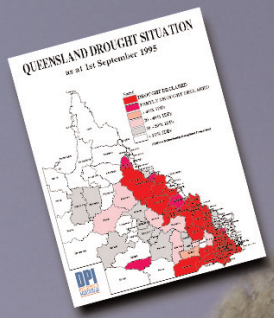
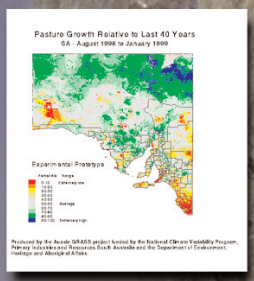
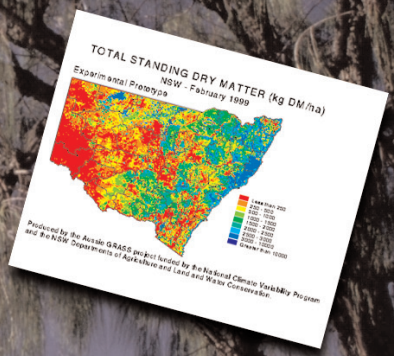
A SURVEY OF THE ASSESSMENT OF SEASONAL CONDITIONS IN PASTORAL AUSTRALIA

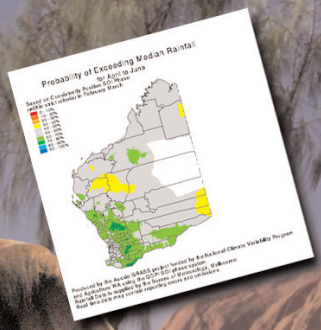
Benchmarking in the *Aussie GRASS* Project

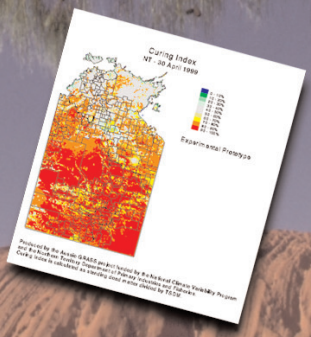
PART 6: NATIONAL SUMMARY











May 2000

Aussie GRASS

Queensland Government

Land & Water Resources Research & Development Corporation

Department of Primary Industries, Queensland-Report Series QO00005
(published for Queensland Centre for Climate Applications)

A SURVEY OF THE ASSESSMENT OF SEASONAL CONDITIONS IN PASTORAL AUSTRALIA

Benchmarking in the *Aussie GRASS* Project

PART 6: NATIONAL SUMMARY

Colin J. Paull and Wayne B. Hall
Qld Centre for Climate Applications
Indooroopilly Queensland

A product of The Aussie GRASS Project

A collaborative research and extension project carried out by:

Queensland Department of Natural Resources
Queensland Department of Primary Industries
Agriculture Western Australia
Department of Primary Industries and Fisheries, Northern Territory
Primary Industries and Resources South Australia
Department of Environment, Heritage and Aboriginal Affairs, South Australia
Department of Land and Water Conservation, NSW
NSW Agriculture

This survey was supported by Agriculture, Fisheries and Forestry - Australia, and Australia's rural R & D Corporations under the Climate Variability in Agriculture Program.

Department of Primary Industries, Queensland
Report Series QO00005
ISSN 0727-6281
Agdex 320/020
May 2000

The support of the National Climate Variability Project, administered by the Land and Water Research and Development Corporation, for this publication and the Aussie GRASS Project is gratefully acknowledged.

General Disclaimer

Information contained in this publication is provided as general advice only. For application to specific circumstances, professional advice should be sought.

The Department of Primary Industries, Queensland has taken all reasonable steps to ensure that the information contained in this publication is accurate at the time of production. Readers should ensure that they make appropriate enquiries to determine whether new material is available on the particular subject matter.

Manager, DPI Publications
Department of Primary Industries
GPO Box 46
Brisbane Qld 4001

CONTENTS

CONTRIBUTING AUTHORS

Detailed results and interpretive comments from this national survey have been published as the following five separate reports in order to encourage and facilitate the interpretation, distribution and fruitful use of the results on a State/Territory basis:

- Paull, C. J. and Hall, Dr. W. (1999) A Survey of the Assessment of Seasonal Conditions in Pastoral Australia – benchmarking in the Aussie GRASS Project, Part 1: Queensland, Queensland Department of Primary Industries Report Series QO99014, ISSN 0727-6281, November;

- Crichton, J., Marvi, H., Tupper, G. and McGufficke, A. (1999) A Survey of the Assessment of Seasonal Conditions in Pastoral Australia – benchmarking in the Aussie GRASS Project, Part 2: New South Wales Report, Queensland Department of Primary Industries Report Series QO99015, ISSN 0727-6281, November;

- Tynan, R. (1999) A Survey of the Assessment of Seasonal Conditions in Pastoral Australia – benchmarking in the Aussie GRASS Project, Part 3: South Australia Report, Queensland Department of Primary Industries Report Series QO99016, ISSN 0727-6281, November;

- Dyer, R., McMahon, K. and Werth, J. (1999) A Survey of the Assessment of Seasonal Conditions in Pastoral Australia – benchmarking in the Aussie GRASS Project, Part 4: Northern Territory Report, Queensland Department of Primary Industries Report Series QO99017, ISSN 0727-6281, November; and

- Roche, J. and Watson, I. (1999) A Survey of the Assessment of Seasonal Conditions in Pastoral Australia – benchmarking in the Aussie GRASS Project, Part 5: Western Australia Report, Queensland Department of Primary Industries Report Series QO99018, ISSN 0727-6281, November.

Each of these reports provides the complete survey results on a regional basis, including all individual responses to open questions, and local interpretation of the responses. This publication is a national summary of the survey results based on the above State/Territory reports.

INTRODUCTION

Australian rangelands have an extremely variable climate which has contributed to land degradation on some pastoral areas over the years. In order for graziers, agribusiness and policy-makers to make timely, profitable and sustainable management decisions, they need to have access to accurate up-to-date information on current and forecast seasonal conditions.

The Aussie GRASS Project

Pasture research over the last 30 years, combined with modern technologies, is opening up new possibilities for assessing seasonal conditions and improving pasture management decisions. From 1991 to 1996, a spatial modelling framework was developed for Australia to provide up-to-date simulations and forecasts of pasture growth and utilisation, but with an emphasis on Queensland. This work integrated climatic and natural resource data, remote sensing, historical agronomic research and simulation modelling. While seasonal rainfall explained only 40% of the variation in seasonal pasture growth, models of soil water and pasture growth explained approximately 70% of observed variation.

The second stage of the project, called Aussie GRASS, commenced in April 1997. It involves nationwide collaboration of organisations in New South Wales (NSW), Northern Territory (NT), Queensland (Qld), South Australia (SA) and Western Australia(WA), in both research and extension; the aim is to expand the spatial modelling framework and make it operational to enable regular assessment of the condition of Australia's grazing lands. The Queensland Department of Natural Resources is lead agency in the Project, which is supported by funding from the National Climate Variability Program (administered by the Land and Water Resources Research and Development Corporation).

A range of 32 spatial mapping products has been produced for the States of Queensland, New South Wales, South Australia, Western Australia and the Northern Territory (including some generic Australia-wide maps). These products can be divided into the following groups: recent rainfall, current pasture production/condition, drought situation, seasonal climate outlook indicators, forecast rainfall/pasture condition, and integration of products. Most products are currently available on one or more of the following information systems: Internet World Wide Web - 'The Long Paddock'; SOI Fax Hotlines; Farmfax - Climate section; and SOI Phone Hotline.

These widely available products will enable more timely and improved assessment of seasonal conditions, recognition of climate-related opportunities and threats, and thus influence management decisions such as stocking rate and burning. This will lead to grazing industries and other resource managers being better in tune with changing seasonal conditions and the natural resource base. As a result, proactive management decisions will minimise land degradation during drought events, and government drought policy will be more transparent and nationally consistent.

The Project involves liaison and interaction with a wide range of stakeholders, agencies and related programs and projects, as the products can help with a wide range of decisions.

The purpose of the survey was to provide a benchmark profile of Australian graziers for the Aussie GRASS Extension sub-project. The survey was designed to gain information primarily from graziers. However, some feedback was also sought from agribusiness operators in pastoral areas who could contribute up a maximum of 10% of the sample.

SUMMARY

A convenience sample of graziers, and a few representatives of agribusiness, were surveyed in each of the collaborating States and the Northern Territory. A total of 217 completed survey forms was returned. The feedback collected covered four areas: general information about respondent; monitoring seasonal conditions; 'big-picture' information; and scaled attitudinal responses. In addition, eight members of Local Drought Committees in central Queensland, who had been exposed to many of the Aussie GRASS products, were also surveyed; this sample was kept separate from other survey feedback in order to obtain a comparison with the convenience sample for that region. Summaries of responses to all questions are given on a State and Territory basis. In order to obtain detailed responses, on a regional basis, it is necessary to go to the publication for that particular State or Territory.

The main results and conclusions from the survey follow.

General Information

- A total of 96% of participants keep daily rainfall records.
- Of these, 93% have 'complete' or 'fairly complete' records.

Monitoring Seasonal Conditions and Decision-making

- A total of 48% of participants believe that their rainfall has become drier.
- 58% believe that their rainfall has become more variable.
- A total of 43% of participants believe that summer day-time temperatures have become hotter.
- 43% believe that there has been 'no change' in the frequency of frosting during the 1980s and 1990s.
- A total of 38% of participants think that there has been no change in relative humidity, while 26% feel that the climate has become more humid.
- 81% said that judgements of future climatic conditions were 'very important' or 'moderately important' in their decision-making.
- A total of 75% of participants do not use long-term climatic records to assist in decision-making.
- 44% said that probability-based information is 'moderately useful' to 'very useful' in the management of their business.
- A total of 37% of participants currently use seasonal climate forecasts in decision-making.
- 56% measure or record information for individual paddocks.
- A total of 39% of participants regularly compare property management options quantitatively.

'Big-picture' Information Products and Access

- A total of 42% of respondents said 'big-picture' information was 'moderately important' to 'very important' in their planning.
- 71% had used at least one product.

- A total of 53% of participants of those who have used big-picture information have found it 'moderately useful' to 'very useful'.

- 44% of those who have not used big-picture information thought it could be 'moderately useful' or 'very useful'.

- A total of 28% of respondents have no problem using 'big-picture' information. However, some have problems with interpreting and using it (22%), and the information was not detailed enough for others (15%). The comments under 'Other problems' indicate some reservations about product accuracy and forecasting ability.

- 85% have a facsimile machine.

- A total of 68% of participants have a computer, 20% currently have access to the Internet, and 42% of respondents are comfortable with an increasing amount of information being computerised (see PART D).

- The most convenient ways to access seasonal climate outlook information are faxed directly (66%), rural newspapers (55%),TV (54%) and radio (47%). However, the main sources of seasonal situation/outlook information used at least once are BoM Fax Services (84%), and the SOI Fax Hotlines (19%).

Scaled Attitudinal Responses

- Some respondents thought these were leading questions.

- 'It is better management practice to simply respond to changing seasonal conditions, rather than try to anticipate and reduce seasonal climatic risks' - 48% either 'agree' or 'strongly agree' with this statement.

- 'I accept that seasonal climate forecasts are better expressed in terms of probabilities (e.g. '60% chance that the next three months will be drier than average') than like a traditional weather forecast' - 65% 'agree' or 'strongly agree' with this statement.

- 'At present, SOI and probability-based forecasting places undue responsibility on 'users' to interpret the information' - average response to this statement was neutral.

- 'Warnings of possible stock feed shortages in 3-6 months time, at a district level, would be valuable in making my management decisions' - 71% either 'agree' or 'strongly agree' with this statement.

- 'At present, adequate experience and information are available to enable me to link climate-related information/forecasts to practical property management' - average response to this statement was neutral to 'agree'.

- 'I am comfortable with the increasing level of climate-related materials now becoming available via computer programs and computer networks' - average response to this statement was neutral to 'agree'.

- 'Warnings of the possible pasture deterioration (e.g. weed invasion, loss of desirable species) at a district level, before the main growing season, would be valuable in making my management decisions' - 52% either 'agree' or 'strongly agree' with this statement.

- 'Generally, the rural media provide credible and useful sources of seasonal climate forecast information' – average response to this statement was neutral to 'agree'.

- 'Warnings of possible soil deterioration (e.g. reduced ground cover, soil loss – see 'Definitions' on last page) on a district level, before the level of pasture ground cover became critical, would be valuable in making my management decisions' - average response to this statement was neutral to 'agree', while 44% answered 'agree' or 'strongly agree'.

- ‘Scientific seasonal climate forecasting is a valuable tool for managing my property in the face of seasonal variability’ - average response to this statement was neutral to ‘agree’, while 52% answered ‘agree’ or ‘strongly agree’.

Conclusions

The following conclusions can be made from the survey:

- The survey results provide reasonable guidance for developing an effective Communication Plan and extension program.

- The knowledge and attitudes of agribusiness managers are not well represented in the data obtained. Some further information may need to be collected by extension staff through personal contact.

- Our extension program needs to help graziers to make better use of their valuable rainfall records, and other climatic records. A total of 75% of respondents do not currently use long-term climatic records to assist in decision-making.

- Graziers are likely to be receptive to training aimed at a better understanding of seasonal climate forecasting, and the use of such information; 37% currently use seasonal climate forecasts in decision-making.

- There is a reasonably good acceptance of the usefulness of probability-based information. In addition, most respondents (65%) agree with releasing seasonal climate forecasts in the form of probabilities. However, in extension activities care needs to be taken to explain the concept simply.

- Answers to questions about the importance and usefulness of ‘big-picture’ information indicate that respondents should generally be receptive to Aussie GRASS extension activities.

- Users of ‘big-picture’ products have some problems with interpreting and using information (22%), and information is not detailed enough for some. There are also some reservations about product accuracy and forecasting ability. These issues need to be addressed in implementing the Aussie GRASS extension program.

- While the most convenient ways to access seasonal climate outlook information are direct fax, rural newspapers, TV and radio, the best current method for pastoralists to obtain accurate information appears to be by facsimile machine. However, their use of computers, software programs and the Internet is likely to increase.

- There appears to be strong support for the concept of Feed Shortage Alerts (70%), and moderate support for the provision of warnings of possible deterioration of pastures (52%) or soil (44%). Note that the support for warnings declines as the sustainability threat is perceived as being further in the future; however, in a separate sample of members of Local Drought Committees in central Queensland, support for each type of warning was consistent (60%).

- The range of ‘big-picture’ products needs to be promoted in an integrated fashion, and focused at the property level by linking the information with on-property observations/experiences.

- As participants indicated some concern regarding the accuracy of seasonal climate forecasts, it is important to improve their accuracy for the various pastoral regions of Australia. Only then can we expect graziers to accept the ‘look-ahead’ products developed under the project.

- In order for the extension of Aussie GRASS products to be effective, the timing of activities and selective use of appropriate decision-support products/tools are essential. It is important that group extension activities be conducted at the most appropriate time in the annual production cycle, when specific products can make a significant difference in the quality of decision-making. Answers to Question 13 help to identify the critical decision-making times for a specific industry in a particular region. Only products/tools relevant

to the key property management decision being analysed should be promoted, and this should be done in the context of overall management of the pastoral business.

- It is desirable to repeat this benchmarking survey, for example after five years, in order to measure the changes that have occurred as a result of achieving significant information and technology transfer.

- A consensus agrees that while a good manager knows his land and its limitations, there is a need for more accurate seasonal forecasts, particularly on a regional or district basis.

- There needs to be further research to establish suitable models for southern Australia; the provision of sample products and further client workshops will help in the development and acceptance of the products.

- Western Australian pastoralists have not been exposed to the concept of El Niño and the SOI as much as producers in eastern states. Obviously, this is due to the reduced effects of this phenonemon on the west coast. However, it also means that they are less sensitive to 'big-picture' climate information. In the east, El Niño and SOI provide effective vehicles for raising the profile of seasonal intelligence. The same is not true in the west and it will not become so unless a complementary index is found for the west coast and promoted.

- Seasonally related 'big-picture' information may have to be tailored differently to producers in Western Australia. Rather than focusing on forecasts, it might be better to concentrate on seasonal context information using their own (often very good) long-term rainfall records. This would allow them to make better judgements about the 'averageness' of current seasons and set stocking rates accordingly.

SURVEY METHOD

Aims

The aims of the survey were:

1. To measure the knowledge, attitudes, skills and aspirations of graziers and pastoral agribusiness managers pertaining to the assessment of seasonal conditions, including the use of seasonal climate forecasting;

2. To ascertain how pastoralists currently assess seasonal conditions, the decision-support information/tools they access, and how the information is used in making key property management decisions; and

3. To provide a sound basis for the development of communication and extension strategies in order to achieve effective and efficient transfer of information and technological outputs of the Aussie GRASS research program.

Survey Design

Research Objectives

The survey was aimed at achieving the following research objectives:

OB1: To measure the *knowledge* of graziers and pastoral agribusiness managers pertaining to the assessment of seasonal conditions including the use of seasonal climate forecasting.

OB2: To measure the *attitudes* of graziers and pastoral agribusiness managers pertaining to the assessment of seasonal conditions including the use of seasonal climate forecasting.

OB3: To measure the *skills* of graziers and pastoral agribusiness managers pertaining to the assessment of seasonal conditions including the use of seasonal climate forecasting.

OB4: To measure the *aspirations* of graziers and pastoral agribusiness managers pertaining to the assessment of seasonal conditions including the use of seasonal climate forecasting.

OB5: To ascertain *how* pastoralists currently *assess seasonal conditions*.

OB6: To determine the decision-support *information/tools accessed* by graziers when assessing seasonal conditions.

OB7: To determine how graziers *use* decision-support *information* related to seasonal conditions in making property management *decisions*.

OB8: To identify the *implications* of the findings for *extension strategies* designed to achieve effective and efficient transfer of information and technological outputs of the Aussie GRASS research program.

OB9: To identify the *implications* of the findings for the *Communication Plan* designed to help achieve effective
and efficient transfer of information and technological outputs of the Aussie GRASS research program.

OB10: To determine what *on-property observations* are made by graziers to help them to assess seasonal conditions.

OB11: To determine *perceptions* of graziers to possible *climate change* trends.

OB12: To identify the *key climate-related decisions* made by graziers in particular regions/industries.

OB13: To establish what *problems* graziers have when *using 'big-picture' information* for assessing seasonal conditions.

OB14: To establish the *needs* of graziers for *'big-picture' information* to make better management decisions.

OB15: To identify the most convenient *ways* for graziers *to access* seasonal situation/outlook *information*.

OB16: To determine the *attitudes* of graziers regarding the potential value of forecasts/*warnings* about possible property management problems over the next 3-6 months.

Questions Addressing Objectives

The numbers of the questions, and supporting questions, addressing each research objective are indicated in the Summary of Questionnaire Design (see Table 1).

Decisions Using Outputs

Data collected by use of the survey instrument was designed to answer the following questions:

DEM D1: What is the *situation in a particular region*/district of pastoral Australia?

D2: What is the relationship between *age* and different attitudes?

PRO D3: What are the *management priorities* in the various pastoral industries?

D4: What are the management priorities in the various agroclimatic regions?

EXP D5: What is the relationship between *years of experience* and knowledge, attitudes, skills and aspirations in the various regions and/or industries?

OB1 D6: What is the *level of knowledge* of producers in a particular region and/or industry?

Table 1. Summary of Questionnaire Design

Code	Data Required/ Research Objective	Question Nos	Supporting Question Nos	Decisions Using Outputs
DEM	Demographics	1, 2, 10f		D1, D2
PRO	Property details	3, 4, 5, 9		D3, D4
EXP	Experience in years	6		D5
OB1	Level of knowledge	31, 26, 13	28, 30,14	D6
OB2	Attitudes of producers	21f, 22-32		D7
OB3	Skills of producers	15, 17a	16,18,23,24,26,28,30	D8
OB4	Aspirations of producers	28, 30	19d	D9
OB5	Components of seasonal condition assessment	14,15,16, 17a, 22	11,16, 19c	D10
OB6	Importance of information/tools	19b, 21e, 27	19a	D11
OB7	Use of information	12, 18	11	D12
OB8	Extension strategies	19c, 19d		D13
OB9	Communication	19c, 19d		D14
OB10	On-property observations	7a, 17b, 17c	7b, 7c, 8, 16	D15
OB11	Climate change	10a - 10e	10f, 10g	D16
OB12	Climate decisions	13, 5		D17, D18
OB13	'Big-picture' problems	19e		D19
OB14	Graziers' needs for 'big-picture'	19a, 19c, 19d, 20		D20
OB15	Information delivery	21d, 21b, 21c	21a, 21e, 27, 29	D21, D22
OB16	Property management warnings	25, 28, 30		D23, D24, D25

OB2 D7: What are the *attitudes* of producers in a particular region and/or industry?

OB3 D8: What is the *level of skills* of producers in a particular region and/or industry?

OB4 D9: What are the *aspirations* of producers in a particular region and/or industry?

OB5 D10: What are the main components of the *process* pastoralists currently use *to assess seasonal conditions* in a particular region and/or industry?

OB6 D11: What is the *relative importance of* various decision-support *information*/tools used by graziers when assessing seasonal conditions in a particular region and/or industry?

OB7 D12: How do graziers *use information* in making property management decisions in a particular region and/or industry?

OB8 D13: In the light of the findings, how can *extension strategies* be improved in a particular region and/or industry?

OB9 D14: In the light of the findings, how can our *Communication Plan* be improved in a particular region and/or industry?

OB10 D15: What *on-property observations* are being made by graziers in a particular region and/or industry?

OB11 D16: What are graziers' perceptions of possible *climate change* in a particular region and/or industry?

OB12 D17: What are the *key* climate-related *decisions* made by graziers in a particular region and/or industry?

D18: What do the answers to D17 indicate as high *business management priorities*?

OB13 D19: What problems need to be addressed to help graziers to *use 'big-picture' information* better in a particular region and/or industry?

OB14 D20: What need do graziers think they have for *'big-picture' information* in a particular region and/or industry?

OB15 D21: What are the most convenient ways for graziers to access information, and what changes should we make to our *information delivery systems* for them?

D22: In the light of answers to D21, what changes are necessary to our Communication Plan and plans for future information delivery systems?

OB16 D23: Do graziers regard *warnings* of possible property management problems as potentially valuable?

D24: How *receptive* will producers be to such *warnings*?

D25: In the light of answers to D23 and D24, what changes are necessary to our extension program and Communication Plan in a particular region and/or industry?

Survey Process

A standard covering letter (Appendix 1) and questionnaire (Appendix 2) were used in the survey. The Results section uses the structure and actual questions of the questionnaire in order to systematically report on the responses of participants.

The eight key questions in the survey were:

- KNOWLEDGE about making sound pasture management decisions regarding stocking rates (Question 16);
- ATTITUDES about the usefulness of 'big-picture' information (Questions 19a and 19d);
- SKILLS in accessing relevant information systems (Question 21e); and
- ASPIRATIONS regarding commitment to adoption of sustainable management practices (Questions 17c, 25, 28 and 30)

The aim was to survey a 'representative' sample of at least 50 graziers and pastoral agribusiness managers (up to a maximum of 10% of the total sample) in each of NSW, SA, WA, NT and Qld – that is a total of 250 people. Samples for surveying were obtained in various ways in the collaborating States and the NT. Many of the extension officers in pastoral areas were involved in the distribution of survey forms and collection of completed survey forms. For example, in Queensland the following approach was used:

> Each of the five Queensland Department of Primary Industries (QDPI) regional climate extension officers involved in the Aussie GRASS Project was requested to obtain at least 10 completed survey forms. For convenience, samples for most regions were obtained from QDPI's Animal Health Agricultural Property System (APS) data base, which was primarily established as a tool for the control of diseases and chemical residues in cattle. In some cases, properties which were less than 100 ha in area were excluded prior to sampling.
>
> In the south-east region of Queensland, a selected sample was obtained using the distribution list for the QDPI's *Beef Newsletter* which is mailed quarterly to every beef producer in the region. This was supplemented by personal contact with graziers who were regarded as representative for the region.
>
> In central Queensland, eight members of Local Drought Committees, who had been exposed to many of the Aussie GRASS products, were also surveyed. This sample was kept separate from other survey feedback in order to obtain a comparison with the convenience sample for that region.

Most people in the sample were phoned prior to sending out the survey form in order to obtain some commitment to providing feedback. However, time constraints did not always permit this.

Survey forms were mailed in March 1998. The generic covering letter was customised by each State/Territory to indicate local involvement in the Project, as was a follow-up letter to those who had not responded within one month of mailing the survey forms.

As promised, those who provided their names and addresses were sent a coloured poster showing historical Australian rainfall maps and SOI graph, and their names were placed in the draw for 16 book prizes. The book prize winners for the State/Territory were named in the covering letter sent with the posters. Again generic covering letters sent with the posters and the book prizes were customised by each State/Territory prior to sending.

An electronic version of the survey form was produced by the Queensland Centre for Climate Applications, and placed on the SILO World Wide Web site. Each State/Territory then entered their own data that was placed in a relational database. Printed copies of the data entered for respondents were then checked and the errors corrected.

Summaries of the data for each State/Territory were distributed to facilitate production of these detailed reports on the findings for each State/Territory. This report summarises the overall findings of the survey.

RESULTS - AUSTRALIA

The following numbers of completed survey forms were received:

Qld	**65**	SA	**49**	NT	**23**
NSW	**54**	WA	**26**	TOTAL	**217**

The following answers and comments were obtained in response to the various questions **(the total number of responses in each category is indicated, with national data in bold type, followed by the percentage of those who responded to the specific question shown in brackets)**:

Part A: General Information About Respondent

Q1: What is your nearest *town*? _____ In what *State*?_____

A summary of responses to the second part of this question is contained in the table above.

Q2: What is the name of your local government area/district? _____

These results are given in the individual State/Territory reports.

Q3: How big is your property? _____ ha.

There were 209 responses to this question:

0 – 1000ha	**31**	(14.8)
>1000 – 10000	**39**	(18.7)
>10 000 – 30000	**44**	(21.1)
>30 000 – 100000	**38**	(18.2)
>100 000 – 300000	**29**	(13.9)
>300000	**28**	(13.4)

Answers by State

Property size (ha)	TOTAL	WA	SA	NT	QLD	NSW
0 – 1000	**31** (14.8)	0	0	0	23	8
>1000 - 10000	**39** (18.7)	2	2	2	19	15
>10 000 – 30000	**44** (21.1)	0	6	0	16	22
>30 000 – 100000	**38** (18.2)	6	18	3	3	8
>100 000 – 300 000	**29** (13.9)	10	11	6	2	0
>300 000	**28** (13.4)	8	9	10	1	0

Q4: How big is your business? ($ turnover per annum).

There were 215 responses to this question:

< 20 000	**14**	(6.5)
> 20 000 - 200 000	**95**	(44.2)
> 200 000 - 2 000000	**103**	(47.9)
> 2 000000	**3**	(1.4)

Answers by State

Annual Turnover ($)	TOTAL	WA	SA	NT	QLD	NSW
Up to 20 000	**14** (6.5)	1	0	1	7	5
> 20 000 - 200 000	**95** (44.2)	5	27	5	33	25
> 200 000 - 2 000000	**103** (47.9)	19	22	16	23	23
> 2 000000	**3** (1.4)	1	0	1	1	0

Q5: What industries are you in?

There were 364 responses to this question (some of the 215 respondents gave more than one answer):

Beef	**155** (72.1)
Sheep	**107** (49.8)
Summer grain	**11** (5.1)
Winter grain	**40** (18.6)
Fodder crops	**16** (7.4)
Dairying	**4** (1.9)
Agribusiness	**3** (1.4)
Other	**28** (13.0)

Answers by State

Industry	TOTAL	WA	SA	NT	QLD	NSW
Beef	**155** (72.1)	13	24	22	56	40
Sheep	**106** (49.8)	18	30	0	11	48
Summer Grain	**11** (5.1)	0	0	0	8	3
Winter Grain	**40** (18.6)	2	5	0	9	24
Fodder Crops	**16** (7.4)	1	0	0	8	7
Dairying	**4** (1.9)	0	0	0	4	0
Agribusiness	**3** (1.4)	0	0	0	1	2
Other	**28** (13.0)	5	3	1	10	9

Other Industries Listed

WA	SA	NT	QLD	NSW
• Transport • Wool • Resource management and enviro-tourism • Tourism • Yabbies	• Wool • Pasture • Wildlife sanctuary • Tourism (x4) • Camels	• Horticulture	• Agistment • Farm stay • Sugar/cane farming (x3) • Feedlot • Flowers • Fruit growing	• Goats (x5) • Research • Poly culturing aquaculture • Tourism • Nursery • Restaurant

Q6: For how long have you been a primary producer? ____ years <u>OR</u> not applicable?

There were 200 responses to this question:

Up to 10 years	**15** (7.5)
> 10 – 20 years	**49** (24.5)
> 20 – 30 years	**44** (22.0)
>30 – 40 years	**42** (21.0)
> 40 – 50 years	**37** (18.5)

> 50 years	**13**	(6.5)

Answer by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Up to 10 years	**15** (7.5)	3	4	1	5	2
> 10 – 20 years	**49** (24.5)	9	9	5	12	14
> 20 – 30 years	**44** (22.0)	8	11	2	14	9
>30 – 40 years	**42** (21.0)	3	4	5	11	19
> 40 – 50 years	**37** (18.5)	2	11	2	15	7
> 50 years	**13** (6.5)	1	5	2	3	2

Q7a: Do you keep daily rainfall records?

There were 216 responses to this question:

Yes	**197**	(91.2)
No	**19**	(8.8)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**197** (91.2)	26	46	22	51	52
No	**19** (8.8)	0	2	1	13	3

Q7b: How many years have you kept these records?

There were 190 responses to this question:

Up to 10 years	**21**	(11.1)
> 10 – 20 years	**55**	(28.9)
> 20 – 30 years	**40**	(21.1)
> 30 – 40 years	**23**	(12.1)
> 40 – 50 years	**17**	(8.9)
> 50 years	**34**	(17.9)

Answers by State

No. of years records have been kept	TOTAL	WA	SA	NT	QLD	NSW
Up to 10 years	**21** (11.1)	3	2	5	7	4
> 10 – 20 years	**55** (28.9)	6	8	4	17	20
> 20 – 30 years	**40** (21.1)	4	9	6	13	8
> 30 – 40 years	**23** (12.1)	1	1	4	7	10
> 40 – 50 years	**17** (8.9)	0	7	0	3	7
> 50 years	**34** (17.9)	11	15	1	4	3

Q7c: How complete are these records?

There were 196 responses to this question:

Complete	**113**	(57.7)
Fairly Complete	**69**	(35.2)
Patchy	**14**	(7.1)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Complete	**113** (57.7)	20	25	9	29	30
Fairly Complete	**69** (35.2)	6	14	11	19	19
Patchy	**14** (7.1)	0	5	2	4	3

Q8: What is your average annual rainfall (mm)?

There were 204 responses to this question:

0 – 200	**34** (16.7)
> 200 – 400	**67** (32.8)
> 400 – 600	**42** (20.6)
> 600 – 800	**43** (21.1)
> 800	**17** (8.3)
Don't know	**1** (0.5)

Answers by State

Rainfall (mm)	TOTAL	WA	SA	NT	QLD	NSW
0 – 200	**34** (16.7)	4	27	0	2	1
> 200 – 400	**67** (32.8)	14	19	5	6	23
> 400 – 600	**42** (20.6)	4	2	4	16	16
> 600 – 800	**43** (21.1)	2	0	5	25	11
> 800	**17** (8.3)	1	0	6	9	1
Don't know	**1** (0.5)	0	0	0	1	0

Q9: When do you receive most of your rainfall?

There were 271 responses to this question (some of the 207 respondents gave more than one answer):

Summer	**124** (59.9)
Autumn	**18** (8.7)
Winter	**51** (24.6)
Spring	**23** (11.1)
Evenly spread	**55** (26.6)

Answers by State

Season	TOTAL	WA	SA	NT	QLD	NSW
Summer	**124** (59.9)	13	20	23	54	14
Autumn	**18** (8.7)	6	3	1	7	1
Winter	**51** (24.6)	16	16	2	1	16
Spring	**23** (11.1)	3	6	1	5	8
Evenly spread	**55** (26.6)	2	16	0	5	32

Part B: Monitoring Seasonal Conditions

Q10: From your experiences and knowledge, do you believe that your climate during the 1980s and 1990s has changed compared with that of the 1960s and 1970s?

Q10a: Rainfall

There were 199 responses to this question:

Don't know	**27**	(13.6)
No change	**53**	(26.8)
Drier	**95**	(47.7)
Wetter	**24**	(12.1)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Don't know	**27** (13.6)	2	9	6	3	7
No change	**53** (26.8)	8	18	8	8	11
Drier	**95** (47.5)	8	9	6	47	25
Wetter	**24** (12.1)	7	9	3	1	4

Q10b: Rainfall variability

There were 197 responses to this question:

Don't know	**23**	(11.7)
No change	**42**	(21.3)
More variable	**114**	(57.9)
Less variable	**18**	(9.1)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Don't know	**23** (11.7)	1	4	5	6	7
No change	**42** (21.3)	8	17	5	6	6
More variable	**114** (57.9)	15	20	8	40	31
Less variable	**18** (9.1)	1	3	5	6	3

Q10c: Summer day-time temperatures

There were 196 responses to this question:

Don't know	**40**	(20.4)
No change	**64**	(32.7)
Hotter	**83**	(42.3)
Cooler	**9**	(4.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Don't know	**40** (21.0)	4	8	8	10	10
No change	**64** (32.3)	8	19	5	8	24
Hotter	**83** (43.1)	11	11	10	39	12
Cooler	**9** (4.6)	1	5	0	1	2

Q10d: Frost

There were 191 responses to this question:

Don't know	**42**	(22.0)
No change	**81**	(42.4)
More frost	**16**	(8.4)
Less frost	**52**	(27.2)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Don't know	**42** (22.0)	3	10	9	10	10
No change	**81** (42.4)	12	23	10	12	24
More frost	**16** (8.4)	4	3	0	2	7
Less frost	**52** (27.2)	3	8	2	32	7

Q10e: Humidity

There were 194 responses to this question:

Don't know	**58**	(29.9)
No change	**73**	(37.6)
More humid	**49**	(25.3)
Less humid	**14**	(7.2)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Don't know	**58** (29.9)	9	10	9	17	13
No change	**73** (37.6)	10	25	7	11	20
More humid	**49** (25.3)	3	9	6	21	10
Less humid	**14** (7.2)	1	0	0	8	5

Q10f: In what year were you born?

There were 209 responses to this question:

1920s	**10**	(4.8)
1930s	**42**	(20.1)
1940s	**58**	(27.8)
1950s	**71**	(34.0)
1960s	**24**	(11.5)
1970s	**4**	(1.9)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
1920s	**10** (4.8)	0	4	2	3	1
1930s	**42** (20.1)	3	7	1	20	11
1940s	**58** (27.8)	9	10	6	14	19
1950s	**71** (34.0)	8	16	9	19	19
1960s	**24** (11.5)	3	8	4	5	4
1970s	**4** (1.9)	1	0	1	2	0

Q10g: Any other comments?

Queensland

All the individual responses were:

- 'My perspective has changed with time and the responsibility of making the "right" decisions. Above answers are more of a gut reaction than a qualitative assessment.'
- '1991 to 1996 were drier years. The late '60s were also very dry. We are in a very dry area. While we may think it is drier, it may not have been so, but the '90s had the longest succession of dry years.'
- 'My records prior to 1980 have been damaged by cyclonic rain. 1997-98 summer was said to be hotter in Townsville since the Second World War. Although we had droughts prior to 1970 (1969 for example) we mostly received a "wet" of 500mm or more.'
- 'Because of my age it is quite hard to answer accurately. From information passed on by my father, neighbours etc., I have come across the answers above. The climate does seem to be erratic.'
- 'Winter seems shorter and warmer (milder). Storms seem later with less monsoon activity, this year being the exception with huge rain depressions.'
- 'Regarding Question 8: 950mm quoted by the Lands Department in those 17 years.'
- 'Question 10a is a bit hard to answer because during the 1980s we had some good winter rain and very little summer rain.'
- 'Regarding question 10a: drier than the 1970s, wetter than the 1960s.'
- 'Winters and summers are getting later.'
- 'Atmosphere must be thinning as "burn" of the sun is increasing.'
- 'The sun burns more.'
- '1960s very dry. 1970s, very wet. 1980s and 1990s were more stable seasons. It is very difficult to make a comparison of rainfall between 1960s and 1970s and now, as there was such a striking difference between those decades. See attached chart of residual rainfall.'
- 'I am convinced climate is changing, drier and hotter. Rate of change is accelerating.'
- 'I have only been on this property for 12 years. I only record rain.'
- 'The regular summer rains of the past just don't come any more. Summer flooding every year doesn't happen.'
- 'Late 1980s and 1990s has seen more discernible change.'
- 'My Dad, who lived from 1890-1972 often said we don't get these old-fashioned thunder storms any more. I say the same now. Perhaps weather changes all the time and maybe goes in 100 year or so cycles, or the same weather never occurs again; or maybe things seem different when you're a kid.'
- 'I have lived on this property since 1972, so my experience goes back to then for the sake of this questionnaire.'
- 'The wet seasons do not seem to be as long and the winters are not as cold. Summers are hotter.'
- 'A response to Question 10d. 'Less frost but more severe.'
- 'A response to Question 9: 'Evenly spread but patchy.'
- 'Perhaps our weather cycle is bigger than the 200 years the records have been kept.'
- 'A response to Question 10b: 'Variability could possibly be calculated, an extensive study. Regarding questions 10c,d, e : No actual records.'
- 'It appears rainfall is more extreme (flooding) in recent years -19 inches in Jan-Feb '97, 12 inches in 1998. Then it clears up, going months without a drop.'
- 'Temperature and rainfall is variable, but I don't think it is any hotter or drier than when I was young.'
- 'A response to Question 9: ' It's supposed to be summer rainfall, but we expect it to come at any time.'
- 'A response to Question 8: '2283.1 points over 30 years, 1957-1986; 2330 points over 40 years, 1957-1996.'
- '1980-90, 8 years over 20 inches, 10 years under 20 inches; 1960-70, 13 years over 20 inches, 6 years under 20 inches.'
- 'Responses to Questions 10a and 10b are substantiated from our records. 10b rainfall is less variable because of absence of "big wets". A couple of "big wets" would restore "normality" to rainfall annual "variability", whatever they are. I have always wished QDPI would core sample and carbon-date the raised mounds/banks left by floods, dropping silt loads on the edges of river channels. Tie that in with tree ring data from the same area.'
- 'Amount of rain is about the same, but falls are usually in smaller amounts - ground dries out quickly and is the {illegible} fall of less use for grass. In 50s, 60s and 70s used to get 5-10 floods per season - now may not get even one.'

- ‘We have had a declining rainfall average over the period 1949-1998.’
- ‘Rainfall is certainly more variable in 1990s; also there's generally less rain and less incidence of substantial falls (eg., over 25mm up to several inches). Longer periods of dry years in succession without break of wet seasons.’
- ‘Rainfall is much less reliable since early 1980s, due to grouping of planets in front of sun, as predicted in print by Indigo Jones in the 1940s. Highly intelligent scientists grope around in the dark and will not tie in effect of planets on weather. Until they do we have no hope from forecasts.’
- ‘I believe rainfall since the early 80s has come in wet periods, that is, a lot of rain over a 2-6 week period, followed by a period with little or useless rain. These drys have been getting longer through the 90s. In the 60s and 70s you could count on at least one useful fall every month. In '98 we get nothing at all for 3-4 week periods and a lot of heat.’
- ‘A response to Question 9: Used to be mainly summer. Has shifted towards autumn. Now has been shifted to drought with very little.’
- ‘A response to Question 7c: 1950-1965, 27 inches; 1965-1980 25 inches; 1980-1998 23 inches. Question 9: Unpredictable.’

Northern Territory

All the individual responses were:

- ‘80s definitely drier than 70s and 90s.’
- ‘Bureau of Rec. 1968-1990 and1997, suggest cyclical years of 5-6 years good rain and average, below seasons.’
- ‘Comment on Q.10 is based on hearsay.’
- ‘Most answers are from experience.’
- ‘Rainfall records since 1960 indicate there has been very little difference in average rainfall and very little difference between highest and lowest rainfall (variability).’

Western Australia

All the individual responses were:

- ‘1974 Station average was 206mm. It is now 220mm. Records started 1964 and we had a 4 year drought 1969/73. Prior to that this land was virgin land.’
- ‘96-97 have been drier but previous years from 83 till 96 have had heavy rain all at once (16in 16 days straight) causing floods and no grass worth speaking of, i.e., in a protein drought.’
- ‘Above comments are based on information from locals - have only been here 2 1/2 years.’
- ‘Cannot comment on 80s/90s V 60s/70s as I did not live in this area then.’
- ‘I have had to watch the destruction of the buffer effect that natural vegetation can have on otherwise erratic weather conditions.’
- ‘In 1963 we had the wettest year on (our) record followed by medium years. Very dry 75/85. Normal dry and average 86/92.Some wet years - all good 92/98.’
- ‘Large scale fires are having a impact on weather.’
- ‘Prior to 1989 was spent on mixed farm on sand plain.’
- ‘The 1980s and 1990s have been normal to drier. The 1960s and 1970s have been wetter to normal with 1969 having been a drought year.’
- ‘The only unusual occurrences on the Fitzroy River system were the decade of large floods 1983/84 to 1990s.’
- ‘There seem to be more extremes eg., records being broken more often.’
- ‘We do not appear to be receiving soaking rains either summer (cyclonic) or winter which is having an effect on the carrying capacity of country eg.: bush always closing down.’
- ‘The period is too short to accurately tell.’

South Australia

All the individual responses were:

- ‘1960s, very dry. 1970s, very wet. 1980s and 1990s more stable seasons. It is very difficult to make a comparison of rainfall between 1960s and 1970s and now, as there was such a striking difference between those decades. See attached chart of residual rainfall.’
- ‘1992 was our wettest recorded year; 1967 our driest year.’
- ‘A slight increase in average rainfall; drier over all seasons.’

- ‘Although the weather appears to alter from one period (say 5 years) to another, I tend to think such variations have probably been going on for centuries.’
- ‘Average rainfall since 1908: 214 since 1977: 244 since 1986: 266.’
- ‘Have had falls of rain in past 4 years 100mm plus in downpours. Have 49 years in pastoral area, and experienced downpours but 4 years a row.’
- ‘Have only lived in this area since 1978.’
- ‘I would like to think that the late 80s and early 90s were dry due to cyclic conditions.’
- ‘Late 60s through the 70s were exceptionally wet years. 80s-90s dried off and now looking forward to wetter than average with hopefully a run of good seasons.’
- ‘Only been on this property 10 years; working answers on previous records.’
- ‘My family has had the lease of the property since 1902.’
- ‘Rainfall events are more variable but not as general or widespread. Temperatures are hotter but for shorter time periods, e.g., 2-3 weeks extreme heat then cool change. During the 60s and 70s, not quite as hot, certainly not as humid, but for months on end.’
- ‘Rainfall in this area seems to run in cycles.’
- ‘Tendency seems to be towards heavy, unpredictable summer falls with winter pattern slow to set in.’
- ‘The data I have over 50 years isn't enough to make assumptions on the climate changes in my area.’
- ‘The summer temperature seems to be similar to temperatures when I was younger.’
- ‘The weather pattern is still as unpredictable as ever and no one can predict it as shown by weather forecasters who hardly get it right for our area.’
- ‘We are in an irregular rainfall area. Some years reasonably good rain falls, then the next year has poor rainfall.’
- ‘Yes, I do feel we are immersed {?} in a climate change’ {the rest is illegible}.

New South Wales

All the individual responses were:

- ‘10d. More frost this year, less frost some years. Summer rain is important for grass bio-mass. Over the past 20 years, 4 and a half years have had good summer rain. Wenterpoein grows less bio-mass and soft pasture that does not last past the first hot day.’
- ‘1960s – dry; 1970s - wetter ; 1980s – wetter; 1990s - drier - hot - cooler - cooler - hotter 1982 - 27 consecutive frosts in May.’
- ‘1990s periods of above average rain (2-3 months) with long (3-6 months) periods of almost no rain.’
- ‘Additional answer to 10.I think you have to look at a bit longer cycle than this to make a judgement. 1960s very drying, 64, 65, 66, 67 70s very wet. 80s seasonally wet, severe drought early in ‘83. ‘90s fairly dry. Has anyone defined a cycle as yet?’
- ‘After 1976 summer rainfall not as reliable.’
- ‘Although we received our average rainfall in the 80s and 90s, the falls were higher more erratic and spaced further apart.’
- ‘Checking records weather patterns of 90s compare roughly with the 60s.’
- ‘Droughts are a way of life controlled by Mother Nature to control the pasture growth. The only change is man-made with his stocking methods and bush fire control. Ferals are also a problem, for which he is in a lot of cases not to blame, except for goats and pigs.’
- ‘It always varies - Equinox may be moving slightly to the north’
- ‘Looking at records shows variation of rainfall from year to year through the whole spectrum. 1965 rainfall was 243 points - 1964 was 535 - 1976 yielded 2,291 points. Records for the 80s apart from 81/1955, 87/1176, 88/1706, 89/860.’
- ‘Only been here for 16 years (came from interstate).’
- ‘Our rainfall has increased in the summer months - heavier falls, but is of little real value due to greater run off. Our rainfall is about 35% consistent.’
- ‘Rain now comes in large amounts, then dry for long periods.’
- ‘Rainfall has become more erratic with heavier falls in summer, which results in less pasture growth.’
- ‘Rainfall has moved to spring in 1990s versus 70s and 80s autumn.’
- ‘Rainfall in storm activity during the last number of years.’
- ‘Rainfall is shifting more to a winter pattern.’
- ‘Seasons have varied so much from wet to very dry - but I do think seasons have become dramatic - we experience more violent weather changes etc.’

- 'Surely it would be more appropriate to look at the big picture. One wonders if you have something better to do.'
- 'The period between 1950 and 1980 has been one of the most stable rainfall periods in Australian history. Are we in a more normal pattern?'
- 'The years specified are too broad to quantify.'
- 'There seems to be longer drier periods.'
- 'These perceptions are confirmed by the Rainman program in this area**.'**
- 'We have records of wet and dry, barometer max. and min. temp, but they have not been analysed.'
- 'We were in a different part of Australia in the 60s and 70s so cannot answer the above questions.'
- 'Were not in the district during 1960s and 1970s so we cannot comment. As a generality - conditions have become drier, last winter was one of the coldest - this summer one of the hottest over a longer period of time.'
- 'You could ask for 10 year graphs instead of 60/70 80/90. 60/70 period doesn't count for me. But the 80s had lots of autumn breaks. The 90s have only had 1 year with a growing season in autumn.'

Q11: How important are your judgements of future climatic conditions (over the next three to 12 months) in your planning or decision-making?

There were 212 responses to this question:

Not at all important	**13**	(6.1)
Slightly important	**29**	(13.7)
Moderately important	**59**	(27.8)
Very important	**111**	(52.4)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Not at all important	**13** (6.1)	3	4	1	0	5
Slightly important	**29** (13.7)	4	7	2	10	6
Moderately important	**59** (27.8)	5	9	8	18	19
Very important	**111** (52.4)	14	26	12	35	24

Q12: Do you currently use long-term (20 years or more) climatic records to assist your decision-making?

There were 214 responses to this question:

Yes	**53**	(24.8)
No	**161**	(75.2)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**53** (24.8)	7	12	1	16	17
No	**161** (75.2)	19	35	22	48	37

Q13: In your business/industry, what are the three most important annual decisions you make in which the outcomes are affected by future climatic influences?

There were 519 responses to this question from 211 repsondents (some gave more or less than three answers to this question):

Selling/agisting of stock	**185**	(87.7)
Sowing crops/pastures	**73**	(34.6)
Buying stock	**91**	(43.1)
Burning pastures	**47**	(22.3)
Forward selling/hedging	**50**	(23.7)
Weed/disease/pest control	**73**	(34.6)

Answers by State

Business/ Industry	TOTAL	WA	SA	NT	QLD	NSW
Selling/agisting of stock	**185** (87.7)	24	42	20	53	46
Sowing crops/pastures	**73** (34.6)	3	6	5	30	29
Buying stock	**91** (43.1)	12	20	9	28	22
Burning pastures	**47** (22.3)	7	2	11	22	5
Forward selling/hedging	**50** (23.7)	7	16	5	11	11
Weed/disease/pest control	**73** (34.6)	3	15	9	22	24

Other Important Annual Decisions

Queensland

Summary of Answers

The main topics covered, and the number of times each was mentioned, were:

Setting stocking rate/reducing stock before winter…….……..	**5**
Cropping decisions/planting or harvesting……..	**4**
Buying feed or supplements/drought feeding…….……	**4**
Mating/calving/lambing/likely herd dynamics/weaning…..…...	**4**
Surface water supplies……	**2**
Budget projection or cashflow/spending decisions…….	**2**
Timing decisions……..1	
Woody weed control……...	**1**

Selected individual comments were:

- 'Don't ever over stock and then play it as it happens. Stock for average season or under stock.'
- 'De-stocking or lightening off before winter.'
- 'To join ewes and rams, or not to join them. '
- 'Why do you not list the most obvious question/decision box?? By far the most important decision is 'budget projections', then on cattle breeding properties like mine, 'herd reproductive efficiency' (translated, means decisions are made about likely herd dynamics). Next is 'ending on repairs, maintenance, burr/timber control, federal income tax and capital items' (in other words, in droughts, herd health, welfare and feeding come first at the expense of repairs etc.) Tell it to animal liberation!!'
- 'Early purchase of feed and feed supplements.'

Northern Territory

Summary of Answers

Other important annual decisions included mustering and weaning, changing from dry to wet season supplements and determining paddock numbers.

All the individual responses were:

- ‘Changing over from dry season to wet season supplements, and vice versa (urea problems).’
- ‘Mustering and weaning.’
- ‘Planning paddock numbers.’

Western Australia

All the individual responses were:

- ‘Breeding seasons.’
- ‘Decisions on spending for capital improvements.’
- ‘Fire control strategies. Stocking rates and calf drops.’
- ‘Mating ewes, setting stocking rates.’
- ‘Ram purchases. Time of shearing. Paddock spelling and numbers. Range monitoring of regeneration.’
- ‘Size of cropping area. Number of stock on holding. Mating number.’
- ‘Stocking rates applied to various areas of the station.’
- ‘Stocking rates, number of ewes to breed from.’
- ‘Whether to mate or not, delaying etc. capital expenditure.’

South Australia

Summary of Answers

The main topics covered, and the number of times each was mentioned, were:

Mating stock……	**7**
Capital investments……..	**1**
Selling stock…….	**1**

All the individual responses were:

- ‘Age groups of stock mated.’
- ‘Breeding numbers.’
- ‘Capital investment in water points’ {? illegible}
- ‘Ewes mated and when.’
- ‘Lambing time.’
- ‘Mating stock.’
- ‘Number of ewes mated.’
- ‘Road repair delayed ‘til after summer rains (cost 000/year); we have 100 km of privately maintained roads on the property, and most are lost annually due to flooding, so repairs are delayed ‘til end March each year in case we get more rain.’
- ‘Selling wool.’
- ‘We sell surplus: sheep in November and sell cattle when fat. The only stock we buy are rams and bulls.’
- ‘Weather is only one factor which comes into play when making decisions for the following year. If we took too much notice of weather-men we would go broke.’
- ‘Whether to mate all ewes or not.’
- ‘Whether to mate ewes if dry.’

New South Wales

All the individual responses were:

- ‘Joining - lambing 2. Shearing.’
- ‘Amount of cash reserve to keep. Amount of fodder and grain to keep.’
- ‘Be brave enough to make decisions and live with them rather than not make them and then blame everyone else and can’t survive with what happened.’
- ‘Conserving dry pasture - to use for base ewe flock; with dry feed supplement.’
- ‘Deciding the number of sheep to join with rams (mating numbers).’
- ‘Destocking Critical Dates.’

- ‘How much fertiliser to apply to a crop.’
- ‘Joining.’
- ‘Other than selling and using adjustment for own stock, never accept stock on agistment. Use the other person's feed. Never let anybody use yours. You never know when you’ll need it yourself.’
- ‘Planning paddock grazing and planning work plan.’
- ‘Sell old ewes, replace with young ewes.’
- ‘Spelling of native pasture for farming country.’
- ‘Stocking rate.’
- ‘We find that the woody stemmed plants, pastures (Buffel grasses etc.) establish best of all, and Native Woody pastures enjoy the elevated $C0_2$. However, Woody Weeds are blowing out in spite of all our efforts to control them.’.
- ‘When to buy/sell.’

Q14: How useful is probability-based information in the management of your business?

There were 208 responses to this question:

I don’t use it	**47**	(22.6)
Not at all useful	**10**	(4.8)
Slightly useful	**59**	(28.4)
Moderately useful	**70**	(33.7)
Very useful	**22**	(10.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
I don’t use it	**47** (22.6)	10	15	5	8	9
Not at all useful	**10** (4.8)	0	2	1	2	5
Slightly useful	**59** (28.4)	3	15	8	21	12
Moderately useful	**70** (33.7)	10	12	7	22	19
Very useful	**22** (10.6)	3	3	0	7	9

Q15: Do you currently use seasonal climate forecasts, for example information on SOI/El Niño/Indian Ocean temperatures/other indicators) to assist with any of your decision-making?

There were 211 responses to this question:

Yes	**78**	(37.0)
No	**133**	(63.0)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**78** (37.0)	7	10	4	28	29
No	**133** (63.0)	19	39	17	34	24

Q16: If you keep stock, how do you decide what stock numbers to carry through the months of the year when feed shortages are most likely to occur?

There were 282 responses to this question (some of the 198 respondents gave more than one answer):

Observe pasture growth/conditions	**186**	(93.9)
Use seasonal climate outlook/forecast	**56**	(28.3)
Measure pasture growth/condition	**34**	(17.2)
Use Australian Rainman	**6**	(3.0)

Answers by State

Decision Aid	TOTAL	WA	SA	NT	QLD	NSW
Observe pasture growth/conditions	**184** (93.9)	21	41	22	55	47
Use seasonal climate outlook/forecast	**56** (28.3)	5	7	1	23	20
Measure pasture growth/condition	**34** (17.2)	7	6	2	11	8
Use Australian Rainman	**6** (3.0)	0	1	0	3	2

Use of Other Aids

Queensland

Summary of Answers

The main topics covered, and the number of times each was mentioned, were:

Supplements on hand or likely availability/feed to be purchased……...…**4**
Condition of stock……**2**
Financial pressures……...**2**
Conservative stocking……..**2**
Historical carrying capacity/GRAZEON…….……...…….**2**
Optimistic assessment or bias……..**2**
Historical rainfall records…….**1**

Selected individual comments were:

- 'The problem, as I see it, is that because of the economic difficulties graziers or agriculture is facing, we are being forced to stress our pastures to keep our heads above water.'
- 'Some pasture monitoring of standing yield at fixed monitoring sites.'
- 'Buy a bit of feed. If the situation persists, destock.'
- 'Specifically, autumn SOI readings are seen as important. A guide to stock numbers (above) will be supplements on hand or likely availability.'
- 'Time of the year helps me decide on numbers; degree of probability, e.g. coming into summer period of expected rain and it hasn't rained for a while; low yearly tally so far set. All taken into account.'
- 'If good summer rain has not arrived by 17/3 I start looking for ways to reduce stock numbers.'
- 'Queensland cattle producers are being paid prices on par with 1986 for our stock. Financial imperatives far outweigh what the SOI is up to (it being responsible for 20% of our rain) or a 55% probability that it might, or might not rain. Thus, about 75% of the decision is financial. About 15% is historical (what is known can be carried).'
- 'Have learnt that it is better to have grass to burn at the end of the season than to run out half way through. Moderate stocking.'

Northern Territory

Summary of Answers

Other aids used included visual assessment of available pasture at the end of the wet season, condition of livestock, and setting safe carrying capacities arrived at from years of experience.

All the individual responses were:

- '1.Use predictions for S.R. and generally under-stock. 2. Estimate S.R. of paddock in terms of A.E. and monitor pasture visually.'
- 'By the end of wet season we are able to plan strategies for the rest of the year as a result of rain/moisture growth.'
- 'Condition of stock. Experience gained through local knowledge and historical records.'
- 'Expand.'
- 'Very rarely have feed shortages.'
- 'Over many years we have found our level.'

Western Australia

All the individual responses were:

- 'Assess stock condition and calving patterns.'
- 'Condition of stock.' (x3)
- 'Depends on autumn rains and grass growth as to whether we sell any ewes prior to handling in May/June. Shear in March and sell off sheep.'
- 'Experience.'
- 'Grazing charts.'
- 'Holding enough lupins on farm to cover stock feeding for 12 to 18 months.'
- 'Observe stock condition especially in relation to previous experience. A periphery influence would be the behaviour of indigenous animals (nesting birds, births of babies, mating etc.).'
- 'Paddock history of previous stocking levels. Land system types and ability to curtain sheep over this period.'
- 'Rainfall trends, e.g. I am bringing stock numbers back after a decade of reasonable seasons. Due for a period of dry seasons.'
- 'Remove bulls and weaners.'
- 'Run the range- land to Agricultural Department carrying capacity recommendations.'
- 'Visually appraise amount of feed available and general state of country in relation to winter rainfall which gives us our greatest bulk of feed.'
- 'We know approximately what numbers each paddock will carry through average seasons following a fair - average rainfall year.'

South Australia

Summary of Answers

The main topics covered, and the number of times each was mentioned, were:

Rainfall…… **2**
Past experience…… **2**
Wind…… **1**
Monitoring pasture yield……..... **1**

All the individual responses were:

- 'As in semi-desert, amount of and timing of rain.'
- 'Depending on heat wind. Wind factor influences life of feed or pasture. In extremely strong or prolonged wind, pasture dries out {illegible} blows away. Natural waters do not last as long.'
- 'I keep fairly stable stocking. After shearing (Oct) I decide what numbers I think I can carry through the summer months. I don't often sell later on, nor do I buy more when there is a surplus of feed.'
- 'If we have had only patchy storms in the previous 12 months, it is time to start destocking.'
- 'Natural grazier.'
- 'Past experiences.'
- 'Some pasture monitoring of standing yield at fixed monitoring sites.'
- 'When season is bad we start to sell off steers and cull cows. Only keep breeding cows. If the season still stays bad we sell weaners to keep cows alive. We always keep 30-50% of the place shut up for when drought comes.'
- 'You must maintain herd nucleus to take advantage of a season should it rain sufficiently to produce one.'

New South Wales

All the individual responses were:

- 'Change of the moon. If no rain on new moon when previous months have been dry then I expect dry conditions to continue from another month. I don't count on rain in April or July.'
- 'Estimate number of Stock. Days of feed and relate to stocking rate.'
- 'Get a weather forecast for primary producers from Western Australia.'

- ‘Gut feeling and years of experience.’
- ‘I use World Water Temp. SOI.’
- ‘Increase stocking rates.’
- ‘Listen to Holmes and Sackett and Mackinnon group regarding stocking to utilise seasonal feed variation.’
- ‘Make sure reserves of fodder are on hand.’
- ‘Observe wildlife. The diver ducks (the ones that build reed nests on dam) never fail.’
- ‘Planned grazing to conserve feed and match stock numbers to available feed.’
- ‘Stock condition is the true indication of pasture conditions. Observe the condition of emus and grey kangaroos when they start to show stress. This is an indication of time to put on your thinking cap.’
- ‘We don’t have stock.’
- ‘We keep a reserve of hay and collar seed and when it {illegible} we {illegible}, lap trees, {illegible} and old trees (making room for young trees), sow seeds for fresh growth following rain to assist pastures (others).’
- ‘Weaning supplement feeding.’

Q17a: What signs or indicators do you look for in a paddock to assess the health of your pasture or stock?

Queensland

Summary of Answers

Pasture

Pasture species composition/best species/changes……..	**28**
Amount of edible pasture material/growth for time of year and rainfall…..……..	**24**
Changes in ground cover/bare patches/pasture density……	**18**
Weeds/density of woody weeds……..	**13**
Pasture quality/colour……...……	**10**
Deterioration of pasture/condition of pasture……..……..**9**	
Amount of rain and when received……...…...……	**6**
Surface water supplies/grazing pressure around water……..……...…….....**5**	
Soil deterioration/loss/movement……...……..……...	**3**
Amount of woody plants/unpalatable grass eaten…..…….……..	**3**
Seeding of pasture…….……..	**2**
Observation and experience…….……	**2**
Insect infestation……...……...…..……...**1**	
Comparison with neighbour’s paddock……..……..	**1**

Stock

Condition of stock…….…….…….……	**13**
Health of stock……..…….....**5**	
Stock behaviour……..……..……..	**3**
Appearance of stock……...….……	**2**
Reproductive performance…….……..	**2**
Stock numbers…….……	**2**
Comparison with neighbour’s stock…….……	**1**

Selected individual responses were:

- ‘The amount of feed, quality; time of year; cattle conditions; how many weeds are around; the types of grasses that are prominent at certain times of the year.’
- ‘Ground cover; main pasture species. DM quantity and quality/ha; how much growth and time of year or season - whether there is soil moisture or not.’
- ‘Abundance and vigour of Mitchell grass. New growth and leaf content on saltbush. Amount of flood herbage such as clover. Amount of annual grass including content of oat grass in sandhills. Condition of stock; numbers of lactating cows. Distance from water out to main feed. Distribution of water (how many dams are full).’

- ‘Edible feed weight estimations. Amount of dry vegetable matter. Amount of mulga eaten. Basal size of grass butts. Dominance of perennial grasses. When pasture last had a chance to seed.’
- ‘Observe pasture growth in relation to rainfall and competitive regrowth.’
- ‘Mainly stock condition; long term observation of increase in poorer species, i.e., wiregrass and woody weeds.’
- ‘Stock are the last to look at - usually too late to act when they are suffering.’
- ‘I don’t believe city people could ever appreciate just how many things there are to look for, or the bush skills needed, or how long it takes to learn Q.17a “indicators”.’
- ‘Pasture: species, ground cover, mulch, albedo, weeds, vegetative phase, erosion, windbreaks, unwanted tree seedlings/woody weeds. Stock: appearance - vigour, body condition, pregnancy/lactation status, signs of distress or disease, weight gain, calving rates.’
- ‘Ground cover changes or changes in overall mass (dry matter weight) by feed estimation; Changes in indicator grasses (e.g., looking at increases/decreases in grasses of intermediate value or undesirable species; Changes or incidence in forbs, weeds and timber growth.’

Northern Territory

Summary of Answers

Pastoralists used a range of indicators to assess the health of their pasture and stock, including pasture composition (26%), ground cover (22%) amount of feed (13%) and the use of monitoring sites (13%).

All the individual responses were:

- ‘All.’
- ‘Amount of grass.’
- ‘Amount of grass and food available.’
- ‘By comparing heavily grazed areas around the watering points and their gradual increase into the healthy pasture. Also an aerial inspection is very useful and revealing.’
- ‘Changes in ground cover.’
- ‘Condition of cattle. Amount of grazing on major perennial grasses. Increase in weeds (woody and annual).’
- ‘Dominance of pasture species, e.g., annual vs. perennials and condition of pasture.’
- ‘Grass gets short and cattle start dropping condition.’
- ‘Grazing effects. Build up of increaser species. Increase in broad leaf species. Weight gains of stock. Condition of cattle. Particular trees.’
- ‘Ground cover. Amount of introduced pasture species or lack thereof.’
- ‘Ground cover. Pasture species. Woody weed. Intrusion.’
- ‘Ground cover, cattle numbers. Feral animals (rabbits). Rainfall.’
- ‘Pasture deterioration.’
- ‘Pasture growth and response.’
- ‘Pasture productivity and monitoring sites.’
- ‘Pasture productivity indicators.’
- ‘Reduction of good grasses.’
- ‘Volume of feed.’
- ‘Pasture deterioration. Pasture productivity indicators.’
- ‘Utilise pasture monitoring sites, which are recorded after the wet season. Use this information with rainfall measurements and stocking rates.’
- ‘We look at ground cover and change in pasture species.’

Western Australia

All the individual responses were:

- ‘Changes in ground cover. Soil Loss. Main species.’
- ‘Condition of feed both around and away from waters - especially perennials.’
- ‘Condition of perennial species the stock eat. Grazing evidence seen of these plants. Amount and quality of annual ground feed.’
- ‘Condition of range-land e.g.: height bush grazed, especially key or preferred bushes. Colour of bush e.g.: vigorous growth currant bush very vivid green as it comes under moisture stress and changes colour to yellow before defoliation.’
- ‘Condition of stock shows heart of country.’

- ‘Ground cover, basal plant diameters, distribution of age of species, plant diversity, biodiversity, watercycle (compaction), mineral cycle, energy flow (growth phases of plants, fodder productivity, hands vs rainfall.’
- ‘Ground cover. Conditions of salt bush pasture.’
- ‘Looking for establishment of juvenile desirable plant species.’
- ‘Monitoring sites and counts.’
- ‘Monitoring what species of shrubs and plants the animals are grazing, and condition of the stock.’
- ‘Number of perennial plants, state of condition of perennial plants and edible scrub; and body condition of stock.’
- ‘Particular species of plant i.e.: the foliage of plant leaves etc. Grazing of certain species less palatable under normal conditions.’
- ‘Pasture indicators; monitoring.’
- ‘Pasture productivity indicators. Productivity based information/forecasts.’
- ‘Pasture productivity indicators.’
- ‘Perennial species total ground cover percentage utilisation by stock.’
- ‘Predominant clover pasture - insect free plant analysis.’
- ‘Salt bush (Bladder) losing leaves and nature box horn or water bush are pretty good indicators in the Nullarbor region. ‘
- ‘Soil testing; insect damage; growth rate; feed on hand.’
- ‘Stock conditions, wool cut and health, pasture conditions using eye and monitoring sights pms.’
- ‘The amount of feed, the quantity WA Rangeland Monitoring (WARMS).’
- ‘What the stock are eating and the condition of the plants and shrubs. Condition of stock - may need to move. Some dependent or reinforce also.’
- ‘What the stock are on and nicer eating.’

South Australia

Summary of Answers

Pasture

Condition of Perennials……**16**
Herbage/ephemerals……**10**
Ground cover…… ..**8**
Indicator species……..**5**
Observation and experience……..…..**4**
Utilization levels……... ..**4**
Surface water supplies…….. ..**3**
Soil moisture……..… ..**3**
Photopoint vegetation changes……..… ..**3**

Stock

Condition of stock……..**7**
Feral and native animals……... ..**4**

All the individual responses were:

- ‘1. Ephemeral-amount, condition 2. Chenopod -amount, condition 3. Total Surface cover 4. Stock condition.’
- ‘A quick and experienced survey of bush and shrubs for signs of stress at a desirable distance from watering point, plus general condition of the stock.’
- ‘Abundance and vigour of Mitchell grass. New growth and leaf content on saltbush. Amount of flood herbage such as clover. Amount of annual grass including content of oat grass in sandhills. Condition of stock; numbers of lactating cows. Distance from water out to main feed. Distribution of water (how many dams are full).’
- ‘At different times of the year, different pastures and bush grow.’
- ‘Availability of edible stock feed and condition of stock. Keep an eye on seasonal plant growth.’
- ‘Bush, grasses.’
- ‘Changes in ground cover. Period since last significant rainfall.’
- ‘Changes to ground cover - salt bush etc.’
- ‘Condition of stock and feed growth.’

- ‘Condition of stock with regard to health; Grazing pressure on bush around waters; Signs of overgrazing.’
- ‘Condition of stock; numbers of kangaroos.’
- ‘Condition of the stock and bush.’
- ‘Experience in observation of stock and the landscape.’
- ‘Feed availability depends on season. It rains in a good year, not in a drought. We generally have the same weather system. Some years they produce rain, others not. Rain seems to follow on. If you start a season with a good rain, most years it follows on.’
- ‘General condition of livestock; excessive grazing of indicator species (more palatable perennial plants); lack of leaf litter and ephemerals between perennial plants (conducive to soil erosion); increase of invader species and weeds.’
- ‘General overall health of the land indicated by condition of the flora, and to a certain degree, its biomass. Recruitment of both plants and native animals.’
- ‘Ground cover.’
- ‘Ground cover/ annual or seasonal grasses. Perennial feed, e.g., assessment of bush grazing pressure in any location, e.g., around waters, etc.’
- ‘Growth - density of perennial grasses and bushes; Presence of ephemeral plants; Rainfall; Cattle condition; Numbers of feral animals.’
- ‘Growth of feed; growth of grass.’
- ‘In SGS they are: ground cover, annuals and perennials, weeds, salinity patches.’
- ‘Look at perennial growth in paddock. Indicator species i.e., bluebush, saltbrush etc. Rabbit numbers high etc. Has the rain been general or storms? Spread of stock over as wide an area as possible. Ferals. Kangaroo numbers.’
- ‘Maintain perennials; ensure woody weed (mulga) not overtaking pasture.’
- ‘Moisture reserves in soil; Time of season and plant maturity.’
- ‘Nothing in general, only experience.’
- ‘Pasture deterioration.’
- ‘Pasture productivity indicators.’ (3).
- ‘Photo points 3 km from watering points.’
- ‘Photo points have been established; stock’s general condition.’
- ‘Quality and quantity of pasture feed.’
- ‘Rabbit and kangaroo numbers; last season/this season growth (bulk); seasonal composition - variations in pasture species prevalent.’
- ‘Species of native bushes and shrubs that are being eaten and to what extent.’
- ‘Stock: condition; Vegetation: condition; Stock numbers are run to what feed condition is like.’
- ‘Sub moisture, quantity, colour, pests, tissue tests.’
- ‘The best indication of country is stock, regardless of what experts say. This country will always come back after good rains, as it will beat you before you beat it. No matter how you try, you will not stop erosion of some kind. Nature has a lot more force than you will ever have or be likely to have. One earth-quake or volcano will change it overnight.’
- ‘The condition of the stock is a good indicator of a paddock’s current health; The type of herbage/grass that is present indicates the length of the assured future, as of course does the bulk of feed present.’
- ‘The health of perennial bush.’
- ‘Usually tonnage of dry matter per ha.’
- ‘Volume of feed matter, by visual inspection; Health of stock is by visual appraisal.’
- ‘Water level in dams; pasture coverage; condition of bush.’
- ‘We have salt bush country and very seldom get short of feed. Surface water is a problem here. When the dams go dry, the paddocks get a spell.’
- ‘You can tell from experience whether you have enough feed to carry your stock and act accordingly.’

New South Wales

All the individual responses were:

- ‘1. Amount of pasture 2. Quality - is it good for stock or not ? 3. Is it green or dry? 4. If it is dry, is there good cover on the soil? Stock.1. The condition of stock. Fat store condition or poor ? 2. Scouring. 3. Strength of the stock.’
- ‘Abundance of annuals and health of these.’
- ‘Amount of pasture and quality of pasture.‘
- ‘Availability of edible pastures.’

- ‘Changes in ground cover and what are the main pasture species left. ‘
- ‘Changes in ground cover. Consistently checking pasture species.’
- ‘Changes in ground cover. Main pasture species.’
- ‘Condition of stock. Total grazing pressure.’
- ‘Density of pasture; whether it has gone to seed or not. Condition of edible shrubs.’
- ‘Diversity of pasture. Bulk of dry pasture. Perennials. Palatable plants. Trefoil on ground. Bare ground.
- Dry matter/ha. Pasture condition - percentage of dry matter/ percentage of green feed.’
- ‘Experience, cover and variety of pasture; condition of stock.’
- ‘Grass - Chenopod ratio kg of useable of feed/ha. Soil moistures.’
- ‘Grass and stock condition.’
- ‘Ground condition. Digestibility of quality of feed.’
- ‘Ground cover and health of perennials.’
- ‘Ground cover, colour type of pasture plants. Stock condition, ability to travel.’
- ‘Ground cover, grass/legume mix, moisture content of feed, estimate protein percentage, fibre content of manure.’
- ‘Ground cover; main pasture species; woody weeds.’
- ‘Growth patterns. Response to rainfall. Pasture density.’
- ‘Health of stock. Pasture colour. Pasture mix. Pasture growth phase.’
- ‘If stock graze, water and camp in mobs they are well fed and watered. If you see them in threes and fours they are starting to starve.’
- ‘It stays dry - dry feed is of better quality than normal. The amount of short butts compared to long summer grass that is not palatable.’
- ‘Lack of pasture growth. Condition of stock.’
- ‘Legume content; grass species and content change in consistency of cattle droppings (used as an indicator for dry supplement), total cover - visual and satellite image (annual).’
- ‘Loss of grass. Watching woody weeds grow.’
- ‘Mainly stock condition; long term observation of increase in poorer species, i.e., wiregrass and woody weeds.’
- ‘Observe the pasture and most importantly the condition of my livestock.’
- ‘Our drought strategy requires us to have 6 weeks feed in front of our cattle - we sell stock to keep this situation.’
- ‘Pasture - look for volume and diversity of plants at a given time of year. I consider these conditions and implications on wool growth and reproduction. I expect most of the time to be dry and some time to be wet. I don’t expect long growing seasons.’
- ‘Pasture composition. Pasture growth rates. Weight of livestock.’
- ‘Pasture deterioration.’
- ‘Pasture deterioration. Pasture productivity indicators.’
- ‘Pasture growth, colour.’
- ‘Pasture species and the amount of them.’
- ‘Pasture species present. Soil and tissue tests and blood tests. Symptoms on leaf or root - colour, distortion, necrosis. Growth rate compared to a benchmark (fenced plots).’
- ‘Pasture productivity indicators and seasonal climate forecasts.’
- ‘Percentage of green and dry feed.’
- ‘Plant growth; Ground cover; Condition of livestock.’
- ‘Responds well to rain. Carries well, good colour.’
- ‘Simply the amount of dry feed available - is this called biomass!!’
- ‘Soil condition. Pasture condition.’
- ‘Speed of response to rain. Amount of ground cover. Stock condition in week by week assessment.’
- ‘Stock condition; Pasture condition.’
- ‘Stressing of pastures from dryness - weed growth - grass seed problems on natural grasses - over grazing - vermin population e.g. rabbits, wild pigs - over grassing from kangaroos after isolated storms.’
- ‘The amount of grass cover.’
- ‘We continually assess 2,3 times a week, the bio-mass visually, stock conditions, kangaroo numbers. We stock sheep and cattle lightly. However, it is impossible to control the large numbers of kangaroos and emus. Resting paddocks is not possible. When we take the sheep or cattle out to re-vegetate or rest, in come more kangaroos than the sheep we had taken out. We have 5000 kangaroos and more move in to help get rid of our grasses.’
- ‘What the stock are eating e.g. old man saltbush is the last species to be eaten. The way stock are grazing.’

- ‘Whether pasture is haying off.’

Q17b: Do you measure or record information for individual paddocks?

There were 212 responses to this question:

Yes	**119**	(56.1)
No	**93**	(43.9)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**119** (56.1)	19	25	16	36	23
No	**93** (43.9)	7	23	7	26	30

Q17c: What do you measure or record in individual paddocks?

Queensland

Summary of Answers

Stock numbers…….……...…….	**24**
Pasture dry matter yield/available pasture……	**8**
Pasture condition……...…...…	**5**
Pasture monitoring……	**4**
Condition of stock……...……....…	**4**
Amount of water/water quality…….	**3**
Animal production/calving percentage…….	**3**
Class of stock…….……...	**2**
Rainfall…….……...…….	**2**
Long-term carrying capacity…….……	**1**
Health of stock……...……..	**1**

Selected individual responses were:

- ‘Have worked out exact area of paddocks how many cattle it can safely carry. I am in the process of establishing pasture monitoring sites.’
- ‘SDH - stock days/ha taken out and remaining or DM yield.’
- ‘Class of stock and numbers. Pasture species and abundance at one point in paddock typical of main pasture type within paddock. Only key species listed.’
- ‘We have two grasscheck sites; accurate stock numbers and time in each paddock.’
- ‘Stock numbers and grazing time. I like to alternate every 10-20 days. Don’t measure grass, just observe species etc., (desirable ones, they must survive).’
- ‘The ultimate “measure/ record” is of course the time control cell grazing system, which QDPI still calls “experimental”.’
- ‘I record quality and quantity of pasture feed and water, by paddock. I record sex, age, breed, condition, health and quantity of stock by paddock.’
- ‘Number of cattle. Class of cattle. Time in and out. Use of monitoring sites.’
- ‘Stock numbers, brandings, etc. Number of donkeys shot in previous year.’

Northern Territory

The survey revealed that 70% of producers recorded individual paddock information with stock numbers recorded in 70% of cases, while pastures, rainfall and monitoring sites were recorded on less than 15% of properties.

Western Australia

All the individual responses were:

- ‘Animal days based on effective rainfall and pasture management.’
- ‘Keep numbers in each paddock. Most paddocks have photographic monitoring sites.’
- ‘Monitoring site information. Stock numbers in each paddock.’
- ‘Number of stock in and out of paddocks.’
- ‘Number on water round 1/2 of year. Number of calves - weaners in Sept’
- ‘Numbers of stock - fertiliser records - spray records; clover content percentage.’
- ‘Observation of pasture regeneration linking to previous rainfall and stocking rates e.g: How the country looks.’
- ‘Range conditions.’
- ‘Rangeland (soil and pasture) types as recorded in the Murchison rangeland survey plus general record of stock carried.’
- ‘Shrubs, perennials condition.’
- ‘Stock numbers.’ (x4)
- ‘Stock numbers and classes. Time grazed.’
- ‘Stock numbers and rainfall.’
- ‘Stock numbers and pasture monitor sites.’
- ‘Stock numbers. Pasture condition.’
- ‘Stock numbers. Pasture Deterioration.’

South Australia

Summary of answers

Stock numbers……	**12**
Photopoint vegetation change……..**3**	
Amount of perennial bush……..	..**2**
Class of stock……..**1**	
Rainfall……...	..**1**
Key species…….	..**1**
Ferals and natives animals……..**1**	

All the individual responses were:

- ‘Amount of bush; stock numbers.’
- ‘Cereal yields; pastoral growth.’
- ‘Class of stock and numbers; pasture species composition and abundance at one point in paddock typical of main pasture type within paddock. Only key species listed.’
- ‘Farming, we do soil tests and tissue tests in crops to check fertility etc.’
- ‘I rely on my experience to make judgements as to the numbers and disposition of stock.’
- ‘I will leave my place as it is and in 50 years I bet it is as good if not better than the ones you try to change.’
- ‘Over 3000 sq miles we only have about 4 paddocks. We are in the desert here.’
- ‘Photo points assess the perennial and annual growth.’
- ‘Photopoint analysis; stock numbers.’
- ‘Plant coverage; variety of species.’
- ‘Record rainfall, state of pasture, pasture regrowth.’
- ‘Rotation cropping methods, chemical and fertiliser use.’
- ‘Sheep numbers.’
- ‘Stock numbers.’ (x8)
- ‘Stock numbers and {illegible}, according to cover.’
- ‘Stock numbers, fertiliser analysis, paddock history, rotations/ sprays/ fertiliser’.
- ‘Stock numbers; Rainfall statistics.’
- ‘Stock numbers, visual recording of vermin, kangaroos, and rabbits etc. and stress on perennial species. We also have a scientific measurement with photo points and transit lines.’
- ‘Stocking rates; pasture conditions, especially perennial species.’
- ‘We have photographic monitoring points - measure plants and numbers etc.’

- ‘Stock numbers. We record what each paddock has been assessed to carry. Monitoring sites photographed-sometimes.’

New South Wales

All the individual responses were:

- ‘Dry matter availability. On fodder crops how much dry matter has been removed. Allows extra fertiliser to be applied.’
- ‘Grazing time, pest time, dse/ha, dse days per ha.’
- ‘Numbers of stock in some paddocks and for how long.’
- ‘Pasture composition. Stock in/out. Livestock weight’
- ‘Rainfall. Stock numbers.’
- ‘Record data off each paddock.’
- ‘Record the change in pasture quality and quantity; whether a paddock is improving in pasture quality.’
- ‘Recovery period stocking rate growth rate. Type of animal. Total SAO/DSE etc. Paddock size. Number of animals. Pasture species, little critters etc.’
- ‘Stock and crop information. Chemical and fertilizer application.’
- ‘Stock dates in and out - dse. Available feed - kg dm/ha.’
- ‘Stock days per hectare per 12 months. DSE days per 100mm. 12 monitoring sites for plants. Diversity and bare ground.’
- ‘Stock in and out photo sites.’
- ‘Stock numbers and rainfall.’
- ‘Stock numbers and vegetation {illegible}, Woody weed landcuts{?} and pasture establishment.’
- ‘Stock numbers and wildlife numbers.’
- ‘Stock numbers dates when put into paddock and date when removed - all data regarding wheat, oats, barley crops - eg Number and type of workings - amount of spray - fertilizer and years when cropped as well as yields and profits or losses made.’
- ‘Stock numbers.’ (x4)
- ‘Stock numbers. Age of stock. Lambs dropped and marked. Pasture species if known. Wool cut can be assessed.’
- ‘Stock numbers. Wool cut.’
- ‘Stock Numbers. Rainfall.’
- ‘Yield protein LL.’

Q18: Do you regularly compare property *management options* by actual calculations of the production and financial outcomes of all options?

There were 200 responses to this question:

Yes	**78**	(39.0)
No	**122**	(61.0)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**78** (39.0)	6	16	12	23	21
No	**122** (61.0)	17	29	11	35	30

PART C: 'Big-picture' information

Q19a: How important is <u>this</u> big-picture information in your *planning*, risk management or decision-making?

There were 211 responses to this question:

Unaware of information	**27**	(12.8)
Not at all important	**26**	(12.3)
Slightly important	**70**	(33.2)
Moderately important	**65**	(30.8)
Very important	**23**	(10.9)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Unaware of information	**27** (12.8)	9	9	4	4	1
Not at all important	**26** (12.3)	2	11	2	5	6
Slightly important	**70** (33.2)	7	8	8	26	21
Moderately important	**65** (30.8)	8	16	5	16	20
Very important	**23** (10.9)	0	4	3	9	7

Q19b: Have you used any of the following types of 'big-picture' information?

There were 330 responses to this question (some of the 147 respondents gave more than one answer):

Recent rainfall maps	**108**	(73.5)
Recent pasture growth maps	**28**	(19.0)
Seasonal rainfall forecasts	**122**	(83.0)
Seasonal pasture growth forecasts	**20**	(13.6)
Drought-declared areas/ exceptional circumstances maps	**52**	(35.4)

Answers by State

Type of information	TOTAL	WA	SA	NT	QLD	NSW
Recent rainfall maps	**108** (73.5)	11	19	9	39	30
Recent pasture growth maps	**28** (19.0)	3	4	3	8	10
Seasonal rainfall forecasts	**122** (83.0)	12	21	10	45	34
Seasonal pasture growth forecasts	**20** (13.6)	0	3	2	8	7
Drought-declared areas/ exceptional circumstances maps	**52** (35.4)	1	4	3	24	20

Q19c: (If you answered 'yes' to any part of Question 19b). Generally to what extent has the information, which you have used, been useful?

There were 151 responses to this question:

Not useful	**6**	(4.0)
Slightly useful	**65**	(43.0)
Moderately useful	**61**	(40.4)
Very useful	**19**	(12.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Not useful	**6** (4.0)	1	1	0	2	2
Slightly useful	**65** (43.0)	4	14	7	25	15
Moderately useful	**61** (40.4)	7	8	7	22	17
Very useful	**19** (12.6)	1	3	4	4	7

Q19d: (If you answered 'no' to all parts of Question 19b). To what extent do you think <u>this</u> 'big-picture' information could be useful to you?

There were 105 responses to this question:

I have no idea	**16** (15.2)
Not useful	**11** (10.5)
Slightly useful	**31** (29.5)
Moderately useful	**32** (30.5)
Very useful	**15** (14.3)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
I have no idea	**16** (15.2)	1	4	5	5	1
Not useful	**11** (10.5)	0	4	2	1	4
Slightly useful	**31** (29.5)	4	11	0	8	8
Moderately useful	**32** (30..5)	7	6	7	4	8
Very useful	**15** (14.3)	4	3	2	4	2

Q19e: What problems have you had in using <u>this</u> 'big-picture' information?

There were 176 responses to this question (some of the 149 respondents gave more than one answer):

I don't use this information	**39** (26.2)
It is difficult to interpret/use	**33** (22.1)
No problems	**41** (27.5)
Information not detailed enough	**22** (14.8)
Access to it is difficult	**36** (24.2)
It is too complex	**5** (3.4)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
I don't use this information	**38** (26.2)	4	12	6	11	6
It is difficult to interpret/use	**33** (22.1)	5	7	5	7	9
No problems	**41** (27.5)	5	6	4	19	7
Information not detailed enough	**22** (14.8)	3	5	1	5	8
Access to it is difficult	**35** (24.2)	4	6	10	4	12
It is too complex	**5** (3.4)	0	0	0	3	2

Other Problems in Using 'Big-picture' Information

Queensland

Summary of Other Problems

Accuracy of forecasts / forecasts do not fully account for variations due to storms……..	**9**
Use information as a guide only / only use it in a limited way……..	**5**
Lack of faith in 'big-picture information/forecasts……..…..…….	**4**
Wants to make better use of the information……...……......	**3**
Information mostly irrelevant / information not required……..	**2**
Interpretation of NOAA imagery……..……..	**1**
Rainfall maps too small…….…….	**1**

Selected individual responses were:

- 'Although it tells you what has happened concerning rainfall etc., if you were not fortunate enough to be in the rainy area, it can't tell you when you will be lucky, only MAYBE.'
- 'I haven't got a lot of faith in some of these systems.'
- 'Realise that general probability and El Niño/SOI based forecasts do not largely account for the storm falls in our area, i.e., storms still occur, although scattered.'
- 'The forecasts were wrong (rainfall).'
- 'I also read comics and treat these somewhat in the same light at present.'
- 'I use the information as a guide only!'
- 'I receive the above information as the Q.G.G.A. (grain growers) representative for the shire, on the Drought Committee. In recent years rainfall has been very patchy within single colour-coded areas.'
- 'Problem: Megabucks of QDPI resources are wasted on last year's rain maps, forums on whether climate is changing (who cares? -just accept it probably is) and lots of historical charts etc. that are wonderful things to hang on walls and decorate stands at field days. QDPI focus is wrong. Too much history and not enough prophesy!'
- '1. Rainfall maps too small and you already have yours recorded. 2. Pasture growth at home only really important. 3. You will know if you are in drought. 4. Useful. 5. You can make your own using your rainfall knowledge and using your power to observe.'
- 'We look at all this "Big Picture" like a road sign which warns of danger, but doesn't have every bump marked. We then try to pick our way through the rocks and bumps as we see them on our property.'
- 'Still relying on probabilities, so not 100% accurate and doesn't always take into account local variations, storm fronts etc.'
- 'I know you cannot make it rain. I do believe SOI info is valuable. You must be honest and not apply it to spring/early summer when {storm?} rain occurs and does not affect. You lose credibility.'

Northern Territory

All the individual responses were:

- '1.Some are wrong - rainfall measures are wrong. 2. These figures are then used to make important decisions such as those for drought declared areas.'
- 'Information sketchy, inaccurate.'
- 'Not enough available in timely manner.'

Western Australia

All the individual responses were:

- 'Still too many variables.'
- 'We know people who have used this information with varied success. It is still too much of a gamble of probabilities; i.e., a sudden cyclone, no way of calculating mid -level weather etc.'

South Australia

Summary of Other Problems

Accuracy of forecasts……. …**4**
Difficult to understand……..….…**1**
Need more information……..….…**1**
Interpretation of results……..….…**1**

All the individual responses were:

- 'As far as seasonal forecasting is concerned, the information is generally not correct.'
- 'I find rainfall analogues with past years most beneficial. My major problem with the rest is it's based on averages, and regardless of the season the average will always be maintained. No definite forecasts attempted.'
- 'I seldom use this information.'
- 'It doesn't matter what is predicted, it is what actually occurs that we act on, for we have learnt from experience that outlooks do not count.'
- 'Jargon is great for scientists, but not for Mr. Average.'
- 'Looking back at rainfall patterns and hoping to fluke a good season when prices are good (is the only problem). But this never happened.'
- 'No forecast has been accurate yet.'
- 'No problems with synoptic charts, but that's all we use.'
- 'No set seasonal patterns in this region. Very unpredictable rain forecast due to location - far NW of SA. Winter is cold; summer is extremely hot.'
- 'Not accurate for particular small areas.'
- 'Still more work to be done to relate the probabilistic information to individual farmer's contexts.'
- 'Very erratic rainfall. No one seems to be able to forecast it.'
- 'Would use if knew where and when it is available.'

New South Wales

All the individual responses were:

- 'Because they are "big" they do not identify my actual property which may or may not have missed rainfall.'
- 'Access has been difficult and expensive, but as local Internet providers come online in the country the expense factor is decreasing. Magazines and journals rarely present all factors.'
- 'Accuracy is not good.'
- 'All the items ticked are not published regularly and are infrequent in Victoria.'
- 'Because they are 'big' they do not identify my actual property which may or may not have missed rainfall.'
- 'CSIRO have not genetically improved native grasses- 20 years behind the rest of the world, but the Native Veg. Act 1977 NSW makes planting Buffill and other introduced perennials as 'cultivating'. This is ridiculous!'
- 'Having to access information from varying sources takes time - Would be easier on a complete computer program.'
- 'Knowing how to put it all together to understand the variables of climate.'
- 'My understanding is that for most of Australia the SOI has less effect on the southern part of Australia. The forecasts are not consistent enough.'
- 'No set patterns in this area.'
- 'Not accurate enough to be useful.'
- 'Not sufficiently accurate.'
- 'Rainfall in this area is very erratic and totally unpredictable at all times. The El Niño effect can cause floods as well as extremely dry conditions. Big picture predictions need not be accurate.'
- 'Seasonal rainfall forecasts accuracy?'
- 'Too inaccurate to have confidence in.'
- 'Using forecast in the Land newspaper and comparing the cloud weather maps on SBS to evaluate the chances of particular weather coming into being or not. Initial fall of rain is temporary. Following up soon after gives you more security.'

- 'We have far more success reading non agricultural magazines, such as the Bulletin to gauge our forward selling based on world trends and markets and do not place any credence on long term weather.'
- 'Whilst forecasts and SOI information can provide trends over large areas, local areas can record totally different results.'

Q20: What 'big-picture' information would help you to make better management decisions, and when or how often is it required?

Queensland

Summary of 'Big-picture' Information Requirements

More reliable and more timely seasonal forecasts / sea-surface temperatures (weekly to half-yearly)…… **11**

Weather forecasting (fresh data)…….……...…... ..**4**

Pasture growth forecasts (at least at the end of April and mid-October) / pasture condition / % of country that is dry, droughted or bountiful…….……. ..**4**

Need a better understanding of the information…….……... ..**4**

Past rainfall history…….…….. ..**1**

Information not relevant…….……... ..**1**

Information with greater accuracy…….……... ..**1**

Market intelligence…….... ..**1**

Times when various types of information were required varied: daily, monthly, quarterly, six-monthly or yearly.

Selected individual responses were:

- 'Earlier interpretation of El Niño and how it will impact on my locality. Interpretation of Indian Ocean temperatures and local impact of them.'
- 'It can only be a guide. Until they can guarantee that SOI information is based on fact then I will only use it as a guide. Plenty of people in our area have said if this is El Niño we would like more of it.'
- 'To try and anticipate market trends by percentage of cattle country that is dry, droughted or bountiful.'
- 'Past history; a sure way of predicting likelihood of rain.'
- 'Seasonal pasture growth forecasts (corrected for man land types) would be required at end of April and mid October as a minimum. This allows for stock adjustments during first and second round of mustering.'
- 'I would like to see this "big picture" information provided by government for publication in *The Land* rural press.'
- 'More reliable seasonal forecasts.'
- 'Future long term seasonal outlook, quarterly.'
- 'I dial 019725352 and receive data that is fresh. The "hotlines" give outdated info. I don't use it.'
- 'Monthly updates at least.'

Northern Territory

All the individual responses were:

- 'A satellite imagery map of the property every three months: 1st Jan, 1st April, 1st July and 1st Oct.'
- 'Feedback or marketing. As we live in the monsoon rainfall area there is little variation in climatic changes.'
- 'Marketing problems outweigh the big picture information.'
- 'More accurate information on the movement of low pressure systems when over land, to allow time for flood preparation.'
- 'Probability of rainfall distribution. We always get sufficient rain for pasture growth. Distribution is more important than amount.'

- ‘Radio broadcasts of weather forecasts.’
- ‘Rainfall, drought, pasture growth, stock numbers, movement monthly.’
- ‘Recent pasture growth maps and seasonal rainfall forecasts, before and after wet season.’
- ‘We only use cyclonic and isobar information. Anything else is not 100% reliable; it is totally unreliable.’

Western Australia

All the individual responses were:

- ‘A system that would accurately forecast seasonal conditions in advance.’
- ‘Analysis of rainfall effectiveness; graphic display of health and productivity variations of a cross section of local range land.’
- ‘Annual, Feb/March.’
- ‘Cattle sale options and prices.’
- ‘District outlook for each season.’
- ‘Early sell off of sheep to reduce stocking pressure. Also better focus for sale. Sheep selling in better condition.’
- ‘End winter, winter break, probability of good winter above average/below average, cyclone activity.’
- ‘It is always handy to know predicted weather forecasts for the oncoming wet season.’
- ‘More info required.’
- ‘Rainfall – Long-term forecasts.’
- ‘Satellite imagery weekly.’
- ‘The big picture which needs painting is setting reliable figures on future commodity prices (i.e. wool) instead of the bullshit we are fed at the moment.’
- ‘The forecasting of known events e.g: El Niño and how it has affected this area in the past.’
- ‘When mid level weather combines with a front we receive good rains which are seldom forecast. We make our own forecasts closely following the cloud and pressure maps on ABC TV.’

South Australia

Summary of ‘Big-picture’ Information Requirements

Accurate quarterly forecasts…….. **7**
Fast access to Internet…… **1**
Drought maps……**1**
Greenness Maps for SA……**1**
Climate Models for SA……..**3**

All the individual responses were:

- ‘4 times a year.’
- ‘4 -5 day forecasts and 3 month forecasts.’
- ‘A quarterly fact sheet giving forecasts for the next 12 months.’
- ‘Access to Internet and faster telecommunications services.’
- ‘Accurate forecasts.’
- ‘Accurate rainfall forecasts. Accurate cattle price movements.’
- ‘Accurate seasonal forecasts for cereal growing.’
- ‘Analogues of previous years combined with rainfall distribution maps of those years’
- ‘As before - it rains in a good year, little or less in a bad year. You make your decisions as you go along.’
- ‘Drought declared area maps.’
- ‘If sea surface temp. relationships in the Indian Ocean could be developed; if Greenness Maps of SA were available similar to what is shown on Web site Longpaddock for Qld.’
- ‘Likelihood of rain’
- ‘Long range forecasts; but cannot be taken as gospel, only as a guide.’
- ‘Monthly-detailed weather forecasting for a more defined area. Not just the NE or NW of SA.’
- ‘More accurate long term rainfall forecasts.’
- ‘More information regarding pastoral areas of S.A.’
- ‘Much more accurate data to correctly determine droughts and good seasons many months in advance.’
- ‘Not sure of its accuracy within this area.’

- ‘Probability information specific to this region (northern SA) - perhaps based on southern or Indian Ocean models.’
- ‘Queensland rainfall info - to indicate the possibility of flooding. In areas of high rain may be looking for share cattle assist in various marketing options.’
- ‘Seasonal pasture growth forecasts (corrected for main land types)would be required at end of April and mid October as a minimum. This allows for stock adjustments during first and second round of mustering.’
- ‘This questionnaire is only keeping you people in a job.’
- ‘Useful models which deliver local answers.’

New South Wales

All the individual responses were:

- ‘All of 19b and short and long term weather maps and statistics, SOI data.’
- ‘All that is listed in q19b Required quarterly.’
- ‘Any movement of warm water e.g. El Niño.’
- ‘Big picture information maybe more applicable to market fluctuations for livestock than deciding on probable pasture availability.’
- ‘Big picture seasonal information on a monthly basis could help.’
- ‘Doubtful whether any of it is of real use in view of local variation in rainfall.’
- ‘El Niño and SOI included in all weather forecasts.’
- ‘Future rainfall distribution.’
- ‘I feel this has to be more scientifically accurate. If this is not achievable this is of no use.’
- ‘If management decisions are to be made based on big picture information then the information must be at least 80% accurate. In this area only the current actual situation is accurate.’
- ‘If the decision to plant a crop is a difficult one the SOI outlook will often tip the scales one way or another.’
- ‘More confidence in Bureau of Meteorology.’
- ‘More reliable prediction of 3 month and 6 and 9 month rainfall.’
- ‘On a monthly basis.’
- ‘Pasture production, computer models.’
- ‘Relevant SOI and SST for our area (South western NSW) Effective rainfall amounts and timing.’
- ‘Sea surface temperature and SOI bi monthly.’
- ‘Seasonal forecasts if reasonably accurate.’
- ‘Seasonal rainfall forecasts on a 3 month basis.’
- ‘The new technology is now available.’
- ‘Training to interpret the reports into useable information.’
- ‘We get a far more accurate prediction of rain from Median rainfall calculations and observation of trees than any SOI or other Agricultural or Met predictions.’
- ‘We need to accept our mean rainfall over a long period and manage accordingly.’
- ‘Weekly for most information, but monthly averages are more important.’
- ‘When droughts would break.’
- ‘Condensed supplement in the *Stock J.*’

Q21a: Do you have a computer?

There were 213 responses to this question:

Yes	**145**	(68.1)
No	**68**	(31.9)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**145** (68.1)	15	30	19	39	42
No	**68** (31.9)	10	17	4	25	12

Q21b: Do you currently have access to the Internet?

There were 214 responses to this question:

Yes	**42**	(19.6)
No	**172**	(80.4)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**42** (19.6)	3	10	3	13	13
No	**172** (80.4)	23	37	20	51	41

Q21c: Do you have a facsimile machine?

There were 216 responses to this question:

Yes	**183**	(84.7)
No	**33**	(15.3)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Yes	**183** (84.7)	25	42	21	47	48
No	**33** (15.3)	1	6	2	18	6

Q21d: What would be the most convenient ways for you to access seasonal climate outlook information?

There were 601 responses to this question (some of the 208 respondents gave more than one answer):

TV	**112**	(53.8)
Radio	**98**	(47.1)
Telephone recordings	**15**	(7.2)
Daily newspapers	**15**	(7.2)
Local newspapers	**14**	(6.7)
Rural newspapers	**115**	(55.3)
Computer packages	**20**	(9.6)
Internet/E mail	**41**	(19.7)
Faxed directly	**139**	(66.8)
Personal conversations/neighbours	**32**	(15.4)

Answers by State

Information source	TOTAL	WA	SA	NT	QLD	NSW
TV	**112** (53.8)	12	23	10	41	26
Radio	**98** (47.1)	10	21	8	32	27
Telephone recordings	**15** (7.2)	2	5	4	2	2
Daily newspapers	**15** (7.2)	1	4	1	8	1
Local newspapers	**14** (6.7)	0	2	2	6	4
Rural newspapers	**115** (55.3)	13	22	8	39	33
Computer packages	**20** (8.7)	4	4	1	6	5
Internet/E mail	**41** (19.7)	2	8	5	10	16
Faxed directly	**139** (66.3)	22	28	17	31	41
Personal conversations/neighbours	**32** (15.4)	2	9	4	12	5

Other Convenient Ways to Access Information

Queensland

Summary

Six comments were received; publications by industry associations, and DPI farm technical updates were mentioned.

Northern Territory

All the individual responses were:

- 'We only use fax of isobar and cloud.'

Western Australia

All the individual responses were:

- 'AGWA newsletters.'
- 'Time delay in receiving daily, local and rural papers.'

South Australia

All the individual responses were:

- 'Internet needs to be available at proper speed and reasonable cost.'
- 'Internet/ e mail, when ISD/STD costs reduce.'

New South Wales

All the individual responses were:

- 'Avfax.'
- 'US Agriculture Science magazine.'

Q21e: Which of the following sources of seasonal situation/outlook information have you used at least once*?*

There were 290 responses to this question (some of the 159 respondents gave more than one answer):

Queensland Centre for Climate Applications (QCCA)††		
SOI Phone Hotline	**11**	(6.9)
SOI Fax Hotlines	**30**	(18.9)
Internet - 'The Long Paddock'	**20**	(12.6)
Bureau of Meteorology (BoM)		
Fax services	**134**	(84.3)
Internet site	**19**	(11.9)
Seasonal Climate Outlook	**16**	(10.1)
Computer Software		
For example, AUSTRALIAN RAINMAN, Metaccess	**17**	(10.7)
SILO (QCCA/BoM)		
Australian meteorological and agricultural information on Internet	**9**	(5.7)
Private Consultant	**7**	(4.4)
Other	**27**	(17.0)

†† Queensland Centre For Climate Applications (QCCA) - a collaborative organisation involving Queensland Department of Primary Industries and Queensland Department of Natural Resources.

Answers by State

Queensland Centre for Climate Applications (QCCA)

Information source	TOTAL	WA	SA	NT	QLD	NSW
SOI Phone Hotline	**11** (6.9)	0	0	0	7	4
SOI Fax Hotlines	**30** (18.9)	2	3	2	13	10
Internet - 'The Long Paddock'	**20** (12.6)	1	3	0	8	8

Bureau of Meteorology (BoM)

Information source	TOTAL	WA	SA	NT	QLD	NSW
Fax services	**134** (84.3)	19	28	19	31	37
Internet site	**19** (11.9)	0	5	2	4	8
Seasonal Climate Outlookn	**16** (10.1)	2	4	0	4	6

Other sources

Information source	TOTAL	WA	SA	NT	QLD	NSW
Computer Software	**17** (10.7)	1	3	0	4	9
SILO (QCCA/BoM)	**9** (5.7)	0	2	0	3	4
Private Consultant	**7** (4.4)	1	2	2	0	2

Other Sources of Seasonal Situation/Outlook Information:

Queensland

All the individual responses were:

- 'SBS cloud photo test pattern.'
- 'I used none.'
- 'Radio/TV.'
- 'Rural newspapers.'
- 'TV; rural papers.'
- 'TV forecasting and papers.'
- 'QCCA, computer software.'
- 'Brisbane Bureau of Meteorology.'
- 'TV, radio, rural newspaper. Further than these, I don't believe it is worth spending the money.'

New South Wales

All the individual responses were:

- 'BOM by phone.'
- 'Peter Norvel (Murrundi) ABC Radio 2UH.'
- 'This is not important.'
- 'Word of mouth and talking to senior station hands.'
- 'Fax 3 day forecasts.'
- 'Information available is not accurate.'
- 'Information in rural papers.'
- '*The Land* Newspaper. I get it every week.'

Northern Territory

All the individual responses were:

- 'Communication is poor in the NT.'
- 'Rural newspaper; QCL info based on QLD Dept. Natural Resources.'

Western Australia

All the individual responses were:

- 'ABC Country Hour. Various rural magazines.'
- 'Australian Meteorological Personnel.'
- 'Landline – TV Weekly - National rainfall recordings.'
- 'Weather maps S.B.S.'

South Australia

All the individual responses were:

- 'ABC Country Hour. Stock Journal.'
- 'None.'
- 'Our own judgement.'
- 'There are several other web-sites.'

Q21f: Considering *all* of the seasonal situation/outlook information sources you know of (including media sources, those above, personal contacts etc.), which source(s) do you think are best and, briefly, why?

Queensland

All the individual responses were:

- 'SBS cloud pattern because you can see the big systems. ABC radio and TV: good information.'
- 'Media sources.'
- 'TV pictures, weather maps in and around Australia. The radio offers more local information. Personal: gives information as to how people react to situations which can differ from place to place and still be right.'
- 'Perhaps personal contacts.'
- 'QCCA/BOM should have an Ag {illegible}'
- 'Short term - Met service. Long term…?'
- 'Weather maps together with local knowledge of area.'
- 'Look at pasture and soil moisture. The future is too unpredictable weatherwise.'
- 'None. No one seems to be able to pick droughts, floods, etc.'
- 'Media sources, weather maps, Internet, because they are constantly upgraded.'
- 'SOI on Net - can peruse past years.'
- 'SBS weather map. It is in colour, available twice daily, and free. Coloured state rainfall summary in Rural Newspaper. NOAA "greenness" image supplied monthly for SA by DEHAA. Both Rural Newspaper and DEHAA provide a good overview on likely cattle supply. QDPI "Longpaddock" pasture growth map as percentage of maximum growth. This places history in context with the present.'
- 'Rural newspapers – ease of access, cost, layout.'
- 'TV, radio, papers. These sources suit me personally.'
- 'TV and rural papers because of easy access.'
- 'Rural News, because I read it every week.'
- 'Media - easy access.'
- 'BoM and SILO - Long Paddock; overall maps and forecast probabilities.'
- 'TV forecast from 1 day to 7 days; rural newspapers up to 6 months. Personal conversations with neighbours: we forecast weather in our own areas in short term and most times in the long term.'
- 'Widely read papers. You have time to digest it and can check later how wrong it is. Australia and even Queensland covers a very large area and a general forecast can be right in one area and very wrong in others. The severe flooding in parts of the north, for example.'
- 'All sources are good. Always pick up and find out news.'
- 'TV and newspaper publications of probability forecasts, working on the assumption that one won't get rain. It's better than betting you will!'
- 'TV/Radio- easy access.'

- ‘Information on TV, radio, guest speakers etc. Also many farmers have not got the newer equipment mentioned.’
- ‘We only listen to forecasts on TV and plan our own planting or cattle work around that.’
- ‘Rural papers.’
- ‘I have not found any to be very accurate.’
- ‘Fax, computer.’
- ‘Morning (6:15 to 7am) ABC Radio; Fax services (providing one knows which numbers to call).’
- ‘Fax, because it is picked off the machine and read (a bit like a phone is always answered).’
- ‘Bureau of meteorology - farm weather, cotton fields etc. I give it 80% accuracy.’
- ‘QCCA - DPI/DNR, because they seem to be well researched and unbiased assessments.’
- ‘Rural press because time to study details.’
- ‘TV, Fax, papers, radio etc., and personal subscriptions to seasonal outlook.’
- ‘Local radio because it is so available in home, vehicle, tractor.’
- ‘TV or maps in *Country Life* or daily paper.’
- ‘ “Long Range Forecast” (rural newspaper).’
- ‘A summary of seasonal conditions in QLD, produced by Dept. of Natural Resources.’
- ‘Melbourne Bureau of Met. Best because: 1. of their fax 019725352 sea temp. data; 2. their meteorologists are in the nerve centre, climate-wise, and if they don’t know, no one does; 3. I suspect that QDPI’s weather, like everything else in QDPI, is highly political at the top level. I wonder do political games muddy the science of QDPI’s weather? Should the ALP gain government, my prediction is for winds of change across the QDPI weather service. If this happens, it will prove my point. When it comes down to meteorologist’s nuances, I’ll back Melbourne.’
- ‘Radio on ABC explained by department personnel. Neighbours with 84 years of family experience.’
- ‘I look at the maps, the markets, my own paddocks, my neighbour’s paddocks, the district in general, and act conservatively.’
- ‘The QDPI day that was conducted recently in Monto with Dr. Roger Stone proved to be most informative and I would recommend it.’
- ‘Fax and Internet, because they have the latest information I can get when I need it.’
- ‘The fax services as they seem to give better detail and Information.’
- ‘Articles in rural press, SOI, QDPI Bulletin and Internet site.’
- ‘Rural newspaper articles and faxed information would be most user-friendly for seasonal climate outlooks.’
- ‘If reliability and credibility were markedly improved, I would reconsider others.’
- ‘Unfortunately, I cannot comment as I have not been aware of most of the above services. Most seasonal info has come from ABC weather, SBS cloud charts and “Qld Country Life” weather.

Northern Territory

Summary of Best Sources of Seasonal Situation/Outlook Information

Most people (91%) used fax machines and considered these the most convenient way to access seasonal outlook information. The TV, radio and Internet rated highly but considered less convenient than fax information.

All the individual responses were:

- ‘ABC TV.’
- ‘Bureau of Meteorology fax services can target information required when convenient.’
- ‘Bureau of Meteorology other information is all tailored to eastern states.’
- ‘Fax services and Internet site, as you can have a printed copy for referral.’
- ‘Fax services.’
- ‘Haven't had a chance to look at all, yet’
- ‘Hotlines and fax services. I have not accessed or been aware of “The Long Paddock” or “SILO”.’
- ‘I am not sure. Do you wish the Northern Territory to participate, or are these really only Queensland?’
- ‘Isobar -shows strong winds for cyclone and for burning off and for bush fire fighting.’
- ‘Radio - comprehensive coverage.’
- ‘Rural newspapers are convenient.’
- ‘TV and radio and faxes are easy and convenient sources of information.’
- ‘TV is the quickest and latest to access.’

Western Australia

All the individual responses were:

- **'**ABC Country Hour. Rural magazines.'
- 'BOM - the only one I am aware of here in WA.'
- 'Bureau of Meteorology and rural media, including the press. TV and radio. Most accessible and most often listened to.'
- 'Bureau of meteorology maps (weather fax)is most accurate.'
- 'Electronic/Fax information is easily accessible- printed material can be sent later on request.'
- 'Faxed directly saves time and money.'
- 'I have not trusted any yet.'
- 'Local Meteorology bloke has most accurate info in a readily accessible form.'
- 'More info required as to what is available.'
- 'None because they are all inaccurate.'
- 'None. They are not specific enough; they are too general. Some private forecasters are having success with troughs, and on days it may rain.'
- 'Our own long-term historical records and our own experiences of conditions.'
- 'Relationships between ground cover and river siltation observed from the air, and monitoring of rainfall incidence, vs reliability of watering points.'
- 'Rural newspapers - SOI - information extended outlook.'
- 'Satellite photos. You can see the facts.'
- 'Weather bureau, satellite fax, With knowledge from elsewhere I get a good idea of the wet's next move. Agriculture Dept. weather forecasts.'

South Australia

Summary of Best Sources of Seasonal Situation/Outlook Information

Fax from BoM……	**11**
Radio……..….	**5**
TV……..…	**4**
Observations……...	**4**
Internet……..…	**2**
Rural Newspapers……..…	**2**

All the individual responses were:

- '4 day BOM forecasts; cloud maps via fax; seasonal probability info specific to SA.'
- 'BOM faxed 4 day forecasts. An attempt to make a judgement, we have to, and live with the decision.'
- 'Bureau fax service 4 day forecast, instant information for spraying programs.'
- 'Computer and fax, always available and can get instant updates.'
- 'Daily synoptic charts and satellite photos from Internet.'
- 'Did not know they are available.'
- 'Direct fax is good because of the weather maps and clouds on satellite photos.'
- 'Fax services because they can be studied at leisure.'
- 'Fax services, Bureau of Meteorology. Easy to access.'
- 'I am not overly confident about predicting the weather. It's sometimes interesting to receive the faxed weather map or watch the weather on the news.'
- 'I do not rely on any long range forecasts.'
- 'I listen to ABC Country hour. I always read the Walker long- range weather forecast.'
- 'I think you have to cross check all sources of forecast and use a common sense approach yourself.'
- 'Internet and personal as these are up to date.'
- 'Look out the window.'
- 'Media - most readily accessible.'
- 'Media - regular information.'
- 'No idea.'
- 'No one area is best. They are used together to look at probable outcomes. Probability factors of what makes a decision high risk or low risk.'
- 'None yet in the main; sowing grain is a major gamble.'

- ‘Personal contacts.’
- ‘Radio 4 day forecast. Pretty accurate for such a dry area.’
- ‘Reports on seasonal situations in rural newspaper; it can be perused at length and filed away for future reference.’
- ‘Rural newspapers - most landholders subscribe to them, and they can read them when time permits.’
- ‘Rural radio reports and newspaper because of the time and ease to us busy farmers.’
- ‘Satellite fax gives you best look at cloud coverage etc.’
- ‘SBS weather map. It is in colour, available twice daily, and free. Coloured state rainfall summary in Rural Newspaper. NOAA “greenness” image supplied monthly for SA by DEHAA. Both Rural Newspaper and DEHAA provide a good overview on likely cattle supply. QDPI ‘Longpaddock’ pasture growth map as percentage of maximum growth. This places history in context with the present.’
- ‘Short term - Met service; Long term -?’
- ‘Television – easy to access.’
- ‘The rural press is a convenient way of gaining such information as I think helpful.’
- ‘TV weather report. It has to be reasonably accurate.’
- ‘TV, radio, Fax. Do not get newspaper.’
- ‘We watch approaching system on Faxed Bureau info. at times.’

New South Wales

All the individual responses were:

- ‘(BoM) Fax because I can access what I want when I want it.’
- ‘(BoM) fax gives the percentage chance of rain occurring for 3-4 days - usually fairly accurate.’
- ‘A combination of all the above and gut feeling.’
- ‘ABC radio/Land newspaper/Gut feeling! and a lot of luck.’
- ‘Described big picture at a local level.’
- ‘BoM - they gather the data.’
- ‘BoM/Internet - costs little, ease of access etc.’
- ‘Bureau of Meteorology because it is on the media sources.’
- ‘Bureau of Meteorology is the only one I have used except long range forecasters in the land.’
- ‘Bureau of Meteorology/easily accessed through media.’
- ‘Don’t know and if I did what would the relevance be?
- ‘Fax – as it is quick and easy: TV as part of the news; wireless as it can be heard while working.’
- ‘Fax - Land news paper - can be sourced when one has time.’
- ‘Fax services.’
- ‘Faxed satellite maps, Bureau of Meteorology - most accurate.’
- ‘Ian Hotton, BoM S. Australia (till he went private). His predictions are more accurate for Victoria.’
- ‘Land newspaper (Don White’s forecast) BoM gives excellent cloud coverage etc.’
- ‘Maps showing rainfall distribution, such as in the back of the 'Old Country Life' are useful.’
- ‘Media, convenient at present.’
- ‘Media-particularly radio - isolated from TV sources relevant to our area. Fax services - up to date, access immediate.’
- ‘None. Too many mistakes.’
- ‘Private consultant as it is more relevant to our location.’
- ‘QCCA SOI phone Hotline. Quick, accessible and good information content.’
- ‘Queensland Climate Centre as their info is clear and easy to understand.’ ‘Rural Press guides to El Niño and SOI.’
- ‘SOI and Rainman to get a probability percentage.’
- ‘The Bureau of Meteorology satellite image. It is the most accurate.’
- ‘The Long Paddock and BoM - best links and quality.’
- ‘The Rainman program is far and away the most useful thing, followed by the weekly Rural Press.’
- ‘Weather maps.’

PART D: Scaled Attitudinal Responses

Q22: "It is better management practice to simply respond to changing seasonal conditions, rather than try to anticipate and reduce seasonal climatic risks."

There were 203 responses to this question:

Strongly disagree	**30**	(14.8)
Disagree	**28**	(13.8)
Neither agree nor disagree	**49**	(24.1)
Agree	**48**	(23.6)
Strongly agree	**48**	(23.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**30** (14.8)	3	6	2	11	8
Disagree	**28** (13.8)	5	5	4	6	8
Neither agree nor disagree	**49** (24.1)	5	10	1	17	16
Agree	**48** (23.6)	6	12	8	13	9
Strongly agree	**48** (23.6)	5	11	6	13	13

Q23: "I accept that seasonal climate forecasts are better expressed in terms of probabilities (e.g. '60% chance that the next three months will be drier than average') than like a traditional weather forecast."

There were 202 responses to this question:

Strongly disagree	**11**	(5.4)
Disagree	**13**	(6.4)
Neither agree nor disagree	**46**	(22.8)
Agree	**79**	(39.1)
Strongly agree	**53**	(26.2)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**11** (5.4)	2	3	1	0	5
Disagree	**13** (6.4)	2	2	0	3	6
Neither agree nor disagree	**46** (22.8)	10	15	1	9	11
Agree	**79** (39.1)	7	14	13	28	17
Strongly agree	**53** (26.2)	3	8	6	20	16

Q24: "At present, SOI and probability-based forecasting places undue responsibility on 'users' to interpret the information."

There were 195 responses to this question:

Strongly disagree	**8**	(4.1)
Disagree	**38**	(19.4)
Neither agree nor disagree	**59**	(30.1)
Agree	**55**	(28.1)
Strongly agree	**36**	(18.4)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**8** (4.1)	1	1	0	6	0
Disagree	**38** (19.4)	2	7	2	14	13
Neither agree nor disagree	**59** (30.1)	8	15	6	17	13
Agree	**55** (28.1)	2	11	11	14	17
Strongly agree	**36** (18.5)	9	6	2	9	10

Q25: "Warnings of possible stock feed shortages in 3-6 months time, at a district level, would be valuable in making my management decisions."

There were 202 responses to this question:

Strongly disagree	**23** (11.4)
Disagree	**12** (5.9)
Neither agree nor disagree	**26** (12.9)
Agree	**59** (29.2)
Strongly agree	**82** (40.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**23** (11.4)	2	6	4	4	7
Disagree	**12** (5.9)	1	2	1	4	4
Neither agree nor disagree	**26** (12.9)	4	4	3	9	6
Agree	**59** (29.2)	6	15	7	15	16
Strongly agree	**82** (40.6)	10	16	6	29	21

Q26: "At present, adequate experience and information are available to enable me to link climate-related information/forecasts to practical property management."

There were 201 responses to this question:

Strongly disagree	**33** (16.4)
Disagree	**39** (19.4)
Neither agree nor disagree	**61** (30.3)
Agree	**49** (24.4)
Strongly agree	**19** (9.5)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**33** (16.4)	7	3	5	6	12
Disagree	**39** (19.4)	5	12	2	10	10
Neither agree nor disagree	**61** (30.3)	5	17	5	19	15
Agree	**49** (24.4)	4	5	7	23	10
Strongly agree	**19** (9.5)	2	5	2	4	6

Q27: "I am comfortable with the increasing level of climate-related materials now becoming available via computer programs and computer networks."

There were 182 responses to this question:

Strongly disagree	**16**	(8.8)
Disagree	**22**	(12.1)
Neither agree nor disagree	**68**	(37.4)
Agree	**54**	(29.7)
Strongly agree	**22**	(12.1)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**16** (8.8)	2	4	0	6	4
Disagree	**22** (12.1)	3	5	3	2	9
Neither agree nor disagree	**68** (37.4)	10	16	9	16	17
Agree	**54** (29.7)	6	10	6	18	14
Strongly agree	**22** (12.1)	1	6	2	6	7

Q28: "Warnings of the possible pasture deterioration (for example weed invasion, loss of desirable species) at a district level, before the main growing season, would be valuable in making my management decisions."

There were 194 responses to this question:

Strongly disagree	**15**	(7.7)
Disagree	**31**	(16.0)
Neither agree nor disagree	**47**	(24.2)
Agree	**56**	(28.9)
Strongly agree	**45**	(23.2)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**15** (7.7)	2	4	1	4	4
Disagree	**31** (16.0)	2	6	0	13	10
Neither agree nor disagree	**47** (24.2)	5	13	7	11	11
Agree	**56** (28.9)	9	6	8	17	16
Strongly agree	**45** (23.2)	4	9	5	16	11

Q29: "Generally, the rural media provide credible and useful sources of seasonal climate forecast information."

There were 205 responses to this question:

Strongly disagree	**10**	(4.9)
Disagree	**32**	(15.5)
Neither agree nor disagree	**64**	(31.1)
Agree	**74**	(35.9)
Strongly agree	**25**	(12.6)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**10** (4.9)	3	3	0	2	2
Disagree	**32** (15.5)	2	6	4	10	10
Neither agree nor disagree	**64** (31.1)	11	13	10	15	15
Agree	**74** (35.9)	7	16	6	27	18
Strongly agree	**26** (12.6)	1	6	1	9	9

Q30. "Warnings of possible soil deterioration (for example reduced ground cover, soil loss - see 'Definitions' on last page) on a district basis, before the level of pasture ground cover became critical, would be valuable in making my management decisions."

There were 192 responses to this question:

Strongly disagree	**19** (9.9)
Disagree	**20** (10.4)
Neither agree nor disagree	**69** (35.9)
Agree	**50** (26.0)
Strongly agree	**34** (17.7)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**19** (9.9)	4	4	1	5	5
Disagree	**20** (10.4)	2	4	0	6	8
Neither agree nor disagree	**69** (35.9)	7	14	12	19	17
Agree	**50** (26.0)	5	9	6	17	13
Strongly agree	**34** (17.7)	3	11	1	11	8

Q31: "Scientific seasonal climate forecasting is a valuable tool for managing my property in the face of seasonal variability."

There were 201 responses to this question:

Strongly disagree	**10** (5.0)
Disagree	**29** (14.4)
Neither agree nor disagree	**58** (28.9)
Agree	**60** (29.9)
Strongly agree	**44** (21.9)

Answers by State

Response	TOTAL	WA	SA	NT	QLD	NSW
Strongly disagree	**10** (5.0)	0	5	1	1	3
Disagree	**29** (14.4)	3	3	3	9	11
Neither agree nor disagree	**58** (28.9)	9	11	10	14	14
Agree	**60** (29.9)	7	11	5	23	14
Strongly agree	**44** (21.9)	6	12	2	14	10

Q32: Do you have any further comments to make, for example on what we may have missed in this questionnaire?

Queensland

All the individual responses were:

- 'SBS and ABC could use the test pattern slot to exhibit various satellite images with a detailed written interpretation of events with more of a global approach, so progress of major systems could be followed; for example, in terms of hay-making the 40 day event is very important. I will soon be purchasing computer software to help me make more informed decisions.'
- 'We feel that seasonal climate forecasting would be a very valuable management tool if it could be more accurately refined.'
- 'If the long term forecast is accurate it would be very useful as a management tool. At present, our management is dictated by (1) the season, and (2) our financial position.'
- Regarding Question 11: 'This is a silly question: we plan on present climatic conditions.' A response to Question 15. 'The worst SOI index in 20 years has resulted in the best season in 20 years.'
- 'Forecasting is like picking winners. Good seasons sometimes do not make for good pastures, ie, heavy falls can be spasmodic and of little use, while more moderate and regular falls can really set up pasture.'
- 'I find the hardest decision on this property to make is if stock should be fed or sold in a dry time. Sometimes you make the right decision and sometimes not. I consider the seasonal forecasts but do not always act on their advice. I would say sometimes I get it wrong but I believe I am in front of the advice from the forecasts.'
- 'By predicting what lies ahead with the weather, graziers have to make decisions themselves. It is our livelihood we are controlling. An outside influence such as SOI can have negative and positive effects on business decisions. I would like to see research continue in the area of weather forecasting. I also think financial pressures force us into carrying more cattle than we think the country can sustain long term.'
- 'To me it is all about having your pasture-soil in a condition where it can make use of every available drop of rain.
- 'Scientific information is very good, providing it is good enough to rely on; and only time will tell if it is good enough to base management decisions on it.'
- 'Yes. When will the next drought be?'
- 'Layout editing.' {of questionnaire}
- 'The ideal situation would be when the pasture yield forecasting had accurate enough land type and growth model information to be accurate at the paddock (100 sq km) scale, and that this could be available (downloaded) into a basic GIS on a farm computer so decisions on feed patchiness, etc. could be made on a paddock basis.'
- 'My thoughts, though not relevant to this questionnaire: Global warming is a fact. We have overcleared, overstocked, overpolluted, wasted resources through lack of conservation policies in the past; and at present, the nature of man to stuff things if he's not restrained. I feel for future generations.'
- 'Seasonal forecasts would be very valuable if they were much more accurate. I reduced my stock considerably last year because of forecasts of a very dry summer. But this has been the best summer for years.'
- 'I filled in this questionnaire keeping in mind my area and not the whole district, because the area varies a lot due to distance; and I am also looking at it from a cane farming point of view, rather than a pastoral one.'
- 'Regarding Question 19a: But as yet unable to use the system.'
- 'Regarding Question 31: Wheat planting in '97 was deliberately delayed because of risk of late frost in low SOI year.'
- 'The SOI info is interesting at all times and of growing importance. Currently, only the autumn scores influence me.'
- 'Weather forecasting, in my experience, is still unreliable.'
- 'A response to Question 22: I attempt to keep numbers low so that I don't have to "react" when it is dry.'
- 'Summary: 1. update everything weekly, esp. on fax. 2. More hard data (oceanography, carbon dating, tree rings) and less fast chatter (spindoctors and "experts") 3. Less history (last month's rain), more prophesy (next month's rain) 4. Same as '3.' above, it's not a bloody joke, it is a serious request from a survey respondent, who usually fills out, then tears up QDPI surveys from utter frustration! 5. Stop asking "why?" Who are we to inquire? "why?" is not ours to ask! "Why climate change?" "Why droughts?" Stop asking "why?" and say "why not?" 6.QDPI should say "Why not roll with the climate king hits and change our

programs to encompass apparent change". Drop "swamp". More on control cell grazing. More on WASCA land rehabilitation. What's 'WASCA'? coming soon to ABC TV 'Landline'. 7. QDPI cannot avoid political interference. So how can its weather? Discuss it, before the *Courier Mail* gets onto it (or would that be a good idea?). P.S.! ! Re "swamp" - at least stop the burning - it accentuates nutrient flux, and it's well known to restore speargrass; spell the paddock.'

- 'Regarding Question 28: Rhodes grass in droughts does disappear under heavy grazing. Native blue grass comes back very well and colonises the Rhodes grass areas. Gatton Panic, Purple pigeon grass and B{illegible} Panic appear to be able to come back.'
- '1. We take note of the big picture climate forecasting for other parts of the world, insofar as it alerts us to changes in our competitors' positions in markets, as well as changes in consumption due to local economic disasters related to climate. It appears to have relevance on a macro basis. 2.When 'Rainman' was developed, I attempted to use it. I was told 'Sorry, we don't have any data for your area'. Later, a second attempt, I learned it was only for IBM compatible equipment, so I thought I would have to bring my data to DPI. Decided it wasn't worth the effort.'
- 'Keep trying. While we may never be able to confidently predict our weather, I feel big steps forward have been made. The more informed we are the better chance we have of surviving in Primary Industry.'
- 'I believe property owners have to be made more aware of ground baring's effect on the number of weeds. Also, some fail to see overstocking as a problem. They continue to blame the weather. How do your pasture availability charts take these into account?'
- 'Do not ask for basically yes/no answers: draw participants out and get their views and opinions. Many scientists jump on band wagons hoping to access funds and keep themselves in a job. This applies to some degree with SOI/El Niño. Virtually all predictions are based on it. Please look further afield to planets, sea surface temperatures, upper air {temperature?}, volcanic activity, cyclones sucking moisture from other areas etc.'
- 'One thing that has been overlooked in analysing rainfall records is the measure of useful daily rain as opposed to useless daily rain, and periods or aggregations of rain, that is, rain influence over 2 days or even 2 weeks. Looking at monthly rainfall does not yield this information, and it is critical information in this present local drought. An example is 1977 with 93.7% useful rain (total 936mm), and 1997 with less than 50% (total 548mm).'
- 'I will not be planting a winter spring pasture this year, because of the information I have received from DNR. I believe the risk of failure is too great.'
- Regarding Question 18. 'No' was also marked. 'I lighten off stocking rate - hard to compare with control of not lightening off.'

Northern Territory

All the individual responses were:

- 'I feel that I can only answer these questions by using personal experience gained over a lifetime.'
- 'PS If I am not successful in the draw for the above books, I would appreciate both books being forwarded to the given address. A cheque to cover costs would be forwarded.'
- 'Regarding questions 22-31 These questions are stupid and treat us as too stupid to observe what we are living on, using and relying upon. I strongly object to your quest and rate it as beyond stupidity!'
- 'We use weather forecasting to an extent; however, it is not accurate enough to base financial decisions on. Ongoing research is essential to get at least 90% accuracy.'

Western Australia

All the individual responses were:

- 'All we can do is encourage and urge governments and all players to put as much funding aside to investigate climatic changes and make seasonal (accurate) forecasts. Unfortunately our Australian records are not sufficiently old. Records on tides, humidity, phases of the moon, sea temperatures, land humidity and wind, mid-level activity etc. are incomplete. One begs the question how come emus, kangaroos and migrating birds know when a season is going to be good and our own computer literate academics don't!!!!'
- 'Because I have never used any of the products available on computer etc. I am a bit sceptical of them. Rain at the right time and a lot of gut feeling and the adrenaline rush of the gamble keep me going.'
- 'Information is not getting out to the GRASS ROOTS. None of this material is any good if it is sitting in the regional office. The ability to understand and interpret at grass roots levels.'
- 'More accurate area-specific forecast could be of great help, as would accurate day to day forecasting which is area specific. The Gascoyne can be a big place when forecasts are predicting rain.'

- ‘Most of information from special interest groups is selected about nature, environment - city telling country what they should do. I distrust some of this information made available to me.’
- ‘Take note: most pastoral stations in WA, NT and Qld are on microlink telephone which works at 25 000 alts per second. This is too slow for the Internet, which needs 85 000.’
- ‘This questionnaire seems to focus on symptoms rather than causes. I feel that the underlying cause i.e., man's part in exposing ground surface to the sun and rain by the destruction of vegetation and the momentum that this trend is developing is being happily ignored. Are we trying to place bets on a riderless horse that we are responsible for having a go???’
- ‘We need accuracy in forecasting when computer models put out 4 different scenarios. Somebody is going to be wrong. Who is going to take responsibility ? If I make a business decision based on a forward e.g. (3 months) ahead weather prediction and it is wrong, who takes responsibility when I’m paying for this information?’
- ‘You can never tell when it will rain or how much.’

South Australia

Summary of answers

Seasonal forecasting would be good if accurate…….	**5**
Present climate models not relevant to SA……...…….	**3**
Willing to liaise to improve……...	**2**
Need more weather stations……...	**1**

All the individual responses were:

- ‘Accuracy is the main issue. Until weather predictions can be 100% accurate, management of properties, especially pastoral, should not alter on hearsay.’
- ‘All information cannot be taken as gospel, as conditions can vary from property to property, especially in pastoral areas.’
- ‘Because of the flukish nature of the rainfall in this area, one property may be in good heart, while the next may be suffering. While general and district forecasts may be some guide, the actual rainfall received is really the crux of the matter.’
- ‘I believe any weather forecasting not based on the probability of rain etc. is dangerous and could lead to people making financially damaging decisions if categorical forecasts were made.’
- ‘In my region there is doubt as to the accuracy of El Niño predictions, and ISO relativity to our climatic patterns. Currently some work is being done on creating a more accurate index.’
- ‘It is very much opportunity country here. Drought is the rule rather than the exception, mostly, and most climatic predictions are regarded a little cautiously in this area.’
- ‘Many questions are difficult to answer because our property is in the very dry pastoral areas with sporadic rain any time of the year.’
- ‘Note: we have 4 self-contained cottages we hire out to tourists and they are often inquiring about our weather patterns and how we manage our stock to suit, so we would appreciate any material you can send us.’
- ‘Nothing we can do will change the coming season and we have to react accordingly. Information allows one to feel more comfortable with his decision whether it be right or wrong.’
- ‘Our area is pastoral area where no chemicals or weed chemicals are used on the stock or land, so we see no invasion of weeds or other problems that need control, other than dingoes and large numbers of kangaroos. These are our major problems along with lack of rain.’
- ‘Part D not really applicable as we do not have stock or crops.’
- ‘Part D, we are grazing only.’
- ‘Q.7a. We keep annual rainfall records. Q.11. Cannot predict weather in this area at all. Part D. Left blank because we do not crop. Q.32. We have, in the past, tried to use past rainfall records etc., to assist in decision-making and have come dreadfully unstuck. We now carry the numbers the present season dictates, sell as it gets drier or as cattle prices are high (which hasn’t been for more than 2 years!). The feel of the weather, acts of nature, weather patterns do indicate whether there is the possibility of near-future rain (within a month).’
- ‘Q.7b. Some trouble locating daily rainfall, but daily is reported to Meteorology Bureau at end of each month. Q.9. Slight summer dominance. Q.32. The ideal situation would be when the pasture yield forecasting had accurate enough land type and growth model information to be accurate at the paddock (100

km sq) scale and that this could be available (downloaded) into a basic GIS on a farm computer so decisions on feed patchiness etc., could be made on a paddock basis.'

- 'Q.19b. Recent rainfall maps: don't mean much. Recent pasture growth maps: mean nothing. Drought-declared areas etc.: we do not have this information. Seasonal rainfall forecasts: never right. Seasonal pasture growth forecasts: can change over one hot, dry day Q.32.This questionnaire has no benefit to us at all, as our seasons are so erratic and cannot be predicted. It might be of some use to people who live on the coast or just inland. If you guarantee that if I made a business plan on your forecasts you will have to guarantee the end profit; then I might have a go.'
- 'Q.12. For research planning Q.32. This is not really an appropriate questionnaire for me. SGSKP is keen to collaborate/collude to improve the usefulness of such forecasts and especially to link them into usable models.'
- 'Q.18. Sometimes.'
- 'Q.6. Have been a primary producer for 16 years (on this property), a family business Q.9. Summer, if thunderstorm activity about Q.11. Optimistic. Q.22. Don't know Q.24. Don't know.'
- 'Question 19b - Have not used drought-declared areas/exceptional circumstances maps in SA.'
- 'Seasonal probability forecasting seems to vary a lot from region to region in terms of accuracy or applicability. Do more region-specific models need to be developed?'
- 'Take the opposite view of long range forecasts and you are just as likely to be right.'
- 'The 90s have produced three wet harvests resulting in weather-damaged grain, but going back through records, this has happened before. Yes, I believe El Niño etc., does affect weather and rainfall. But, some El Niño years are wet, others dry. For example, last year the experts forecast dry conditions for this area. The result was the opposite!!'
- 'This property is 100% pastoral relying mostly on bush cover.'
- 'We live in semi-arid district. Most of our rain comes in thunderstorm weather. When conditions are right in autumn and spring, we get sufficient rain to grow cereal crops. Part C. We do not use El Niño maps.'
- 'We live in the driest part of the driest state of the driest continent in the world.'
- 'We strongly push that small country weather stations be manually maintained to keep up with the vast and variable weather locations across our state and nation.'

New South Wales

All the individual responses were:

- 'Regarding Question 31 - comment (not enough proof yet).'
- 'A good question could be: what are your current management decisions with current predictions? What would be the decisions with accurate 12 month predictions? How would it affect your net income?'
- 'As far as I am concerned all these fancy computers methods etc. are in their infancy and can be more a hazard than a benefit. Even when it is established as fool- proof (which I don't think will happen in my life time), I will rely on my own hunches. Rely on yourself and your own judgement. If it is right 75% of the time you are in front. If you are wrong you only have yourself to blame. Following the judgement of others, if failure occurs you cannot get recompense. From there it's just stiff.'
- 'As shown by this last summer the SOI is only one of many factors governing our rainfall so the more information we can get the better we can make a judgement on what management moves would be appropriate.'
- 'At this time seasonal climatic predictions are not accurate enough to be useful in this area. If predictions could be 80% they would be very useful.'
- 'Computer based access via the Internet is more timely and easy to comprehend - if only our telephone lines could carry data.'
- 'Don't overdo the forecasting. We should be growing crops, beef, wool etc. to feed and clothe the world, not to make the almighty dollars for the banks and multi-nationals and governments. Qs 22-31: response was not in pastoral crop area.'
- 'How did the old timers know! Were they just lucky? Time is worth money today! Drought and bad returns are no combination! Have one without the other and survival could be possible.'
- 'I feel that a NSW Agric. site like Long Paddock with an emphasis on climate patterns across NSW - not excluding the rest of Australia and maybe the region.'
- 'If the forecasts, as they stand, are as accurate as they can get I do not see them being beneficial in pastoral country. I feel your own observations are the best.'
- 'Longer range forecasting would be much more useful if it was based on regions e.g. Southern, Central + Northern NSW rather than lumped together on a map of Australia. This is because different systems have different predictive powers for different areas.'

- ‘No one can predict the weather for the future in my opinion. The management of my property is on a day-to-day basis according to the climatic conditions at the time. I don’t believe you can make decisions for the future based on long range weather forecasts. They are not always correct; it is only a calculated guess.’
- ‘No point in making forecasts if they are not accurate.’
- ‘Q.9. Most rainfall should be in summer, but has changed . 17 year 3 and half summer rain. Q.32. We need (in NSW) improved and increased seeds of perennial grasses, summer and winter, and legumes and clover to plant or distribute by hand to assess the changes. We have to change with the elements, CO2 etc. CSIRO {illegible} has researched measuring grass butts, but fail to {illegible} to the climate change in not developing grasses. Not much use measuring without a plan to develop selectively and genetically. No work has been done with allelopathy,-important for us to know how to use allelopathy and have to make native grasses {illegible} to this effect.’
- ‘The usefulness of seasonal forecasting is unknown due to {end of sentence missing} Good managers learn their land and its capability and be conservative in a dry spell. Always a fifty/ fifty bet.: Varying pasture species: xxxx variation – climate.’
- ‘There are a number of new theories as to weather patterns. They need the test of time to be embraced with confidence. If you would like rainfall records let me know.’
- ‘There is a great need for low interest loans (max 2%) for graziers in the Western Division of NSW for soil conservation work. This is the single biggest problem facing graziers.’

‘Warnings on stock feed situation and soil deterioration at district level are irrelevant as individual farms have different management strategies. More accurate interpretation of SOI and how it will affect particular districts would help with long term plans.’

- ‘We deal with the present not in the future.’
- ‘We have found following and observing natural occurrences on our own place a more reliable indicator of weather probabilities. Apple Bush and Mallee will send out fresh shoots 6-8 weeks before useful rain for example.’
- ‘Your time would be better spent developing whole of life technology and not just a minute point. Graziers/farmers have the tools but perhaps not the technology to put those tools to work. Rainfall cannot and hopefully will not be predictable. Water efficiency is the only input for pasture growth which can be managed. This should lead to an increase in everything including profitability i.e. change to EASY management.’

DISCUSSION

The aim was to obtain 50 completed forms per participating State/Territory, and this was achieved in Queensland, NSW and South Australia (49). A total of 23 forms were received in the NT, which represents an excellent sample. However, 26 returns in WA was disappointing and the smaller representative sampling in the western third of the continent needs to be kept in mind when looking at national summaries of the data.

Part A – General Information about Respondent

The data in Part A emphasises the wide range of property situations that pastoralists operate in around Australia. For example, property size, annual turnover, annual rainfall and the season when most rainfall is received all vary greatly. This needs to be kept in mind when interpreting the survey data, particularly the answers to open questions. In many cases the results may be more valuable by referring to the individual reports for each State/Territory. Some of these give data and information for particular regions, and also compare regions.

In retrospect, the categories for ‘$ turnover per annum’ were probably not well chosen (Question 4). While the lower category of ‘<20 000’ indicates that 7% were in the ‘hobby-farm’ size, less than 2% of the sample was in the highest category of ‘>2 000 000’.

A total of 72% of property owners surveyed are involved in the beef industry, while 50% run sheep (Q5). Many of the respondents are involved in a range of other industries, but less than 2% of the sample represented agribusiness.

Eighty-six percent of respondents had been involved in primary production for 10 to 50 years (Q6), and surprisingly there was a reasonably even spread over this range.

A total of 91% of respondents keep daily rainfall (Q7a). Eighteen percent of these respondents said they had kept daily rainfall records for more than 50 years (Q7b), however, in Question 6 only 7% responded that they had been primary producers for more than 50 years. Obviously there is some confusion between how long the grazier has kept records and the total number of years that property rainfall records have been maintained. Out of those who keep daily rainfall records, 93% have 'complete' or 'fairly complete' records (Q7c). Fifty percent of survey properties have an average annual rainfall of 400 mm or less (Q8).

Part B – Monitoring Seasonal Conditions

Question 10 examined respondents' perceptions of climate change; 82% of them were 48 - 78 years of age. Forty-eight percent of respondents believe that their rainfall has become drier and 27% that there is no change (Q10a). A total of 58% of respondents believe that rainfall has become more variable, while 21% think that there has been no change (Q10b).

Forty-three percent of respondents believe that summer day-time temperatures have become hotter, and 33% that there has been no change (Q10c). Question 10d revealed that 42% of respondents believe that there has been no change in frost frequency, while 27% believe that there has been 'less frost' during the 1980s and 1990s (10d). Thirty-eight percent believe that there has been no change in humidity, and 25% feel that the climate has become more humid (Q10e).

Questions 11 and 12 were concerned with the use of climatic information. Eighty percent of respondents said that judgements of future climatic conditions were 'very important' or 'moderately important' in their planning or decision-making (Q11). However, 75% do not use long-term climatic records to assist in decision-making (Q12). It is therefore concluded that they are likely to be receptive to training aimed at a better understanding of seasonal climate forecasting and the use of such information.

Respondents were asked to list their most important annual decisions in Question 13. Selling/agisting stock was mentioned by 88% of participants, while 43% highlighted 'buying stock'. Surprisingly under 'Others', very few respondents mentioned financial budgeting, but others infered it by refering to various variable expenses/capital improvements.

In Question 14, 44% of respondents surveyed said that probability-based information is 'moderately useful' to 'very-useful' in the management of their business. Thirty-seven percent of respondents currently use seasonal climate forecasts in decision-making (Q15)

A total of 94% of participants observe pasture growth/conditions when deciding on what stock numbers to carry through the months of the year when feed shortages are most likely to occur (Q16). Fifty-six percent of owners measure or record information for individual paddocks (Q17b) and 39% regularly compare property management options quantitatively (Q18).

Part C – 'Big-picture' Information

Part C reviews land owners' thoughts on 'big-picture' information, which is developed from seasonal climate forecasting systems, pasture production computer models and satellite imagery.

The results of the survey revealed that 42% of owners believed that big-picture information was 'moderately important' to 'very important' in their planning, although 13% were 'unaware' of this information (Q19a). Question 19b found that the main types of big-picture information used by respondents are seasonal rainfall forecasts (83%) and recent rainfall maps (74%) .

Fifty-three percent of those who have used big-picture information have found it moderately useful to very useful (Q19c). Forty-five percent of those who have not used big-picture information thought it could be moderately useful or very useful, while 15% of respondents have no idea how useful it might be (Q19d).

While users of big-picture products have some problems with accessing information (24%), and interpreting and using it (22%), the comments under 'Other problems' indicate some reservations about product accuracy and forecasting ability (Q19e).

Sixty-eight percent of the graziers and pastoral agribusiness managers surveyed have a computer (Q21a) and 20% currently have access to the Internet (Q21b). The most commonly used information source was the facsimile machine with 85% of respondents owning one.

The most convenient ways to access seasonal climate outlook information are by fax, rural newspapers, TV and radio (Q21d). The main sources of seasonal situation/outlook information used at least once are BoM Fax Services and the SOI Fax Hotlines (Q21e).

Part D – Scaled Attitudinal Responses

Forty-seven percent of respondents either 'agreed or 'strongly agreed' with the statement "Is it better management practice to simply respond to changing seasonal conditions, rather than try to anticipate and reduce seasonal climatic risks" (Q22).

"I accept that seasonal climate forecasts are better expressed in terms of probabilities (e.g. '60% chance that the next three months will be drier than average') than like a traditional weather forecast" (Q23) – 65% 'agree' or 'strongly agree' with this statement.

"At present, SOI and probability-based forecasting places undue responsibility on 'users' to interpret the information" (Q24) – the response of 30% of respondents to this statement was neutral while 57% agreed.'

Seventy percent of those surveyed 'agreed' or 'strongly agreed' with question 25: "Warnings of possible stock feed shortages in 3-6 months time, at a district level, would be valuable in making my management decisions".

"At present, adequate experience and information are available to enable me to link climate-related information/forecasts to practical property management" (Q26) - the average response to this statement was 'neutral', but 36% of respondents disagreed.

"I am comfortable with the increasing level of climate-related materials now becoming available via computer programs and computer networks" (Q27) - average response to this statement was 'neutral' to 'agree', while 42% agreed.

"Warnings of the possible pasture deterioration (e.g. weed invasion, loss of desirable species) at a district level, before the main growing season, would be valuable in making my management decisions"(Q28) - 52% either 'agree' or 'strongly agree' with this statement.

"Generally, the rural media provide credible and useful sources of seasonal climate forecast information" (Q29) –49% 'agree' or 'strongly agree' with this statement.

Forty-four percent of respondents 'agreed' or 'strongly agreed' with the statement: "Warnings of possible soil deterioration (e.g. reduced ground cover, soil loss – see 'Definitions' on last page) on a district level, before the level of pasture ground cover became critical, would be valuable in making my management decisions" (Q30).

"Scientific seasonal climate forecasting is a valuable tool for managing my property in the face of seasonal variability" (Q31) - 52% answered 'agree' or 'strongly agree'.

Comparison with Biased Sample (Qld)

Eight members of Local Drought Committees in central Queensland (CQ LDC), who had been exposed to many of the Aussie GRASS products, were also surveyed. This sample was kept separate from the main sample from which results are quoted above. Selected results from the convenience sample for central Queensland region (CQ), compared with the results from the CQ LDC sample, are listed below:

In central Queensland 31% of respondents (CQ LDC 50%) said 'big-picture' information was 'moderately important' to 'very important' in their planning.

A total of 67% (CQ LDC 80%) had used at least one product.

In central Queensland 43% (CQ LDC 67%) of those who have used big-picture information have found it 'moderately useful' to 'very useful'.

A total of 29% (CQ LDC 0%) of those who have not used big-picture information thought it could be 'moderately useful' or 'very useful'.

In central Queensland 60% (CQ LDC 50%) of respondents have no problem using 'big-picture' information.

'Warnings of possible stock feed shortages in 3-6 months time, at a district level, would be valuable in making my management decisions' - 72% (CQ LDC 60%) either 'agree' or 'strongly agree' with this statement.

'Warnings of the possible pasture deterioration (e.g. weed invasion, loss of desirable species) at a district level, before the main growing season, would be valuable in making my management decisions' - 50% (CQ LDC 60%) either 'agree' or 'strongly agree' with this statement.

'Warnings of possible soil deterioration (e.g. reduced ground cover, soil loss – see 'Definitions' on last page) on a district level, before the level of pasture ground cover became critical, would be valuable in making my management decisions' - 50% (CQ LDC 60%) answered 'agree' or 'strongly agree'.

'Scientific seasonal climate forecasting is a valuable tool for managing my property in the face of seasonal variability' - 56% (CQ LDC 80%) answered 'agree' or 'strongly agree'.

CONCLUSIONS

The following conclusions can be made from the results of the survey:

- The survey results provide reasonable guidance for developing an effective Communication Plan and Extension Program.

- The knowledge and attitudes of agribusiness managers are not well represented in the data obtained. Some further information may need to be collected by extension staff through personal contact.

- As 96% of respondents keep daily rainfall records, and 93% of these have 'complete' or 'fairly complete' records, the challenge is to help them to make better use of the valuable records being produced. A total of 75% of respondents do not currently use long-term climatic records to assist in decision-making.

- A total of 81% said that judgements of future climatic conditions were 'very important' or 'moderately important' in their planning or decision-making, so they are likely to be receptive to training aimed at a better understanding of seasonal climate forecasting, and the use of such information. While 83% of respondents have used seasonal climate forecasts (Q19b), only 37% of them currently use them in decision-making.

- There is a reasonably good acceptance of probability-based information (Q14), as 44% said that probability-based information is 'moderately useful' to 'very useful' in the management of their business. In addition, most respondents (65%) agree with releasing seasonal climate forecasts in the form of probabilities (Q23).

- While 41% said big-picture information was 'moderately important' to 'very important' in their planning, 13% were unaware of the information. In addition 53% of those who have used big-picture information have found it 'moderately useful' to 'very useful'. Also, 44% of those who have not used big-picture information thought it could be 'moderately useful' or 'very useful', while 15% of respondents have no idea how useful it might be. Thus respondents should generally be receptive to Aussie GRASS extension activities.

- Users of big-picture products have some problems with accessing information, interpreting and using it (22%); also there are some reservations about product accuracy and forecasting ability. These issues need to be addressed in implementing the Aussie GRASS extension program.

- The most convenient ways to access seasonal climate outlook information are direct fax, rural newspapers, TV, and radio. As 85% have a facsimile machine, this appears to be the best current method for pastoralists to obtain accurate information. However, 68% have a computer, 20% currently have access to the Internet and most respondents accept that an increasing amount of information will be computerised. Thus their use of software programs and the Internet are likely to increase.

- There appears to be strong support for the concept of Feed Shortage Alerts (70%), and moderate support for the provision of warnings of possible deterioration of pastures (52%) or soil (44%). Note that the support for warnings declines as the sustainability threat is perceived as being further in the future; however in the CQ LDC sample, support for each type of warning was consistent (60%).

- The range of 'big-picture' products needs to be promoted in an integrated fashion, and focused at the property level by linking the information with on-property observations/experiences.

- As participants indicated some concern regarding the accuracy of seasonal climate forecasts, it is important to improve their accuracy for the various pastoral regions of Australia. Only then can we expect graziers to accept the 'look-ahead' products developed under the project.

- In order for the extension of Aussie GRASS products to be effective, the timing of activities and selective use of appropriate decision-support products/tools are essential. It is important that group extension activities be conducted at the most appropriate time in the annual production cycle, when specific products can make a significant difference in the quality of decision-making. Answers to Q13 help to identify the critical decision-making times for a specific industry in a particular region. Only products/tools relevant to the key property management decision being analysed should be promoted, and this should be done in the context of overall management of the pastoral business.

- It is desirable to repeat this benchmarking survey, for example after five years, in order to measure the changes that have occurred as a result of achieving significant information and technology transfer.

- A consensus agrees that while a good manager knows his land and its limitations, there is a need for more accurate seasonal forecasts, particularly on a regional or district basis.

- There needs to be further research to establish suitable models for southern Australia; the provision of sample products and further client workshops will help in the development and acceptance of the range of products.

- Western Australian pastoralists have not been exposed to the concept of El Niño and the SOI as much as producers in eastern states. Obviously, this is due to the reduced effects of these on the west coast. However, it also means that they are less sensitive to 'big-picture' climate information. In the east, El Niño and SOI provide effective vehicles for raising the profile of seasonal intelligence. The same is not true in the west and it will not become so unless a complementary index is found for the west coast and promoted.

- Seasonally related 'big-picture' information may have to be tailored differently to producers in Western Australia. Rather than focusing on forecasts, it might be better to concentrate on seasonal context information using their own (often very good) long-term rainfall records. This would allow them to make better judgements about the 'averageness' of current seasons and set stocking rates accordingly.

ACKNOWLEDGEMENTS

Contributions by the following are gratefully acknowledged:

Contributing Authors

John Crichton, Harpal Marvi, Graeme Tupper, Alan McGufficke, Rodger Tynan, Rodd Dyer, Katrina McMahon, Jeff Werth, Julie Roche and Ian Watson.

Survey Design

Peter Hastings, Diane Keogh, Arnold Wissemann, Alan Beswick, John Crichton, Rodger Tynan, Ian Watson, Greg McKeon, Rebecca Lines-Kelly, Andrea Clowes and Chris Lang.

Data Collection

Ross Ballin, Neil Cliffe, Damien O'Sullivan, Paul Walmsley, Ron Wheeler, David George, Paul Carberry, David Buckley, Maureen Beattie, David Blood, Simon Osborne, Peter Marin, Kathryn Egerton-Warburton and Leigh Hunt.

Data Processing and Administration

Alan Beswick, Keith Moodie, David Ahrens, Amanda Bowden, Belinda Cox, Margaret Uriarte, Tracy Van Bruggen, Julie Wolfe, Alison Darley and Sandra Ward.

Graphics

Alan Peacock.

APPENDIX 1: Survey Cover Letter

Queensland Centre for Climate Applications

80 Meiers Road
Indooroopilly Qld 4068

Phone: (07) 3896 9587; Fax: (07) 3896 9843
Email: paullc@dnr.qld.gov.au

How do you assess seasonal conditions in pastoral areas to improve management decisions?

Dear Landholder,

There is currently a lot of interest and concern about our variable climate and its effects on primary production. A number of projects are being developed in Australia to help you to anticipate climatic trends and seasonal conditions, in order to improve your management of climatic risks and opportunities.

The national Aussie GRASS Project (see attached leaflet) is aimed at producing improved assessments of seasonal conditions in pastoral areas to help graziers, agribusiness and policy-makers to improve their management decisions. However, this work will only be successful if combined with your knowledge and experiences of the land, climate and how to respond to changing seasonal conditions.

We need your help in developing up-to date products which look at seasonal conditions, and to test such products for their value in operating your business. Your completion of the following questionnaire will contribute significantly to this goal.

Confidentiality of individual responses is assured. Responses will be amalgamated and studied as a group, and there is no need to supply your name. Participation is, of course, voluntary - but I encourage you to take part.

I would be grateful if you could complete the feedback sheet, and ***return it via the pre-addressed and paid envelope within two weeks.*** Any responses, even if incomplete, would be greatly appreciated.

If you request a summary of the grouped findings, we will also send you a **coloured poster** showing annual Australian rainfall maps, El Niño events and SOI. In addition, your name will be put into the draw to **win** one of 15 books entitled 'Australia's Weather Patterns - an Introductory Guide' (retail price $29-95) or 'Will it Rain? - the effects of the Southern Oscillation and El Niño on Australia' (retail price $20).

Yours faithfully,

Col Paull
Leader
Extension Sub-Project

APPENDIX 2: Survey Form

FEEDBACK FROM GRAZIERS, FARMERS AND BUSINESS ON SEASONAL FORECASTING INFORMATION

PART A Some general information about yourself (no need to supply your name).

1. What is your nearest **town**? _____ In what **State**?_____

2. What is the name of your local government area/district? _____

3. How big is your property? _____ ha.

4. How big is your business? ($ turnover per annum) (*Tick one box).*

<20 000 ❑ 200 000 - 2 000 000 ❑

20 000 - 200 000 ❑ > 2 000 000 ❑

5. What **industries** are you in? (*Tick appropriate boxes).*

Beef ❑ Summer Grain ❑
Sheep ❑ Fodder Crops ❑
Dairying ❑ Agribusiness ❑
Winter Grain ❑ Other (specify)_____ ❑

6. For how long have you been a primary producer? ____ years OR Not applicable ❑

7a. Do you keep daily rainfall records? Yes ❑ No ❑
(tick appropriate box) (go to Question 8)

7b. How many years have you kept these records?_____years

7c How complete are these records? *(tick appropriate box).*

Complete ❒ Fairly Complete ❒ Patchy ❒

8. What is your average annual **rainfall**? _____ mm.

9. When do you receive most of your rainfall? (*Tick appropriate box/boxes).*

Summer ❑
Autumn ❑
Winter ❑
Spring ❑
Evenly spread ❑

PART B **This section is about how you monitor seasonal conditions and respond to a changing situation. The following questions ask for your opinions and your reasoning. These might be based on information or advice from outside sources and/or your own observations, 'rules of thumb' and so on. There are no 'right' or 'wrong' answers.**

10. From your experiences and knowledge, do you believe that your climate during the 1980s and 1990s has changed compared with that of the 1960s and 1970s? (*Tick appropriate boxes).*

10a	Rainfall	Don't know ❑	No change ❑	Drier ❑	Wetter ❑
10b	Rainfall variability	Don't know ❑	No change ❑	More variable ❑	Less variable ❑
10c	Summer day-time temperatures	Don't know ❑	No change ❑	Hotter ❑	Cooler ❑
10d	Frost	Don't know ❑	No change ❑	More frost ❑	Less frost ❑
10e	Humidity	Don't know ❑	No change ❑	More humid ❑	Less humid ❑

10f. In what year were you born? *(this influences your answer to the above questions).*_____

10g. Any other comments?

……
……
……

11. How important are your judgements of future climatic conditions (over the next three to 12 months) in your planning or decision-making? *(Tick one box).*

not at all important ❑ slightly important ❑ moderately important ❑ very important ❑

12. Do you currently use long-term (20 years or more) **climatic records** to assist your decision-making? (*Tick one box*).

Yes ❑ No ❑

13. In your business/industry, what are the three most important annual **decisions** you make in which the outcomes are affected by future climatic influences? *(please indicate three).*

Selling/agisting of stock ❑ Sowing crops/pastures ❑
Buying stock ❑ Burning pastures ❑
Forward selling/hedging ❑ Weed/disease/pest control ❑
Others (please describe)

……
……

14. How useful is probability-based information (see 'Definitions' on last page) in the management of your business? (*Tick one box).*

I don't use it ❒ not at all useful ❒ slightly useful ❒ moderately useful ❒ very useful ❒

15. Do you currently use **seasonal climate forecasts**, for example information on SOI /El Niño / Indian Ocean temperatures/other indicators) to assist with any of your decision-making? (see 'Definitions' on last page) (*Tick one box).*

Yes ❑ No ❑

16. If you keep stock, how do you decide what **stock numbers** to carry through the months of the year when feed shortages are most likely to occur? *(Tick appropriate boxes).*

Observe pasture growth/conditions ❑ Use seasonal climate outlook/forecast ❑
Measure pasture growth/condition ❑ Use AUSTRALIAN RAINMAN ❑
Use other aids (give details)…….. ❑
……
……
……

17a. What signs or **indicators** do you look for in a paddock to assess the health of your pasture or stock? (see 'Definitions' on last page - pasture productivity indicators).
……
……
……
……
……

17b. Do you measure or record information for individual paddocks? (for example pasture species, stock numbers).

Yes ❑ No ❑
(go to Question 18)

17c. What do you measure or record in individual paddocks?
……
……
……

18. Do you regularly compare property **management options** by actual calculations of the production and financial outcomes of all options? (*Tick one box).*

Yes ❑ No ❑

PART C **Several groups have recently developed seasonal climate outlook information, seasonal climate forecasting systems (based on the Southern Oscillation, El Niño, SOI, sea-surface temperature patterns), pasture production computer models and satellite imagery (see 'Definitions' on last page). This work has resulted in a range of 'big-picture' products being made available, usually in the form of a map, covering recent rainfall, recent pasture growth, drought-declared areas, seasonal rainfall outlook and pasture growth prospects. The following questions ask for your thoughts on <u>this</u> 'big-picture' information. There are no 'right' or 'wrong' answers.**

19a. How important is <u>this</u> big-picture information in your **planning**, risk management or decision-making? (*Tick one box).*

unaware of information	not at all important	slightly important	moderately important	very important
❒	❒	❒	❒	❒

19b. Have you used any of the following types of 'big-picture' information? *(tick appropriate boxes).*

Recent rainfall maps	Yes ❑	No ❑
Recent pasture growth maps	Yes ❑	No ❑
Drought-declared areas/exceptional circumstances maps	Yes ❑	No ❑
Seasonal rainfall forecasts	Yes ❑	No ❑
Seasonal pasture growth forecasts	Yes ❑	No ❑

19c. (If you answered 'yes' to any part of Question 19b). Generally to what extent has the information, which you have used, been useful? (*Tick one box).*

Not ❑	slightly ❑	moderately ❑	very ❑
useful	useful	useful	useful

19d. (If you answered 'no' to all parts of Question 19b). To what extent do you think this 'big-picture' information could be useful to you?

I have no idea	not useful	slightly useful	moderately useful	very useful
❒	❒	❒	❒	❒

19e. (If applicable). What **problems** have you had in using this 'big-picture' information? *(tick appropriate boxes).*

I don't use this information ❑	It is difficult to interpret/use ❑
No problems ❑	Information not detailed enough ❑
Access to it is difficult ❑	It is too complex ❑

Others (please give details)……
……
……

20. What 'big-picture' information would help you to make better management decisions, and when or how often is it required?
……..
……..

21a. Do you have a **computer**? Yes ❑ No ❑

21b. Do you currently have access to the **Internet**? Yes ❑ No ❑

21c. Do you have a **facsimile machine**? Yes ❑ No ❑

21d. What would be the most convenient ways for you to **access** seasonal climate outlook **information**? *(Tick appropriate boxes).*

TV ❑	Computer packages ❑
Radio ❑	Internet/Email ❑
Telephone recordings ❑	Personal conversations/neighbours ❑
Daily newspapers ❑	Faxed directly ❑
Local newspapers ❑	Others (please name) ❑
Rural newspapers ❑	……..

21e. Which of the following **sources** of seasonal situation/outlook **information** have you used at least once*? (Tick appropriate boxes).*

Queensland Centre for Climate Applications (QCCA)*	• SOI Phone Hotline	❑
	• SOI Fax Hotlines	❑
	• Internet - 'The Long Paddock'	❑
Bureau of Meteorology (BoM)	• Fax services	❑
	• Internet site	❑
	• Seasonal Climate Outlook subscription	❑
Computer Software	For example, AUSTRALIAN RAINMAN, Metaccess	❑

SILO (QCCA/BoM) - Australian meteorological and agricultural information on Internet ❑

Private Consultant ❑

Others (*please name*: ……..…….) ❑

Note: * Queensland Centre For Climate Applications (QCCA) - a collaborative organisation involving Queensland Department of Primary Industries and Queensland Department of Natural Resources.

21f. Considering *all* of the seasonal situation/outlook information sources you know of (including media sources, those above, personal contacts etc.), which source(s) do you think are best and, briefly, why?

……
……

PART D How do you respond to the following statements concerning seasonal situation assessment in pastoral crop areas? Tick the box that indicates your 'position' on the scale, where: 1 = I strongly disagree; 2 = I disagree ; 3 = I neither agree nor disagree; 4 = I agree; 5 = I strongly agree.

22. "It is better management practice to simply respond to changing seasonal conditions, rather than try to anticipate and reduce seasonal climatic risks."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
23. "I accept that seasonal climate forecasts are better expressed in terms of probabilities (e.g. '60% chance that the next three months will be drier than average') than like a traditional weather forecast."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
24. "At present, SOI and probability-based forecasting places undue responsibility on 'users' to interpret the information."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
25. "Warnings of possible stock feed shortages in 3-6 months time, at a district level, would be valuable in making my management decisions."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
26. "At present, adequate experience and information are available to enable me to link climate-related information/forecasts to practical property management."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
27. "I am comfortable with the increasing level of climate-related materials now becoming available via computer programs and computer networks."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
28. "Warnings of the possible pasture deterioration (for example weed invasion, loss of desirable species) at a district level, before the main growing season, would be valuable in making my management decisions."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
29. "Generally, the rural media provide credible		1	2	3	4	5	

and useful sources of seasonal climate forecast information."	strongly disagree	❑	❑	❑	❑	❑	strongly agree
30. "Warnings of possible soil deterioration (for example reduced ground cover, soil loss - see 'Definitions' on last page) on a district basis, before the level of pasture ground cover became critical, would be valuable in making my management decisions."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree
31. "Scientific seasonal climate forecasting is a valuable tool for managing my property in the face of seasonal variability."		1	2	3	4	5	
	strongly disagree	❑	❑	❑	❑	❑	strongly agree

32. Do you have any further comments to make, for example on what we may have missed in this questionnaire? If you need more space, please write on the reverse.

……
……
……
……
……
……
……

✂----------
-✂

THANK YOU FOR YOUR TIME AND THOUGHTS. PLEASE RETURN YOUR ANSWERS IN THE PRE-PAID ENVELOPE PROVIDED.

Use of Survey Results

Survey results will be formally reported to key "stakeholders", and I expect they will help in fostering more effective exchanges between pastoral groups. I will also endeavour to make this information generally available. However, individual responses will remain **confidential**.

The study outcomes will assist in the development of new information products and services through greater understanding and appreciation of producers' knowledge, opinions and needs.

Would you like to receive a summary of the grouped findings? We would also like to send you a **coloured poster,** with our thanks**,** showing annual Australian rainfall maps, El Niño events and SOI. In addition, your name will be put into the draw to **win** one of 15 books entitled 'Australia's Weather Patterns - an Introductory Guide' (retail price $29-95) or 'Will it Rain? - the effects of the Southern Oscillation and El Niño on Australia' (retail price $20).

If you would like to receive a concise summary of the grouped findings and the coloured poster, and also enter the draw to win a book, please contact me direct or supply your name and address:

……
……

Best wishes for a happy and prosperous 1998,
Col Paull, Leader, Extension Sub-Project Phone: (07) 3896 9587; Fax: (07) 3896 9843

Definitions

'Big-picture' seasonal information helps to describe the seasonal conditions 'outside a particular property' at a district, state or national scale. It provides part of the context in which individual property management decisions are made.

When the SOI is strongly negative, rainfall in the Indonesian and Australian region can be well below average - a possible drought in an **El Niño** event.

Pasture deterioration is a decline in pasture condition resulting in a long-term reduction in its capacity to produce animal products. This may result from trends such as a reduction in the more palatable pasture species (which produce more animal product) and weed invasion.

Pasture production computer models calculate how much pasture grew, or may grow, from a specific amount of rainfall at a particular location.

Pasture productivity indicators are factors that can be observed/measured to signal a change in the capacity of the pasture to produce animal products. For example, changes in ground cover, the main pasture species, the density of woody weeds and soil loss.

Probability-based information/forecasts are obtained by analysis of historical records. For example, 'a 70% probability of below average winter rainfall', or 'the chances are that winter rainfall will be below average in seven years out of 10 years'.

Satellite imagery is natural resource information in the form of a map, produced using measurements by instruments on a satellite.

Seasonal climate forecasts deal with time-frames of months, looking ahead up to 12 months in some situations.

Sea-surface temperature patterns are also important indicators in seasonal climate forecasting. For example, warmer-than-normal water in the central and eastern equatorial Pacific Ocean is characteristic of an El Niño event; **Indian Ocean sea-surface temperatures** off Western Australia are indicators of rainfall prospects in Southern Australia, and from north-west cloudbanks.

Sea-surface temperature patterns are also important indicators in seasonal climate forecasting. For example, warmer-than-normal water in the central and eastern equatorial Pacific Ocean is characteristic of an El Niño event; **Indian Ocean sea-surface temperatures** off Western Australia are indicators of rainfall prospects in Southern Australia, and from north-west cloudbanks.

Soil deterioration on a pastoral area is a decline in soil condition (for example soil loss, scalding, and salting) resulting in a long-term reduction in its capacity to produce animal products.

The **Southern Oscillation** is a see-saw of air pressure between the eastern equatorial Pacific Ocean and the Indonesian region. When the surface atmospheric pressure is abnormally high over one region, it is usually abnormally low over the other. The Southern Oscillation explains up to 40% of the year-to-year variability in eastern Australian rainfall.

The strength of the Southern Oscillation is measured by the **Southern Oscillation Index (SOI),** which is the difference in air pressure between Tahiti and Darwin. The SOI usually ranges from -30 to +30.