a wet August.

'We had just purchased a new block and we couldn't afford to be running on chance', Bill said.

'We worked towards getting the cane planted before August and we took every chance we could to cut.

'As the year rolled on those two decisions worked out well. Our plant cane got up and away before the bulk of the rain came and we got a lot of cutting done in the early part of the year when it was drier', said Bill.

'Whenever the harvester was free we would get it to come and cut, starting on the wettest blocks and working up to the dryer ground so that water wouldn't lie around. This was an instance where it worked.

'We grew a successful cane crop and managed to harvest it all, something not many farmers in the district achieved.'

FROM THE 2004 CASE STUDY...

Trash blanketing improves soil structure, which influences water filtration and the soil's water holding capacity. It also helps control weeds, suppress grass and control rats.

The Atkinsons have been using trash blankets for over 15 years. Their soil has improved dramatically and in dry years moisture is conserved, meaning less water is required for irrigation. The difference can be measured in megalitres – meaning that irrigation savings can be significant.

'There's been some studies showing that with trash blankets you can save up to one or two waterings a year,' said Paul. 'So now we would only burn if it was absolutely necessary, on a year when the indications showed it was looking very wet.'

Web site
http://www4.tpgi.com.au/users/billwebb/bsesext/mainurls/weather.htm *- a site of weather links put together by extension officer Bill Webb. While he has put the site together for Proserpine farmers (and people thinking of going fishing) there are numerous useful links for broader applications.*

The proof in the pudding

ERL AND ROSLYN HAPP

Happs Vineyard

Western Australia

22 hectares at Dunsborough, with 800mm average rainfall

135 hectares at Karridale with 1200mm average rainfall

Producing wine grapes and quality wines

CLIMATE MANAGEMENT TOOLS USED ON HAPPS VINEYARD

- **Monitoring temperature at 20 minute intervals using small temperature loggers at vine height.**
- **Downloading and analysing data to identify heat spikes which can negatively affect grape flavour.**
- **Comparisons with classic wine producing regions around the world.**
- **Focusing vineyard operations on the site with the most favourable climate characteristics.**

Jesse Blackadder

BACKGROUND

In 1999, when he was first interviewed for Masters of the Climate, Margaret River wine maker Erl Happ's theories about the relationship between grape flavours and temperature had yet to be proved. But it turns out the answer was sitting in the winery right at that moment.

The Three Hills 1999 Shiraz provided all the proof Erl could want. It was reviewed by US wine writer Robert Parker Jr who awarded it 95 points (out of a possible 100) and said it 'may be the finest Shiraz I have ever tasted from Western Australia'.

High praise indeed and the review created worldwide interest in the wine. But creating such a successful premium wine (and being able to repeat its success with the 2002 and 2003 vintages) isn't just a fluke. Erl has been studying the effects of climate on grape flavours for many years and he relocated most of his grape growing activities 100km south of the winery to take advantage of the near-perfect conditions for grape maturation that he found there.

DETAILED TEMPERATURE READINGS

Originally holding only 22 hectares in Dunsborough, Erl first started analysing climate in the early 1990s. He quickly realised that mean temperature information was not nearly detailed enough. He invested in a new technology – small and relatively cheap temperature loggers that he sited on vineyards from the Swan River through to Esperance. Each temperature logger is housed in a ventilated metal screen and can store a

reading every 20 minutes over three months.

Erl was working on a hunch: that unusually hot days in the month before harvesting could affect the flavour of the grapes, and therefore the quality of the wine that could be made from them.

'It's quite dramatic here when you get heat spikes,' he said. 'The maximum daily temperature is normally about 25°C. Then it suddenly jumps up to 38°C and you can see there's tissue damage occurring. Scientific work supports this – if the temperature departs too much from the norm too quickly and humidity is low and wind is up, plants stop photosynthesising and they don't recover.

'For a couple of weeks in February the land tends to influence our temperatures much more than the sea. That's when the damage is done.'

THE CRITICAL TEMPERATURE FOR GRAPE FLAVOUR

Erl needed one vital piece of information for his analysis. What was the cutoff point of maximum temperature, after which grape flavour was affected?

'I looked at temperatures in the classic wine growing regions in France, such as Burgundy. I found that these regions had no more than 500 degree hours of temperatures over 22°C during the month of ripening. That gave me a benchmark figure – if you get more than 500 degree hours over that level, don't expect to make classic wines!

'All chemical reactions are driven by time and temperature. The berry is a little chemical factory. It synthesizes flavours. The berry will happily make its flavours at 22°C and it will hold on to them much better if the temperature rarely rises above that figure.'

With this information, Erl concentrated his study area on the coastline between Dunsborough and Albany in the south west corner of Western Australia. With the combination of the data from the temperature loggers and an Excel spreadsheet, he quickly found out where the heat load was favourable. One hundred kilometers south of Dunsborough looked perfect. The Happs purchased additional land at Karridale and focused their grape growing activities on the second property.

'Viticulturally speaking it's a paradise because no matter what variety you grow, the south coast conditions give you a very long season,' said Erl. 'The grapes mature in ideal conditions. You won't get the heat spikes that destroy the flavours.'

FURTHER RESEARCH INTO PLANT PERFORMANCE

Unlike the other Masters of the Climate participants, the Happs did not have to deal with a major drought in the last five years.

'This part of the world has ideal temperatures for growing any grape variety,' said Erl. 'Our winter rainfall is like clockwork, and although our soils are old and leached, they're ideal for grapevines which can conserve mineral elements from year to year.'

While other farmers across Australia struggled to survive, Erl was able to continue his study into temperature and find other applications for the data. He now aims to:

- estimate the potential of a site to reliably ripen a cultivar;
- identify the range of cultivars that will succeed on a certain site, so that the grower can blend different varieties or widen their product range;
- quantify the risk of frost, winter freeze, rainfall, disease or any other site-related circumstance that might jeopardise the enterprise;
- work out whether physiological ripeness might coincide with sugar maturity; and
- ensure that ripening conditions will be favourable to the conservation of flavour in the berry.

'I am collecting data across each 24 hour period and accounting for the experience that a plant has in the zones that are critical to its performance. It gives me a much better idea of why it behaves as it does under different thermal regimes,' said Erl.

'In summary, I've got a much more accurate account of the thermal environment than you can get by simply looking at the daily maximum and minimum temperature.'

If you come across Erl and Ros Happ's premium wine, the Three Hills 1999 Shiraz, I suggest you drink to that.

FROM THE 1999 CASE STUDY...

According to Happ, the change in climate in Europe from Dijon to Marseilles (450 km) is about the same as that between Frankland and the South Coast of WA, some 140 km. Therefore a careful measure of the environment is more critical in Australia than in France…

Happ's conclusion is that appropriate land management for quality wine production begins with selecting sites, choosing varieties and predicting ripening times for each combination of site and variety.

The next step is to check the temperature for one month prior to ripening to look for hot spells which might reduce the content of flavour producing substances. Then the grower can choose the best combination of site and variety to produce quality fruit.

The only objective way to determine if Happ's innovations have succeeded in improving wine quality is to taste new wines, yet to be released. He maintains that the differences are obvious, even to the untrained palate.

FROM THE 2004 CASE STUDY...

'I published three papers in the Australian and New Zealand Wine Industry Journal, but nobody took any notice. Then last year I heard from viticulturalists in Virginia on the east coast of the United States. They were very interested in my theories on temperature and invited me to come and make a presentation.

'I worked through what I've done about grape flavours and heat spikes, and then I went on to my current research into trying to predict when a grape variety will ripen. In the United States many people are gathering temperature data and they mostly use it for predicting pest activity or the risk of disease like powdery mildew. But once the data's there, it can be used for other purposes. They were fascinated.

'My objective is to take data from any part of the world and look back at the ripening conditions and know what you can expect before you even plant a grape. It's much more complicated than I first imagined and I'm still working on it.'

Erl has now enrolled at Curtin University to develop his ideas further in a Masters of Science by research.

Websites

www.happs.com.au - *the site for the Happs winery, which also contains Erl's research papers on temperature and grape flavour.*

What happens when the tap turns off?

JOHN HAMPARSUM

'Drayton'

Breeza, New South Wales

620mm average rainfall

1,480 hectares

Producing irrigated and dryland cotton, sorghum, sunflowers and wheat.

CLIMATE MANAGEMENT TOOLS USED ON DRAYTON

- **Integrating climate and weather information in the transition from mainly irrigated to mainly dryland farming.**
- **Neutron probe technology to measure sub-soil moisture, combined with weather and climate outlooks to make cropping decisions.**
- **Observation of natural indicators.**
- **Weatherzone and Long Paddock websites for weather and climate information.**

Jesse Blackadder

BACKGROUND

John Hamparsum's property Drayton at Breeza, (near Tamworth, NSW) started out as a grazing enterprise when his father first bought it in 1961. Drayton went on to become one of the first irrigation properties in the area, producing cotton, with some wheat, sunflowers and sorghum. Water comes mainly from bores, with some surface water from high flows in the Mooki River.

When I first visited Drayton in 1999, the Hamparsums were facing a major challenge. A departmental change in water licensing from area to volumetric in the early eighties resulted in over-allocation of water resources. John told me they faced losing up to 77 percent of their allocation of groundwater for irrigation.

This posed a serious threat to the farm, which had infrastructure set up for 100 percent irrigation allocation. John's lifelong interest in weather and climate was exacerbated by this pressure and he aimed to run the farm by minimising the amount of water he needed to put on the paddocks and keep it 'in the bank' until dry times.

LOSING 69 PERCENT OF IRRIGATION ALLOCATION

When I visited John again in July 2004, the Hamparsums were still facing the same

uncertainty about their final irrigation allocation.

'The groundwater licences in this valley are severely over-allocated and we're facing a 69 percent permanent reduction in our ground water irrigation licence,' said John.

'That is still going to occur under the new water sharing plan, which is set to start in July 2005. It's a difficult situation and we have to learn to manage our water very efficiently.

'The information we're getting on weather and climate is going to be even more important to us then, because we're going to be in the lap of the gods as far as rainfall goes. Dryland farmers don't have the opportunity to turn on the tap the way an irrigator does. It's going to be a massive change for us to adjust to not having as big a tap.'

'We're already growing dryland cotton and strategically irrigated cotton, where we use pre-irrigation to fill the moisture profile in the soil and then plant and grow it as a dryland crop. That works very well if there's a wet summer.'

Having had a number of years to adjust and plan for the new situation, John has explored new technologies and approaches to keep the farm sustainable after the change. Matching neutron probe technology with weather forecasts is one example.

'You lower the neutron probe down into an aluminium tube in the ground and it sends neutrons into the soil which bounce off hydrogen ions, and it counts the number that come back,' said John.

'Download that into your computer and it shows your soil moisture content at various levels. You can do the same measurement again two days later and the change in soil moisture allows you to work out how many millimetres per day the crop is using. From that you can try and predict when you're going to run out of moisture.

'Then you know how many days away you are from an irrigation. I use it in conjunction with weather forecasts. Say we're ten days away from irrigation but there's a possibility of rain coming in seven days, then I'd keep watching the weather and perhaps save myself an irrigation by not going out early and missing the benefit of the rainfall.'

Although in 1999 John was putting enough faith in longer term climate forecasts to make major farm decisions, he now believes that climate change is making it harder to predict seasonal conditions. He tends to place a stronger reliance on weather forecasts up to 15 days ahead, rather than longer term seasonal forecasts.

'I haven't greatly changed how I find climate information, and I don't believe any new science has popped up as a great indicator of climate. But I rely less on the information I'm getting because I believe climate change is having a big influence on what's happening. Our summer rainfall patterns have changed in a lot in the past 10 or 20 years. There's a lot more guess work now.'

TAPPING INTO INDIGENOUS KNOWLEDGE

Drayton is located in the country of the Kamilaroi people and John is interested in indigenous understanding of climate.

'I believe we really need to tap into that information and try and learn from it. They've had 40,000 years in this climate and we ignore that at our peril. I think it's imperative to gather that information and integrate it with modern science.

'My father learned a few things from an Aboriginal fella about monitoring native plants and he passed it on to me. I've noticed that the native trees can suddenly put out shoots in the middle of a drought. They were quite accurate in this last drought. It happened a couple of times and I put it in the diary and usually within five or six weeks a rain event occurred. It helped us a bit to make irrigation decisions or wait and try to pick up some rainfall. Although this drought was far too severe for it to make much difference!

'That information is thousands of years old and it would be a pity if it died out with the older people in those communities. There's a few fellas around who are able to share their ideas and I think it's up to us to ask as well.'

FROM THE 1999 CASE STUDY...

On 19 January 1991 John Hamparsum experienced first hand the power of weather over his livelihood. In a matter of minutes a hail storm destroyed 80 percent of the year's cotton crop – a catastrophe that almost cost him the farm…

…John had early success using seasonal forecasts to help the farm recover from the 1991 losses. Under pressure from the bank, he was facing forecasts of a dry season in 1992. After talks with the National Climatology Centre, John decided to take the risk of putting down a new irrigation bore, at a cost of $150,000.

'To make the money back we needed a crop. To grow a crop we needed water' John said. 'We put the bore down and as a result managed to increase our yield during a period of no rain. I was able to compare the fields that were irrigated with those that weren't.

'We increased yield by 1.5 bales of cotton per acre on 450 acres in a drought year. We ended up with a 300 percent return on our investment in the first year.'

FROM THE 2004 CASE STUDY...

'I heard [climatologist] Roger Stone comment recently that at the moment the Pacific Ocean is leaning towards an El Niño constantly and it won't take much to push it into El Niño. That tells me I have to manage my business with the information that we could go into El Niño more easily than in the past.

'For me that means cutting back on high risk crops that require water and increasing winter acreage, which isn't so sensitive to heat. We look at the varieties we choose and the timing of the planting – for example, last season [03/04] we had 49 cold shock days for the cotton – the average for the area is 24. Right on top of that, we then had 42 heat shock days which is also unusual.

'We have to get rid of the old attitude of "let's plant on the first of October" and instead really monitor the weather trends leading up to planting. It's getting more complex.'

Websites

www.weatherzone.com.au - *an Australian weather site with various levels of access depending on the needs of the user. Public access levels provide information similar to the Bureau of Meteorology.*

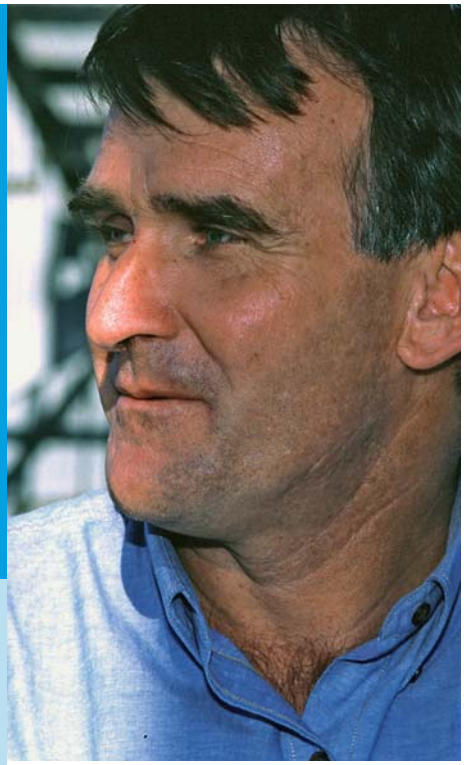
How climate affects the price of crumpets

MARK O'BRIEN

National Grain Manager

Weston Cereal Industries
Tamworth, NSW

Purchasing grain that the company processes into stock feed and flour



Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED BY WESTON CEREAL INDUSTRIES

- **Rainman software.**
- **Bureau of Meteorology seasonal outlook.**
- **Monthly climate forecasts from the QLD Centre for Climate Applications.**

CLIMATE INFORMATION FOR GRAIN PURCHASING

It's not only farmers who are analysing climate and making business decisions accordingly. Mark O'Brien is the national grain manager for Weston Milling and Weston Cereal Industries, with the job of purchasing grain that the company then processes into stock feed and flour.

Mark began using climate information after the 1994 drought. In his first Masters of the Climate interview in 1999 he said: 'There was a very good paper published where researchers Nichols and Rimmington correlated Australia's rainfall by state with the SOI for the previous 30 years.

'I thought NSW and QLD showed reasonably good correlation and that's what woke me up. I only became aware of that paper in 1995, after the 1994 drought had been quite a lesson for everyone.

'I was also strongly influenced by several published papers showing that plant growth correlates to the SOI more strongly than it does even to rainfall.'

Mark's research convinced him of the value of following climate forecasts and factoring them into his management decisions.

'The products that we use now are the seasonal climate outlook from the Bureau of Meteorology, the monthly climate forecast from the QLD Centre for Climate Applications and Rainman software,' said Mark. 'We're particularly interested in how climate variability and rainfall impacts on wheat production. We look across Australia, but with an emphasis on the eastern states.

'If the forecasts are telling us we're going to have a drought, then we may buy more grain well ahead of the harvest to avoid the drought premium that comes from reduced crops.

'If the predictions are for plentiful rainfall, that means a large crop, but it might have lower protein levels and for making various flours there are specific protein requirements for baking. Then we have an idea if high protein wheats will be hard to get.'

GETTING IT RIGHT IN A DROUGHT

When I first visited the company in 1999, Mark had an impressive series of examples of how using climate information had saved Weston Cereal money or improved profit margins [see 1999 box story]. In 2004 he was more circumspect about being able to correctly analyse complex climate information and apply it for the greatest benefit.

'The tools work very well, but we didn't use them as well in the 2002 drought. Though the SOI held in negative through late August, it was only around minus 10 to minus 15 and I didn't believe that would result in a severe drought.

'As the people at the Department of Primary Industries in QLD often point out,

you can have a SOI pattern of minus 10 or minus 20 and still have no drought, it just decreases the likelihood of rainfall.'
With the 'drought premium' pushing up prices early in the season, Mark decided to wait and see what happened, knowing that planting could take place any time through to July and that reasonable rainfall was likely. But in this instance the deferred purchase didn't pay off.

'As the season progressed, none of those events occurred. We ended up having a severe drought in 2002 across eastern Australia and our decision not to buy more grain earlier resulted in much high prices through to December,' said Mark.

'If we hadn't done any climate analysis at all, we probably would have done the same thing and not purchased any grain. But we could have made a better choice, which was to acknowledge we needed to pay a risk premium that year and purchase grain at a higher price. We thought it was too high at the time, but it would have been lower than the prices that eventuated.

'The main thing I learned was to accept the lack of certainty. You've got to work with probability better, and accept that there's no such thing as a guaranteed outcome. You can only make decisions in light of the probabilities that are shown to you at that point in time.'

FROM THE 1999 CASE STUDY

'In 1996 indications were for good winter rainfalls, and we thought it might be hard to get high protein wheat, because protein levels are related to winter rainfall. We contracted wheat much earlier in the year.

'In 1997 the SOI just plunged during April and it influenced us to buy a greater than normal amount of our wheat early on to ensure supply. By the spring the price of grain had gone up about 70% because of the very tight winter.

'Weather is also of interest and is probably more heavily used than climate in my job' said Mark. 'That's partly because you can immediately see the outcome of a weather event.

'For example, in 1991 we had a drought here in the eastern States. Someone offered sorghum at a particular price and I thought we haven't sown the sorghum crop yet, perhaps I'd better buy that as security. But they had looked at the satellite chart and seen a big mass of cloud coming across whereas I hadn't.

'After that rain the market fell seven percent within a week. It taught me to look at it each and every morning!'

FROM THE 2004 CASE STUDY

'We used the tools well during the 1990s, mainly because of our belief that the SOI is well correlated with poor crops, particularly in QLD and northern NSW.

'In 2002 I thought we might have a repeat of what happened during the 1990s, where often you would have a very low SOI in Queensland and far northern NSW through to Port Macquarie, however southern and central NSW and Victoria would still have reasonably good crops.

'As it turned out, in NSW the crop went down from seven million tonnes to two million tonnes. Our company had to import grains from overseas.

'In hindsight, I probably was being a bit too nit-picky in trying to deny the risk premium earlier in the year when the risk was substantially lower. In this situation again, we'd recognise that we do need to pay some insurance premium.'

Websites
http://www.dpi.qld.gov.au/climate/ *- the site of the Queensland Centre for Climate Applications.*

Making money from moisture

CHRIS AND SARAH ROCHE

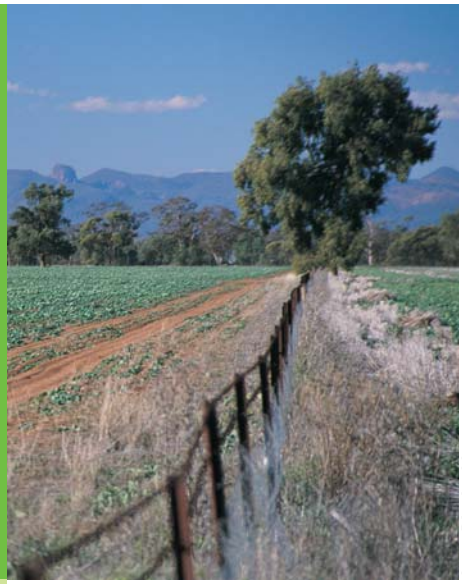
'Reedsdale'

Gulargambone, NSW

590mm average rainfall

2400 hectares

Producing wheat, lupins, canola, lucerne, merino sheep and fat lambs.



Jesse Blackadder

CLIMATE MANAGEMENT TOOLS USED ON REEDSDALE

- **Watching the SOI to look for high rainfall indications.**
- **Understanding rainfall probabilities through the 'chocolate wheel' approach.**
- **Conserving available moisture through practices such as zero till.**
- **Varying crop rotations to account for seasonal conditions.**
- **Being prepared to act quickly to capitalise on rainfall events rather than working to set schedules.**
- **Long Paddock and COLA websites for weather and climate information.**

BACKGROUND

Reedsdale is a mixed cereal farm growing wheat, canola, barley and lupins, plus running merino sheep and fat lambs. Chris and Sarah Roche have farmed the property since 1992.

Five years ago, when he first participated in Masters of the Climate, Chris was an enthusiastic member of a climate study group run by the local office of NSW Agriculture as part of research trial funded by the Grains Research and Development Corporation.

Today he has tempered his initial enthusiasm for basing his crop rotations on seasonal outlooks and SOI movements with the philosophy of being ready to take every opportunity to capitalise on available moisture.

THE SOI IS A BLUNT INSTRUMENT

Chris remembers the first meeting of the climate group in a local hall in 1998, after a run of four dry years following the 1994 drought. Climatologist Peter Hayman (then with NSW Agriculture) told the group that wet times were coming and by the end of the meeting, rain was drumming on the roof.

'It started raining at Curban Hall and then hardly stopped for the next two years,' said Chris. 'In 1998 and 99 they were able to say with a lot of confidence that it was going to be wet and they were right.'

The group used the 'chocolate wheel' model developed by Peter Hayman as a way of understanding probabilities. This method shows the seasonal probabilities in relation to the Southern Oscillation Index (SOI) on a pie chart. For example, a falling SOI in April/May results in pie chart showing a 38% change of normal rainfall, a 29% chance of lower than average rainfall and a 33% chance of higher than average rainfall for the Gulargambone district. Farmers are encouraged to look at the circular pie graph as a spinning chocolate wheel – the needle can land anywhere when the wheel stops spinning, but the chances of it being normal (in this example) are higher.

In the first two years of using the chocolate wheel and examining the SOI, Chris and Sarah were able to make specific choices about crop rotations, long fallowing versus cropping back-to-back, and applications of nitrogen fertiliser. They could see the benefits of the new tools very quickly (see '1999 case study' box below).

However after 1999, Chris found that following the SOI movements was less informative than in the first two years.

'Since 1999 they haven't been able to say anything very much with a lot of confidence,' he said. 'The last three or four years, the SOI has been a very blunt instrument for us and that's a problem. We haven't been able to get a lot of value out of it. In the last two years I haven't been able to confidently go and put extra nitrogen out based on that information.

'The main thing I've learned is that a low SOI isn't necessarily bad for this area. The

years that are bad for us are when it hangs around zero all the time.'

Chris now sees climate information as being one tool for farm decision making, but far from the most important one. He says there is so much to get right in his area from a cropping point of view, that if a farmer does succeed, he is in effect successfully managing the climate.

'At the end of the day, the SOI is a probability and for the past few years the probabilities have been around 50 percent, which is no better or worse than a farmer going outside for a look and saying "It's a blue sky, it's not going to rain today",' said Chris.

'But having said that, if there was a positive or steadily rising SOI in March or April I'd be battening down the hatches and expecting pretty high rainfall! We haven't seen that since 1999.'

The Roches are focusing their efforts on maximising moisture conservation and being ready at any moment to take advantage of available moisture.

'I'm really big on being ready when something happens,' said Chris. 'If I'm planning to sow in April, I have all the machinery ready by the middle of March because if it suddenly rains in the first week of April, I want to go in straight away. This year we finished sowing on May 17th and there were a hell of lot of people who hadn't even started.

'We have a five year rotation, but it varies depending on how much moisture is there at sowing time. I sit down in about March and look at the sub-soil moisture and then plan the crop rotation for the year.

'At the end of the day, we try and conserve as much moisture as we can, because we're in the business of trying to make money out of moisture. In this country, money is made by using correct rotations and conserving moisture.'

FROM THE 1999 CASE STUDY

'If the SOI is falling or negative and I've got low sub soil moisture, I would long fallow to take advantage of any extra moisture. Under that rotation I would be looking at three wheat crops in five years,' said Chris.

'I used to always crop long fallow like this, but in an above average rainfall year a lot of moisture would be wasted. After studying climate in more detail, I saw that in certain years I could crop back-to-back instead.

'This year we have a full profile of moisture and a rising SOI, so I will grow pulse crops instead of fallowing. Combined with zero-till and no grazing on our cropping country, we are getting better moisture retention and we are better able to make use of high rainfall years.'

FROM THE 2004 CASE STUDY

'You've got to deal with what you've got. If it does rain, but they say it's going to be a below average season, I'd be a fool not to sow anyway.

'When they're saying they don't know what the season's doing, I don't pump the crop up for big yields and I'd use less fertiliser.

'At the moment I'd really like to put some nitrogen out on the canola and wheat, but the SOI's not telling us anything, it's all over the shop. They're not telling us with enough assurance for me to be putting out $10,000 worth of fertiliser. I've got the nitrogen ordered and ready to go and I'm looking at the ten day forecast pretty closely.'

Web site

http://grads.iges.org/pix/prec7.html - *the 10-day precipitation outlook for Australia from the Centre for Ocean Land Atmosphere Studies.*

http://www.longpaddock.qld.gov.au/ - *climate management information for rural Australia, provided by the Queensland Government.*

Science behind the case studies

By Dr Barry White
Research Coordinator
Managing Climate Variability Program
Land & Water Australia

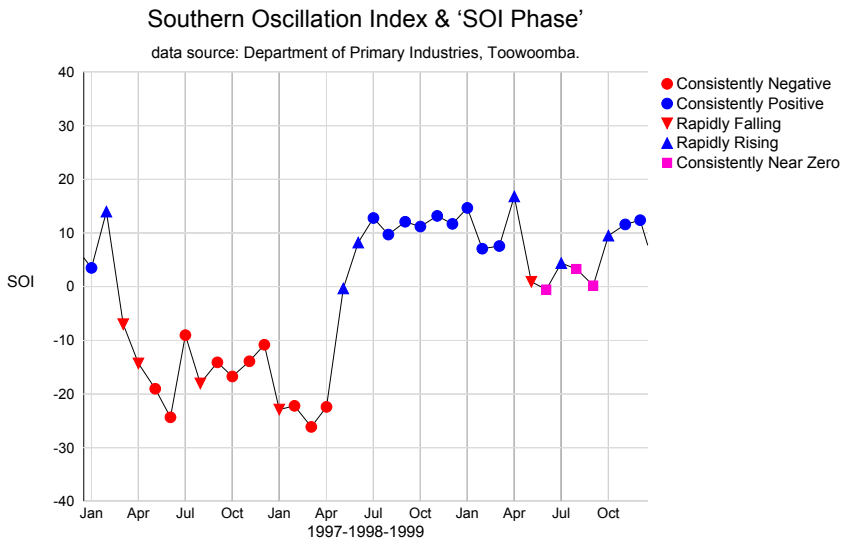
The Masters of the Climate case studies drew out a number of tools that participants are using to manage for climate variability. This article explains how some of those tools can contribute to improved climate risk management. The information on use of seasonal forecasts is necessarily general and should be checked for its relevance in particular situations.

TRACKING THE SOI

The Southern Oscillation of atmospheric pressure across the tropical Pacific has long been recognised as a major climate feature. The Southern Oscillation Index (SOI) is a measure of the air pressure difference between Tahiti and Darwin. The SOI can be used at some times and places, especially across eastern Australia in winter and spring, to see whether the chances of above or below average rainfall have changed for the next few months.

The SOI has been remarkably enduring as a simple predictor of chance of rainfall a few months ahead, but the pattern is not simple or constant over the year and needs to be understood to assess usefulness at a particular location. Darwin pressures partly reflect the Southern Oscillation and correlations were developed between Darwin winter pressures and spring rainfall in parts of Victoria in the first half of last century.

All of the farmers interviewed for Masters of the Climate were aware of the SOI and applied it to some degree in predicting seasonal rainfall. They generally understood too that the SOI only explained a small part of the variability in their rainfall, but it could give them an edge.



ENSO - THE SOUTHERN OSCILLATION INDEX MEETS EL NIÑO

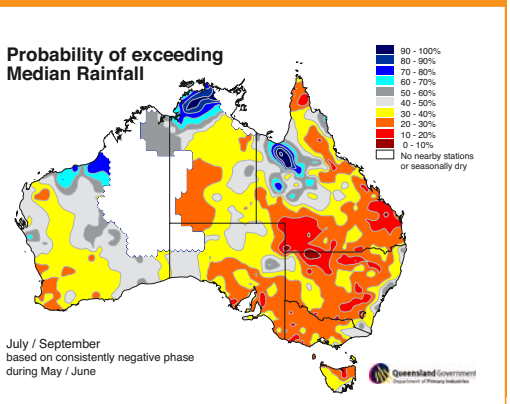
El Niño was traditionally seen as an occasional and unusual warming event in the tropical eastern Pacific. In the middle of the last century the breakthrough connection was made between the two sides of the coin – the SOI as a measure of unusual patterns in atmospheric pressures and El Niño characterised by sea surface temperatures (SST). The SOI does give a good indication of ENSO (El Niño Southern Oscillation) as indicated by SST in defined areas of the eastern Pacific. But not so good that you can rely on one measure and not the other.

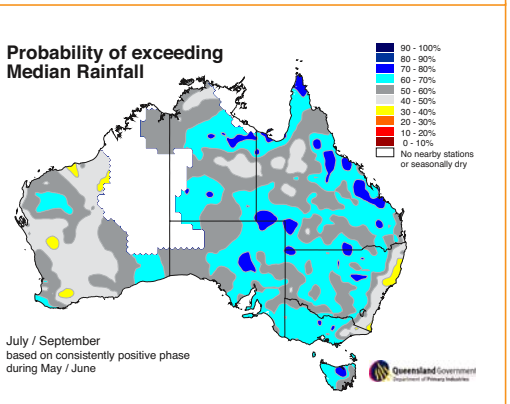
EL NIÑO AND LA NIÑA

ENSO is not a regular cycle but it does have some clear, now well understood, and very useful patterns. A typical El Niño event typically shows up in the SOI and SST measures in early winter and persists, often through to the next autumn (see the SOI diagram below). An El Niño event (defined by higher than average SST in an eastern Pacific region) will usually be reflected in a consistently negative SOI in winter and spring. The impact on Australian rainfall is a markedly increased chance of below-average rainfall, particularly in eastern Australia in winter and spring, but less so in most areas near the coast.

The La Niña phase is the opposite and was a big factor in some of the record rainfall periods, for example during the 1950s and the 1970s. The SOI example overleaf shows the 1998-1999 La Niña event which some of the Masters of Climate farmers reported responded to, for example moving livestock from country with an increased flood risk, or planting an extra summer crop.

In the graph of the SOI and the associated SOI phases, the consistently positive value of the index of over 10 through winter and spring through 1998 indicates how the La Niña event developed and persisted.
The El Niño event that developed during autumn and persisted through spring in 1997 is a classic example. The consistently negative SOI through the winter and spring of 1997 was a very similar pattern to previous El Niño events. The rainfall patterns in those previous events gives the basis for a forecast of the likely impact on rainfall probabilities.





FORECASTS USING SOI PHASES

The El Niño and La Niña examples show the typical and broad scale pattern of the SOI through two of its more extreme cycles. Only some El Niño events flip so dramatically to a La Niña. Key points to note are that the autumn period is when the big changes mostly happen and a new ENSO phase is consolidated.

The El Niño and La Niña years are usually the years when there are big deviations in the SOI from its average value of zero. These are also the years when there are the most sustained and widespread shifts in the rainfall odds – for an El Niño in mid winter, the chances of above average spring rain are halved across much of eastern Australia. Thus the seasonal climate forecasts are most useful when rainfall is often most critical. Not suprisingly ENSO accounts for a large part of the variability in national wheat yields.

CHANGING THE CHANCES - EL NIÑO IMPACTS ON FARMS, MARKETS AND ECOSYSYSTEMS

Over the last century, El Niño events have occurred about one year in four, irregularly spaced and even back-to-back. This frequency is less than what most would recall as big droughts. That one-in-four frequency shows that not every El Niño results in a big drought. It is also true that some droughts are not associated with an El Niño event. What can be said is that an El Niño event in the Pacific changes the chances.

The red and brown areas on the map have a less than 30% chance of recording above median rainfall. This is about the same as saying that at the end of June in previous El Niño events, only about three out of ten had received above average rain from July to September. That can be further turned around to say that during an El Nino year below average rainfall is more than twice as likely as above average rainfall. This sort of approximation is also in keeping with the precision in the map which shows what happened for the number of years in a particular phase.

The odds are such that a particular location or farm might miss out on a drought in a particular El Niño event. But there are wider implications. El Niño droughts are typically widespread to the extent that they can have major regional and national impacts on feed and livestock markets, as well as water resources and ecosystems. For example the eight most severe droughts in the Australian grain producing regions have been El Niño events. Risk management will therefore often need to take a wider perspective.

LOOKING DOWN AND UP - MONITORING TO ADD VALUE TO SEASONAL CLIMATE FORECASTS

Once farmers looked to the skies for clues to the weather. Now we can add the oceans to the list, particularly for the season ahead. But the best forecast is often already in place. Stored soil water has often been overlooked for its value in determining the possibilities for the next crop. And the combination of knowing current soil moisture and a seasonal climate forecast can be even more valuable. In northern NSW the prospects for a summer crop don't change much in an El Niño if there is a good profile of soil water. Further north an opportunistic summer crop might be contemplated in a La Niña summer depending on current soil moisture reserves. In a grazing enterprise, the soil moisture story and current pasture reserves need to be taken into account with a seasonal climate forecast.

USING FORECASTS INCLUDING THE SOI AND INDIAN AND PACIFIC OCEAN TEMPERATURES.

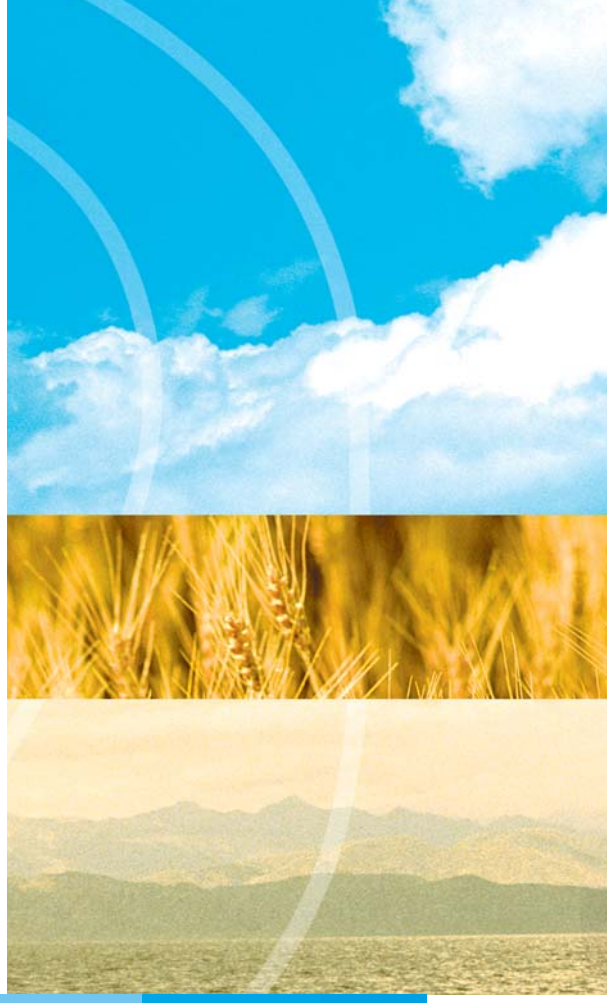
There are a number of professional forecasting services available in Australia, as well as the Bureau of Meteorology. The Bureau of Meteorology seasonal climate outlook is based on sea surface temperatures in the Pacific and Indian Oceans. The addition of the Indian Ocean temperatures appears to be of particular value in autumn in some regions. The Long Paddock (QLD Department of Primary Industries) seasonal climate forecasts are based on the five SOI phases. Several of the farmers interviewed were able to make use of specific forecasts for their area and integrate the information into their farming practices.

FROM PUNTER TO BOOKIE

Some of the farmers adapted and changed their approach btween 1999 and 2004. The traditional punter style was to try and pick a winner and that determined the decision in an all-or-nothing sense. Some realised, sometimes after bitter experience, that seasonal climate forecasts do nothing more than change the odds. The bookie style is to aim to cover the main chances and aim for something closer to a win/win situation. A simple example is bringing forward the usual time when additional feed is purchased if the chances of an El Niño are increasing. Another is extra nitrogen on a summer crop in the expectation of a La Niña summer, but recognising that if the nitrogen is not all used up, there will be some carryover benefit.

As Mark O'Brien noted 'The main thing I learned was to accept the lack of certainty. You've got to work with probability better, and accept that there's no such thing as a guaranteed outcome.'

Glossary of terms



40-DAY WAVES
Also known 30-60-day waves, intra-seasonal oscillations, or Madden-Julian oscillations. Low pressure waves sweeping west to east across the top end of continent irregularly every 30-60 days (average 40 days), and triggering rainfall events.

AVERAGE
Average rainfall is calculated by dividing the total by the number of entries, i.e. the arithmetic mean.

DECILES
Divide a set of recorded rainfalls (monthly, seasonal or annual) into ten groups. The lowest 10% of falls belong to decile range 1, the next lowest to decile range 2 and so on, up to the highest 10% of recorded falls, which belong to decile range 10. The top of decile range 5 is the median.

DROUGHTS
Or severe rainfall deficits, occur when a 12-month period receives less rain than in the driest 10% of calendar years. In eastern and northern Australia, they are often associated with strongly negative SOI values, commonly referred to as El Niño event or episode.

ENSO
(El Niño-Southern Oscillation) is a composite term referring to the whole suite of events associated with these negative SOI episodes.

Glossary of terms continued

EL NIÑO
Originally referred specifically to a warming of the sea off the coast of Peru, now more generally used for the unusual warming of a large area of the eastern equatorial Pacific Ocean. This is strongly linked to changes in the Walker Circulation and to negative phases of the Southern Oscillation.

LA NIÑA
Now used to refer to the opposite of an El Niño , or events associated with positive values of the SOI.

MEDIAN
Median rainfall is calculated by ranking totals from highest to lowest. The middle figure is the median. Annual rainfall averages and medians are usually close. Monthly averages may be well above the median in arid regions where the average is distorted by rare, but torrential, rainfall events.

PROBABILITY
The chance of an event happening expressed as a percentage. A probability of 70% means the event can be expected to occur in 7 out of 10 years.

SOUTHERN OSCILLATION
A see-saw of atmospheric pressure anomalies between the Indonesian region and the eastern tropical Pacific Ocean.

SOUTHERN OSCILLATION INDEX (SOI)
Southern Oscillation Index measures the strength of the Southern Oscillation; Troup's Index compares the difference in atmospheric pressure between Tahiti and Darwin.

SST
Sea surface temperature.

WALKER CIRCULATION
The cellular flow of air in a vertical plane over the equatorial Pacific Ocean. Warm, moist air rises over the Indonesian region and tropical western Pacific within the ITCZ, releasing rain. The air then moves at high altitude (12 000 m) to the east and descends over the colder water of the eastern Pacific.

Masters of the Climate is a joint project between

MANAGING CLIMATE VARIABILITY R&D PROGRAM

LANDCARE AUSTRALIA

blackadder communication.

words that work