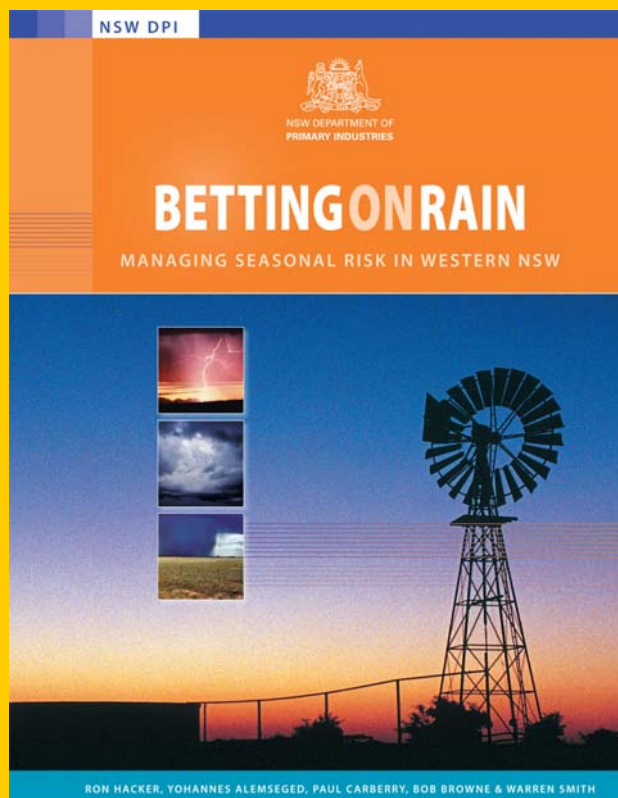


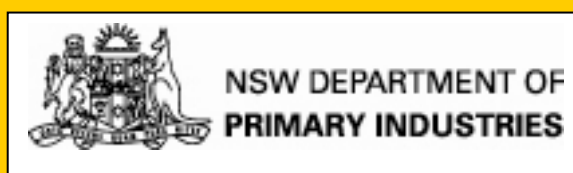
IMPROVED SEASONAL FORECASTS FOR WOOL PRODUCERS IN WESTERN NSW



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FINAL REPORT
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ABSTRACT

This project aimed to

1. Investigate the skill and operational usefulness of seasonal climate forecasts (SCF) in the NSW pastoral zone and the adjacent marginal cropping zone
2. Work with graziers to develop protocols for incorporating SCF into management decision making, including the identification of critical dates/periods and
3. Develop and deliver, in conjunction with graziers, a learning package on the use of SCF in grazing management systems.

A network of 323 co-operators was established throughout the Western Division and the adjacent cropping zone to achieve the industry interaction required by the project. Experience gained by interaction with this network indicated that the term 'seasonal risk assessment' (SRA) is less likely to lead to ambiguity than SCF, and the term has consequently been adopted in this report.

Surveys of these co-operators identified the management decisions most likely to be influenced by SRA. In livestock enterprises, these are primarily tactical decisions to sell (or buy) stock. Strategic decisions relating to the cycle of animal husbandry are not likely to be influenced by SRA. Similarly, major cropping decisions at the start of the growing season are not amenable to influence by SRA but in-crop management decisions could be.

With cooperation from the national support project we identified the SOI phase system, with assessments based on the probability of exceeding median pasture growth rather than median rainfall, as the best of the currently operational SRA systems for western NSW. Useful skill is restricted to (3-month) outlook periods commencing between June and September (inclusive) but assessments at this time can contribute to important tactical decisions regarding livestock sales or purchases, and to in-crop management.

At other times, when SRA's have little skill, trigger points for livestock sales (or purchases) can be determined from analysis of historical growth patterns derived from the WinGRASP model. These growth patterns, and their associated trigger points, were identified for 21 locations throughout the project area in cooperation with participating landholders. Growth patterns derived from WinGRASP were modified by graziers to fit their experience of seasonal growth fluctuations for a further 6 locations. Most producers throughout the region should now be able to interpret trigger points for their own property.

Feedback was received from the co-operator network in response to nine newsletters distributed during the project and 14 regional workshops (some poorly attended). Critical issues identified by this feedback are the need to distinguish short term weather forecasts from SRA, and to clearly understand probabilistic nature of the latter. Effective promotion of SRA tools will also require careful explanation of pasture growth modelling and the increased skill associated with pasture growth compared to rainfall, and succinct explanation of the derivation of trigger points. In the longer term, the re-evaluation of forecast skill for more extreme events than the median, particularly events below the 20th percentile, would probably increase the interest in SRA for many producers.

Tools for managing seasonal risk, based on climatological data and the findings of the project, have been published in the booklet *Betting on Rain: Managing seasonal risk in western NSW*, 3500 copies of which are now available at no cost to woolgrowers in the project area.

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**Land & Water Australia
Project Reference No.** DAN16

Project Title: Improved Seasonal Forecasts for Wool Producers in
Western New South Wales for the Climate
Sub-program of Land, Water & Wool.

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Project duration: Phase 1 15/11/2002 – 15/11/2005
Phase 2 15/11/2005 – 30/5/2006

Report due date: 30 May 2006

Project objectives:

1. To investigate the skill and operational usefulness of seasonal climate forecasts (SCF) in the NSW pastoral zone and the adjacent marginal cropping zone;
2. To work with graziers to develop protocols for incorporating SCF into management decision making, including the identification of critical dates/periods;
3. To develop and deliver, in conjunction with graziers, a learning package on the use of seasonal climate forecasts in grazing management systems.

Summary of results against objectives:

Objective 1: To investigate the skill and operational usefulness of seasonal climate forecasts (SCF) in the NSW pastoral zone and the adjacent marginal cropping zone.

With the assistance of the national support project the usefulness of alternative seasonal risk assessment systems was investigated for the area of western NSW comprising the Western Division and the adjacent Rural Lands Protection Boards (RLPB) on the eastern margin. In total this area contains approximately 9000 RLPB rate payers. The area was subdivided into seven subregions, based on RLPB boundaries, in an attempt to reflect the gradients in rainfall seasonality and amount that exist from north to south and east to west, respectively, across the region. Both the SOI (5) Phase system and the SST (9) Phase system were evaluated for a range of lead times and outlook periods commencing at monthly intervals throughout the year, and with both rainfall and pasture growth as dependent variables. The initial evaluation of these systems was based on the chi square statistic and particular combinations of dependent variable, lead time, outlook period and starting month were considered to have 'useful skill' within a subregion if the chi square values (relating to individual 5 x 5km pixels) were significant ($P < 0.05$) over at least 80 per cent of the area. The conclusions of this analysis were that the 'skill', or more precisely the strength of the association between indicator and dependent variable as measured by chi square, was greater:

- for the SOI phase system then the SST phase system;
- for pasture growth compared with rainfall;
- for 0 or 1 month lead times, and 3 month forecast periods, than for other combinations
- in spring and early summer, compared with other times.

Following the second project workshop in June 2004 these analyses were repeated by the national support project using the Kruskal-Wallis statistic rather than chi square. At this time, the NSW project did not have the resources available to repeat the subregional analysis of the resulting significance images but visual comparison provided no basis for any substantial revision of the original conclusions.

Following the project review in April 2005 the national support project again reanalysed the relationships using the LEPS (Linear Error in Probability Space) approach to forecast skill assessment. Visual interpretation of these analyses, for three month pasture growth and zero lead time, indicated that the period of high and spatially coherent skill commenced two months earlier than indicated by the original chi square analysis, and also terminated earlier. We therefore concluded that for practical purposes useful skill could be considered to exist for zero lead, three month pasture growth forecasts commencing from June to September (inclusive). Since LEPS scores for pasture growth could not be calculated for forecasts with longer lead times, but chi square analysis had indicated strong associations at non-zero lead times for some subregions, we further determined that for practical purposes some risk assessments with non-zero lead times should be made available, with the caveat that they be regarded as 'experimental prototypes'. This decision was taken in conjunction with the LWW Program Coordinator. These experimental prototypes were subsequently published, with lead times of up to two months, based on the SOI phase observed from June to September (inclusive).

Separate surveys of wool producers and mixed farmers in the Western and Central Divisions respectively indicated that decision making in livestock enterprises was similar in both systems. In particular, the annual husbandry calendar was largely determined by the perceived importance of grass seed problems in spring. The need to have sheep in short wool at this time, and for lambs to be old enough to shear before the critical period, determined both the shearing and lambing dates for many producers. The timing of such activities is not likely to be influenced by seasonal risk assessments. However, in both systems the sale and, to a lesser

extent, purchase of sheep can occur at any time during the year and these tactical decisions are likely to be highly amenable to influence by seasonal risk assessments.

Major decisions at the start of cropping operations (e.g. whether or how much to sow) were found to be strongly influenced by current conditions rather than by seasonal climate forecasts. However, in-crop management decisions (e.g. to apply extra fertiliser or to graze off a crop likely to fail) would probably be much more amenable to such input.

We therefore concluded that the operational usefulness of seasonal risk assessments was restricted to tactical decisions in the winter-spring period and that (particularly for wool producers) assessment of likely pasture growth based on the SOI Phase system was the most useful information currently available.

Objective 2: To work with graziers to develop protocols for incorporating SCF into management decision making, including the identification of critical dates/periods.

In addition to the surveys of wool growers and mixed farmers in the Western and Central Divisions noted above, we established a network of 323 co-operators who received a total of nine newsletters over the course of the project. Many of these co-operators provided formal feedback to simple questionnaires included in the newsletters, and a relatively small number attended one of 14 workshops organised during phase 1. The Project Coordinator, Mr Bob Browne was largely responsible for the establishment of this network.

Overall, the major conclusions drawn from the producer surveys were that:

- Annual livestock husbandry calendars are not likely to be influenced by seasonal risk assessments but tactical decisions related to sale or purchase of stock (particularly sales) could be strongly influenced;
- Substantial opportunity exists to increase the number of livestock producers using seasonal risk assessments in this way;
- Planting decisions in cropping operations are not strongly influenced by seasonal risk assessments but in-crop management decisions could benefit from such information.

Use of seasonal risk assessments to assist tactical decision making is thus the major means by which such information can benefit wool producers and mixed farmers in western NSW.

Major issues identified by the feedback from newsletters and workshops were:

- Widespread concern for the ‘accuracy’ of seasonal risk assessments or forecasts, despite apparent acceptance by most participants that such assessments are statements of probability and are therefore neither ‘right’ nor ‘wrong’;
- Widespread support (64 of 115 respondents to one newsletter survey) for seasonal outlooks based on the probability of more extreme seasons than the median, particularly for events either below the 20th percentile or above the 80th percentile ;
- Most producers (over 90%) apparently required a probability of at least 70 per cent in order to change a management decision on the basis of a seasonal risk assessment;
- Limited support (only about 40% of 169 co-operators contacted by the Project Coordinator) for seasonal risk assessments based on pasture growth rather than rainfall, indicating considerable unease with this new approach, and the modelling that supports it, despite higher forecast skill;
- General agreement that data from the SOI Phase system would be useful at those times when skill is relatively high;
- The project newsletter had been an effective communication tool and the inclusion of educational articles in response to producer feedback has been integral to its success;
- Qualified support for the concept of trigger points provided the model used to generate growth profiles was well calibrated for specific situations, particularly ‘red’

soils versus 'black' soils, the method of deriving the growth profiles from historical simulation data was well understood, and a measure of inter-annual variability in growth could be provided.

Some of these issues could not be addressed within the scope of the project (e.g. development of risk assessments based on more extreme events). Others in various ways shaped the development of the major output from the project (see Objective 3 below).

Early in the project we abandoned the idea of attempting to define critical dates or periods in the annual management calendar for which useful seasonal forecasts should be developed in favour of an evaluation of the degree of predictability present in the biophysical system. When this is known, producers may take advantage of it as best suits their operation or, if feasible, change their operation to take advantage to whatever predictability is available. Our analysis of seasonal risk assessments under objective 1 above is consistent with this approach.

Nevertheless, wool producers will sometimes need to make important tactical decisions at times when no useful skill is available in seasonal risk assessments provided by the SOI Phase system. To assist such decisions we developed the concept of 'trigger points' - calendar dates beyond which decisions that depend of future forage availability should not be delayed if actual conditions on the ground are cause for either concern or (less critically) optimism. We developed a method of defining these dates based on (simulated) growth profiles that reflect three-monthly growth potential for fortnightly starting points throughout the year, and tested the concept with producers in some of the workshops conducted in phase 1. Based on their generally favourable response, but also on concerns expressed for the accuracy of the modelled data and the need to understand inter-annual variability of pasture growth, we subsequently cooperated with 41 producers who volunteered to evaluate a range of alternative growth profiles and data presentation formats for their properties. Acceptable profiles based on modelled pasture growth were identified for 21 locations, while co-operators modified the modelled patterns to conform to their experience in a further six cases. There was no distinct preference for data presentation formats and a combined format was thus developed for publication of the 27 data sets, together with details of the broad country types associated with each, in '*Betting on Rain*' (see below). Many (though not all) graziers across the project area should now be able to identify trigger points for their property based on the data provided.

Objective 3: To develop and deliver, in conjunction with graziers, a learning package on the use of seasonal climate forecasts in grazing management systems.

The learning package developed by the project is the publication '*Betting on Rain: Managing seasonal risk in western NSW*'. This booklet contains the major scientific findings of the project, simple manual-like instructions for use of the tools based on these findings, and background material dealing with weather and climate systems in western NSW. This background material was included specifically in response to feedback received at project workshops in phase 1.

Unfortunately, training workshops for producers based on this publication were not feasible in phase 2 of the project due to delays associated with the rigorous and beneficial review process to which the manuscript was subjected, and the time required to resolve a number of issues arising from the subprogram review in April 2005. However, deteriorating seasonal conditions across the region during this period would probably have severely curtailed such activity in any event.

Adoption, communication and technology transfer

The network of 323 co-operators throughout western NSW comprised mostly wool producers but included a small number of service providers. Over the course of the project, communication with these co-operators included:

- Distribution of nine newsletters containing project results, articles on specific issues that feedback indicated required clarification, and seasonal outlooks at appropriate times. Five of the newsletters provided an opportunity for formal feedback;
- Conduct of 14 workshops in local venues which included presentations on weather and climate systems affecting western NSW, project results, and the opportunity to raise issues with the project team. Overall, these workshops were poorly attended with a total of 84 participants not all of whom were members of the co-operator network.

Experience gained during the project indicated that the term 'seasonal risk assessment' (SRA) is less likely to lead to ambiguity than SCF, and the term has consequently been adopted in communication of project results related to pasture growth. Confusion probably arises due to the tendency to equate probabilistic three-month seasonal climate forecasts with categorical short term weather forecasts which can be assessed as 'right' or 'wrong'. Probability based statements cannot be assessed in this way.

The free-of-charge publication '*Betting on Rain. Managing seasonal risk in western NSW*' will be the major resource to assist adoption of SRA in this region. In addition to general background information on weather and climate systems this booklet contains data that should enable producers in the region to better manage seasonal risk on an ongoing basis. These data include:

- Monthly rainfall deciles for 12 locations throughout the region
- SOI Phase probability maps (showing the probability of exceeding median pasture growth for three month outlook periods and for each phase of the SOI) for those periods and lead times considered to display reasonable 'skill';
- Pasture growth profiles for 27 locations throughout the region that should enable many (though probably not all) producers to identify 'trigger points' to assist stocking decisions, especially at times when no reliable risk assessment is provided by the SOI Phase system.

Adoption of the concepts incorporated in the booklet, and promotion of its use as a basic resource for western wool producers, will be achieved in a number of ways and will be an ongoing process. During the term of the project, related activities in addition to the newsletter and workshops described above have included:

- Two workshops presenting the concepts contained in the booklet for staff of service organisations; a total of 14 individuals attended representing extension, advisory, and regulatory staff of DPI (6), Catchment Management Authority (CMA) staff (3), RLPB ranger (1), Western Lands Commission inspector (1), Drought Support Worker (1), private agronomist (1) and ABC Rural Reporter (1);
- Distribution of a promotional flyer and order form for '*Betting on Rain*' to all landholders in the Western Division through the March-April 2006 issue of the Western Division Newsletter (2800 flyers were distributed but this represents the entire newsletter mailing list which includes numerous individuals and institutions outside the Western Division). At the time of writing 170 orders for the booklet had been received;
- Promotional articles for '*Betting on Rain*' in the Western Division Newsletter and *Agriculture Today*, a DPI newspaper that is distributed monthly as an insert in *The Land* and reaches a wide audience in NSW;

- Provision of promotional material on ‘*Betting on Rain*’ for newsletter use by the national Bestprac project, Central West Farming Systems and the Western, Lower Murray-Darling and Murrumbidgee CMAs;
- Direct distribution of the booklet to the 323 members of the co-operator network;
- Distribution of the booklet to:
 - landholders participating in the WEST 2000 Plus Enterprise Based Conservation Program annual meeting (Balranald; 14 copies);
 - participants in the Western Regional Landcare Forum hosted by the Barrier Landcare Group (White Cliffs, approx. 40 copies);
 - members of the RLPB State Council Travelling Stock Reserves (TSR) Committee (11 copies) and
 - members of Central West Farming Systems (45copies to date);
- Development of a distribution network throughout the project area based on DPI, RLPB and (possibly) CMA offices; the objective is to have the booklet available through one outlet in as many towns as possible. The network is not yet finalised but is expected to include at least 18 towns across the project region;
- Posting of the booklet in whole or in sections on the DPI website.

Future promotional and technology transfer activities will include:

- Invited presentation to the Cobar RLPB (June 2006)
- Incorporation of resource material from the booklet into climate workshops conducted routinely by the NSW Climate Advisory Officer (Paul Carberry) and into relevant short courses, particularly Tactical Grazing and Wean More Lambs.

Commercial potential

There is no commercial potential in the products of the project. ‘*Betting on Rain*’ has been made freely available to producers in western NSW and is also available to the general public through the DPI web site. Sections of the book, particularly the phase probability maps, will also be available through the Departmental Intranet for inclusion in presentations by DPI staff.

Publications

Scientific publications

- Alemseged Y. Hacker R.B. Hayman P.T. Carberry P.M. and Henry B.K. (2004). Improved seasonal forecasting for wool producers in western NSW. Proceedings of the 13th Biennial Australian Rangelands Society Conference. Alice Springs 5th – 8th July 2004. pp 241-42.
- Hacker, R.B., Alemseged, Y., Carberry, P.M. and Smith, W.J. (2006). ‘Trigger points’ for stocking decisions in western NSW. Poster paper presented to 14th Biennial Conference, Australian Rangeland Society, Renmark, September 3-7.
- Hacker R. B., Alemseged, Y., Carberry, P.M., Browne, R.H. and Smith, W.J. (2006). *Betting on Rain. Managing seasonal risk in western NSW*. NSW Department of Primary Industries. ISBN 0 7347 1727 X. 93pp.

Extension publications

- Alemseged, Y. (2003). Keeping up with changes in climate. Agriculture Today, 05/03
- Alemseged, Y. (2003). Improved Seasonal Climate Forecasting for Better Natural Resource Management. Narromine News. 05/04
- Carberry, P. (2003). Improved Seasonal Forecasts for Wool Producers in Western New South Wales. Range Management Newsletter 03/2
- Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 1, July 2003

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 2, August 2003

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 3, September 2003

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 4, November 2003

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 5, May 2004

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 6, August 2004

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 7, September 2004

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 8, October 2004

Improved seasonal forecasts for wool producers in western NSW – Newsletter Vol 9, December 2004.

Carberry, P (2005). ‘Trigger Point’ – a useful concept in climate risk. Western Division Newsletter Number 105, Mar-Apr 2005, p.10.

Carberry, P (2006). Betting on Rain – managing seasonal risk in western NSW. Western Division Newsletter Number 110, Mar-Apr 2006, p.13.

Carberry, P. (2006). Using the southern oscillation index. Western Division Newsletter (*In press*).

Hacker, R. and Alemseged, Y. (2006). Identifying trigger points for stocking decisions in western New South Wales. Western Division Newsletter (*In press*).

Milestone components from contract schedule (Milestone 8):

MILESTONE COMPONENT	ACHIEVEMENT CRITERIA
An evaluation of the Guide, based on the relevant evaluation questions from the Climate Sub-Program M&E plan including activities with Bestprac groups	Acceptance of Final Report by Land & Water Australia
An evaluation of training workshops (a) for landholders and (b) for DPI advisory staff, front line staff of RLPBs and CMAs, and private consultants based on the relevant evaluation questions from the Climate Sub-Program M&E plan, including activities with Bestprac groups	
Ongoing activities: Brief report to LWA outlining the ongoing provision of seasonal risk assessments, including summary of negotiations with the LWW national project (QNR30) to provide dynamic seasonal risk assessments, or SOI phase information, via the LongPaddock web site	
An appendix consisting of a technical guide consolidated from previous Milestone reports, which will serve as a record of the technical approaches used during the project	
Response to review: actions taken by the Project in response to each recommendation in the Climate Sub-Program Review (Indooroopilly, April 2005)	
Additional component: Confirmation that <ul style="list-style-type: none"> • the guide has been published and distributed • two technical articles have been provided to the May-June edition of the Western Division Newsletter • a promotional article has been provided to Bestprac, CMA and producer group newsletters 	

Results for achievement of criterion 1: An evaluation of the Guide, based on the relevant evaluation questions from the Climate Sub-Program M&E plan, including activities with Bestprac groups.

Responses to relevant questions from the LWW Climate Evaluation Summary Sheet are shown in Table 1.

Results for achievement of criterion 2: An evaluation of training workshops (a) for landholders and (b) for DPI advisory staff, front line staff of RLPBs and CMAs, and private consultants based on the relevant evaluation questions from the Climate Sub-Program M&E plan, including activities with Bestprac groups.

Responses to relevant questions from the LWW Climate Evaluation Summary Sheet are shown in Table 2.

Note: A combined evaluation summary sheet, containing some additional material not provided in Tables 1 and 2 is included in Appendix 3, together with the results of Newsletter feedback compiled during the project.

Table 1. Evaluation of the guide ('*Betting on Rain. Managing seasonal risk in western NSW*') according to LWW criteria.

LEVEL	EVALUATION QUESTION	ANSWER
Resources	Innovative funding ideas used in the project	Utilisation of DPI, RLPB and (possibly) CMA offices to achieve local distribution and minimise postage charges.
People	What is the level of demand for products from the program?	170 orders received to date in response to 2800 promotional flyers/order forms distributed through the Western Division Newsletter (This distribution included a substantial number of non-wool growers and individuals /institutions outside the Western Division). Demand is expected to be variable, consistent with the variation in attitude among wool growers to the value of seasonal climate forecasts and seasonal risk assessments.
	Woolgrowers attending field days, sites, training etc.	<ul style="list-style-type: none"> • 323 co-operators, mostly woolgrowers, received nine project newsletters during phase 1 which included material subsequently incorporated in '<i>Betting on Rain</i>'. All will receive copies of '<i>Betting on Rain</i>' directly. • 84 individuals, mostly wool growers, attended 14 workshops during phase 1 which presented material subsequently included in '<i>Betting on Rain</i>'. • 14 wool growers participated in a climate workshop, and received copies of the booklet, during the annual WEST 2000 Enterprise Based Conservation Program meeting in Phase 2. • 11 copies provided to members of the State Council of Rural Lands Protection Boards Travelling Stock Reserves Committee. • Approx. 40 copies of the booklet were distributed at the Western Landcare Forum in phase 2. • 45 copies of the booklet distributed to date through Central West Farming Systems, Condobolin.
	Service Providers attending workshops, field days, sites etc.	<ul style="list-style-type: none"> • Co-operator network in phase 1 included three service providers (1 consultant, 1 producers' association employee, 1 producer group employee); positive feedback on the seasonal risk assessments provided by the project was received from the consultant. • 14 service providers participated in two workshops specifically related to '<i>Betting on Rain</i>' in phase 2 representing DPI (6), CMAs (3), RLPB (1), Western Lands Commission (1) and including a Drought Support Worker, a private agronomist and an ABC Rural Reporter.
Reactions	Anecdotal feedback from people involved in the project	<ul style="list-style-type: none"> • Four wool growers who reviewed drafts of the booklet provided overall positive responses. At least one of these was a Bestprac group member. (Detailed comments provided in Milestone 7 report, 31 March 2006).
	Proportion of Woolgrowers satisfied with the project investments	<ul style="list-style-type: none"> • No figures specifically related to '<i>Betting on Rain</i>' available. Of the comments received in response to project newsletters during Phase 1 which could be considered to express an opinion on the value of the project as a sink for investment of funds 37 (88%) were positive and 5 (12%) were negative.
	Proportion of Woolgrowers satisfied with products and activities	See responses above. No other specific figures available.
	What do institutions/partners think about the project?	<ul style="list-style-type: none"> • The booklet carries a foreword by the Director-General of NSW DPI. It is anticipated it will be launched by the NSW Minister for Primary Industries. • The booklet has stimulated 'quite a lot of interest' among members of the Travelling Stock Reserves Committee of the State Council of Rural Lands Protection Boards, who requested a copy each (Helen Gosper, Publications and

		<p>Conference Coordinator, State Council of Rural Lands Protection Boards; pers. comm.).</p> <ul style="list-style-type: none"> The booklet will become a standard resource for future climate workshops in western NSW and it is expected that resource material will be included in appropriate short courses for wool producers (eg Tactical Grazing, Wean More Lambs).
	Are woolgrowers seeking additional climate information compared to 2001? Why?	At the start of the project 50.4% of 141 respondents to the first project newsletter used some form of seasonal climate outlook to assist decision making. At the end of phase 1, 71.1% of 45 respondents to the last project newsletter indicated they would use seasonal climate outlook information to assist decision making. 73.3% of these 45 respondents claimed to have a better understanding of climate science compared with the period before the project. It is not possible to determine if the respondents to the last survey are a self-selected group.
	Summary of media activity	<p>To the time of writing media activity specifically related to the booklet included:</p> <ul style="list-style-type: none"> Ministerial press release (currently in draft form, pending launch); 1 article to be published in Agriculture Today, subsequent to launch; Promotional article in Western Division Newsletter; Promotional material provided to Bestprac project, Western, Murrumbidgee and Lower Murray-Darling CMAs, and Central West Farming Systems; 4 technical articles in Western Division Newsletter related to material included in the booklet; 1 radio interview – ABC Broken Hill.
	Proportion of Woolgrowers who believe they have an increased ability to act on climate related issues	<p>Of 45 respondents to the final newsletter in phase 1</p> <ul style="list-style-type: none"> 71.1% indicated they would use seasonal climate outlooks to assist decision making, compared with 50.4 % of 141 respondents who reported using such information at the start of the project. 73.3% claimed to have a better understanding of climate science compared with the period before the project. 55.5% claimed the project had helped them change the way they use seasonal climate outlook information to assist decision making.
Knowledge, Aspirations, Skills & Attitudes	Proportion of Woolgrowers who are aware of Climate related issues and their importance in NRM	All wool growers are aware of the relationship between seasonal rainfall and feed availability, and the implications for land degradation of excessive grazing pressure. Most take a keen interest in weather and climate but differ greatly in their attitude to scientific seasonal risk assessments and their role in decision making aimed at adjusting forage demand to forage supply.
	Do woolgrowers have a greater understanding of the NRM issues addressed in this project and is there evidence of motivation to adopt better practices?	Yes. The willingness of 41 graziers to cooperate with the project to identify appropriate pasture growth profiles for trigger point determination suggest a willingness to accept this concept and use it to address the forage demand-forage supply issue which is fundamental to resource management in the project area.
Practice Change	Has there been on-farm practice change as a result of the project	<ul style="list-style-type: none"> Yes - see figures above based on respondents to the last project newsletter. Most wool growers are willing to change management if the probabilities associated with seasonal risk assessments are sufficiently high
	Has there been practice change in the extension community (Government, CMA, private) as a result of	Yes – staff of DPI can be expected to routinely use the resources provided in <i>'Betting on Rain'</i> in their interaction with clients. This will include direct advice, use of material in climate workshops and other presentations, and incorporation of material into short courses such as Tactical Grazing and Wean More Lambs.

	the project	
	Has there been practice change in the research community as a result of the project	Good cooperative relationships have been established with QDNRM in particular which may provide a basis for future collaboration. The collaboration with an extensive producer network was a worthwhile component of this project. The decision to employ a retired grazier as a project coordinator proved very successful as he was instrumental in establishing the co-operator network.
Social, Financial & Environmental Impact	Real or estimated	No data available. However, managing seasonal risk is expected to become increasingly important as a result of climate change, with implications for social, financial and environmental outcomes in semi-arid production systems. All of these aspects are therefore expected to benefit from the development of relevant skills among wool growers.

Table 2. Evaluation of training activities according to LWW criteria.

LEVEL	EVALUATION QUESTION	ANSWER
Activities	Training workshops for landholders, including activities with Bestprac groups.	<ul style="list-style-type: none"> • See Table 1 for details of workshops conducted in phase 1. Members of some current or former Bestprac groups attended these workshops but none was conducted specifically for a Bestprac group. • Additional presentations in phase 1 included information days at Brewarrina, Nyngan and Condobolin in autumn-winter 2003 aimed at recovery following the extreme drought conditions of 2002. • Climate session included in WEST 2000 Plus Enterprise Based Conservation Program annual workshop (Balranald, 1-2 June 2006) (14 copies of 'Betting on Rain' distributed). • No other landholder training workshops have been conducted. Questions raised by the review panel in April 2005 concerning the use of long lead forecasts seriously disrupted plans to proceed with the publication of 'Betting on Rain' and the associated publicity foreshadowed in the phase 2 proposal. These issues were not resolved until December 2005 when permission was granted by the LWW Program Coordinator to publish long lead forecasts as 'experimental prototypes'. By this time the opportunity to proceed as originally planned had passed. However, given that the entire project area had experienced no sustained recovery from the 2002 drought it is doubtful if landholder interest in training workshops would have been sufficient to meet the criteria for self organised groups set out in the phase 2 proposal i.e. groups of at least 10 landholders in the Central Division and 5 in the Western Division.

	Training workshops for DPI advisory staff, front line staff of RLPBs and CMAs, and private consultants.	<ul style="list-style-type: none"> • See details of two service provider workshops in Table 1. • The booklet ‘Betting on rain’ was well received at these workshops. See Table 1 above for details of expected practice change in the service community.
People	Woolgrowers attending field days, sites, training etc.	<ul style="list-style-type: none"> • See Table 1.
	Service Providers attending workshops, field days, sites etc.	<ul style="list-style-type: none"> • See Table 1.
Reactions	Anecdotal feedback from people involved in the project	<p>Over the course of the project a wide range of comment was received through the feedback mechanisms provided. Climate risk assessment is a subject that tends to elicit both strong support and strong antipathy, even among those who have agreed to participate in a project of this nature. Some examples include:</p> <ul style="list-style-type: none"> • Keep up the great work! My understanding of the climate forecasting tools has improved greatly thanks to this program. • Enjoyed Broken Hill workshop. Learned a few things like where our moisture really comes from. • Be nice to think positive for a couple of years instead of having to think survival mode so often. We need a general turn in weather to get our confidence back. But keep predicting! • Does our type of climate mean that accuracy of forecast is even more difficult? Yes. • Not even sure what kg/ha exists normally let alone what growth we get. Probably an area of training that has been identified. • In a dry time, one can’t even rely on the weather forecast – just potluck. • As a wool grower, I would rather see money spent on devising a ration that can be fed to ewes and lambs during the critical months in the late winter to November.
Knowledge, Aspirations, Skills & Attitudes	Proportion of Woolgrowers who are aware of Climate related issues and their importance in NRM	<ul style="list-style-type: none"> • See Table 1.
	Do woolgrowers have a greater understanding of the NRM issues addressed in this project and is there evidence of motivation to adopt better practices?	<ul style="list-style-type: none"> • See Table 1.
Practice Change	Has there been on-farm practice change as a result of the project	<ul style="list-style-type: none"> • See Table 1.
	Has there been practice change in the extension community (Government, CMA, private) as a result of the project	<ul style="list-style-type: none"> • See Table 1.
	Has there been practice change in the research community as a result of the project	<ul style="list-style-type: none"> • See Table 1.

Results for achievement of criterion 3: Brief report to LWA outlining the ongoing provision of seasonal risk assessments, including summary of negotiations with the LWW national project (QNR30) to provide dynamic seasonal risk assessments, or SOI phase information, via the LongPaddock web site

The major vehicle for the ongoing provision of seasonal risk assessments is the publication *'Betting on Rain: Managing seasonal risk in western NSW'*. Some 3500 copies of this book have been printed, most of which will be distributed at no cost to landholders in western NSW. This publication provides SOI Phase probability maps for the project area for those outlook periods and lead times for which reasonable skill has either been demonstrated by the LEPS statistic (for zero lead assessments) or inferred from the Chi square statistic. Producers can use these maps in the period June-September (inclusive), when the reliability of the assessments is highest, to determine the historical probability of exceeding median pasture growth provided they know the current SOI Phase. The current phase can be readily obtained from the LongPaddock site via the link given in *'Betting on Rain'*. This link, from the 'rainfall and pasture growth' page of LongPaddock, was provided by the national project at the request of the NSW project. The availability on the LongPaddock site of "current" as distinct from 'historical' probabilities for zero lead, three month pasture growth assessments, and their advantages, has also been emphasised in *'Betting in Rain'* and the appropriate links provided.

Results for achievement of criterion 4: An appendix consisting of a technical guide consolidated from previous Milestone reports, which will serve as a record of the technical approaches used during the project.

See Appendix 1.

Results for achievement of criterion 5: Response to review: actions taken by the Project in response to each recommendation in the Climate Sub-Program Review (Indooroopilly, April 2005).

The NSW response to each of the 12 recommendations made by the review panel is given below.

Recommendation 1: The projects include hind-cast verifications, using conventional cross-validation.

Response: Action on this recommendation was primarily the responsibility of the national support project which satisfied the requirement by calculating LEPS skill scores for three-monthly, zero lead forecasts for both rainfall and pasture growth based on the SOI Phase system. Calculation of these scores for pasture growth represented a major computing task, the completion of which was a major achievement for QDNRM staff. These scores subsequently influenced the period of useful skill for pasture growth assessments identified in western NSW, and the SOI Phase probability maps published in 'Betting on Rain', although they did not alter the overall impression of the temporal variation in the value of the SOI Phase system, and the need for other aids to seasonal risk assessment for much of the year.

Recommendation 2: The project teams apply rigorous and consistent statistical methods in assessing the hind-cast skill when existing and peer reviewed forecast systems are adapted to longer lead times, different forecast periods and finer scales. This is particularly important to underpin plans to issue forecasts at lead times beyond the original design of the systems. Care needs to be taken to avoid false skill, which may be exhibited in the as yet incompletely verified long-lead systems presented. For this reason, extension of these approaches is discouraged prior to further validation.

Response: This recommendation was probably more relevant to other regional projects since the NSW team had adopted the view early in the project that attention should be directed to informing landholders of whatever predictability is inherent in the biophysical system rather than to attempts to develop forecasts for particular critical dates or periods. In the final analysis, SOI Phase probability maps with lead times up to two months were included in 'Betting on Rain' for those four starting months for which the zero lead pasture growth forecasts demonstrated a high and spatially coherent level of skill across the project area. This was considered justified by the chi square and KW analyses, given that LEPS scores for non-zero lead times could not be computed for pasture growth forecasts. The decision was taken in conjunction with the national support project and the LWW Program Coordinator on the basis that all such assessments should be identified as 'Experimental Prototypes'. In fact, all probability maps in 'Betting on Rain', even for zero lead time, were labelled in this way.

Recommendation 3: P-values should not be used in isolation as a measure of skill.

Response: Following the review, skill of the SOI Phase system for pasture growth (three month forecast period, zero lead time) was evaluated by the national project using the LEPS statistic. The analysis was undertaken as part of a larger re-evaluation of all the forecast systems used during the project overall.

Recommendation 4: The skill of the forecast systems should be assessed prior to operational implementation. Definitions and measurement of skill and value used in the projects should be consistent with internationally accepted standards. In future MCVP projects, greater emphasis on forecast value is recommended.

Response: As a result of the LEPS-based skill evaluation noted above, the period in which useful skill was considered to exist for the SOI Phase-pasture growth seasonal risk assessment system developed by the NSW project was revised slightly compared with the assessment made initially based on the chi square and Kruskal-Wallis statistics. When evaluated by LEPS, the period of skill for a three month forecast period with zero lead was considered to extend from June to September (inclusive) rather than August to October. The phase probability maps included in 'Betting on Rain' were adjusted accordingly. While the NSW project did not specifically attempt to develop long lead forecasts, risk assessments with lead times up to two months were included in 'Betting on Rain' where this was considered justified by the original chi square analysis. No LEPS scores were available for these assessments and they were included in the publication after discussion with the LWW Project Coordinator (Dr Rohan Nelson) and the National Support project (Dr Beverley Henry). As with all other probability maps, even those with zero lead time, they were labelled as 'experimental prototypes'.

Recommendation 5: Once the projects commence providing routine seasonal forecasts, they should include a forecast verification component, to ensure that public forecasts are assessed in near real-time (the minimum required is periodic assessment every few years).

Response: No action required by the current project.

Recommendation 6: The projects should adopt a consistent methodology for accounting for spatial correlation, and determine a level of smoothing which is appropriate for seasonal rainfall outlook information and associated spatial displays. Map displays and other communication of spatial coherence should be guided by work resulting from recommendations about scale issues, to avoid display of noise that could be misinterpreted.

Response: No smoothing has been applied to the phase probability maps presented in 'Betting on Rain' although some preliminary investigation of smoothing algorithms was undertaken

within DPI. The probabilities are thus presented at the 5x5km scale generated by AussieGRASS. Given that this review occurred at the end of the project no opportunity has been available for any comprehensive investigation of smoothing algorithms by the national support project, and no standardised protocol has been applied. A number of factors will reduce the likelihood of misinterpretation of noise in the phase probability maps published in 'Betting on Rain' viz:

- Probabilities have been published only for those starting months (June, July August and September) for which the LEPS statistic for zero lead, three-month pasture growth forecasts shows strong spatial cohesion across western NSW;
- Probabilities for longer lead assessments have been published only for those outlook periods for which the spatial coherence of the chi square statistic was demonstrated or could be inferred to be high for at least part of the project area;
- Workshop discussion of the probability maps with producers emphasises that the assessment should be taken in a regional context, and no attempt should be made to interpret probabilities at a property level.

Recommendation 7: MCVP/LWW should commission a small working group led by Dr David Jones and Dr Roger Stone (and involving project members as necessary) to meet with the aim of resolving the "phase locking" with the SST phase system and other related issues.

Response: No response required from NSW. Forecasts based on the SST system were not pursued in NSW after the initial evaluation.

Recommendation 8: On the matter of utility and interpretation of ENSO state predictions by numerous GCMs, MCVP/LWW should refer it to the Bureau of Meteorology and QNR&M for investigation with a view to improving the information available on Australian websites.

Response: No response required from the NSW project.

Recommendation 9: All service deliverers should preface forecasts with information about the strength of the signal for a given season and for that pastoral zone, with regard to an appropriate skill measure.

Response: The NSW approach has been to publish phase probability maps in 'Betting on Rain' only for those outlook periods for which this was considered justified by skill or statistical association, and to encourage producers to check the SOI phase in the relevant months (June to September). While the publication does not actively discouraged producers from seeking SOI-based information at other times it does emphasise that skill is lower outside the stated months. The NSW project has also invested considerable effort in developing the 'trigger point' concept to assist decision making at times when SOI-based skill is low, and actively promotes this concept to producers as an alternative to SOI-based assessments outside the preferred band. In addition, zero-lead 'current' pasture growth assessments on the LongPaddock site are now accompanied by a LEPS skill map (for the relevant SOI Phase) at all times. The link is provided in 'Betting on Rain'.

Recommendation 10: Forecasts of meteorological variables should be differentiated from the term "climate risk assessment".

Response: The recommendation is accepted as consistent with conventional terminology within the climate science community. Nevertheless, it is unfortunate that use of the term 'forecast' in relation to three month outlooks for rainfall or other meteorological variables probably creates confusion between categorical weather forecasts (which are commonly judged as 'right' or 'wrong') and probabilistic seasonal climate forecasts. Since the NSW project has published only probabilities related to pasture growth the conflict does not arise.

The term 'seasonal risk assessment', as used in 'Betting on Rain', can be legitimately applied to these probabilities and the information is thus more clearly targeted at the risk management issues that producers need to address.

Recommendation 11: In the wider context (relevant beyond the suite of projects under review), there are valid concerns about possible impact of climate change on seasonal forecasting systems. Within the next decade, if climate change continues its current path, the impact on operational systems could become serious. Basic research is therefore needed on better analysis of the potential problems for Australia and on whether operational systems can be optimised to minimise climate change contamination.

Response: Agreed but no action required within the current project. Brief reference to the possible effects of climate change on historical rainfall probabilities is made within 'Betting on Rain', in relation to use of climatological data.

Recommendation 12: Future projects engage a steering committee to be consulted on technical and methodological matters. This recommendation may benefit the efficiency and outcomes of a wide variety of projects funded through Land and Water Australia, particularly where new cross-disciplinary research effort is part of the project, such as within the Managing for Climate Variability Program. For example, it may be possible to incorporate new tools or scientific standards into project methodology more quickly.

Response: While no action can be taken within the current project this recommendation needs to be actioned by research managers responsible for future projects of this type. The failure to reach agreement at the outset on appropriate protocols for skill testing was a serious deficiency in this project which resulted in considerable frustration for project leaders, unreasonable demands on the national support project team and lengthy delays in the publication of project outputs.

Results for achievement of criterion 6: Confirmation that the guide has been published and distributed; two technical articles have been provided to the May-June edition of the Western Division Newsletter; a promotional article has been provided to Bestprac, CMA and producer group newsletters.

The print run of '*Betting on Rain*' (3500 copies) was delivered to Trangie Agricultural Research Centre on 25 May 2006 and distribution is currently in progress. Further details are provided in *Adoption, communication and technology transfer* above.

The technical articles provided to the Western Division Newsletter for inclusion in the May-June 2006 edition, together with the promotional article provided for use, as appropriate, by the Bestprac, Central West Farming Systems, and Western, Lower Murray-Darling and Murrumbidgee CMA newsletters, are included in Appendix 4.

Acknowledgements

Our grateful thanks for their sustained contribution to the project go to our co-operators – all 323 of them. Completion of the analyses for risk assessment skill and trigger point determination would not have been possible without the excellent support of our colleagues in the national component, particularly Dr. Beverly Henry, Mr. Peter Timmers, Dr. Greg McKeon and Dr. Doreen Bruget. Bob Browne, the Project Coordinator, did a great job in establishing the co-operator network, distributing newsletters and collating returns, and organising the regional workshops. Other colleagues in NSW DPI provided valuable assistance in a variety of ways, particularly Dr. Gavin Melville, Mr. Ian MacGowen and Mr. Warren Smith. We also acknowledge the guidance and assistance of the LWW Program

Coordinators, particularly Dr Barry White but more recently Dr Rohan Nelson and Mr Mike Wagg.

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APPENDIX 1. TECHNICAL GUIDE TO PROJECT ACTIVITIES

Introduction

The wool industry in western NSW faces the dual challenge of increasing profitability while softening its environmental footprint. While higher stocking rates in better seasons can contribute substantially to enterprise viability, grazing pressure during drier periods is a major source of degradation, animal welfare problems and financial stress. Western NSW, like the rest of the Australian pastoral zone, has experienced well documented land degradation associated with droughts (1879-1902, 1943-1945, 1960-64 and 1982) (McKeon *et al.* 2004). This degradation has taken the form of soil erosion, reduction of perennial forages and the subsequent increase of woody species.

Non-seasonal rainfall in this region poses serious difficulties for managers in deciding whether or not to hold stock, particularly in autumn and spring. In contrast to the pastoral zones of northern and southern Australia there are no well recognised trigger points to force stocking decisions prior to a seasonally dry period. The National Drought Policy defined drought as a mismatch between agriculturalists' expectations and the subsequent climate. In this sense, the non-seasonality of the NSW pastoral zone lends itself to frequent mismatches and consequent challenges for the land, the welfare of stock and the viability of pastoral businesses. It also presents an opportunity for climate science to develop useful aids to management decision making, thus contributing to the financial and ecological sustainability of wool producers, despite the view of many landholders in the region, and some researchers, that climate science (or at least the most familiar tool-the SOI) has little to offer.

Objectives

1. To investigate the skill and operational usefulness of seasonal climate forecasts (SCF) in the NSW pastoral zone and the adjacent marginal cropping zone;
2. To work with graziers to develop protocols for incorporating SCF into management decision making, including the identification of critical dates/periods;
3. To develop and deliver, in conjunction with graziers, a learning package on the use of seasonal climate forecasts in grazing management systems.

Methods and Results

Objective 1: To investigate the skill and operational usefulness of seasonal climate forecasts (SCF) in the NSW pastoral zone and the adjacent marginal cropping zone.

(a) Skill analysis

Methods

The original intention of this project was to provide producers with seasonal risk assessments at critical times of the year, particularly autumn and spring, and to evaluate the usefulness of this information for management decision making. Subsequently, following discussions within the project team and at the first project workshop (11-12 December 2002), and considering the initial results of skill testing conducted in cooperation with the national support project, an alternative approach was adopted.

This alternative was prompted by an appreciation of the temporal and spatial variability of forecast skill across the project area, and the variability of management calendars among producers. Instead of attempting to provide seasonal risk assessments at critical times, attention was focussed on providing producers with an understanding of the 'useful' forecast skill available in their region. This approach would provide a basis for adjustment of management calendars to take advantage, as far as possible, of whatever predictability exists in the bio-physical environment. It was thought to be a particularly useful approach in

pastoral systems where buying and selling of stock, which can occur at any time in the annual cycle, is the major activity impacted by seasonal expectations.

Two seasonal risk assessment systems¹ were evaluated – the Southern Oscillation Index (SOI) 5 Phase system (Stone *et al.* 1996) and the Sea Surface Temperature (SST) 9 Phase system (Drosdowsky 2002).

The determination of ‘useful skill’ was achieved initially by analysis of chi square (χ^2) images provided by the national support project and made available to all state projects via the ‘Map Arranger’ within the LongPaddock website. The χ^2 statistic is calculated for 5 x 5 km pixels from the distribution across the phases of the indicator of years with above median values for the dependent variable. A significant value of χ^2 for a particular pixel thus represents a strong association between the phases of the indicator and the frequency of above-median conditions. Analyses of the χ^2 images were conducted for 7 sub-regions based on Rural Lands Protection Board boundaries (Figure 1.1). Sub-regions were defined in an attempt to capture the gradients in rainfall seasonality and amount that operate in north-south and east-west directions, respectively, within the region.

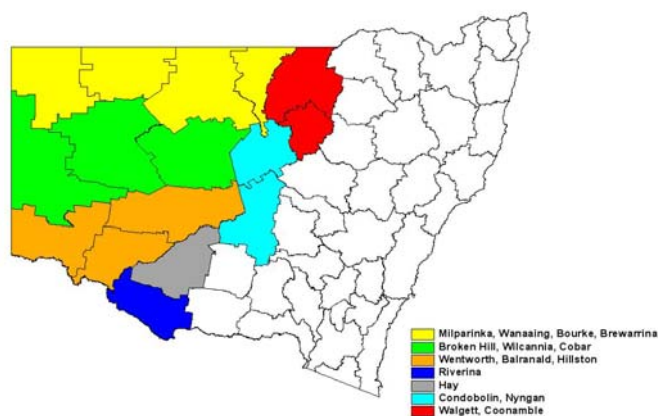


Figure 1.1. Sub-regions used for determination of ‘useful skill’.

Risk assessments were considered to have ‘useful skill’ if the probability of χ^2 was less than 0.05 over at least 80% of the region. This measure of ‘spatial coherence’ was arbitrary but was also considered reasonably stringent. Quantification of the spatial extent of significant χ^2 values in each subregion was undertaken by the Resource Information Unit of NSW DPI, following acquisition of the digital images (in ERDAS Imagine format) from the national support project.

Assessments failing to meet these criteria of spatial coherence and statistical significance were considered not to provide ‘useful skill’ and were not considered further in communication with producers. The combinations of lead time, outlook period and starting point for the various risk assessment systems evaluated in this way are shown below:

¹ The term ‘seasonal risk assessment’ is preferred to ‘seasonal climate assessment’ as explained below and in the main text.

Indicator	Lead time* (months)	Outlook period** (months)	Starting points	Response variables
SOI Phase	0,1,3,6	1,3,6	Monthly	Rainfall Pasture growth
SST Phase	1,3,6	1,3,6	Monthly	Rainfall Pasture growth
<p>* Lead time indicates the period in months between the start of the forecast period and the end of the period over which the indicator is measured. Thus for the forecast period March-April, zero lead time specifies the SOI or SST phase ending 28th February, the 1 month lead time specifies the SOI or SST phase ending 31st January etc. Note that the SOI phase is determined over a two-month period and the SST phase over a one month period. Zero lead time is not evaluated for the SST phase system as in practice data are not available at this time.</p> <p>** Outlook period specifies the period in months over which rainfall or pasture growth is accumulated</p>				

Following the second project workshop in June 2004 these analyses were repeated by the national support project using the Kruskal-Wallis (KW) statistic rather than χ^2 . At this time the NSW project did not have access to the resources required to repeat the analysis of spatial coherence at the subregional level. Analysis of the KW results was thus restricted to a visual comparison with the χ^2 images.

A further analysis of the relationship between seasonal indicators and pasture growth or rainfall was undertaken by the national project following the sub-program review in April 2005. This analysis was prompted by the recommendation of the review panel that P-values should not be used in isolation as a measure of skill. This analysis was consequently based on the LEPS (Linear Error in Probability Space) statistical procedure (Potts *et al.* 1996) which measures the improvement in the probability of exceeding median growth obtained by using seasonal indicator information (e.g. SOI phase) compared with long-term history. This statistic is considered to be the appropriate measure of forecast skill, as distinct from the statistical association measured by both χ^2 and KW. However, when the dependent variable is pasture growth, LEPS scores can only be computed for zero lead time forecasts due to the dependence of pasture growth on starting conditions which in practice can only be computed the 'zero lead' in this context.

Results and discussion

The level of statistical association varied with sub-region, lead time, indicator and response variable. Results (Table 1.1) indicated that:

- the SOI phase system provided considerably more 'useful skill' than the SST phase system;
- all of the 'useful skill' identified by the analysis related to pasture growth rather than rainfall;
- a three month outlook period provided the best compromise in terms of practicality and skill, which was generally low for the 6 month outlook period;
- 'useful skill' was mostly confined to outlook periods commencing in late winter and spring (August-October) and to lead times of zero or 1 month although exceptions included the Riverina and Hay regions - where 'useful skill' for the SOI phase system extended to a 3 month lead time - and the Walgett-Coonamble region where 'useful skill' in the SST phase system existed for a forecast period commencing in November.

Table 1.1. Three-month periods for which seasonal climate forecasts have ‘useful skill’ in the 7 subregions, showing lead times (0, 1, 3 or 6 months for the SOI phase system and 1, 3 or 6 months for SST phase system) and predicted variable (rainfall or pasture growth). Months indicate the start of the forecast period. Lead times for which no ‘useful skill’ existed are not shown.

Region (Rural Lands Protection Boards)	Lead time	Predicted variable	System	
			SOI phase	SST phase
Milparinka/Wanaaring/ Bourke/Brewarrina	0	Pasture growth	August, September	N/A
	1	Pasture growth	September	
Broken Hill/ Wilcannia/Cobar	0	Pasture growth	August	N/A
	1	Pasture growth	September	
Wentworth/Balranald/ Hillston	0	Pasture growth		N/A
	1	Pasture growth	September	
Riverina	0	Pasture growth	August, September	N/A
	1	Pasture growth	September, October	
	3	Pasture growth	October	
Hay	0	Pasture growth	August, September	N/A
	1	Pasture growth	September, October	
	3	Pasture growth	October	
Condobolin/Nyngan	0	Pasture growth	September, October	N/A
	1	Pasture growth	October	
Walgett/Coonamble	0	Pasture growth	August, September	N/A
	1	Pasture growth	August	November

Analysis of these relationships using the KW test revealed some differences compared with the χ^2 results for the SST phase system but no substantial differences for the SOI phase system, based on visual comparison of the images. Our conclusions from the χ^2 analysis were therefore not substantially altered as a result of the KW testing.

The LEPS analysis completed by the national support project following the review of April 2005 did not substantially change our general understanding of the value of the available forecast systems derived from the χ^2 analysis. However, this final analysis showed that a high and spatially coherent level of skill for zero-lead, three-month pasture growth forecasts derived from the SOI Phase system (again determined by visual appraisal) existed across the project area two months earlier than previously thought i.e. for the growth period starting in June, and that skill was less than originally thought for the growth period commencing in October. The SOI phase probability maps finally published in '*Betting on Rain*' thus included

- zero-lead forecasts for those periods identified by the LEPS analysis, commencing June-September inclusive and
- forecasts with lead times up to 2 months, starting from these same months, where this appeared justified from the χ^2 analysis.

This represented a deliberately conservative approach, with no three month lead times included. Even so, after discussion with the Program Coordinator, all published phase probability maps were labelled as 'experimental prototypes'.

(b) Pasture growth profiles and trigger points

Methods

The lack of useful skill in the summer-autumn period, noted above, is a serious deficiency in all of the seasonal risk assessment systems currently available. At this time particularly, management could be assisted by the establishment of 'trigger points', beyond which a decision should not be delayed in the face of declining feed availability. These trigger points (calendar dates) can be identified by analysis of historical pasture growth patterns. The time at which the expectation of medium term pasture production is minimal, for example, should represent a trigger point for stock sales if forage supplies are already limited. Conversely, maximal expectations for medium term pasture growth might trigger a decision to buy if forage conditions are already favourable.

Identification of trigger points was carried out cooperatively with the national project by use of the WinGRASP model. The process initially involved:

- calculation of long run daily pasture growth using an appropriate WinGRASP parameter set and SILO or CLIMARC climate files
- calculation of exceedance probabilities for pasture growth over three monthly periods commencing at fortnightly intervals throughout the year;
- production of a pasture growth index for each fortnightly starting point, calculated as the area under the exceedance curve and
- plotting of the pasture growth indices to allow visual identification of maxima and minima (i.e. trigger points).

We chose to use the area under the exceedance curve as a generalised index of pasture growth potential as it provides an integrated measure over the entire range of biomass production levels. Its use therefore avoids anomalies that might arise from comparisons based only on the exceedance probability for some fixed level of biomass, or on the median level of biomass production.

WinGRASP parameter sets available for the project area included Gilruth Plains (C4 grassland), Lake Mere (C3 or mixed grassland), Kinchega (chenopod shrubland) and the 'NSW average' set. Initial feedback from co-operators, when preliminary results from these models were presented to regional workshops, indicated that while the concept had merit, close attention was required to the selection of parameter sets to best suit particular localities, and that a measure of inter-annual variability would be useful to assist interpretation of the pasture growth indices.

Subsequently, 41 co-operators who expressed interest in the concept via the project newsletter were provided with a range of products, representing combinations of parameter sets and climate files most likely to suit their location. They were also provided with alternative forms of data presentation *viz.* bar charts of the pasture growth index, or 20th, 50th and 80th percentile traces aimed at displaying inter-annual variability. Co-operators were asked to comment on (a) the graph (if any) which best reflected the pattern of pasture growth on their property and (b) their preferred form of presentation. If none of the products reflected their perception of the pasture growth pattern, co-operators were asked to amend the bar charts accordingly if they were prepared to do so.

Results and discussion

Responses from 21 co-operators nominated a specific combination of parameter set and climate file that produced an acceptable result for their location. A further 6 considered that some amendment was required and indicated the necessary changes on the bar charts. In these cases it is difficult to determine if the differences between graziers' perceptions and the products provided were due to a genuine mismatch between local conditions and the parameter set/climate combination used, or to differences in the temporal scale of graziers' observations compared with the long run, historical data. Co-operators were more or less evenly divided between the pasture growth index and decile traces as the preferred means of data presentation. Both formats have been combined for the presentation of pasture growth profiles in '*Betting on Rain*', except for those instances where co-operators adjusted the growth index profile in light of their experience. In these cases percentile traces cannot be provided. Since co-operators' returns also provided broad details of the vegetation types on their properties, the collective data sets should allow other landholders to select growth curves, and the associated trigger points, most likely to reflect their own conditions.

While identification of trigger points in this way should have application to tactical decision making, the growth profiles now available may also assist strategic decisions. Timing of lambing or calving, for example, could be related to growth expectations, with correlated consequences for other critical dates in the management calendar.

Objective 2. To work with graziers to develop protocols for incorporating SCF into management decision making, including the identification of critical dates/periods.

Methods

Severe drought conditions throughout the project area initially hindered the establishment of the co-operator network envisaged in the project application. Members of the project team (particularly Mr Paul Carberry and Dr Yohannes Alemseged) participated in a series of Farm Family Gatherings in late 2002 and early 2003 organised by (the then) NSW Agriculture as part of the drought relief measures implemented by the NSW Government. At these meetings they presented a brief outline of the aims and objectives of the project, encouraged participants to complete a simple survey (regarding drought response, the potential to apply seasonal climate forecasts and the calendar of management operations), and discussed the opportunity for continued involvement with any interested landholders. Other attempts to develop a co-operator network included the distribution of project publicity and a producer survey to all landholders in the Western Division in the March-April 2003 edition of the Western Division Newsletter.

However, the major factor leading to the successful establishment of the network was the direct contact with landholders by the Project Coordinator, Mr Bob Browne formerly of Bukulla station, Brewarrina. His efforts were largely responsible for the final engagement of 323 producers across the region, a figure which considerably exceeded the project teams' expectation and the contractual commitment (225). While the network comprised mainly wool growers it also included a small number of consultants and service providers e.g.

Resource Consulting Services Pty Ltd and Grain Growers Association. These co-operators received regular project newsletters. Some provided feedback to these newsletters and/or participated in workshops. The distribution of these co-operators across the sub-regions identified in Figure 1.1 was:

Milparinka, Wanaaring, Bourke, Brewarrina	59
Broken Hill, Wilcannia, Cobar	58
Wentworth, Balranald, Hillston	51
Riverina	24
Hay	32
Condobolin, Nyngan	51
Walgett, Coonamble	48

Over the course of the project interaction with producers included:

- The compilation of a producer survey for wool growers in both the Central Division (69 responses collected through Farm Family Gatherings and a mail out with the first project Newsletter in July 2003) and the Western Division (109 responses to the survey distributed through the Western Division Newsletter). The survey questionnaires varied somewhat between these regions to reflect differences in the production systems and are included in Appendix 2.
- Nine newsletters distributed to the co-operator network, five with formal requests for feedback.
- 14 workshops conducted throughout the project area (some poorly attended) with a total participation of 84 producers, not all of whom were co-operators in the project. Each workshop lasted approximately 2 hours and was broken into two sections. The first comprised a formal presentation dealing with:
 - Major climate and weather influences in Australia and their interpretation;
 - Current weather and climate forecast;
 - Average and median rainfall and their possible importance in decision making;
 - Probability-based outlooks and seasonal skill;
 - The concept of ‘trigger points’.

The second part was mainly for general discussion but participants were especially encouraged to focus on their understanding of probability-based seasonal outlooks, the usefulness of the project newsletters, and the concept and use of trigger points in decision making.

Results and discussion

As noted above, the original intention of identifying critical dates or periods for the application of seasonal risk assessments was abandoned early in the project in favour of an examination of the forecast skill inherent in the biophysical system and an examination of the management decisions amenable to such influence or, alternatively, the opportunity to alter management to take advantage of the skill available. Most interaction with producers during the course of the project was therefore influenced by this perspective.

(a) Producer surveys

The survey of Western Division graziers found that many were prepared to make major changes from normal practice when seasonal conditions are dramatically different from average. In the past year, under serious drought conditions, most had made several big changes (Figure 1.2).

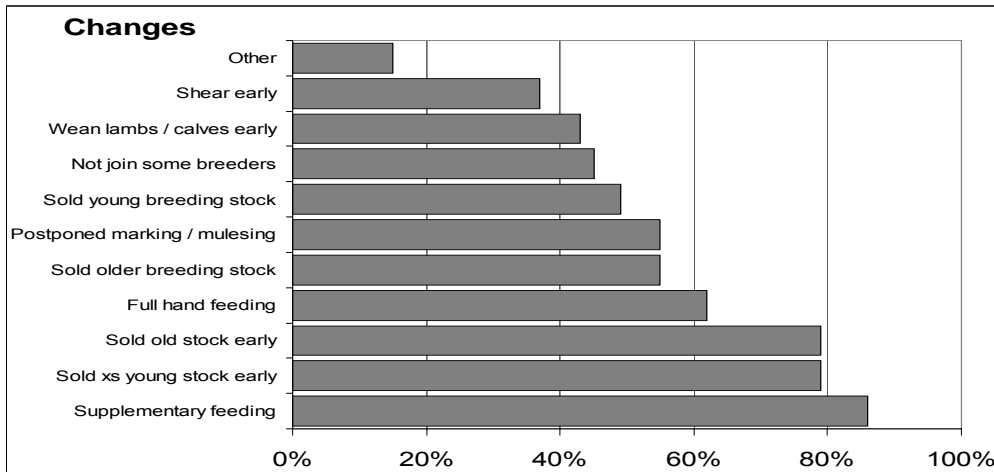


Figure 1.2. Changes to normal management practices made by Western Division wool growers in response to drought

The only management activities with clear seasonality for these producers are joining and shearing (Figure 1.3). For most, it appears that joining and shearing are set primarily by annual cycles of blow fly and grass seed activity, and to a lesser extent green feed, and that there is little flexibility. The number of ewes joined could vary if seasonal conditions six months ahead could be reliably forecast but this is not currently possible. Other activities have no specific time frames and selling, in particular, is very flexible with many responses of “as the season allows” or “when they are ready”. Given this flexibility of sale time there appears to be strong potential for seasonal outlooks to contribute to selling decisions at any time of year, allowing producers to hold stock if there is a high chance of favourable conditions or sell earlier, or more than usual, if chances are low.

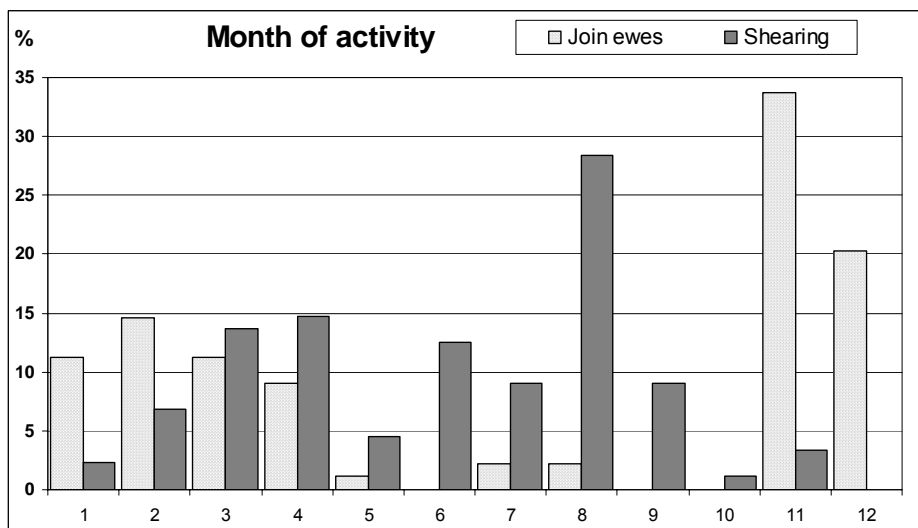


Figure 1.3. Distribution of shearing and joining times for Western Division producers.

The survey of mixed farmers in the wheat sheep zone found that decision making for the livestock component of these businesses was remarkably similar to that described above for Western Division graziers. In both instances, grass seed is a major factor affecting the timing of sheep husbandry operations. The desirability of having sheep in short wool in the late spring, when grass seed problems are most likely to occur, determines not only the

predominance of August shearing but also the peak of joining in November-December in order to ensure that lambs are old enough for shearing in August.

The importance of factors influencing decisions to sell stock in this zone is summarised in Figure 1.4.

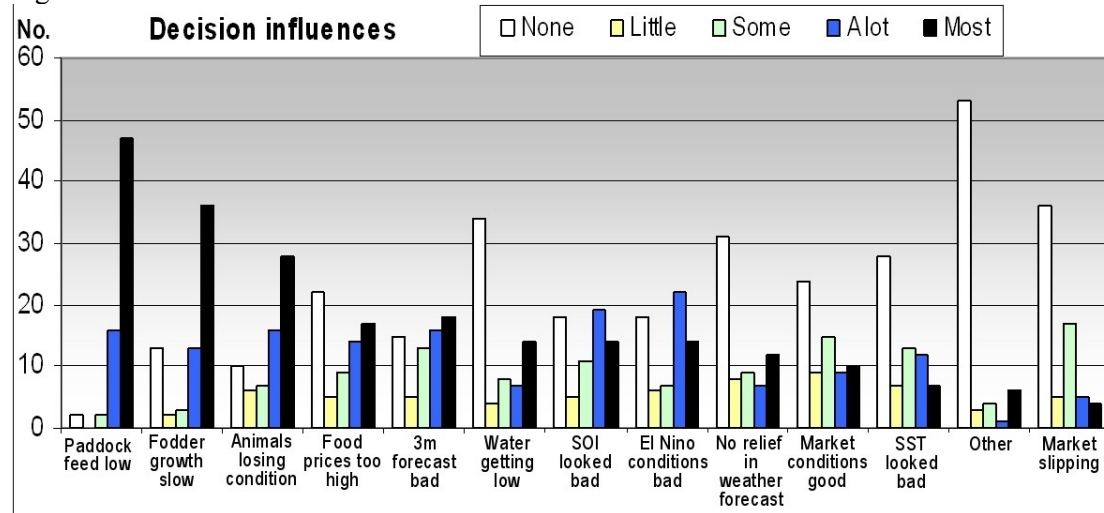


Figure 1.4. Importance ratings for factors contributing to decisions to sell stock in mixed farming enterprises in western NSW (n=67).

The most important factors relate to the current on-property situation such as livestock condition, feed supply and current feed growth rate. A secondary group of factors includes the Bureau of Meteorology three month seasonal outlook and SOI or El Nino conditions, with market considerations the least important influence.

The number of respondents rating the influence of seasonal indicators as ‘most’ or ‘a lot’ (around 50%) indicates that many producers do use a range of seasonal indicators, in combination, to assist livestock management decision making. However, considerable potential still remains to increase both the proportion of producers using these indicators and the amount of influence they exert.

In comparison to the livestock component of mixed farming enterprises, cropping decisions are much less influenced by seasonal outlook (Figure 1.5). The major factors are again current on-property conditions, especially fallow moisture and sowing rain, with seasonal indicators considered a ‘most’ important influence by only about 20% of producers. These are the same producers of whom 50% consider seasonal indicators to be important in livestock decisions.

It appears that the restricted window for decision making and the risk buffering provided by sub-soil moisture substantially reduce the potential of seasonal outlooks to contribute to a ‘sow’ or ‘no sow’ decision. The scale and consequences of this decision are such that probability-based seasonal risk assessments are usually unable to exert much influence.

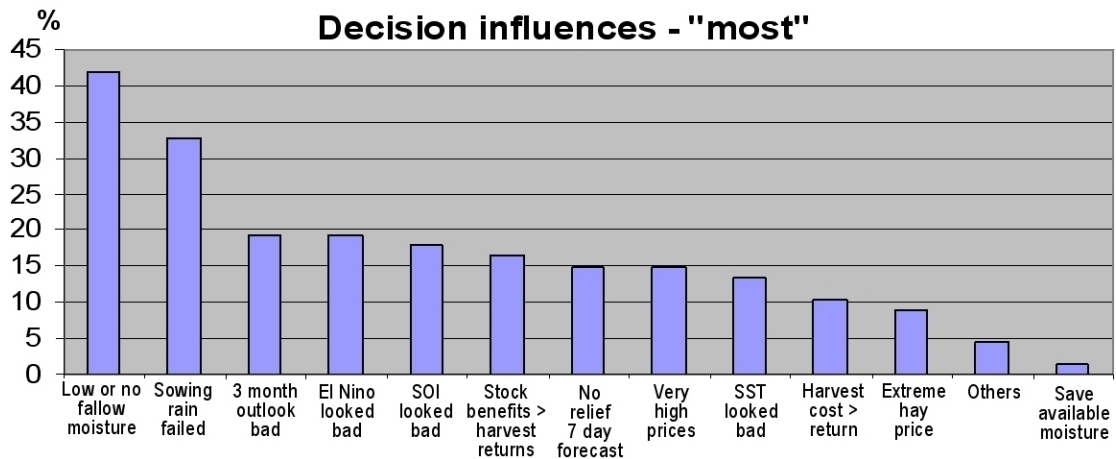


Figure 1.5. Factors considered to exercise the 'most' important influence on decisions to sow in mixed farming enterprises in western NSW

Although seasonal outlooks are not influential in sow/no-sow decisions they may influence in-crop management more strongly e.g. decisions related to forward marketing, application of supplementary fertilizer, bailing or grazing portions of the crop, or in-crop weed control. These decisions allow almost infinitely varying proportions of the crop to be treated differently and may benefit from outlooks that provide a good assessment of the likely success of differing strategies. The potential for use of seasonal risk assessments in this way was not an outstanding feature of the survey results but warrants further exploration.

Overall, the major conclusions drawn from the producer surveys were:

- Annual livestock husbandry calendars are not likely to be influenced by seasonal risk assessments but tactical decisions related to sale or purchase of stock (particularly sales) could be strongly influenced;
- Substantial opportunity exists to increase the number of livestock producers using seasonal risk assessments in this way;
- Planting decisions in cropping operations are not strongly influenced by seasonal risk assessments but in-crop management decisions could benefit from such information.

(b) Newsletter feedback

Feedback from the five project newsletters that provided an opportunity for a formal response is summarised in Appendix 3. Data from this feedback has also been incorporated in the LWW evaluation forms included in the main report, and the combined evaluation form included in Appendix 3. Newsletter feedback was generally positive but even among producers who had agreed to participate in the project there remain some who are highly sceptical of seasonal risk assessments. Indeed, the subject tends to elicit both strong support and strong criticism.

Important insights resulting from the newsletter feedback included:

- Slightly more than half of respondents to one feedback survey question (64 of 115) indicated a preference for seasonal outlooks based on the probability of more extreme seasons than the median;
- Of those wanting to understand the risk of more extreme conditions, the preference was for a 1 in 5 event (i.e. pasture growth or rainfall being either below the 20th percentile or above the 80th percentile), with only a slight preference for the 'dry' over the 'wet' extreme;
- The great majority of producers (over 90%) would require a probability of 70 per cent or higher in order to change a management decision on the basis of a seasonal risk assessment. This question was asked specifically in relation to the forecasts of the more extreme events noted above but it is unlikely that graziers'

would be less demanding towards the forecasts provided by the project, based on the median.

(c) Workshop feedback

Fifteen (15) workshops were organised throughout the region for the period 29 March to 20 May 2004 to provide direct input to co-operators regarding important concepts promoted by the project and to allow the opportunity for specific issues to be discussed or clarified. Some 169 individuals were contacted directly by the project Coordinator to solicit their attendance as well as to obtain any verbal feedback forthcoming on the progress of the project. In the event, only 14 workshops were held one being cancelled due to poor commitment, and attendance was always lower than expected based on the Coordinator's contact with co-operators.

Participants were largely producers already using both weather and climate information in their management but wanting to be able to use it better. They were seeking detail on the sources of accurate and well presented information as well as more background on how the major weather and climate systems work as an aid to interpreting the information they get.

The major themes emerging from the workshop discussions were:

- The seasonal pasture growth outlook maps provided in the project newsletters were generally accepted and most workshop participants apparently had no difficulty in interpretation of probability-based risk assessments. Nevertheless, only about 40% of the co-operators contacted directly by the project Coordinator were supportive of risk assessments based on pasture growth rather than rainfall, indicating considerable unease with this new approach and the modelling that underpins it despite the fact that forecast 'skill' is higher than for rainfall;
- Most participants accept that probability-based outlooks are 'accurate' in the sense that they have been correctly calculated from historical data and otherwise cannot be classed as 'right' or 'wrong'. Nevertheless, direct feedback from co-operators indicated that concern for the 'accuracy' of the outlooks still appeared to be a major issue for the co-operators overall. Eighty (80) per cent of the 169 producers contacted by telephone indicated that they would benefit from the availability of a forecast that is 'reliable and close to accurate' with the assessment, again based on telephone feedback, that it would need to be over 80% 'accurate' in order to be useful;
- There was a general agreement that data from the SOI Phase system would be useful at those times when skill is relatively high. Some participants had already worked out potential management applications for those times when probabilities of exceeding the median are higher than the 40-60% range;
- The newsletter format had been an effective communication technique and the inclusion of educational articles in response to producer feedback had been integral to its success;
- There was qualified support for the concept of trigger points but also concern regarding
 - Failure of the model used for the northern centres (the Gilruth Plains version of WinGRASP) to reflect accurately the potential for winter growth;
 - Difficulty in understanding the growth potential index (based on the area under the cumulative growth exceedance curve) and the lack of any measure of inter-annual variability of growth at each fortnightly starting point;
 - Perceived need to construct separate responses for different soil types (especially black versus red soils), and if possible even for different species or paddocks to tailor the trigger point analysis to individual properties.

A further insight resulting from general interaction with producers related to terminology. We formed the view that use of the term 'seasonal risk assessment' for medium term outlook statements was preferable to the conventional 'seasonal climate forecast' which appears to

risk the confusion of probability-based statements of medium term outlook with categorical statements of short term weather expectations. The latter may be judged as ‘right’ or ‘wrong’ and can realistically be accorded a level of accuracy. The ‘accuracy’ of the former is not an issue, except in the trivial sense that they have been calculated correctly. Rather, the issue for producers is the level of probability that will influence management. From this perspective the term ‘seasonal risk assessment’ is more in keeping with both the nature of the data and the decision making context of producers.

Objective 3. To develop and deliver, in conjunction with graziers, a learning package on the use of seasonal climate forecasts in grazing management systems.

Methods

The learning package developed by the project is the publication ‘*Betting on Rain: Managing seasonal risk in western NSW*’. This booklet contains the major scientific findings of the project, particularly SOI Phase probability maps of three-monthly pasture growth for those periods and lead times for which ‘useful skill’ was identified, and pasture growth profiles for trigger point identification. Additional material dealing with weather and climate systems was included specifically in response to feedback received at project workshops in phase 1.

The final text was the result of a rigorous review process which included feedback from:

- LWW Managing Climate Variability Sub-Project National Review Panel – April 2005
- Project Managers from Land and Water, Australia (Mike Wagg, Rohan Nelson, Andrew Lawson) – June 2005
- Extension consultant to Land, Water and Wool Program (Peter Hanrahan) – October 2005
- Dr Beverley Henry, A/Manager Climate Impacts and Natural Resource Systems, Qld Department of Natural Resources, Mines and Water – October 2005
- Managing Climate Variability Project Workshop – November 2005
- Four landholders from western NSW.

Delivery of the print run (3500) of this publication to NSW DPI Trangie Agricultural Research Centre occurred on 25 May 2006.

Delays resulting from the review process, and from issues flowing from the program review in April 2005, prevented earlier publication of this booklet. These issues included, in particular, the need for the national support project to re-analyse forecast skill using the LEPS statistic, and the policy issue associated with the publication of non-zero lead forecasts. The delay also prevented the conduct of training workshops for landholders during phase two of the project. However, the continuing decline in seasonal conditions across the region during this period would probably have severely curtailed such activity in any event.

Results and discussion

Material contained in ‘*Betting on Rain*’ will contribute to improved management of seasonal risk in western NSW in a number of ways. These include:

- Ongoing use of the booklet as a reference manual by wool producers in the target region to determine probabilities of exceeding median pasture growth or identify trigger points for their individual properties;
- Incorporation of the material into routine advisory programs conducted by NSW DPI. These will include the general use of the booklet as reference material for climate workshops, incorporation of SOI Phase probabilities for pasture growth and the trigger point concept into the Tactical Grazing short course, and use of pasture growth profiles in the adaptation of the Wean More Lambs short course for pastoral areas;

- Increased awareness of climate risk management tools by staff of RLPBs, CMAs, producer groups and private service providers.

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Potts J.M., Folland C.K., Joliffe I.T., Sexton D. (1996) Revised "LEPS" scores for assessing climate model simulations and long-range forecasts. *Journal of Climatology* **9**: 34 – 53.

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APPENDIX 2. SURVEY QUESTIONNAIRES FOR THE WESTERN DIVISION AND THE MIXED FARMING AREAS

WESTERN DIVISION SURVEY

Name

Address
.....

Postcode

Phone No
.....

Q1. Which of the following decisions did you have to make due to the current (2001, 2002, and 2003) drought? Tick any and all appropriate boxes.

- 1. Supplementary feeding stock that normally graze
- 2. Full hand feeding of at least some stock
- 3. Sold surplus young stock early
- 4. Sold young stock that are normally retained as breeders
- 5. Sold old stock early
- 6. Sold older breeding stock that are normally retained
- 7. Early weaning
- 8. Postponed lambmarking, mulesing or joining
- 9. Not joined at least some breeding stock
- 10. Shear early
- 11. Other

Q2. Which one of these was the most difficult decision? Number

.....

Q3. For that one most difficult decision,
what information finally made you decide to go ahead and do it?

Circle each of the following on how much it influenced your decision.	None	A little	Some	A lot	Most important
Favourable market conditions	1	2	3	4	5

Market slipping	1	2	3	4	5
Paddock feed running out	1	2	3	4	5
Animals loosing condition	1	2	3	4	5
Fodder growth slowed or stopped	1	2	3	4	5
Feed prices got too high	1	2	3	4	5
Water getting low	1	2	3	4	5
3 month Seasonal forecast looked bad	1	2	3	4	5
Southern Oscillation Index looked bad	1	2	3	4	5
El Nino looked bad	1	2	3	4	5
No relief in the 4 - 7 day forecast	1	2	3	4	5
Others	1	2	3	4	5
Others	1	2	3	4	5

**Q4. What information would you have liked to have that was
(a) not available or (b)
difficult to find?**

- Current Seasonal rainfall forecasts
- Seasonal pasture growth forecasts
- Future availability and price of supplementary feed
- Reliable future livestock prices
- Stock feeding information
- Other**

**Q5. What information did you have access to but
need some help to use it to best advantage?**

.....

.....

.....

.....

Q6. Under normal conditions when do you do the following and why do you do them at these times?

DECISION	TICK THE MONTH YOU NORMALLY DO THIS.												Reason – Please tell us why you do these things at these times - for example ; Be in short wool for the grass seed season Start of a reliable feed growth period Allows me to meet a target market Contractor is available reliably at this time Before a common dry period in the region Provides cash for loan repayments due about then Sold off shears while mustered or whatever your reason is.	IF A RELIABLE * SEASONAL FORECAST WAS AVAILABLE, WOULD YOU CHANGE THE TIMING OF THIS ACTIVITY ?	
	J	F	M	A	M	J	J	A	S	O	N	D		Yes / maybe	Never
Joining Ewes Cows														<input type="checkbox"/>	<input type="checkbox"/>
Wean lambs Wean calves														<input type="checkbox"/>	<input type="checkbox"/>
Sales Sell														<input type="checkbox"/>	<input type="checkbox"/>
Sell														<input type="checkbox"/>	<input type="checkbox"/>
Sell														<input type="checkbox"/>	<input type="checkbox"/>
Sell														<input type="checkbox"/>	<input type="checkbox"/>
Buy in Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Drenching 2 nd Drenching ?														<input type="checkbox"/>	<input type="checkbox"/>
Shearing														<input type="checkbox"/>	<input type="checkbox"/>
Crutching														<input type="checkbox"/>	<input type="checkbox"/>
Jetting														<input type="checkbox"/>	<input type="checkbox"/>
Other														<input type="checkbox"/>	<input type="checkbox"/>

You are welcome to add comments on the back.

* Reliable means it is right twice as often as it is wrong

MIXED FARMING AREAS SURVEY

**IMPROVED SEASONAL FORECASTS FOR WOOL PRODUCERS
IN WESTERN NEW SOUTH WALES –**

A project for the Climate Sub program of Land, Water & Wool

The Manager,

Part of this project is to identify inputs used by Western NSW producers for decision making during drought. While the project is directed to wool producers we recognise many are also growing some crop or may be mainly farming and also make serious cropping changes according to conditions or seasonal forecasts.

The information you provide will help in the development, promotion and delivery of timely, suitable and useful information to assist in management decisions which could change when seasonal climate is different from normal, either good or bad.

It would be appreciated if the main decision maker of your farm business could take five minutes to complete the survey. Responses should be just what you first think, no checking of records should be necessary.

Name

Address

Rural Lands Protection Board

Postcode

Phone No

I would like to participate further in this project Yes No

(this means adding your name to a mailing list to be used only for this project.

All responses will be treated in accordance with NSW confidentiality policy.)

Q1. Which of the following stock decisions did you have to make due to the 2002 / 03 drought? Tick any and all appropriate boxes.

- 12. Supplementary feeding stock that normally graze
- 13. Full hand feeding of at least some stock
- 14. Sold surplus young stock early
- 15. Sold young stock that are normally retained as breeders
- 16. Sold old stock early
- 17. Sold older breeding stock that are normally retained
- 18. Early weaning
- 19. Postponed lambmarking, mulesing or joining
- 20. Not joined at least some breeding stock
- 21. Shear early
- 22. Other

Q2. Which one of these was the most difficult decision? Number

Q3. For that one most difficult livestock decision,
what information finally made you decide to go ahead and do it?

Circle each of the following on how much it influenced your decision.	None	A little	Some	A lot	Most important
Favourable market conditions	1	2	3	4	5
Market slipping	1	2	3	4	5
Paddock feed running out	1	2	3	4	5
Animals loosing condition	1	2	3	4	5
Fodder growth slowed or stopped	1	2	3	4	5
Feed prices got too high	1	2	3	4	5
Water getting low	1	2	3	4	5
3 month Seasonal forecast looked bad	1	2	3	4	5
Southern Oscillation Index looked bad	1	2	3	4	5
El Nino looked bad	1	2	3	4	5
SST looked bad	1	2	3	4	5
No relief in the 4 - 7 day forecast	1	2	3	4	5
Others	1	2	3	4	5

Q4. Which of the following crop decisions did you have to make due to the 2002 / 03 drought? Tick any and all appropriate boxes.

1. Reduce area of crop planted
2. Reduce fertiliser rate of planted crop
3. Reduce seed sowing rate
4. Use moisture seeking sowing points
5. Changed crop type (eg oats to wheat)
6. Changed variety within a crop type
7. Used wider row spacing
8. Grazed off or baled a crop planned for harvest
9. Planted but did not get grazing or harvest
10. Did not sow any of the planned area at all
11. Reduced or did not do any of the normal in crop weed control
12. Increased pest control to maximise crop return
13. Harvested a low yielding crop you would normally abandon
14. Baled straw normally left in the paddock
15. Other

Q5. Which one of these was the most difficult decision? Number

Q6. Just for that one most difficult cropping decision, what type of crop was involved (wheat, oats, etc) and what information finally made you decide to go ahead and do it?

Circle each of the following on how much it influenced your decision.	None	A little	Some	A lot	Most important
Low or no fallow moisture	1	2	3	4	5
Sowing rain failed to arrive in time	1	2	3	4	5
Harvest cost likely to be more than return	1	2	3	4	5
Stock benefit greater than harvest return	1	2	3	4	5
3 month Seasonal forecast looked bad	1	2	3	4	5
Southern Oscillation Index looked bad	1	2	3	4	5
El Nino looked bad	1	2	3	4	5
SST looked bad	1	2	3	4	5
No relief in the 4 - 7 day forecast	1	2	3	4	5
Very high grain prices	1	2	3	4	5
Extremely high hay prices	1	2	3	4	5
Save available moisture for next season	1	2	3	4	5
Other:	1	2	3	4	5

Q7. During 02/03, what information would you have liked to have that was not available or difficult to find?

- Current Seasonal rainfall forecasts not available difficult to find?
- Seasonal pasture growth forecasts not available difficult to find?
- Future availability and price of supplementary feed not available difficult to find?
- Reliable future livestock prices not available difficult to find?
- Stock feeding information not available difficult to find?
- Other not available difficult to find?

Q8. What information did you have access to but need some help to use it to best advantage?

.....

.....

.....

.....

Q9. Under normal conditions when do you do the following things with livestock - and why do you do them at these times ?

DECISION	TICK THE MONTH YOU NORMALLY DO THIS.												Reason – Please tell us why you do these things at these times - for example ; Be in short wool for the grass seed season Start of a reliable feed growth period Allows me to meet a target market Contractor is available reliably at this time Before a common dry period in the region Provides cash for loan repayments due about then Sold off shears while mustered or whatever your reason is.	IF A RELIABLE * SEASONAL FORECAST WAS AVAILABLE, WOULD YOU CHANGE THE TIMING OF THIS ACTIVITY ?	
	J	F	M	A	M	J	J	A	S	O	N	D		Yes / maybe	Never
Joining Ewes Cows														<input type="checkbox"/>	<input type="checkbox"/>
Wean lambs Wean calves														<input type="checkbox"/>	<input type="checkbox"/>
Sales Sell														<input type="checkbox"/>	<input type="checkbox"/>
Sell														<input type="checkbox"/>	<input type="checkbox"/>
Sell														<input type="checkbox"/>	<input type="checkbox"/>
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Buy in Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Buy														<input type="checkbox"/>	<input type="checkbox"/>
Drenching 2 nd Drenching ?														<input type="checkbox"/>	<input type="checkbox"/>
Shearing														<input type="checkbox"/>	<input type="checkbox"/>
Crutching														<input type="checkbox"/>	<input type="checkbox"/>
Jetting														<input type="checkbox"/>	<input type="checkbox"/>

* Reliable here means it is right twice as often as it is wrong.

Q 10. Under normal conditions, what are your main crops ?

	Crop	Normal area (Please nominate Ha or acres)	What date would you prefer to plant each one ?	What is the latest you would consider planting it ?	If a reliable* seasonal forecast was available, would you make changes to this activity ?		
					Yes	no	If yes – what?
Winter					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
Summer					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	
					<input type="checkbox"/>	<input type="checkbox"/>	

For further information and **return survey to** :Paul Carberry, NSW Agriculture, PMB 944, Tamworth 2340, Ph: 67631132, **Fax: 67631222**, email paul.carberry@agric.nsw.gov.au

If you have email and would you like future contact from the project team to be via email,

You email address _____@_____

APPENDIX 3. COMBINED LWW CLIMATE EVALUATION SUMMARY SHEET AND NEWSLETTER FEEDBACK.

COMBINED LWW CLIMATE SUB PROGRAM EVALUATION SUMMARY

<i>LEVEL</i>	<i>EVALUATION QUESTION</i>	<i>ANSWER</i>
Resources	Funds and personnel	LWW \$154,139; NSW DPI \$322,095
	Innovative funding ideas	Utilisation of DPI, RLPB and (possibly) CMA offices to achieve local distribution and minimise postage charges.
Activities	Sites, publications, field days, courses, workshops, briefings etc	<ul style="list-style-type: none"> • Nine project newsletters distributed in phase 1, with feedback received from five. • 14 producer workshops conducted in phase 1. Members of some current or former Bestprac groups attended these workshops but none was conducted specifically for a Bestprac group. • Presentations at information days at Brewarrina, Nyngan and Condobolin in autumn-winter 2003 aimed at recovery following the extreme drought conditions of 2002. • Major publication from the project - 'Betting on Rain. Managing Seasonal Risk in Western NSW' – presents findings in the form of a manual for on-going use by wool growers to assist seasonal risk management. • 2 training workshops for DPI advisory staff, front line staff of RLPBs and CMAs, and private consultants. The booklet 'Betting on rain' was well received at these workshops. • Climate session included in WEST 2000 Plus Enterprise Based Conservation Program annual workshop (Balranald, 1-2 June 2006).
People	What is the level of demand for products from the program?	170 orders for ' <i>Betting on Rain</i> ' received to date in response to 2800 promotional flyers/order forms distributed through the March/April 2006 issue of Western Division Newsletter. (This distribution included a substantial number of non-wool growers and individuals /institutions outside the Western Division).Demand is expected to be variable, consistent with the variation in attitude among wool growers to the value of seasonal climate forecasts and seasonal risk assessments.
	Woolgrowers attending field days, sites, training etc.	<ul style="list-style-type: none"> • 323 co-operators, mostly woolgrowers received nine project newsletters during phase 1 which included material subsequently incorporated in '<i>Betting on Rain</i>'. • 84 individuals, mostly wool growers, attended 14 workshops during phase 1 which presented material subsequently included in '<i>Betting on Rain</i>'. • 14 wool growers participated in a climate workshop, and received copies of '<i>Betting on Rain</i>', during the annual WEST 2000 Enterprise Based Conservation Program meeting in Phase 2. • 11 copies of '<i>Betting on Rain</i>' provided to members of the State Council of Rural Lands Protection Boards Travelling Stock Reserves Committee. • Approx. 40 copies of '<i>Betting on Rain</i>' were distributed at the Western Landcare Forum (White Cliffs, June 2006). • 45 copies of the booklet distributed to date through Central West Farming Systems, Condobolin.
	Service Providers attending workshops, field days, sites etc.	<ul style="list-style-type: none"> • Co-operator network in phase 1 included three service providers (1 consultant, 1 producers' association employee, 1 producer group employee; Positive feedback on the seasonal risk assessments provided by the project was received from the consultant. • 14 service providers participated in two training workshops specifically related to '<i>Betting on Rain</i>' in phase 2 representing DPI (6), CMAs (3), RLPB (1), Western Lands Commission (1) and including a Drought Support Worker, a private agronomist and an ABC Rural Reporter.

LEVEL	EVALUATION QUESTION	ANSWER
Reactions	Anecdotal feedback from people involved in the project	<p>Over the course of the project a wide range of comment was received through the feedback mechanisms provided, particularly via Newsletter feedback sheets but also through personal contact with co-operators by the Project Coordinator. Climate risk assessment is a subject that tends to elicit both strong support and strong antipathy, even among those who had agreed to participate in a project of this nature. Some examples include:</p> <ul style="list-style-type: none"> • Keep up the great work! My understanding of the climate forecasting tools has improved greatly thanks to this program. • Enjoyed Broken Hill workshop. Learned a few things like where our moisture really comes from. • Be nice to think positive for a couple of years instead of having to think survival mode so often. We need a general turn in weather to get our confidence back. But keep predicting! • Does our type of climate mean that accuracy of forecast is even more difficult? Yes. • Not even sure what kg/ha exists normally let alone what growth we get. Probably an area of training that has been identified. • In a dry time, one can't even rely on the weather forecast – just potluck. • As a wool grower, I would rather see money spent on devising a ration that can be fed to ewes and lambs during the critical months in the late winter to November. <ul style="list-style-type: none"> • Four wool growers who reviewed drafts of 'Betting on Rain' provided overall positive responses. At least one of these was a Bestprac group member. (Detailed comments provided in Milestone 7 report, 31 March 2006).
	Proportion of Woolgrowers satisfied with project investments	<ul style="list-style-type: none"> • Of the comments received in response to project newsletters during Phase 1 which could be considered to express an opinion on the value of the project as a sink for investment of funds 37 (88%) were positive and 5 (12%) were negative. • No figures specifically related to 'Betting on Rain' available.
	Proportion of Woolgrowers satisfied with products and activities	See responses above. No other specific figures available.
	What do institutions/partners think about the project?	<ul style="list-style-type: none"> • 'Betting on Rain' carries a foreword by the Director-General of NSW DPI. It is anticipated it will be launched by the NSW Minister for Primary Industries. • 'Betting on Rain' has stimulated 'quite a lot of interest' among members of the Travelling Stock Reserves Committee of the State Council of Rural Lands Protection Boards, who requested a copy each (Helen Gosper, Publications and Conference Coordinator, State Council of Rural Lands Protection Boards; pers. comm.) • 'Betting on Rain' will become a standard resource for future climate workshops in western NSW and it is expected that resource material will be included in appropriate short courses for wool producers (eg Tactical Grazing, Wean More Lambs).
	Are woolgrowers seeking additional climate information compared to 2001? Why?	At the start of the project 50.4% of 141 respondents to the first project newsletter used some form of seasonal climate outlook to assist decision making. At the end of phase 1, 71.1% of 45 respondents to the last project newsletter indicated they would use seasonal climate outlook information to assist decision making. 73.3% of these 45 respondents claimed to have a better understanding of climate science compared with the period before the project. It is not possible to determine if the respondents to the last survey are a self- selected group.

LEVEL	EVALUATION QUESTION	ANSWER
	Summary of media activity	<ul style="list-style-type: none"> • 3 general articles on the project (Agriculture Today, Narromine News, Range Management Newsletter) <p>Media activity specifically related to ‘<i>Betting on Rain</i>’ included:</p> <ul style="list-style-type: none"> • Ministerial press release (currently in draft form, pending launch); • 1 article to be published in Agriculture Today, subsequent to launch; • Promotional article in Western Division Newsletter; • Promotional material provided to Bestprac project, Western, Murrumbidgee and Lower Murray-Darling CMAs, and Central West Farming Systems; • 4 technical articles in Western Division Newsletter related to material included in the booklet; • 1 Radio interview – ABC Broken Hill.
	Proportion of Woolgrowers who believe they have an increased ability to act on climate related issues	<p>Of 45 respondents to the final newsletter in phase 1</p> <ul style="list-style-type: none"> • 71.1% indicated they would use seasonal climate outlooks to assist decision making, compared with 50.4 % of 141 respondents who reported using such information at the start of the project. • 73.3% claimed to have a better understanding of climate science compared with the period before the project. • 55.5% claimed the project had helped them change the way they use seasonal climate outlook information to assist decision making.
Knowledge, Aspirations, Skills & Attitudes	Proportion of Woolgrowers who are aware of climate related issues and their importance for NRM.	All wool growers are aware of the relationship between seasonal rainfall and feed availability, and the implications for land degradation of excessive grazing pressure. Most take a keen interest in weather and climate but differ greatly in their attitude to scientific seasonal risk assessments and their role in decision making aimed at adjusting forage demand to forage supply.
	Do woolgrowers have a greater understanding of NRM issues addressed in this project and is there evidence of motivation to adopt better practices?	Yes. The willingness of 41 graziers to cooperate with the project to identify appropriate pasture growth profiles for trigger point determination suggest a willingness to accept this concept and use it to address the forage demand-forage supply issue which is fundamental to natural resource management in the project area.
Practice Change	Has there been on-farm practice change as a result of the project	<ul style="list-style-type: none"> • Yes - see figures above based on respondents to the last project newsletter. • Most wool growers are willing to change management if the probabilities associated with seasonal risk assessments are sufficiently high
	Has there been practice change in the extension community (Government, CMA, private) as a result of the project.	Yes – staff of DPI can be expected to routinely use the resources provided in ‘Betting on Rain’ in their interaction with clients. This will include direct advice, use of material in climate workshops and other presentations, and incorporation of material into short courses such as Tactical Grazing and Wean More Lambs.
	Has there been practice change in the research community as a result of the project	Good cooperative relationships have been established with QDNRM in particular which may provide a basis for future collaboration. The collaboration with an extensive producer network was a worthwhile component of this project. The decision to employ a retired grazier as a project coordinator proved very successful as he was instrumental in establishing the co-operator network.
Social, Financial & Environmental Impact	Real or estimated	No data available. However, managing seasonal risk is expected to become increasingly important as a result of climate change, with implications for social, financial and environmental outcomes in semi-arid production systems. All of these aspects are therefore expected to benefit from the development of relevant skills among wool growers.

Feedback from Newsletter No. 1 – July 2003

Total number of respondents 141													
Q1 Do you currently use long-term climate records to assist your decision making?	Yes – 53 (37.5%) No – 88 (62.5%)												
Q2 Do you currently use any seasonal climate outlook information to assist your decision making?	Yes – 71 (50.4%) No – 70 (49.6%)												
Q3 Do you have any questions about using the two seasonal outlook maps provided here (in the Current Outlooks section of this newsletter)?	<p>Questions:</p> <ul style="list-style-type: none"> • why the variance over small areas? • for average years, what SOI phase to expect? <p>Comments: (generalised comments with number of individual comments expressing similar sentiments in brackets)</p> <ul style="list-style-type: none"> • simplify its understanding & usefulness (11) • no faith, more accuracy & waste of time (9) • maps need to be coloured (8) • QDPI Region specific maps better than BOM's (2) • useful with written explanation • used in conjunction with a historical grazing chart, then maps would be more useful • no; been checking them for years • use 5 websites; No problems. 												
Q4 How do you rate the usefulness of the pasture forecast map provided?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td>Very useful</td> <td style="text-align: right;">9 (6.3%)</td> </tr> <tr> <td>Useful</td> <td style="text-align: right;">50 (35.0%)</td> </tr> <tr> <td>Moderate</td> <td style="text-align: right;">56 (39.2%)</td> </tr> <tr> <td>Not very useful</td> <td style="text-align: right;">18 (12.6%)</td> </tr> <tr> <td>Not very useful at all</td> <td style="text-align: right;">10 (7.0%)</td> </tr> <tr> <td>Total responses</td> <td style="text-align: right;">143</td> </tr> </table>	Very useful	9 (6.3%)	Useful	50 (35.0%)	Moderate	56 (39.2%)	Not very useful	18 (12.6%)	Not very useful at all	10 (7.0%)	Total responses	143
Very useful	9 (6.3%)												
Useful	50 (35.0%)												
Moderate	56 (39.2%)												
Not very useful	18 (12.6%)												
Not very useful at all	10 (7.0%)												
Total responses	143												
Q5 Would a forecast based on potential plant growth be better than just rainfall?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td>Yes</td> <td style="text-align: right;">77 (55.4%)</td> </tr> <tr> <td>No</td> <td style="text-align: right;">59 (42.5%)</td> </tr> <tr> <td>Both</td> <td style="text-align: right;">2 (1.5%)</td> </tr> <tr> <td>Maybe</td> <td style="text-align: right;">1 (0.7%)</td> </tr> <tr> <td>Total responses</td> <td style="text-align: right;">139</td> </tr> </table>	Yes	77 (55.4%)	No	59 (42.5%)	Both	2 (1.5%)	Maybe	1 (0.7%)	Total responses	139		
Yes	77 (55.4%)												
No	59 (42.5%)												
Both	2 (1.5%)												
Maybe	1 (0.7%)												
Total responses	139												
Q6 Would you be prepared to adjust your management calendar to take advantage of the higher forecast skill available during certain periods (as shown in Figure 2 of this Newsletter)?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td>Yes</td> <td style="text-align: right;">98 (71.5%)</td> </tr> <tr> <td>No</td> <td style="text-align: right;">37 (27.0%)</td> </tr> <tr> <td>Maybe</td> <td style="text-align: right;">2 (1.5%)</td> </tr> <tr> <td>Total responses</td> <td style="text-align: right;">137</td> </tr> </table>	Yes	98 (71.5%)	No	37 (27.0%)	Maybe	2 (1.5%)	Total responses	137				
Yes	98 (71.5%)												
No	37 (27.0%)												
Maybe	2 (1.5%)												
Total responses	137												
If yes, what times of the year are of special interest to you?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td>All year 7 (13.0%)</td> <td style="text-align: right;">Aut.-Spring 15 (27.8%)</td> </tr> <tr> <td>Jan/Feb 2 (3.7%)</td> <td style="text-align: right;">Mar/Apr 3 (5.6%)</td> </tr> <tr> <td>Apr/May 10 (18.5%)</td> <td style="text-align: right;">Jun/Jul 3 (5.6%)</td> </tr> <tr> <td>Jul/Aug 2 (3.7%)</td> <td style="text-align: right;">Aug/Sep 2 (3.7%)</td> </tr> <tr> <td>Oct/Nov 10 (18.5%)</td> <td></td> </tr> <tr> <td>Total responses</td> <td style="text-align: right;">54</td> </tr> </table>	All year 7 (13.0%)	Aut.-Spring 15 (27.8%)	Jan/Feb 2 (3.7%)	Mar/Apr 3 (5.6%)	Apr/May 10 (18.5%)	Jun/Jul 3 (5.6%)	Jul/Aug 2 (3.7%)	Aug/Sep 2 (3.7%)	Oct/Nov 10 (18.5%)		Total responses	54
All year 7 (13.0%)	Aut.-Spring 15 (27.8%)												
Jan/Feb 2 (3.7%)	Mar/Apr 3 (5.6%)												
Apr/May 10 (18.5%)	Jun/Jul 3 (5.6%)												
Jul/Aug 2 (3.7%)	Aug/Sep 2 (3.7%)												
Oct/Nov 10 (18.5%)													
Total responses	54												
Q7 Any general comments about the conclusions we drew from the Stock Survey?	<p>Generalised comments with number of individual comments expressing similar sentiments in brackets</p> <ul style="list-style-type: none"> • accurate (15) 												

	<ul style="list-style-type: none"> • close & OK (15) • surprise lambing % to ewes joined • surprise at % being fed, full feeding & supplementary feed • wouldn't hold stock on chance of rain • good summary • well done • there is a heavy emphasis on selling stock when things get tough, rather than buying in when going is good • those who didn't fully feed - must have sold stock. 																		
Q8 In particular, do you agree that April - September is the most likely period for stock sales?	<table> <tr> <td>Yes</td> <td>80 (60.2%)</td> </tr> <tr> <td>No</td> <td>53 (39.9)</td> </tr> <tr> <td>Total responses</td> <td>133</td> </tr> </table> <p>Comments:</p> <ul style="list-style-type: none"> • selling livestock decisions can be made on seasonal Outlooks • how many deaths & why the deaths? • thought more sheep shorn in summer • info is useful, but head is still a bit smoky like the season's. 	Yes	80 (60.2%)	No	53 (39.9)	Total responses	133												
Yes	80 (60.2%)																		
No	53 (39.9)																		
Total responses	133																		
If not, when	<table> <tr> <td>All year 2 (5.7%);</td> <td>Dec/Jan 3 (8.6%);</td> </tr> <tr> <td>Feb/Mar 2 (5.7%);</td> <td>Apr/May 1 (2.9%);</td> </tr> <tr> <td>Oct/Nov 3 (8.6%);</td> <td>Nov/Dec 4 (11.4%);</td> </tr> <tr> <td>Feb to Sep 2 (5.7%);</td> <td>Mar to Jul 1 (2.9%);</td> </tr> <tr> <td>Apr to Oct 3 (8.6%);</td> <td>Jun to Oct 2 (5.7%);</td> </tr> <tr> <td>Jul to Nov 1 (2.9%);</td> <td>Aug to Oct 1 (2.9%);</td> </tr> <tr> <td>Sep to Apr 4 (11.4%);</td> <td>Sep to Dec 1 (2.9%);</td> </tr> <tr> <td>Dec to May 2 (5.7%);</td> <td>Jun to Dec 3 (8.6%).</td> </tr> <tr> <td>Total responses</td> <td>35</td> </tr> </table>	All year 2 (5.7%);	Dec/Jan 3 (8.6%);	Feb/Mar 2 (5.7%);	Apr/May 1 (2.9%);	Oct/Nov 3 (8.6%);	Nov/Dec 4 (11.4%);	Feb to Sep 2 (5.7%);	Mar to Jul 1 (2.9%);	Apr to Oct 3 (8.6%);	Jun to Oct 2 (5.7%);	Jul to Nov 1 (2.9%);	Aug to Oct 1 (2.9%);	Sep to Apr 4 (11.4%);	Sep to Dec 1 (2.9%);	Dec to May 2 (5.7%);	Jun to Dec 3 (8.6%).	Total responses	35
All year 2 (5.7%);	Dec/Jan 3 (8.6%);																		
Feb/Mar 2 (5.7%);	Apr/May 1 (2.9%);																		
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Jul to Nov 1 (2.9%);	Aug to Oct 1 (2.9%);																		
Sep to Apr 4 (11.4%);	Sep to Dec 1 (2.9%);																		
Dec to May 2 (5.7%);	Jun to Dec 3 (8.6%).																		
Total responses	35																		

Feedback from Newsletter No. 3 - September 2003

Total number of respondents 115			
Q1 Are maps easier to use now than they were at first?	Perfect	4	4.4%
	Much easier	64	71.0%
	Somewhat	37	41.0%
	Only just	2	2.2%
	Not easier	4	4.4%
Q2 What else could we do to make them easier to use?	Comments (generalised comments with number of individual comments expressing similar sentiments in brackets):		
	<ul style="list-style-type: none"> • add major towns, centres & rivers (23) • make them larger (10) • they are ok, fairly simple (6) • teach me how to read them (3) • colour blind have trouble (2) • make regions larger (2) • don't know (2) • show current & forecast SOI graphs (1) 		
Q3 We have been including short articles explaining some background to both the maps and to how seasonal outlooks are made . Are these articles any help to you?	Very useful	28	(24.6%)
	Useful	67	(58.8%)
	Moderate	13	(11.4%)
	A little use	3	(2.6%)
	Not very useful at all	3	(2.6%)
Q4 All the outlook maps give the chance of exceeding median rainfall or growth. Would you prefer to have the split made at a different point in the range, for example the chance of having a very dry season or maybe a really wet season? If yes, what split is most important to you?	Yes	56	(44.8%)
	No	67	(53.6%)
	Both	2	(1.6%)
	Dry		
	1 in 10	14	(24%)
	1 in 5	31	(53%)
	1 in 3	13	(23%)
	Wet		
	1 in 10	11	(23%)
	1 in 5	24	(52%)
1 in 3	12	(26%)	
If you ticked one of these, what % chance would you need before you change	55%	1	(1.8%)
	60%	0	(0%)
	65%	2	(3.6%)
	70%	11	(19.6%)
	75%	16	(28.6%)
	80%	14	(25.0%)
	85%	6	(10.7%)
	90%	3	(5.3%)
	95%	2	(3.6%)
100%	1	(1.8%)	

Feedback from Newsletter No. 5 – May 2004

Total number of respondents 55																					
Q1 Do you think the "Trigger Point" concept is useful?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Very useful</td> <td style="width: 10%; text-align: center;">13</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(24%)</td> </tr> <tr> <td>Useful</td> <td style="text-align: center;">27</td> <td></td> <td style="text-align: right;">(50%)</td> </tr> <tr> <td>Moderate</td> <td style="text-align: center;">13</td> <td></td> <td style="text-align: right;">(24%)</td> </tr> <tr> <td>A little useful</td> <td style="text-align: center;">1</td> <td></td> <td style="text-align: right;">(2%)</td> </tr> <tr> <td>Not useful at all</td> <td style="text-align: center;">0</td> <td></td> <td style="text-align: right;">(0%)</td> </tr> </table>	Very useful	13		(24%)	Useful	27		(50%)	Moderate	13		(24%)	A little useful	1		(2%)	Not useful at all	0		(0%)
Very useful	13		(24%)																		
Useful	27		(50%)																		
Moderate	13		(24%)																		
A little useful	1		(2%)																		
Not useful at all	0		(0%)																		
Q2 Any suggestion on how it might be made more useful?	<p>Comments:</p> <ul style="list-style-type: none"> • useful if a problem is to be solved • most set triggers if it hasn't rained by a certain time, it is assessed continuously • most use a variation of this principle • essential to running a property • link to SOI maps showing pasture growth • use more stations across the Western Division (2 responses) • measuring & budgeting feed availability to set critical dates for action with stocking rates • struggling with the concept • temperature outlook, evaporative level • has own trigger points: <ul style="list-style-type: none"> 1 available feed 2 time of year 3 rainfall to date on current weather patterns. 																				
Q3 Which version of the trigger point data do you prefer? A - Pasture growth index B - Median pasture growth C - Median, with 20 th and 80 th percentiles	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">A - Pasture growth index</td> <td style="width: 10%; text-align: center;">20</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(35%)</td> </tr> <tr> <td>B - Median pasture growth</td> <td style="text-align: center;">17</td> <td></td> <td style="text-align: right;">(29%)</td> </tr> <tr> <td>C - Median, with 20th & 80th pctiles</td> <td style="text-align: center;">21</td> <td></td> <td style="text-align: right;">(36%)</td> </tr> </table>	A - Pasture growth index	20		(35%)	B - Median pasture growth	17		(29%)	C - Median, with 20 th & 80 th pctiles	21		(36%)								
A - Pasture growth index	20		(35%)																		
B - Median pasture growth	17		(29%)																		
C - Median, with 20 th & 80 th pctiles	21		(36%)																		
Q4 Would you be interested in evaluating pasture growth models for you district	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Yes</td> <td style="width: 10%; text-align: center;">41</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(77%)</td> </tr> <tr> <td>No</td> <td style="text-align: center;">12</td> <td></td> <td style="text-align: right;">(23%)</td> </tr> </table>	Yes	41		(77%)	No	12		(23%)												
Yes	41		(77%)																		
No	12		(23%)																		
Q5 We have included a short article with graphs, explaining when high or low probabilities of exceeding median pasture growth are likely to occur. Is this article of any help to you?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Very useful</td> <td style="width: 10%; text-align: center;">13</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(25%)</td> </tr> <tr> <td>Useful</td> <td style="text-align: center;">23</td> <td></td> <td style="text-align: right;">(44%)</td> </tr> <tr> <td>Moderate</td> <td style="text-align: center;">13</td> <td></td> <td style="text-align: right;">(25%)</td> </tr> <tr> <td>A little use</td> <td style="text-align: center;">2</td> <td></td> <td style="text-align: right;">(4%)</td> </tr> <tr> <td>Not useful at all</td> <td style="text-align: center;">1</td> <td></td> <td style="text-align: right;">(2%)</td> </tr> </table>	Very useful	13		(25%)	Useful	23		(44%)	Moderate	13		(25%)	A little use	2		(4%)	Not useful at all	1		(2%)
Very useful	13		(25%)																		
Useful	23		(44%)																		
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A little use	2		(4%)																		
Not useful at all	1		(2%)																		

Feedback from Newsletter No. 6 – August 2004

Total number of respondents 13																
Q1 Do you think the "Glove Box Guide for Climate Risk Assessment" concept is useful?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Very useful</td> <td style="text-align: center; padding: 2px;">3</td> <td style="text-align: right; padding: 2px;">(23%)</td> </tr> <tr> <td style="padding: 2px;">Useful</td> <td style="text-align: center; padding: 2px;">5</td> <td style="text-align: right; padding: 2px;">(38%)</td> </tr> <tr> <td style="padding: 2px;">Moderate</td> <td style="text-align: center; padding: 2px;">1</td> <td style="text-align: right; padding: 2px;">(8%)</td> </tr> <tr> <td style="padding: 2px;">A little useful</td> <td style="text-align: center; padding: 2px;">2</td> <td style="text-align: right; padding: 2px;">(16%)</td> </tr> <tr> <td style="padding: 2px;">Not useful at all</td> <td style="text-align: center; padding: 2px;">1</td> <td style="text-align: right; padding: 2px;">(8%)</td> </tr> </table>	Very useful	3	(23%)	Useful	5	(38%)	Moderate	1	(8%)	A little useful	2	(16%)	Not useful at all	1	(8%)
Very useful	3	(23%)														
Useful	5	(38%)														
Moderate	1	(8%)														
A little useful	2	(16%)														
Not useful at all	1	(8%)														
Q2 If useful, what topics would you like covered or included	<p>Comments:</p> <ul style="list-style-type: none"> • pasture growth according to SOI Phases • photo standards of pasture cover to maintain fro minimal erosion • Web addresses: Long and Mid range forecasts • pasture growth predictions quarterly • risk % against soil moisture profile to soil type (red or black) • rainfall probabilities matched to SOI variation developed from newsletter concept and connected to pasture expectations • topics currently covered are good • explanation of Probability and Predictions • regional maps for different phases and different times of the year • history of SOI and El Nino events • simple explanation of risk x price/cost (E. Margin) assessment as per Newsletter #3. 															

Feedback from Final Newsletter, No. 9 – December 2004

Total number of respondents 45																													
Q1 How do you rate your understanding of climate science now as compared with to the period before the project?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">About the same</td> <td style="width: 10%; text-align: center;">12</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(27%)</td> </tr> <tr> <td>Somewhat improved</td> <td style="text-align: center;">10</td> <td></td> <td style="text-align: right;">(22%)</td> </tr> <tr> <td>Has improved</td> <td style="text-align: center;">19</td> <td></td> <td style="text-align: right;">(42%)</td> </tr> <tr> <td>Improved a lot</td> <td style="text-align: center;">4</td> <td></td> <td style="text-align: right;">(9%)</td> </tr> </table>	About the same	12		(27%)	Somewhat improved	10		(22%)	Has improved	19		(42%)	Improved a lot	4		(9%)												
About the same	12		(27%)																										
Somewhat improved	10		(22%)																										
Has improved	19		(42%)																										
Improved a lot	4		(9%)																										
Q2 Would you use seasonal climate outlook information to assist your decision making?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Yes</td> <td style="width: 10%; text-align: center;">32</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(71%)</td> </tr> <tr> <td>No</td> <td style="text-align: center;">13</td> <td></td> <td style="text-align: right;">(29%)</td> </tr> </table>	Yes	32		(71%)	No	13		(29%)																				
Yes	32		(71%)																										
No	13		(29%)																										
Q3 Has this project helped you change the way you use seasonal outlook information assist your decision making?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Yes</td> <td style="width: 10%; text-align: center;">25</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(57%)</td> </tr> <tr> <td>No</td> <td style="text-align: center;">19</td> <td></td> <td style="text-align: right;">(43%)</td> </tr> </table> <p>Comments (generalised comments with number of individual comments expressing similar sentiments in brackets):</p> <ul style="list-style-type: none"> • more aware of SOI significance late winter/spring & closer monitoring SOI & SST (1) • To use as a guide (12) • aware now of SOI at certain times (5) • Anomaly with historical trend & forecasts with more accuracy (1) • better understanding of variability (1) • trigger point information essential (1). 	Yes	25		(57%)	No	19		(43%)																				
Yes	25		(57%)																										
No	19		(43%)																										
Q4 How would you like to get information on seasonal climate outlooks?	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Radio</td> <td style="width: 10%; text-align: center;">13</td> <td style="width: 10%;"></td> <td style="width: 50%; text-align: right;">(12.7%)</td> </tr> <tr> <td>TV</td> <td style="text-align: center;">14</td> <td></td> <td style="text-align: right;">(13.7%)</td> </tr> <tr> <td>Newspaper</td> <td style="text-align: center;">12</td> <td></td> <td style="text-align: right;">(11.7%)</td> </tr> <tr> <td>Newsletter</td> <td style="text-align: center;">26</td> <td></td> <td style="text-align: right;">(25.5%)</td> </tr> <tr> <td>Internet</td> <td style="text-align: center;">25</td> <td></td> <td style="text-align: right;">(24.5%)</td> </tr> <tr> <td>Fax</td> <td style="text-align: center;">9</td> <td></td> <td style="text-align: right;">(8.8%)</td> </tr> <tr> <td>Recorded phone messages</td> <td style="text-align: center;">3</td> <td></td> <td style="text-align: right;">(2.9%)</td> </tr> </table> <p>Comments (generalised comments with number of individual comments expressing similar sentiments in brackets):</p> <ul style="list-style-type: none"> • BOM difficult to use (1) • more Newspaper articles (1) • Internet the best (1) • a simple website with data required (1) • newsletter for future referencing (3). 	Radio	13		(12.7%)	TV	14		(13.7%)	Newspaper	12		(11.7%)	Newsletter	26		(25.5%)	Internet	25		(24.5%)	Fax	9		(8.8%)	Recorded phone messages	3		(2.9%)
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Internet	25		(24.5%)																										
Fax	9		(8.8%)																										
Recorded phone messages	3		(2.9%)																										
Q5 What still need to be done to help you improve your climate risk management?	<p>A. With the information (Number of responses in brackets)</p> <ul style="list-style-type: none"> • confidence (5) • accuracy (12) • 2-18 month forecasts (4) • longer term involvement (DPI) (2) • larger maps (1) • experience, practice & updates (1) • build local reference sets(1) • trouble understanding effectiveness SOI phases (2) • more workshops (1) 																												

	<ul style="list-style-type: none"> • make it all easier to understand (1). <p>B. With ways it can be used in decision making (Number of responses in brackets)</p> <ul style="list-style-type: none"> • longer lead time (2) • accuracy in forecasts may delay joining & other management decisions (5) • reliability (3) • explore trigger points further (2) • booklet excellent start (1) • SOI trend indicator (1). <p>Other comments (generalised comments with number of individual comments expressing similar sentiments in brackets):</p> <ul style="list-style-type: none"> • thanks for taking on a difficult subject (3) • interest in further involvement 1/2 day workshops (1) • forget pasture forecasts (1) • accuracy (2) • in nth-west treat most years as impending drought (1) • the probability understanding (1) • lack of time to take in info (2) • continue with information & more research (7)
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APPENDIX 4. TECHNICAL ARTICLES PROVIDED FOR WESTERN DIVISION NEWSLETTER AND PROMOTIONAL ARTICLE ON ‘BETTING ON RAIN’

WESTERN DIVISION NEWSLETTER – TECHNICAL ARTICLE NO. 1.

IDENTIFYING TRIGGER POINTS FOR STOCKING DECISIONS IN WESTERN NEW SOUTH WALES

Ron Hacker¹ and Yohannes Alemseged²

¹Research Leader (Pastures and Rangelands), Trangie Agricultural Research Centre ²Rangeland Research Officer, Trangie Agricultural Research Centre

In the March-April 2005 issue of the Western Division Newsletter, Paul Carberry introduced the concept of ‘trigger points’ – calendar dates based on analysis of historical pasture growth patterns that may prompt decisions about livestock sales or purchases. Identifying a trigger point is like having a ‘rule of thumb’ about how long you can afford to delay a decision to reduce stock numbers if the season is already looking poor, or what might be the best time to buy if the season is already looking promising. Making these sorts of decisions, particularly sale decisions, is always difficult, and more so when rainfall is not strongly seasonal as in western NSW.

There are times when other seasonal risk assessments eg those provided by the SOI Phase system (see the article by Paul Carberry in this issue) can be of considerable assistance but when these are not particularly useful having a ‘trigger point’ may be the best alternative.

We have now completed the project, funded by Land and Water Australia and Australian Wool Innovations Limited, aimed at developing better seasonal risk assessments for western NSW. As part of this project we have worked on developing pasture growth profiles for various locations throughout the region that would allow ‘trigger points’ to be identified.

These profiles are based on long term (more than 100 years) daily pasture growth records provided by a simulation model called WinGRASP which has been calibrated for several general pasture types relevant to western NSW. The model can be run using long term daily meteorological data (rainfall, temperature, evaporation etc) from any of the numerous stations for which these records have now been compiled.

To identify ‘trigger points’ we first converted the daily pasture growth records to total growth figures for three monthly periods, starting at fortnightly intervals throughout the year i.e. for 3 month periods starting 1 January, 15 January, 29 January etc. in each year. We then summarised the three monthly data to produce either a

Growth potential index - which summarised the set of 3-month growth data for each starting date into a single figure, dates with higher growth potential having a higher index value

or

Critical percentiles – the amount of growth that defined the lowest 20%, 50% and 80% of the historical values.

Defining trigger points from these profiles is straight forward for the growth potential index as the highest and lowest values are easily identified (although for some locations the values for several dates may be similar). Defining trigger points using critical percentiles has the advantage of providing an indication of the historical variability of pasture growth associated with each starting date – indicated by the difference between the 20th and 80th percentile values. This information may lead to some adjustment of the trigger points that would otherwise be identified from the 50th percentile values alone, or those identified from the growth potential index.

To define these profiles across western NSW we worked with a number of graziers who offered to assist by assessing profiles for their location produced by a number of possible alternatives

(e.g. different combinations of model calibration and climate record). In a few cases, our co-operators thought that none of the alternatives provided was a good representation of their situation, and they modified the profiles accordingly. Most, however, were able to identify one of the alternatives as a reasonable fit to their experience. As a result, we were able to identify growth profiles for 27 locations across the region, 21 directly from model output and 6 by landholder modification of the output (Figure 1).

We also recorded the type of country on each property for which a growth profile was identified. Graziers on similar types of country in the same general area should now be able to identify trigger points for their own properties, provided they are satisfied that the profile presented is a reasonable representation of their particular situation. An illustration of trigger points and their interpretation is given in Figure 2.

This information has now been published in the booklet 'Betting on Rain - Managing Seasonal Risk in Western NSW'. In addition to the growth profiles, the booklet draws together basic information on weather and climate systems and the use of the SOI Phase system, at appropriate times, to determine the prospects for future pasture growth (see the article by Paul Carberry in this issue). Copies may be obtained by contacting your local DPI office or Trangie Agricultural Research Centre (Tel. 02 6880 8000).

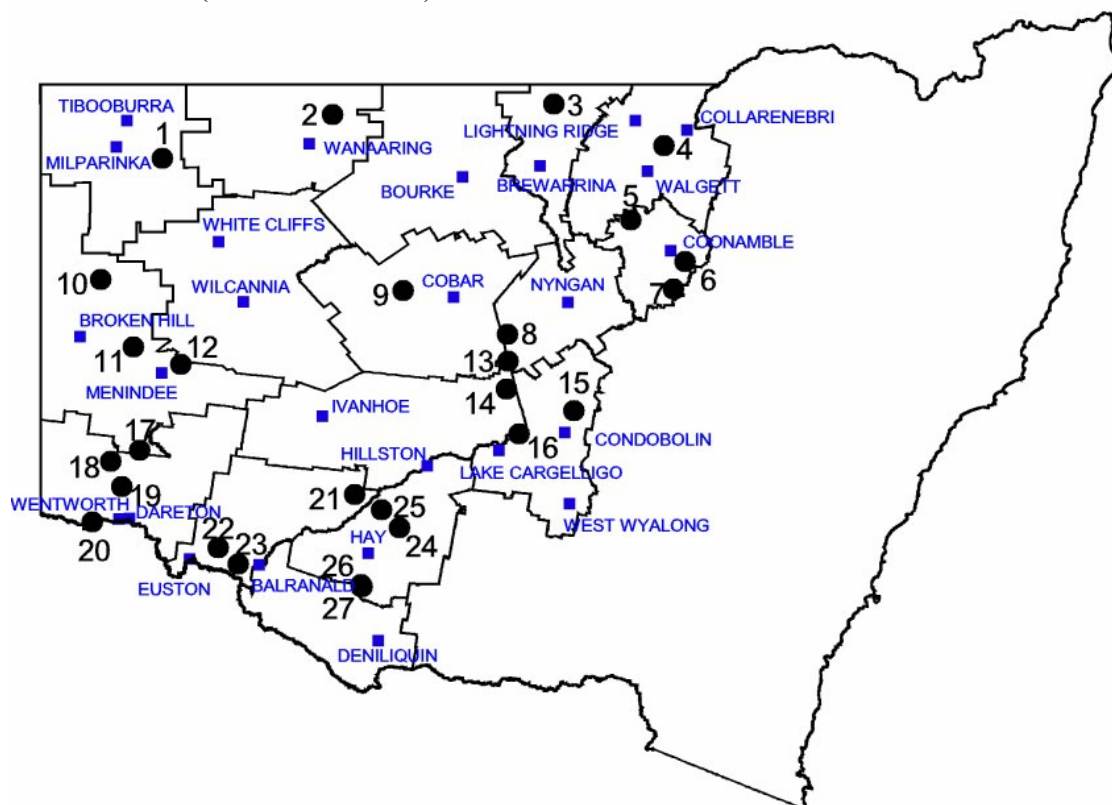


Figure 1 Location diagram showing the 27 centres for which pasture growth profiles have been defined.

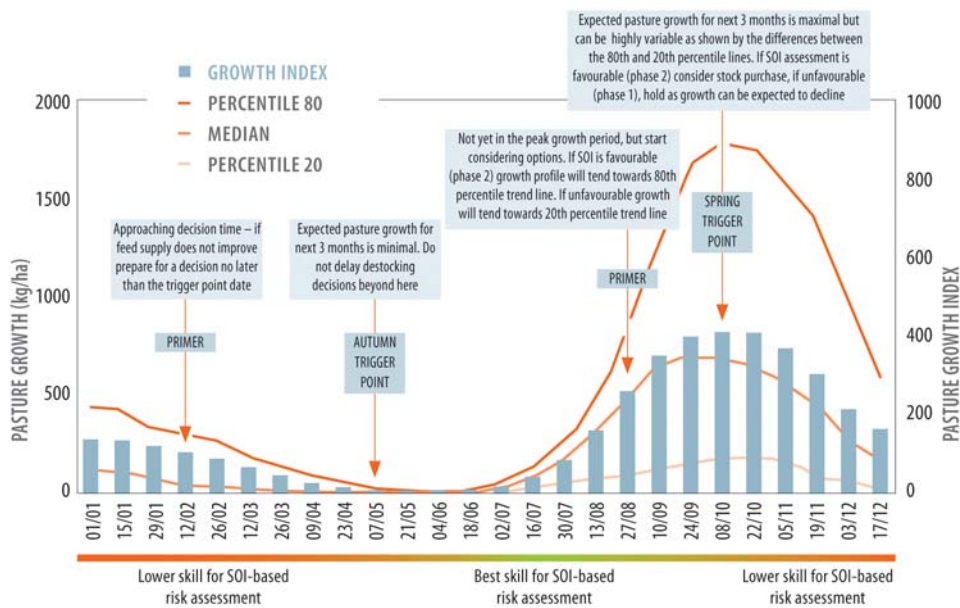


Figure 2. Example of how to use the growth potential index and critical percentile profiles to determine trigger points beyond which decisions that depend on future pasture growth should not be delayed. Note the ‘primer’ point, some time before the trigger point, when preparation for a decision and consideration of options should start.

WESTERN DIVISION NEWSLETTER – TECHNICAL ARTICLE NO. 2.

USING THE SOUTHERN OSCILLATION INDEX

Paul Carberry, Climate Advisory Officer, NSW DPI, Tamworth Agricultural Institute

The Southern Oscillation Index (SOI) is calculated from the air pressure at Darwin and at Tahiti. These are tropical locations and subject to monsoon type conditions in their “wet season”. This influences the SOI numbers that result during that time.

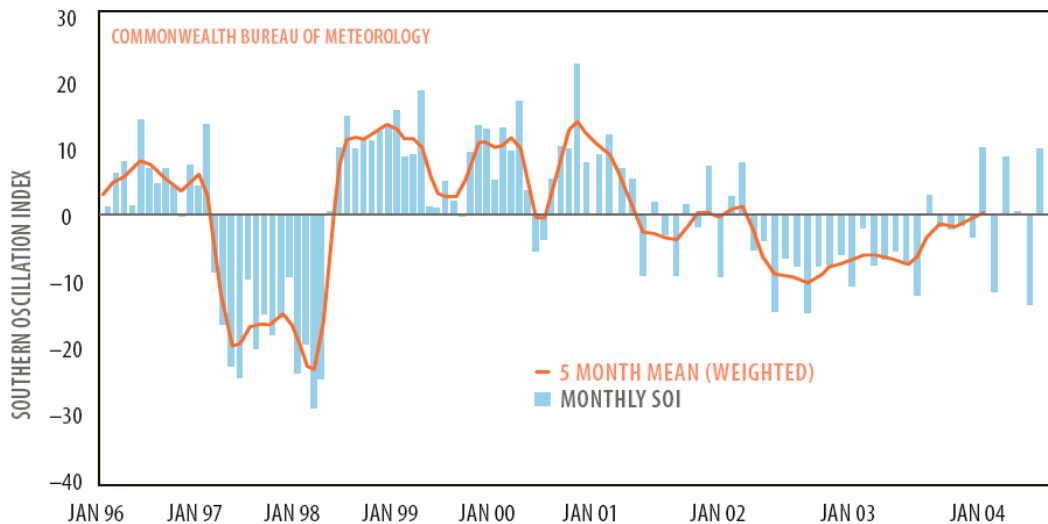
As a consequence of this tropical weather influence, the SOI often goes through a period of rapid change when the monsoon draws to an end. This is most often in late autumn.

The six months or so after this change usually sees the SOI very steady and looking through historical records one can find some very useful relationships between the SOI and rainfall for the time when the SOI remains steady.

Unfortunately, users need to wait till the annual change at the end of each year’s monsoon before the SOI settles into any useful pattern. For most of western NSW this is the end of May but you sometimes need to wait till the end of June before you know if it is really settled.

This autumn period is a time when managers want to make some important decisions and would like to use indicators of the potential for the coming season but the SOI is really no good for most places during autumn.

The relationship between May-June SOI and winter and spring rainfall can be very useful and similarly June-July and July-August SOI can be strong pointers to the potential for spring rain so it can be a big contributor to management decisions later in the year.



This graph, from the recently released booklet “Betting on rain – Managing seasonal risk in western NSW”, shows how the SOI varies most years, with major changes in autumn before settling through winter. The booklet details how this pattern can be used. It goes further than just the rainfall relationship and uses modelled pasture growth, accounting for factors such as soil and pasture type, evaporation, runoff, temperature and average animal impacts to get a relationship between SOI, or more precisely its two-monthly pattern called the SOI Phase, and potential plant growth. This is the ‘effective rainfall’ result.

The booklet contains plant growth maps (expressed as the chances of exceeding median growth) for those months when the SOI Phase has a strong relationship with growth in western NSW. Considering these chances when making management decisions can put some real numbers on the risk of getting an adverse outcome, or define the potential for a beneficial outcome. Getting a good idea of what the odds are allows you to make truly informed choices.

The booklet also contains pasture growth potential profiles that can help define ‘trigger points’ to assist decision making at times when the SOI is not useful (see the article by Ron Hacker and Yohannes Alemseged in this issue). Copies of the booklet may be obtained by contacting your local DPI office or Trangie Agricultural Research Centre (Tel. 02 6880 8000).

PROMOTIONAL ARTICLE PROVIDED TO CENTRAL WEST FARMING SYSTEMS AND WESTERN, MURRUMBIDGEE AND LOWER MURRAY-DARLING CATCHMENT MANAGEMENT AUTHORITIES

(Note: An earlier version of this article was also provided to the National Bestprac Coordinator).

BETTING ON RAIN – MANAGING SEASONAL RISK IN WESTERN NSW.

NSW DPI has recently published this guide to accessing and using climate information for producers in western NSW. It is the product of several years of research and discussion with numerous co-operators across the target region which includes the Western Division and the adjacent Rural Lands Protection Boards of Walgett, Coonamble, Nyngan, Condobolin, Hay and Riverina. .

The booklet focuses on making the linkages between indicators like the phases of the Southern Oscillation Index and the probabilities of getting above or below median seasons. It has gone past rainfall to the more useful outcome of pasture growth and its relationship to the indicators.

There is plenty of background information on how weather and seasonal climate systems work, and the things that can change these systems. There is also background on what the probability numbers really mean and how they can add to the information used to make decisions on-property.

Details of the relationship between pasture growth and the SOI Phase at those times when the relationship is strongest are presented in map format so producers can readily include this information in future decisions. Most importantly there are guides to likely pasture production for a range of centres throughout the region at times when there is no useful relationship with the indicator. These are all presented in a format intended to provide a useful reference for years to come.

The booklet is available free to producers within the target area. Contact your nearest office of NSW DPI or Trangie Agricultural Research Centre (02 6880 8000)