

Agforce Queensland - FarmReady Project GMS - 0506

Developing and Implementing Grains Best
Management Practices for Managing Climate
Change and Climate Variability

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Final Technical Report

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EXECUTIVE SUMMARY

The “Managing Climate Risk” module developed in this project aims to improve sustainable and profitable grains production in the Northern Grains Region through a needs-based education programme. It is a significant addition to the Grains ‘*Best Management Practice*’ (BMP) program developed in Central Queensland that empowers grain growers with the capacity to assess their current management practices against a set of industry defined BMP standards, and to then identify a suite of actions to improve farm production practices. The Climate Module considers a suite of 24 BMP standards for managing the variability of seasonal conditions and longer-term changes in climate. These 24 BMPs are divided into 4 areas: (i) linking climate and crop production, (ii) risk management principles, framework and process, (iii) agronomic tactics and strategies for managing climate risks, and (iv) managerial skills.

The project’s first three milestone reports described development of the climate module and the initial rollout of the module via training at six grower workshops and three professional development workshops. This fourth and final milestone report describes the results of delivering the final eight workshops and evaluates the project outputs and outcomes. Tasks and results for milestone 4 were:

| Task | Result |
|--|---|
| 1. Deliver the ‘Managing Climate Risk’ module to eight groups of growers at workshops in Qld and NSW | The module was successfully delivered via eight grower workshops in the Northern Grains Region of NSW and Queensland from Narrabri to Clermont during the period Sept 2011 to Feb 2012 |
| 2. Analyse and evaluate project results (including analysis of the on-line self-assessment data) and more generally evaluate the Grains BMP Climate Risk Module. | Feedback from 69 workshop participants (87 attended), analysis of on-line data from 74 grain growers (re current practices for managing climate risk), actions to improve management, and feedback from 15 longitudinal interviews concerning practice change were evaluated. |
| 3. Communicate project results and the Grains BMP climate risk module to industry and other stakeholders. | Project results were communicated to industry and stakeholders via media releases, newsletters and scientific publications. Recommendations covered best management practice standards, key messages and future extension processes. |
| 4. Provide recommendations to allow update of the Grains BMP package (five modules) in Queensland and Northern NSW. | A set of 16 recommendations to update the previously existing Grains BMP modules are provided. |

Participant numbers at Milestone 4 workshops were significantly greater than at the Milestone 3 workshops due in part to more effective communication, and gave an over-all average of 6 participants per workshop for the 14 workshops held. The main reason for reduced numbers of grain growers attending workshops was due to a combination of increased workloads from prolonged wet weather, competing activities (e.g. flood, weed control, crop nutrition and coal seam gas workshops), and the politics of climate change causing mixed messages and confusion throughout the wider community.

Over-all, the project was successful on four fronts that are highly relevant to the FarmReady Industry Grant Objectives that focus on promotion, uptake, best practice and integration with industry. Firstly, development of the climate module is significant because it identifies best management practices for grain growers in the Northern Grains Region. The 24 BMP standards in this module for management of climate risk encourage a robust flexible approach to managing seasonal conditions and longer term risks. They were endorsed and accepted by key stakeholders via reference panels in southern and central Queensland, 87 grain growers attending 14 workshops from Narrabri in NSW to Clermont in Central Queensland, and 27 grain industry consultants, researchers and extension officers at three professional development workshops. The BMP standards now provide useful benchmarks for extension programs that can be transferable nationally, and thus should be promoted to agencies such as the Grains Research and Development Corporation, training organisations for vocational education, and State Departments of Agriculture. Improved risk management, better record keeping and development of forecast skills were the main areas where practice change was most evident during the interviews of the longitudinal study.

Secondly, the project was successful because mechanisms were put in place for ongoing interaction and influence on industry to improve the management of climate risk. This includes development of an effective workshop process, registration of this workshop in the FarmReady Training Program, development of communications materials including a video of the climate module, and installation of the Grains BMP Climate Module on the Grains BMP website (www.grainsbmp.com.au). Furthermore, the material is useful to formal training programs such as vocational training to achieve the Unit of Competency "AHCAGB501A Developing Climate Risk Management Strategies". These mechanisms enable grain growers to access on-going opportunities to improve management of climate risk in grains production.

Thirdly, the project has successfully developed an effective framework and process for embedding management of climate change adaptation within an overall process for managing climate risk.

Fourthly, a stronger 'climate risk network' now exists, that is able to mentor other grain-growers to better manage climate risk in not only grains production, but potentially other rural production and natural resource management systems.

Variable weather patterns are a great challenge to sustainable and profitable grain production in the Northern Grains Industry with climate risks having a large influence on the yield of crops, profits, environmental assets, the well-being of farming families and the prosperity of communities. In addition, global warming and climate change are likely to have significant long-term impacts that will probably be most felt through the jolts of extreme events such as drought, flood, and heatwave rather than smooth transitions that can be difficult to perceive. Consequently, the BMP standards used in the climate module for managing risk and assessing the chance of events need to be soundly based.

BMP Standards in the Climate Module concerning risk management conform with the principles and guidelines for the Australian Standards on Risk Management (ISO 31000: 2009).

In analysing the variability of seasonal conditions and the impacts of climate change, the best practice "minimum standard" for assessing the likelihood of events was identified in this project as the likelihood calculated from continuously updated historical weather and climate data. This is consistent with research elsewhere and it is recommended here that this best practice "minimum standard" be adopted by industry. Continual refinement of decisions with continuously updated weather data provides the mechanism needed for climate change adaptation. Growers usually support on-going research on long-

term adaptations that may be needed for climate change but often reject immediate uptake of adaptation practices when expected impacts are beyond a short-term outlook.

The most important climate risks to manage as perceived by grain farmers were found to be low and variable rainfall, and catastrophic events such as drought, intense storms, flood and unseasonal severe frost. Managing opportunities such as the “perfect” weather for grain production and other risks such as heat waves, windy conditions wet weather impacts on pests and pathogens were also rated as important.

Developing management skills to address strategic and tactical operations at paddock, whole-farm and off-farm levels were identified as central to effective management of climate risk. Similarly, making best use of continuously updated historical weather records and skills to assess current weather patterns, seasonal forecasts and long-range climate change forecasts were seen as priorities.

Further priorities for management included the use of a robust risk management framework and process. Similarly, a healthy lifestyle to mitigate climate induced stresses, business planning and skills in using weather/climate forecasts were rated as important. On-farm priorities for cropping are strategic investments in machinery (such as zero till, controlled traffic and effective planting equipment), seasonal adjustments to agronomic practices, maintaining natural resources, diversification, and periodic reviews of land capability when changes in climate occur. Off-farm investments and off-farm employment activities were also considered to be an important hedge in managing climate risk.

Over two thirds of grain-growers (N=74) considered their current management practices were meeting the minimum BMP standards of the Grains BMP Climate Module. A further 15% assessed their current practices were “below” the minimum BMP standard, and 12% considered they were achieving best management practice (i.e. their practices met the criteria to be “above” the minimum BMP standard). These are mean values over all 24 practices of the module and were found by analysis of the on-line data on the Grains BMP website (www.grainsbmp.com.au). Variation between practices was pronounced.

A significant proportion of growers considered their practices were below the minimum industry standard for risk management (48%), risk assessment (31%), record keeping (39%) and business planning (12%). However, most growers considered their current agronomic practices for managing climate risk were either best management practice (19% of growers) or at the industry minimum BMP standard (75% of growers), and very few growers assessed their current practices as below standard. Many actions were identified by growers to improve their practices for managing climate risk; either to achieve the minimum standard or to achieve best practice.

Research, development and extension programs should promote the uptake of robust, flexible management systems for managing the variability of seasonal conditions as the key approach for adaptation to climate change.

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DEVELOPING AND IMPLEMENTING GRAINS BEST MANAGEMENT PRACTICES FOR MANAGING CLIMATE CHANGE AND CLIMATE VARIABILITY

INTRODUCTION

The Grains 'Best Management Practice' (BMP) program for Australia's Northern Grains Region is a voluntary, industry-led process which enables broad acre grain growers to improve on-farm production practices. The program was based around five modules: (1) property design and layout, (2) making the most of rainfall, (3) crop nutrition and soil fertility management, (4) integrated pest management, and (5) pesticide application. This project expanded upon these modules by considering the management of climate risk and carbon efficiency in the northern grains industry. Self-assessment is a central concept in the Grains BMP process. Grain growers assess their management of climate risk in the Climate Module by:

- considering current practices for managing climate risk in relation to industry standards
- identifying potential areas for improvements to their business
- assessing priorities and developing action plans to change farming practices.

The five objectives of the project were to:

1. review the existing five grains BMP modules to identify their adequacy in considering climate variability and climate change and maximising carbon efficiency
2. develop a new BMP module that specifically addresses best management practices in the northern grains region for managing climate risk and carbon efficiency with emphasis on achieving greater resilience and adaptations for managing climate change
3. deliver and test the climate risk BMP module with twelve industry groups, and support a broader and on-going pathway for delivery of the module in the Northern Grains Region
4. implement delivery of the 6 modules (including the Climate Risk module) of the Grains BMP as an updated integrated package to assist farmers to improve practices to handle climate variability and maximise carbon efficiency
5. evaluate project results and communicate findings to stakeholders and industry.

Objectives 1, 2 and 3 were documented in Milestone reports 1, 2 and 3. While the main focus of this report is on objective 5, the report also adds to objectives 3 and 4.

The Grains BMP Climate Risk Module was developed in the early stages of the project. This involved endorsement by the grains industry through Reference Panels in Central and Southern Queensland. The panels were made up of high level grain growers, key advisors and consultants in the grain industry. Endorsement of the module and BMP standards took several rounds of review and feedback. A key part of this process was gaining endorsement of practices for managing climate risk that were identified to be at the "minimum industry BMP standard", and also of practices that were identified as either below or above the "minimum industry BMP standard". Each of these BMP standards and description of the module are shown in Appendix 7. Key features of the module are:

1. The climate module uses the same layout and methodology as used in other Grains BMP modules
2. Both opportunities and challenges are recognised when managing the positive (upside, beneficial) aspects of climate risk as well as the negative (downside, threats) aspects of climate risk.

3. The module identifies 24 areas of paddock, whole farm and off farm practices for managing climate risk that cover short-term operating decisions and long-term strategies. They are divided into the following 4 key areas:
 - Key Area 1. Survey of enterprise and climate information regards monitoring the current situation, analysing historical data and evaluating short-term, seasonal and climate change forecasts
 - Key Area 2. Risk management principles, framework and process including risk assessment (likelihood, impact and treatment priority), communication, monitoring and review
 - Key Area 3. Review of strategies for managing climate risks (opportunities and threats) such as the “perfect” season for grain production, low and variable rainfall, severe and catastrophic events , excessive rain and high intensity storms, cool weather and frost, hot-dry weather, and windy conditions
 - Key Area 4. Managerial skills for strategic and tactical management of climate risks at paddock, whole-farm and off-farm levels.
4. Different approaches to each of these practices were rated as above, equivalent to or below a “minimum” industry standard (these ratings were endorsed by industry reference panels in southern and central Queensland)
5. Practices are “best management practice” if they satisfy all of the criteria of the category “above minimum BMP standard”.
6. Growers are asked when completing the module to self-assess their management practices and to then identify whether or not the level of their practice was above, equivalent to or below the “minimum” industry standard
7. Management of both climate variability and climate change are covered by the module, with better management of climate variability the major component and the pre-requisite to better management of climate change
8. Agricultural practices which deal effectively with the climate risks evident in progressively updated historical records are identified as being at the minimum industry standard, while practices that also deal with future climate risks projected from climate change scenarios are usually assessed as desirable but above the minimum industry standard.
9. Agricultural practices concerning carbon efficiency are fully integrated with agricultural practices concerning management of climate risk.

Booklets for the module use the same layout as used for the initial five modules of the BMP program. It was loaded onto the Grains BMP website (www.grainsbmp.com.au) maintained by Agforce Queensland and can now be accessed in the same way as the initial five modules of the BMP program. A PDF copy of the module (see attached file GrainsBMP_climate_module_20110415.pdf) with facilities for data entry was also produced. This file enables growers to electronically enter their data during workshops and hence eliminates the need to have access to the internet. In this circumstance the completed PDF form is uploaded to the Grains BMP website at a later date by the workshop facilitator. Growers can then log onto the Grains BMP website (password protected) at a later date to read/edit information relevant to their enterprise. The PDF can be printed to produce booklets.

OBJECTIVES OF MILESTONE 4

The five deliverables required for milestone 4 of the project were specified as:

1. Evaluate project results and communicate findings to stakeholders and industry
2. Analysis and evaluation of the self-assessment data
3. Formal evaluation of the climate risk BMP module
4. Communicate results of climate risk BMP module to industry and other stakeholders
5. Deliver the 'Managing Climate Risk' module to eight groups of growers in workshops in to be held in Queensland and Northern New South Wales

These deliverables are addressed via the following:

- Task 1. Deliver and test the Grains BMP Climate Risk Module with 8 groups of growers at workshops in Qld and NSW
- Task 2. Evaluation of the content, process and outcomes from Grains BMP Climate Risk Module. This includes:
- Analysis of feedback data from workshops
 - Analysis of the on-line self-assessment data
 - Analysis of longitudinal data collected by follow-up interviews with workshop participants
- Task 3. Communication of results to industry and other stakeholders.
- Task 4. Discussion and Recommendations.

METHODS, RESULTS AND DISCUSSION

Task 1: Deliver and Test the Grains BMP Climate Risk Module with 8 Groups

The Grains BMP Climate workshops (see sample flyer in Appendix 1) were advertised by Agforce on 9 occasions and successfully delivered to remote parts of central and southern Queensland on 8 occasions in the period Sep 2011 to Feb 2012 with an average of 8 participants per workshop. Just one workshop was postponed (due to a funeral). This contrasts earlier workshops (Oct 2010 to Sep 2011) when it was necessary to postpone 75% of workshops due to lack of registrations. Earlier workshops were postponed at the last minute on 18 occasions due to lack of registrations (less than 3 participants) and required cancellation of travel arrangements, hire of computers, venues and catering. Most workshops were cancelled in Central Queensland (71%) with least in Southern Queensland (40%).

The total number of workshops advertised in the project was 33 with delivery on 14 occasions (see table 1). Highest attendance was in Southern Queensland (an average of 8 growers per workshop) and least in NSW (4 per workshop). Average attendance over all 14 workshops was 6 growers per workshop. Enquiries have revealed the following as the main reasons that prevented greater attendance.

- **Wet weather and High Work Loads.** Record levels of persistent wet weather in the northern grains region over a long period from July 2010 to March 2012 (Figure 1) which created floods, damage, havoc in agricultural operations and an extended period of exceptionally busy times for growers. There have been some drier periods, however, high levels of soil moisture have meant

continued busy times for growers. The wet weather has meant a significant increase in cropping frequency (jumping from 1 to 2 crops in 2 years during drought years prior to 2007 to 3 or 4 crops over the last 2 years). This has required more planting, spraying and harvest operations. Crops have taken longer to plant and required more sprays for weed control and pest management. Harvests have been delayed for months in many cases and often took longer because of large areas planted and high yields. Higher work-loads on machinery took more maintenance and flood damage needed repair. In the uncertain wet weather conditions growers were not able to effectively plan their time.

Table 1. Locations and dates of Grains BMP Climate workshops

| | Region | Location | Date | Attendance ** |
|--------------|---------------|-----------------|--------------|------------------------|
| 1 | South Qld | Pittsworth | 28 Sep 2010 | cancelled |
| 2 | | Kingaroy | 29 Sep 2010 | cancelled |
| 3 | | Glenmorgan | 1 Oct 2010 | 5 |
| 4 | NSW | Moree | 5 Oct 2010 | cancelled |
| 5 | | Walgett | 6 Oct 2010 | cancelled |
| 6 | Central Qld | Clermont | 18 Oct 2010 | cancelled |
| 7 | | Emerald | 19 Oct 2010 | cancelled |
| 8 | | Biloela | 21 Oct 2010 | cancelled |
| 9 | Central Qld | Clermont | 29 Mar2011 | cancelled |
| 10 | | Capella | 30 Mar2011 | cancelled |
| 11 | | Springsure | 31 Mar2011 | cancelled |
| 12 | NSW | Moree | 27 Apr 2011 | 3 |
| 13 | | Walgett | 28 Apr 2011 | cancelled |
| 14 | South Qld | Dalby | 3 May 2011 | cancelled |
| 15 | | Chinchilla | 4 May 2011 | cancelled |
| 16 | | Brookstead | 5 May 2011 | 6 |
| 17 | Central Qld | Middlemount | 10 May2011 | cancelled |
| 18 | | Biloela | 11 May2011 | cancelled |
| 19 | | Theodore | 12 May2011 | cancelled |
| 20 | | Capella | 16 May 2011 | cancelled |
| 21 | | Springsure | 17 May 2011 | cancelled |
| 22 | | Springsure | 19 July 2011 | 2 |
| 23 | | Capella | 20 July 2011 | 6 |
| 24 | South Qld | Goondiwindi | 26 July 2011 | 1 |
| 25 | NSW | Walgett | 31 Aug 2011 | 8 |
| 26 | | Narrabri | 1 Sep 2011 | 2 |
| 27 | Central Qld | Springsure | 8 Nov2011 | cancelled |
| 28 | | Clermont | 9 Nov 2011 | 8 |
| 29 | | Biloela | 10 Nov 2011 | 7 |
| 30 | South Qld | Jandowae | 29 Nov 2011 | 11 |
| 31 | | Jimbour | 30 Nov 2011 | 8 |
| 32 | | Talwood | 1 Dec 2011 | 15 |
| 33 | Central Qld | Emerald | 14 Feb 2012 | 5 |
| Total | | 33 | | 87 participants |

** 33 workshops were advertised, however, 19 were cancelled at the last minute due mainly to lack of registrations.

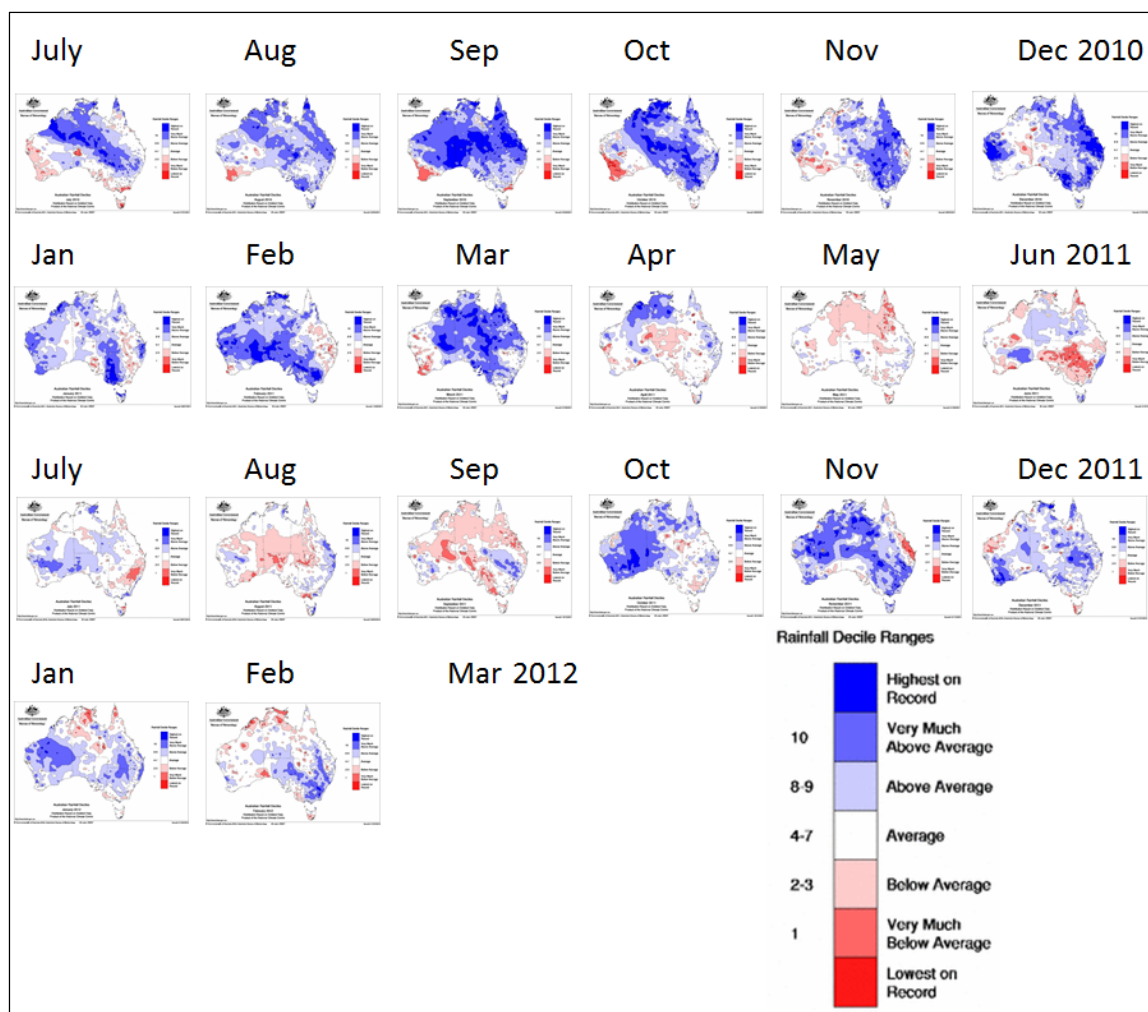


Figure 1. Deciles of Australian monthly rainfall for the period July 2010 to February 2012

- Other Priorities.** Other training needs and community actions often took priority. Flood damage recovery information and activity took priority for many growers as have relevant operational issues regards control of weeds and pests, and in particular the emerging problem of spray resistant fleebane and feather top Rhodes grass. Furthermore, heavy rains and flooding have led to low soil nitrogen levels and grain proteins and this has drawn considerable attention from growers as a key issue to solve. These specific and immediate issues have been the result of climatic impacts which have decreased the capacity of growers to develop a broader level of knowledge and skills about climate risks.
- Coal Seam Gas.** Concerns about the impact of mining for coal seam gas (CSG) on agricultural land have been a high priority for many growers. For example, on 19th July three people attended the Grains BMP climate workshop at Springsure whereas 80 people attended a neighbouring CSG meeting that was organised with just a few days of notice.
- Disenchantment with climate issues.** Political processes have divided the community in regard to actions that are needed to address climate change. This together with the run of good seasons has caused a rise in resistance to development of knowledge and skills to address climate issues.

Recommendation: Future projects should aim to hold climate related activities at times when climate risk is a central issue of importance (e.g. during dry spells) and to avoid times when growers have busy work-loads due to wetter conditions.

The Grains BMP climate workshops were facilitated by Dr Jeff Clewett and introduced where possible by local staff (Rebecca Byrne, District Agronomist, NSW I&I, Moree, Tim Weaver, District Agronomist, NSW DPI, Wee Waa, Vicki Horstman, Grains BMP Officer, CHRRUP, Emerald for workshops in the Central Highlands, Rod Collins and Hayley Eames (Qld DEEDI) at Biloela and Lisa Cleary (Brigalow Jimbour Floodplain Group) at Jandowae and Jimbour. Alan Rae (Agforce) coordinated activity at Talwood. The workshops were generally held from 8.30 am to 3.30 pm (except Jimbour 6.30 to 10.30 am) in a shire hall or similar venue and were delivered with the following content:

1. An introduction to the Grains BMP process and an overview of the four key areas of the climate module. This included an exercise for growers to identify their “high priority” practices for managing climate risk.
2. Opportunities for growers to:
 - (a) consider their current practices for managing climate risk in relation to industry standards
 - (b) identify action plans to improve their management of climate risk
 - (c) review the action plans developed during the course of the day including discussion on further use of the Grains BMP web site and future training
3. Presentations and discussion to develop knowledge and skills regards the Australian Standards on Risk Management (AS/NZS 31000:2009) and also science issues concerning use of short-term weather information, seasonal climate forecasts based on processes such as the El Nino Southern Oscillation and long-term climate change forecasts
4. Discussion of the workshop process and use of the workshop resources (booklets, computers and Grains BMP website) to provide information and record current practice and action plans. A kit of laptop computers was used in each workshop (one per person). This enabled growers to review their current practices and enter their action plans into PDF files that were later uploaded to the Grains BMP website.
5. Monitoring and review of the workshop content and process. This included a feedback questionnaire (see Appendix 4).

Details of the workshop program used by facilitators are in Appendix 3. Most participants used the laptop computers supplied to read the climate module content and to enter their action plans into the PDF documents. Some participants connected their own laptops to the Grains BMP website and a few others preferred to just use the workshop booklets.

Task 2: Evaluation of the Grains BMP Climate Risk Module.

Evaluation Methods

The content, process and outcomes of the Grains BMP Climate Module were evaluated by:

1. **Identifying grower perceptions of “high priority” practices** for managing climate risk. This was done as an “Top Ten” exercise at the start of workshops and participants were asked to: (a) consider each of the 4 key areas and 24 practices in the Grains BMP Climate Risk Module, and (b) identify which practices they considered to be high priority (participants had 10 votes each and had to allocate 2 votes to each key area plus an additional 2 votes to key area 3). The exercise provided a useful process for participants to gain an overview of the workshop content (see results in Table 8).
2. **Asking workshop participants to complete a feedback questionnaire** that considered workshop content and process, and importantly feedback on priority actions for managing climate risk (see Appendix 4 and further details below)
3. **Interviewing workshop participants** (including members of the Project’s Reference Panels) in a longitudinal study. Interviews with 20% of participants (7 growers in Central Queensland and 8 growers in Southern Queensland) occurred several months after the workshops and provided some opportunity to gain insights and assess practice change. This was mainly done as face to face interviews, however, where this was not possible some interviews were conducted by phone. The interview covered a range of topics and included the questionnaire in Appendix 5.
4. **Analysing data on the Grains BMP website** concerning the current practices that are being used by grain growers to manage climate risk. This was done at a regional level so that practices used by individual growers were not evident. The number of farmers that considered their current practice to be either below, at or above the minimum BMP standard for each of the 24 practices in the Grains BMP Climate Module were analysed (see results in Table 9).

Workshop participants were asked to complete parts of the feedback questionnaire at the start, during and at the close of workshops. There were three sections of the questionnaire:

- **Section 1** was completed on arrival and asked participants about how they had received information about the workshop, the importance of climate risk in cropping, how well climate risk was managed by industry, some important practices for managing climate risk and what they expected from the workshop.
- **Section 2** was designed to identify the “top ten” priority actions for managing climate risk and to provide feedback on the standards that had been specified by the project’s reference panels. This section rated the importance of practices concerning each of the 24 questions identified in the module, and by asking for opinions on whether or not the participants considered the standards specified for each practice were too low, about right or too high. This section also asked participants provide feedback on their priority actions for managing climate risks.
- **Section 3** was completed at the end of the workshop and asked participants for feedback on the quantity and quality of materials, information and processes, and their opinions on key learnings, future actions and methods for improvement.

Evaluation Results and Discussion

Results and discussion from the above “Top Ten” priorities, feedback questionnaire, interviews and on-line data are considered together in the following order:

- Numbers of participants and respondents
- Promotion and communications
- Importance and capacity for managing climate risk
- Feedback on the “minimum BMP standards” on practices for managing climate risk
- Current practice and priority actions - Key area 1: Linking climate and crop production
- Current practice and priority actions - Key area 2: Risk management
- Current practice and priority actions - Key area 3: Strategies for managing climate risks
- Current practice and priority actions - Key area 4: Management skills
- Feedback on content and process of workshop
- Feedback on key learnings from workshop
- Feedback from interviews

Number of Participants and Respondents

The total number of workshop attendees was 87 (an average of 6 per workshop) and the number of respondents to the workshop feedback questionnaire was 69. Numbers from Central Queensland, Southern Queensland and NSW were 20, 39 and 10 respectively. The number of enterprises with data contributing to the Grains BMP website for the Climate Risk Module was 74. Some contributors did not attend workshops but entered their enterprise details, current practices and actions directly onto the website. 15 participants were interviewed in the longitudinal study. The main reason for reducing the capacity of grain growers to attend workshops (20 were proposed with 15 participants/workshop) was increased workloads from prolonged wet weather, competing activities (e.g. flood, weed control, crop nutrition and coal seam gas workshops) and the politics of climate change (see details in Task 1).

Promotion and communications

In response to the first question in the feedback questionnaire “*How did you find out about today’s workshop*” the results in Table 2 show that:

- Personal phone calls and emails with a follow-up flyer were the most effective ways of communicating with growers and this view was subsequently supported in discussion with growers during the interviews (see details of communication methods in Task 3).
- The least effective method was through flyers in the post: just 11 people attended the workshops in response to the many thousands of flyers distributed via letter drops. Most growers attending could not recall seeing a flyer although in many cases it is likely that one was delivered to their household. Flyers sent by email distribution networks without a personal contact were not effective.
- No doubt many other growers heard about the workshops but chose not to attend because of other work pressures and commitments.

Importance and Capacity for managing Climate Risk

Management of climate risk in farming was rated as very important by the majority of workshop participants. When asked the question “***How important is the management of climate risk in farming***” 80 % said it was important and 57% indicating that it was very important (see Table 3). In contrast, Table 4 shows that only 5% indicated that the capacity of industry to manage climate risk was very good, however, 91% did indicate that they considered their capacity to be at least average.

Expectations for Workshop

The main expectation that people had in attending the workshop was firstly to gain a better understanding of weather and climate, and secondly to learn/discuss concepts on better ways to improve on-farm management practices (see Table 5). Few people attended the workshop expecting to spend a high proportion of the day in planning mode identifying actions to specifically improve their business.

Example comments were:

- *Gain an understanding of practices we can use to manage climate risk*
- *Management decisions regards SOI seasonal forecasts*
- *Practices to help minimise impact of climate change*
- *Tools and tips to make more informed decision making*
- *Gain some good ideas to improve management and financial position*
- *To improve profitability and sustainability*
- *Understand how climate change effects farming in CQ*
- *Better management of climate risk*

Feedback comments from participants in response to the question” ***In your view, what are two valuable and effective practices for managing climate risk***” were mostly in regard to tactical farming operations, climate information and forecasts (see Table 6). Typical comments were:

- *Risk assessment prior to planting*
- *Diversification*
- *Flexible farming system*
- *Zero till farming*
- *Record keeping and referring to records regularly*
- *Understanding weather, forecasts and prediction*
- *Understanding how weather changes*
- *Crop selection according to climatic conditions*
- *Forecasting*
- *Minimal till - stubble mulching*
- *Staggering planting dates*
- *Zero till and control traffic farming*
- *Flexibility with cropping program and management*
- *Having property in more than one location*
- *Financial investment elsewhere for income security*

Table 2: Workshop Feedback Data on Q1 - How did you find out about today's workshop? **

| | Flyer in Post | Email | Phonecall | Newspaper | Radio | Friends | Other | Total |
|------------|---------------|-------|-----------|-----------|-------|---------|-------|-------|
| Number | 11 | 34 | 19 | 3 | 0 | 4 | 2 | 73 |
| Percentage | 16% | 50% | 28% | 4% | 0% | 6% | 3% | 107% |

** Several participants identified more than 1 category and thus % adds to more than 100

Table 3: Workshop Feedback on Q2 - How Important is the Management of Climate Risk in Farming?

| | Not Important | Average | Very Important | Total | | |
|-----------------------|---------------|---------|----------------|-------|-----|------|
| Number of Respondents | 0 | 2 | 9 | 19 | 39 | 69 |
| % of Respondents | 0% | 3% | 13% | 28% | 57% | 100% |

Table 4: Workshop Feedback on Q3: How do you rate the capacity of your industry to manage the opportunities and challenges of climate risk

| | Poor | Average | Very Good | Total | | |
|-----------------------|------|---------|-----------|-------|----|------|
| Number of Respondents | 0 | 3 | 29 | 30 | 3 | 65 |
| % of Respondents | 0% | 5% | 45% | 46% | 5% | 100% |

Table 5: Workshop Feedback on Q4: What is the main thing you hope to achieve from the workshop today (with data categorised into 5 groups)

| Category | Number of Respondents | Percent of Respondents |
|--|-----------------------|------------------------|
| 1. Better understanding of weather and climate information/forecasts | 19 | 33% |
| 2. Improved practices for risk management | 7 | 12% |
| 3. Improved on-farm management practices (strategic or tactical) | 15 | 26% |
| 4. Improved financial management of climate risks | 4 | 7% |
| 5. Other, learning in general | 13 | 22% |
| Total | 58 | 100% |

Table 6: Workshop Feedback on Q5: In your view, what are two valuable and effective practices for managing climate risk

| Category | Number of Respondents | Percent of Respondents |
|---|-----------------------|------------------------|
| 1. Access historical records (climate/crop) and forecasts | 16 | 23% |
| 2. Planning, flexibility, diversify, assess risk | 12 | 17% |
| 3. Strategic farm setup (zero till, control traffic, machinery, land) | 11 | 16% |
| 4. Tactical Decisions (soil moisture, crop choice, variety, agronomy) | 27 | 39% |
| 5. Financial | 2 | 3% |
| Total | 68 | 99% |

Feedback on the Minimum Standards on Practices for Managing Climate Risk

In developing the Grains BMP Climate Module, considerable thought and discussion was directed towards identifying appropriate standards for each of the 24 questions in the module. During workshops participants were asked to give their opinion about what should be the minimum BMP standard for each of the key areas of the climate risk module and were asked to rate the minimum BMP standards as “too low”, “about right” or “too high”. Two thirds of workshop attendees (69%) considered the standards were “about right” when averaged across all questions, 11% identified the minimum BMP standards as a little low, 18% as a little high and 3% as too high (see Table 7). The break down across key areas was similar with the “about right” category ranging from 64% (Key area 2: Risk management) to 74 % (Key area 1: Linking climate and crop performance).

It was concluded that the standards identified were appropriate for on-going use regards climate risk management practices in the Northern Grains Region and therefore recommendations can be made to this effect. Discussion with several growers at the workshops and during the follow-up interviews concluded that the term “*benchmarks*” could also be used and in many situations preferable.

Recommendation: The standards for climate risk management practices that are specified in the Grains BMP Climate Risk Module be adopted for continuing use in the Northern Grains Region.

Recommendation: Extension programmes in the northern Grains Region adopt the standards specified in the Grains BMP Climate Risk Module as appropriate benchmarks for improving grains production practices.

Table 7. Workshop Feedback Data: Percentage of workshop participants that considered the *Minimum Industry Standards for the Grains BMP Climate Module* were too low, about right or too high for each key area of the module (65 participants responded to this question)

| | Minimum Industry Standard | | | | | Total |
|--|---------------------------|-------------|----------|-----|----|-------|
| | Too Low | About Right | Too High | | | |
| Key Area 1: Linking climate and crop production | 0% | 8% | 74% | 17% | 2% | 100% |
| Key Area 2: Risk management | 0% | 12% | 64% | 22% | 2% | 100% |
| Key Area 3: Strategies for managing climate risk | 0% | 12% | 65% | 19% | 4% | 100% |
| Key Area 4: Management skills | 0% | 12% | 72% | 12% | 4% | 100% |
| Mean | 0% | 11% | 69% | 18% | 3% | 100% |

Current Practice and Priority Actions - Key area 1: Linking Climate and Crop Production

The highest priorities identified by participants in key area 1 were in regards to developing better record keeping systems (62% of participants), and use of weather and short-term forecast information (52% of participants) (see Table 8). The area of least concern in taking action was in regard to forecasts of climate change (identified by 17% of participants as a priority). Growers usually support on-going research on long-term adaptations that may be needed for climate change but often reject immediate adoption of adaptation practices when expected impacts are beyond a short-term outlook.

Results from the Grains BMP website show that most people (60 to 81%) have assessed their current practices as at the minimum BMP standard in Key Area 1 (see Table 9) ranging from 60% for record

keeping to 81% for assessing historical weather records. A very high proportion of people (39%) did assess their record keeping as below standard. Some examples of priority actions identified by growers in the six practice areas were (grower comments in italics):

- | | |
|--|--|
| 1.1. Assessing local climate from historical weather records | <ul style="list-style-type: none"> • <i>Use climate tools (e.g. BoM website, Rainman) to better assess historical data</i> • <i>Use currently available tools more effectively</i> • <i>Use Rainman to analyse data</i> • <i>Look up Climate Kelpie</i> • <i>Assess records from neighbours</i> • <i>Start using Internet tools</i> |
| 1.2. Reviewing historical paddock and enterprise records | <ul style="list-style-type: none"> • <i>Record and analyse farming practices</i> • <i>Use new software to cross refer yields to weather events, Use tools such as Whopper cropper</i> • <i>Use Phoenix cropping, stock, mapping, financial, weather to analysis company</i> |
| 1.3. Recording weather events, paddock conditions and crop performance | <ul style="list-style-type: none"> • <i>Better systems in place to record data</i> • <i>Use electronic recording system</i> • <i>Keep written records as we go in tractor/spray rig</i> • <i>Establish a record keeping system for paddock history</i> • <i>Start historical record keeping</i> • <i>Include more data on paddock records eg production data and weather events.</i> |
| 1.4. Assessing current weather forecasts | <ul style="list-style-type: none"> • <i>Learn how to interpret weather charts for forecasting</i> • <i>Investigate websites on weather</i> • <i>Research more about weather systems and develop a better understanding of what they mean and the influence they'll have on our decisions.</i> |
| 1.5. Assessing short-term (10 day) and seasonal (2 to 4 months) climate and crop forecasts | <ul style="list-style-type: none"> • <i>Learn more about MJO, SOI and SST</i> • <i>Get better knowledge of indicators such as the MJO, SOI, ENSO wrap up and SSTs.</i> • <i>Use POAMA to gauge SSTs in central pacific and use this to predict rain coming months</i> • <i>Learn to use technology in paddock</i> • <i>link weather/climate data to crop production targets</i> |
| 1.6. Assessing long-range forecast information about climate change | <ul style="list-style-type: none"> • <i>Look to better understanding climate change information</i> • <i>Assess likely local impacts and effects on river and water allocation for irrigation</i> • <i>Become more familiar with information available especially specific to our district eg CSIRO reports</i> |

Recommendation: Extension processes need to target record keeping and practices to develop knowledge and skills regards weather information and seasonal forecasting targeted to regional grain-growing areas as high priorities.

Table 8. Percent participants that rated each practice as a high priority when allocating two votes per section (four votes in key area 3)

| Practice | Priority Rating (% participants) |
|--|--------------------------------------|
| Key Area 1: Linking Climate and Crop Performance | |
| 1.1. Assessing local climate from historical weather records to identify key climate risks and likelihoods | 22% |
| 1.2. Reviewing historical paddock and enterprise records of crop production | 49% |
| 1.3. Recording weather events, paddock conditions and crop performance | 59% |
| 1.4. Assessing forecast information: - current weather forecasts (e.g. use of BoM website) | 14% |
| 1.5. Assessing forecast information: - short-term (10 day) and seasonal climate forecasts (e.g. use of software) | 39% |
| 1.6. Assessing forecast information: - long-range forecast information about climate change | 18% |
| Key Area 2: Risk Management Practices and Processes | |
| 2.1. Over-all approach to risk management (e.g. using the principles & guidelines from the Australian Standards) | 16% |
| 2.2. Risk assessment methods (what can happen, likelihoods, impacts, consequences) | 73% |
| 2.3. Evaluating options and deciding on action plans | 95% |
| 2.4. Seasonal review and communication of climate risk | 16% |
| Key Area 3: Cropping Strategies for Managing the Following Climate Risks | |
| 3.1. "Perfect" weather for dryland grains production (practices that give high returns in "perfect" weather) | 44% |
| 3.2. (a) Low and variable rainfall: strategic improvements (e.g. investment in land, infrastructure, equipment) | 73% |
| (b) Low and variable rainfall: seasonal adjustments (e.g. crop choice, planting, spraying, nutrition decisions) | 83% |
| 3.3. (a) Severe and catastrophic events: business plans (e.g. diversifying to spread risk, financial arrangements) | 59% |
| (b) Severe and catastrophic events: maintaining your health (holidays, lifestyle, community engagement) | 42% |
| 3.4. Storms with high intensity rainfall causing runoff (e.g. contour banks, maintain surface cover, strip cropping) | 42% |
| 3.5. Excessively wet conditions with little runoff | 8% |
| 3.6. Hot or cold weather conditions including frosts and heat-wave | 44% |
| 3.7. Windy conditions (e.g. building insurance, spray decisions) | 4% |
| Key Area 4: Managerial Skills for Strategic & Tactical Management of Climate Risks | |
| 4.1. Education and training to develop management skills | 27% |
| 4.2. Periodic reviews of land capability and land use planning with change in climate/land condition | 41% |
| 4.3. Strategic management of resources: investment in land, machinery and infrastructure | 55% |
| 4.4. Tactical management of the cropping system: grain marketing (e.g. contracts, on-farm storage) | 55% |
| 4.5. Off-farm investment and use of skills (e.g. share/property investment, contract labour, professional services) | 22% |

Table 9. Percent of farmers that have self-assessed their current practice to be either below, at or above the minimum BMP standard for each practice in the Grains BMP Climate Module with the number of farmers in each practice shown as N (data from Grains BMP website data base)

| Practice | N | Below Std | Min Std | Above Std | Total |
|---|----|-----------|---------|-----------|-------|
| Key Area 1: Linking Climate and Crop Performance | | | | | |
| 1.1 Assessing local climate from historical weather records | 74 | 9 | 81 | 9 | 100 |
| 1.2 Reviewing historical paddock and enterprise records | 73 | 26 | 73 | 1 | 100 |
| 1.3 Recording weather events, paddock conditions and crop performance | 72 | 39 | 60 | 1 | 100 |
| 1.4 Assessing current weather forecasts | 68 | 10 | 78 | 12 | 100 |
| 1.5 Assessing short-term (10 day) and seasonal (2 to 4 months) climate and crop forecasts | 70 | 19 | 71 | 10 | 100 |
| 1.6 Assessing long-range forecast information about climate change | 67 | 18 | 76 | 6 | 100 |
| Key Area 2: Risk Management Practices and Processes | | | | | |
| 2.1 Over-all risk management practice | 65 | 48 | 52 | 0 | 100 |
| 2.2 Risk assessment | 52 | 31 | 69 | 0 | 100 |
| 2.3 Evaluating options and deciding on action plans | 50 | 20 | 80 | 0 | 100 |
| 2.4 Seasonal review of climate risk | 45 | 20 | 76 | 4 | 100 |
| Key Area 3: Cropping Strategies for Managing the Following Climate Risks | | | | | |
| 3.1 Managing 'perfect' weather for dryland grains production and care of environmental assets | 59 | 5 | 63 | 32 | 100 |
| 3.2a Managing low and variable rainfall: seasonal adjustments | 60 | 3 | 75 | 22 | 100 |
| 3.2b Managing low and variable rainfall: strategic improvements | 58 | 5 | 81 | 14 | 100 |
| 3.3a Managing severe and catastrophic events: business plans | 59 | 12 | 76 | 12 | 100 |
| 3.3b Managing severe and catastrophic events: maintaining your health | 54 | 6 | 83 | 11 | 100 |
| 3.4 Managing flood flows and storms with high intensity rainfall causing runoff | 44 | 5 | 70 | 25 | 100 |
| 3.5 Managing excessively wet conditions with little runoff | 44 | 11 | 64 | 25 | 100 |
| 3.6 Managing hot or cold weather conditions including frosts and heat-wave | 42 | 2 | 83 | 14 | 100 |
| 3.7 Managing windy conditions | 44 | 5 | 77 | 18 | 100 |
| Key Area 4: Managerial Skills for Strategic & Tactical Management of Climate Risks | | | | | |
| 4.1 Development of management skills | 54 | 15 | 81 | 4 | 100 |
| 4.2 Land capability and land use planning | 51 | 10 | 73 | 18 | 100 |
| 4.3 Strategic management of resources: investment in land, machinery and infrastructure | 52 | 13 | 69 | 17 | 100 |
| 4.4 Tactical management of the cropping system: grain marketing | 50 | 26 | 58 | 16 | 100 |
| 4.5 Off-farm investment and use of skills | 47 | 9 | 72 | 19 | 100 |
| Average | 56 | 15 | 73 | 12 | 100 |

Current Practice and Priority Actions - Key area 2: Risk Management.

Risk assessment and appropriate evaluation of options were the highest priorities for risk management identified by workshop participants during the “Top Ten” priorities exercise. However, analysis of current practices show that significant proportions of growers felt their current practice was below standard regards their overall approach to risk management (48% of growers) and risk assessment (31% of growers) (see Tables 8 and 9). This practice had the highest percentage of growers in the below standard and no-one assessed that they were in the above standard category. Thus, this is an obvious area where improvements can be made.

The highest priority for action was in developing an overall approach to risk management (identified by 63% of participants as a high priority) and often this was linked with business planning. Examples of priority actions identified by workshop participants in the four practice areas were:

- | | |
|--|---|
| 2.1. Over-all risk management practice | <ul style="list-style-type: none">• <i>Develop a risk management plan</i>• <i>Read more about the Australian Standards on Risk Management</i>• <i>Access Australian Standards data and implement strategies for our business</i>• <i>Undertake risk management to work out where to get most “bang for buck/time”</i>• <i>Incorporate climate risk into whole business planning</i> |
| 2.2. Risk assessment | <ul style="list-style-type: none">• <i>Take time to assess risks and develop strategies to overcome problems</i>• <i>Develop a risk register</i>• <i>Be mindful of effects of climate change</i>• <i>Look at scenarios good and bad</i>• <i>Identify climatic risks and access impact</i> |
| 2.3. Evaluating options and deciding on action plans | <ul style="list-style-type: none">• <i>Use a strategic whole farm approach which includes risk and action planning</i>• <i>Develop off farm options. Develop and record action plans</i>• <i>Look at whole-of-enterprise and off farm options of managing risk</i> |
| 2.4. Seasonal review of climate risk | <ul style="list-style-type: none">• <i>Talk more [to family members, consultants and peers]</i>• <i>Evaluate the results of risks taken</i>• <i>Review what the results were at the end of a season</i> |

Recommendation: It is recommended that extension processes should target risk management. A key part of the risk assessment approach is in assessing climate data to identify the likelihood of events. This could be how often a drought or flood might occur, or the frequency of planting opportunities, intense storms or severe frosts and heatwave. Most farmers recognise that climate change is having an effect on the likelihood of weather events. However, the impacts of climate change are uncertain and therefore the minimum industry standard for estimating likelihoods in risk assessment is *“The likelihood of events is based on historical weather records that are being continually updated.”* In contrast, the requirement for practice in the above standard category is *“Effects of climate change are also considered in assessing risk”*.

Current Practice and Priority Actions - Key Area 3: Strategies for Managing Climate Risks

All of the risks identified in key area 3 are of significant importance to the grains industry and are a focus of investment by grain growers and RD&E programs.

Most growers considered their current agronomic practices for managing climate risk were either above the minimum BMP standard (19% of growers at best management practice) or at the industry minimum BMP standard (75% of growers), The exception was in business planning for catastrophic events with 12% assessing they were below standard. Overall, the above ratings are at a higher level than the other key areas.

The two risks that were of highest priority to grain growers were: (1) managing low and variable rainfall, and (2) managing the impacts of catastrophic events such as prolonged severe drought, major floods and extreme out-of-season frost. Low and variable rainfall was assessed as a high priority risk by 76% of growers and catastrophic events by 68% of growers. These two risks were also identified as priority areas for taking further management actions to improve the enterprise.

A high proportion of growers (>20%) considered their current practices to meet the criteria for “above the minimum BMP standard” in regard to practices 3.1 (managing perfect weather for grains production), 3.2 (managing low and variable rainfall), 3.4 (managing flood flows and high intensity storms) and 3.5 (managing excessively wet conditions).

Importantly, and in regard to the management of catastrophic events, only 6% of growers felt they were below standard in their approach to managing their health.

Wet conditions and windy weather can be disruptive to farming practices. While these two risks were rated as a high priority by a few participants, most farmers considered their current management of these risks to be adequate.

The seven climate risks considered in the module and examples of priority actions to address these risks by workshop participants were:

- | | |
|---|--|
| 3.1. Managing ‘perfect’ weather for dryland grains production and care of environmental assets | <ul style="list-style-type: none">● <i>Maintain gear for when the opportunity comes</i>● <i>Make better use of SOI and other climate tools</i>● <i>Identifying the optimum inputs for the best yields</i>● <i>Further improve cropping frequency</i>● <i>Double crop when soil moisture is available.</i>● <i>Invest in technology to improve farming practices</i>● <i>More flexible operations to maximize profits</i> |
| 3.2. Managing low and variable rainfall: (a) strategic improvements, and (b) seasonal adjustments | <ul style="list-style-type: none">● <i>Invest in land and equipment, diversify income</i>● <i>Having equipment to best utilise the weather conditions (zero till, control traffic)</i>● <i>Investment in moisture seeking and variable rate application equipment</i>● <i>Choose crop type/variety carefully, timely planting</i>● <i>Adjust planting rates, row spacing, planting depth</i>● <i>Don't plant a crop on low sub moisture unless big rains are forecast</i> |

- | | |
|---|---|
| 3.3. Managing severe and catastrophic events: (a) business plans, and (b) maintaining your health | <ul style="list-style-type: none"> • <i>Diversify (cattle, off-farm investments)</i> • <i>Spread risk planting dates, crop types and varieties</i> • <i>Diversify so we can maintain income in tougher years</i> • <i>Compare event to other events in history</i> • <i>Develop strategies for recovery</i> • <i>Analyse return on capital and equity growth and better farm management software</i> • <i>Improve communication, develop social networks</i> • <i>Maintain healthy lifestyle, have a holiday</i> • <i>Use consultants to reduce workload</i> |
| 3.4. Managing flood flows and storms with high intensity rainfall causing runoff | <ul style="list-style-type: none"> • <i>Retain stubble to slow down water flow</i> • <i>Ensure strip crops, contours and diversion banks are right to reduce the risk of erosion</i> |
| 3.5. Managing excessively wet conditions with little runoff | <ul style="list-style-type: none"> • <i>Capacity to spray farm within 10 days</i> • <i>Earthworks for low areas, gravel for roads</i> • <i>Keep stock off cropping country in wet periods</i> |
| 3.6. Managing hot or cold weather conditions including frosts and heat-wave | <ul style="list-style-type: none"> • <i>Manage planting windows</i> • <i>Stagger plantings and varieties</i> • <i>Balance risks of frost and dry finish</i> • <i>Look into viable crop options for frost resistance</i> |
| 3.7. Managing windy conditions | <ul style="list-style-type: none"> • <i>Watching spray drift and only spraying in safe conditions</i> • <i>Ensure stubble retained</i> • <i>Document risks /strengths of infrastructure</i> • <i>Replace roof nails with screws, plant tree lines</i> |

Recommendation: Catastrophic events were previously noted as priority risks that require high levels of skill in business management and maintaining health to financially and mentally cope with severe drought, flood and other extreme events. The results above and discussions during the workshops and in the longitudinal study interviews identified business/health management skills as areas that could be improved. Thus it is recommended that extension and training programs should give priority to developing business and life skills to cope with catastrophic events.

Current Practice and Priority Actions - Key Area 4: Management Skills

Strategic management of resources (such as investment in land, machinery and infrastructure) was seen as the highest priority (59% of participants). The four other practices in this key area were rated equally in terms of importance (see Table 8).

The ratings on current practices in key area 3 were similar to the other key areas with about 70% of growers assessing their current practice as at the minimum BMP standard. However, the exception was grain marketing as a hedge in managing climate risk. In this case, a fairly high proportion of growers considered they were below the minimum BMP standard (26%), and also a high proportion considered they were above the minimum BMP standard (16%) (see Table 9).

Feedback from workshops gave the following as priority actions:

- | | |
|--|--|
| 4.1. Development of management skills | <ul style="list-style-type: none">• <i>Training to develop management skills</i>• <i>Regional benchmarking with fellow producers</i>• <i>Get a deeper knowledge of climate change</i>• <i>Gain better knowledge of weather systems and seasonal forecasts</i>• <i>Workshop re property analysis and cropping gross margins</i> |
| 4.2. Land capability and land use planning | <ul style="list-style-type: none">• <i>Review land use planning with change in climate</i>• <i>Adjust cropping country to appropriate land use where needed</i> |
| 4.3. Strategic management of resources: investment in land, machinery and infrastructure | <ul style="list-style-type: none">• <i>Build machinery base</i>• <i>Control traffic farming for headers</i>• <i>Investigate investment in on farm storage, and grain drying and cleaning ability</i> |
| 4.4. Tactical management of the cropping system: grain marketing | <ul style="list-style-type: none">• <i>Further education and training on marketing and risk management</i>• <i>Proactively manage grain marketing</i> |
| 4.5. Off-farm investment and use of skills | <ul style="list-style-type: none">• <i>Maintain off-farm skills and increase experience</i>• <i>Continue to develop all off-farm income opportunities, gravel, properties, shares</i>• <i>look into alternative investment opportunities – determine thresholds</i> |

Feedback on Content and Process of Workshop

The content and processes used in the workshop were considered to be good or very good by the majority of respondents (>80%). For example over 80% of respondents said the presentation of materials, booklet and opportunity to participate were in this category, and more than two thirds of participants indicated that the workshop was a useful investment of their time and contributed to sustainability and profitability. Similarly, more than two thirds of respondents indicated that they were: (a) likely to follow through with the Climate module by reviewing their action plan on the Grains BMP website, and (b) that they would like to keep in contact with the Grains BMP Program. The proportion was slightly higher in Central Queensland where people were more familiar with the Grains BMP process.

Further training regards climate risk was considered favourably by most participants. However, about one third of participants indicated they were not so interested and this minority proportion is consistent with the number of participants not accepting climate change concepts. One third of participants did not accept the science of climate change and disagreed with the following statements (see Table 10):

- Increasing levels of green-house gases will lead to a warmer planet
- A good capacity to manage climate variability will give resilience for managing climate change
- Emphasis in the workshop on climate change was about right.

The above finding is consistent with results from other studies.

Recommendations:

The Climate Module should be retained on the Grains BMP website and grain growers should be encouraged through media and newsletter communications to use the website as a mechanism for improving management of climate risk.

There is a clear need to continue programs to address perceptions about global warming and climate change.

Table 10. Feedback on content and process of workshops (percentage of participants)

| | N | Rating | | | | | Total |
|--|----|----------|-------|---------|------|-----------|-------|
| | | Poor | Fair | Average | Good | Very Good | |
| • Presentation of materials | 65 | 0% | 18% | 0% | 49% | 32% | 100% |
| • Grains BMP Initiative & Booklet | 61 | 0% | 16% | 0% | 56% | 28% | 100% |
| • Use of Laptops | 63 | 0% | 21% | 6% | 41% | 32% | 100% |
| • Opportunity to participate, reflect/share | 62 | 0% | 5% | 2% | 37% | 56% | 100% |
| • Meeting as investment of tax funds | 64 | 0% | 19% | 6% | 41% | 34% | 100% |
| • Meeting as investment of my time | 64 | 0% | 27% | 9% | 36% | 28% | 100% |
| • Contribution towards Sustainability | 59 | 0% | 25% | 3% | 47% | 24% | 100% |
| • Contribution towards Profits | 60 | 0% | 28% | 5% | 43% | 23% | 100% |
| | | Disagree | | Maybe | | Agree | |
| • Increasing levels of Green House Gases will lead to a warmer planet | 62 | 8% | 34% | 5% | 35% | 18% | 100% |
| • Good capacity to manage climate variability will give resilience for managing climate change | 62 | 0% | 32% | 3% | 37% | 27% | 100% |
| • Emphasis in the workshop on climate change was about right | 62 | 2% | 26% | 6% | 45% | 21% | 100% |
| | | No | Maybe | | Yes | | |
| • Will you review your action plan on www.grainsbmp.com.au | 59 | 3% | 31% | 5% | 34% | 27% | 100% |
| • Would you like to keep in contact with Grains BMP program | 61 | 3% | 26% | 7% | 20% | 44% | 100% |
| • Would further workshops on climate risk be useful | 58 | 3% | 34% | 16% | 21% | 26% | 100% |

Feedback on Key Learnings from Workshops

Risk management was nominated by the most participants (28%) as the key learning outcome from the workshop when asked the question “*are there concepts/practices/learning from the meeting that you will use in your current work?*” Responses from participants included:

- *Better risk management practices*
- *Use of the Australian Standards on risk management*
- *Need to look at risk in a more structured manner*
- *Need to look at a number of scenarios*
- *Risk assessment*
- *Formalisation of risk strategies*
- *Risk management - see if my consultant can do*

Other subjects most frequently nominated (and examples of participant comments) were:

1. Weather and climate forecasts
 - *Awareness of more weather climate web sites*
 - *The ocean models that drive our climate*
 - *SOI/MJO information*
 - *Better understanding of climate change concepts*
2. Record keeping
 - *Importance of keeping records and then reviewing them against climate records*
 - *Maintain better records*
 - *Increase recording of farm data into analysed systems*
 - *Update records in the tractor cab office*
3. Crop management practices
 - *Being more prepared for opportunity*
 - *Improving rainfall efficiency*
 - *Importance of zero till and controlled traffic farming*
 - *Updating machinery to lower risk*
 - *Try and spread and slow water flows*
 - *Importance of diversity and enterprise mix*
4. Other
 - *Diversity of income to build resilience*
 - *Off farm investments*
 - *Make better use of web sites*

Some general comments made by participants that may be considered as strengths and limitations were:

- *Felt it touched on a lot of subjects but only briefly, maybe fewer topics to cover would be better in the future, more in depth information*
- *The discussion between farmers was very good and opened your eye to different thoughts and views*
- *Not all aspects of global warming were explored*
- *This information is heavy going for someone who has not been following climate change*
- *I probably would like to have done the full workshop, will do next time, good start*
- *Too much to fit in 10 -5:30 workshop!*
- *Overall a good workshop - informative inclusive and interesting*

- *Need areas in booklet for notes beside the written format already there*
- *Consider webinars as another delivery option. We are finding locally that it is harder and harder to get the number at workshops and people are asking for more flexible options*
- *Introduction was a little bit long but good content, I found it useful*
- *Thank you very much was very informative*
- *Well presented*
- *Meeting was interesting and informative*
- *More ideas for reducing risk need to be presented*
- *Have free copies of software for people to take home e.g. Rainman, How Wet, How Often*
- *Course was also useful for livestock operations*
- *Email some templates for risk management and any other templates that might be helpful*

Feedback from Interviews

The important issues raised during the workshops were again raised by grain growers in the longitudinal interviews that were held several months after the workshops.

Effective approaches or “*tools to help with risk management*” was the most frequent category of comment expressed during the interviews. This often led to discussion about various aspects of risk assessment and evaluation, and the principles and guidelines of the Australian Standards on Risk Management. 40% of people interviewed said they had taken steps to improve risk management. Typical comments were:

- *Identify high risks and avoid to maximise outcomes*
- *Identify risks and plan how to mitigate*
- *Become more resilient, better prepared.*

The importance of good record keeping as an aid to improved risk management was frequently raised as a conclusion from the workshop. Ten of the 15 people interviewed said they had improved their record keeping as a result of the workshops. Use of smart phone applications for record keeping and references to making the tractor cab “*a better office*” was discussed during the workshops and during the interviews.

Use of weather and climate forecasts was another prominent conclusion that participants had from the workshop and 80% of those interviewed said they had improved their use of the internet to access weather and climate forecast information. The emphasis was equally on weather information and seasonal forecast information, and was mainly in regard to use of the Bureau of Meteorology website. Accessing further information about climate change was not a priority of those interviewed and several were still sceptical. However, most had their “*ears open*” in regards to new climate change information.

Half of those interviewed had read through the workshop booklet after the workshop and several had discussed the workshop with others. Most people were planning to use the Grains BMP website when they had some “*spare time*”, however, at the time of the interview only a few people had used the website to further develop action plans. Many found the log-on procedure difficult.

The Grains BMP Climate Module was considered to be larger and more complex when compared with other modules in the Grains BMP program. This point of view was given by the majority of growers from

Central Queensland that had also done other modules, and was because the subject matter in the Climate Module covered many aspects of farm management.

Although the last two summers have been relatively “wet”, grain growers still emphasised the importance of “*managing the drier years*” and that the “*biggest parameters are what water is available and what seasonal conditions are likely.*” Typical answers to the question “*please describe how you are seeking to improve climate risk management*” were similar to those discussed at the workshop and included:

- *Maintain stubble cover*
- *Zero till and control traffic farming*
- *Achieve high cropping frequency*
- *Diversify, off-farm investment to lessen financial risks of climate impacts*
- *Continue learning*
- *Achieve a healthy work-life balance.*

Task 3: Communications to Industry and Stakeholders

Project results and information about the Grains BMP Climate Risk Module were communicated to industry and other stakeholders at multiple levels as follows.

Direct contact with growers (letter drops, newsletters, radio, emails and phone calls). The main contact with growers was via letter drops through local post offices and via the Agforce Newsletter. Radio advertising was used for the Feb 2012 workshop. Communication to growers via personal phone calls and email occurred to a limited extent in milestone 3 and this was lifted to a more vigorous level in Milestone 4. Project staff and local champions played a key role in this activity. Communications in Central Queensland were assisted by a network of field staff making phone calls to growers (particularly through the Central Highlands Regional Resources Use Planning Cooperative and the Queensland Government via DEEDI). Communication in Southern Queensland was greatly assisted by the Brigalow Jimbour Floodplain Group with activities including a full page newsletter promotion sent to 800 people. On several occasions email networks were also used (e.g. Walgett and Narrabri workshops) and local assistance and promotions by the NSW Dept of Primary Industries was greatly appreciated. A local grower played a key role for the Talwood workshop (15 attended). The flyers (see example Appendix 1) were delivered for each workshop location via neighbouring post offices (e.g. 781 flyers were distributed for the Springsure/Capella workshops in July 2011 and typically 300 to 400 flyers were distributed per event). A total of 33 workshops were advertised and 14 were delivered with 87 grain growers attending (Table 1).

Media Contact through newsletters and newspapers. Several media releases to newspapers have occurred to promote the workshops (see example in Appendix 2). These media releases were published in rural newspapers such as the Queensland Country Life, The Land and other more local outlets.

Recommendation It is recommended that media communications continue into the future with a focus on disseminating results from the project. In particular these communications should:

- Encourage growers to improve their management of climate risk
- Use /apply the standards identified in the module as specific examples of how this can be achieved
- Focus the timing of communications to when growers are receptive to climate risk issues.

Website communication and contact with industry. The Grains BMP website (www.grainsbmp.com.au) contains general information about the Grains BMP program and more specifically on the “Managing Climate Risk” module. This website is maintained by Agforce and grain growers can use the website to complete Grains BMP Climate Module. This includes all aspects of the activity used in the workshops to (a) define current practices in relation practices that are below, at or above the minimum industry, and (b) identify action plans to improve practices for managing climate risk. In addition the website can be continually updated as action plans are reviewed and improved. In this sense the website provides an excellent and confidential planning tool for growers to upgrade their management of climate risk (and the other areas farm management on the website such as crop nutrition, farm layout and design). The current number of enterprises with climate data and action plans on the website is 74.

Continuing Communications via FarmReady Courses. The Grains BMP Climate Module has been registered as an approved FarmReady Course so that there is an on-going pathway for the delivery of the module after this project concludes. Although the current FarmReady concludes in June 2012 it is possible that similar opportunities for on-going delivery of climate materials to the agriculture sector will continue in some other form. Principles were developed for preparation of the application and were:

1. Agforce would encourage other training organisations to submit courses to FarmReady for approval so that there are several avenues for the module to be delivered
2. Agforce would authorise other organisations to use the materials developed in this project
3. Agforce would maintain the Grains BMP website and would retain copy right on the data on the Grains BMP website.

An application to FarmReady was prepared by the author of this report (Dr Jeff Clewett) on behalf of Agroclim Australia to deliver the course “*Managing Climate Risk (Opportunities and Challenges)*” Delivery of the module by Agroclim will provide continuity in the delivery of workshops and the same workshop training materials (booklets, PDFs, PowerPoint Slides) will be used. Farmers completing the module via Agroclim workshops will be able to access the Grains BMP website maintained by Agforce.

Recommendation: Agforce should continue to encourage other training organisations to develop training courses and use of the training materials developed from this project (booklet, PDF of module, video) should be made available to those organisations so that the opportunity for continuing delivery is maintained.

Communication via Video. A short video entitled “Grains BMP Managing Climate Risk Webinar” has been produced for use by grain growers and can be downloaded from the Grains BMP website (www.grainsbmp.com.au). The main objective was to reproduce the content of the Grains BMP Climate Risk Module so grain growers can:

- (a) View the key points of the module (either as a preview of a FarmReady workshop to be held in the future, or as an introduction to completing the module on-line without attending a workshop)
- (b) Improve their knowledge and skills and hence management of climate risk
- (c) Improve the profitability, sustainability and well-being of their grain production enterprises.

The content of the one-hour video includes the introductory comments and PowerPoint slides used in the workshop to introduce the central concepts of the Grains BMP Climate Module and each of the Key Areas

and high priority practices. The video also contains commentary from producers attending the Jandowae workshop in November 2011.

Contact with regional colleagues: The Grains BMP Climate module has been promoted to professional colleagues in Central Queensland, Southern Queensland and Northern NSW via email and phone calls. The three professional development workshops for the module (Train the Trainer workshops) was the focus of this activity. These one-day workshops reviewed the Grains BMP Climate Module and related regional activities. They were held in Emerald, Toowoomba and Narrabri, were facilitated by Dr Jeff Clewett and were attended by 27 consultants, researchers and extension officers. The main outcome was increased knowledge and skills to deliver of programs aiming to improve the management of climate risk.

Publication in science media: Three papers have been presented at national and international conferences (a fourth paper has been accepted for oral presentation) to gain peer review. They have successfully promoted the Grains BMP climate module process and activity in both scientific and industry circles. Positive feedback from these activities has been received. The four papers are:

Clewett JF, George D and Murray N (2012 accepted). Priorities for Managing Climate Risk and Adaptation in the Northern Grains Region. Climate Change Adaptation Conf., NCCARF, Melbourne, June 2012. (see abstract in Appendix 6). Key messages from this paper are below.

Clewett JF, Murray N, Collins R and Hickey D (2011). *Grains Best Management Practice for Managing Climate Opportunities and Threats*. Proc. Climate Change Research Strategy for Primary Industries Conference, NCCARF, Melbourne, Feb 2011.

Clewett JF (2010). *Climate Change: Implications for Summer Cropping in Australia*. Proc. First Australian Summer Grains Conf., Gold Coast, June 2010. This paper highlighted grain industry issues regards climate change and progress in developing the Grains BMP module.

Clewett JF, Huggins JA, Murray N, Collins and Hickey D (2010) *Grains Best Management Practice for Managing Climate Variability and Climate Change*. Climate Change Adaptation Conf., NCCARF, Gold Coast, June 2010

Task 4: Discussion and Recommendations

The project has involved a significant number of growers, advisors and consultants from the Northern Grains Region through a range of reference panel meetings, workshops and interviews. This has provided a firm base to make a series of conclusions and recommendations in regard to:

- Acceptance of standards in Grains BMP Climate Risk Module
- Future extension processes
- Key messages for communication to industry
- Upgrading of other Grains BMP modules in relation to climate risks.

Recommendations on Acceptance of Standards in Grains BMP Climate Risk Module

It is recommended that the standards for climate risk management practices that are specified in the Grains BMP Climate Risk Module be adopted by the grains industry for continuing use in the Northern Grains Region. These standards were identified by industry based Reference Panels and were accepted by the majority of growers at workshops. Growers should be encouraged to at least achieve the minimum BMP standard and preferably to achieve above standard practices for managing climate risk. The minimum BMP standards are as follows (high priority areas are marked with **).

Key Area 1: Linking Climate and Crop Performance

- 2.2. **Assessing local climate.** Long-term weather records are available and can be analysed to assess key features of the local climate.
- 2.3. **Reviewing historical paddock and enterprise records.** Historical records of farming methods, crop production and the environment are available for comparing with local weather records
- 2.4. **Record Keeping .**** Observations are routinely recorded including weather events, paddock conditions and crop performance
- 2.5. **Weather Forecasts.**** The business has a broad understanding of regional weather systems, local conditions and weather forecasts for use in decision making.
- 2.6. **Seasonal Forecasts.**** A proactive approach is used to gain a better understanding of short-term and seasonal climate and crop forecasts, especially for those times when forecast indicators (such as the MJO, SOI and SST) have value in decision making and when they don't.
- 2.7. **Long-term Climate Change Forecasts.** The business has a broad understanding of concerns about global warming, climate change and the expected impacts on the environment and agriculture in the Australian region.

Key Area 2: Risk Management

- 3.1. **Overall Approach.**** A proactive approach is being taken to developing a plan for managing climate risk that is consistent with the Australian Standards on Risk Management.
- 3.2. **Risk Assessment.** Climate risks are prioritised in terms of their likelihood and expected impact on key elements of the enterprise. The likelihood of events is based on historical weather records that are being continually updated.
- 3.3. **Evaluating Options and Action Plans.** Options and likely outcomes have been evaluated, and actions are now being progressed to address the main climate risks for the enterprise.
- 3.4. **Seasonal Review and Communications.** Seasonal changes in climate risk and the practices that need to be seasonally adjusted are regularly reviewed and discussed with other members of the business.

Key Area 3: Strategies for Managing Climate Risks.

- 4.1. **"Perfect" weather for dryland grains production.** The farming system is managed to increase both the frequency and productivity of crops during "good" season opportunities.
- 4.2. **Low and variable rainfall.****
 - (a) Progress towards strategic improvements to the cropping system are being implemented so that the business is more resilient and maintains productive capacity over a wide range of seasonal conditions.
 - (b) Seasonal adjustment of planting operations to optimise water use efficiency is a priority. Several risk management practices are seasonally adjusted to reduce climate threats and increase opportunities.
- 4.3. **Severe and catastrophic events. ****
 - (a) The business has a robust plan which includes several strategies to prepare for, manage and recover from severe and catastrophic events such as crop failures, extended drought and severe floods.
 - (b) Good communications and maintaining a healthy lifestyle (including items such as holidays and community engagement) are recognised as priorities to achieve greater resilience and capacity to manage adversity.

- 4.4. **Storms with high intensity rainfall causing runoff.** Plans are being implemented to reduce the risk of erosion from flood flows and high intensity storms by: (a) avoiding crop production on highly erodible land, (b) adopting farming practices that maintain cover, maximize infiltration and safely remove runoff.
- 4.5. **Excessively wet conditions with little runoff.** Several risk management practices such as use of forecasts and controlled traffic farming are being implemented to provide resilience in maintaining productive capacity in wet conditions.
- 4.6. **Managing hot or cold weather conditions.** Crop choice, varieties and planting windows are adjusted each season to reduce the threat of temperature extremes to farming objectives. The incidence of frost, cold weather, hot-dry weather and heatwaves are taken into account.
- 4.7. **Managing windy conditions.** Threats from wind are being managed to minimise: (a) the opportunity for spray drift, (b) the chance of soil erosion, (c) the likelihood of lodging losses, and (d) the consequence of wild storms on infrastructure.

Key Area 4: Managerial skills.

- 2.1. **Education and training to develop management skills** A proactive approach is used to develop knowledge and skills of weather systems, climate variability and climate change for both strategic and tactical management of climate risk at paddock, whole-farm and off-farm levels.
- 2.2. **Land capability and land use planning.** The influence of climate risk (determined from historical weather records) on land capability is continually reassessed, and changing land use is considered as an option to overcome changes in climate risk.
- 2.3. **Strategic management of resources.**** Investments in land, machinery and infrastructure to achieve better management of climate risk are proactive, on-going and place priority on maintaining cover, infiltration of rainfall, carbon efficiency, safe removal of runoff, grain storage and diversification.
- 2.4. **Tactical management of crops.**** Seasonal adjustment of cropping practice includes proactive management of grain marketing as a hedge in managing climate risk.
- 2.5. **Off-farm investment and use of skills.** Opportunities for off-farm investment and/or application of skills are periodically considered as a hedge to managing climate risk.

Recommendations on Communication and Extension Processes

Grain growers are mainly concerned with short-term decisions of one to ten seasons and are seeking practical, robust and flexible approaches to manage climate risks. Research on ways that will be eventually needed for adapting to longer-term climate risks such as climate change are supported by most growers.

In this environment the assessment of climate risk should be based on analysis of the climate variability evident in continuously updated historical weather data as a first priority. This method recognises the uncertainty of climate change projections, the difficulty of perceiving change, the need for grain growers to have a simple practical method for assessing risks and is supported by scientific reviews (Stokes and Howden 2010, Clewett 2010). Continual refinement of decisions with continuously updated weather data provides the mechanism needed for climate change adaptation. This approach of continual refinement can accommodate both incremental change in management practices (e.g. updating planting windows or crop choice) and also trigger transformational change such as changing land use to pastures. Marginal lands for grain crops should be (and generally are) under continual review for appropriate land use.

The Climate Module should be retained on the Grains BMP website and grain growers should be encouraged through media and newsletter communications to use the website as a mechanism for improving their management of climate risk.

Agforce should continue to encourage other training organisations to develop training courses and the training materials from this project (booklet, PDF of module, video) should be made available to those organisations so that the opportunity for continuing delivery is maintained.

There is a significant opportunity to use the materials developed in this project in formal training programs which are provided by Registered Training Organisations (e.g. Agforce, University of Queensland). In particular the content and materials of the Grains BMP Climate Module complement the *ClimEd* Training materials developed by the Queensland Government and Agforce (George et al. 2004) and can be mapped to the Unit of Competency "AHCAGB501A (formerly RTE 5523A) Developing Climate Risk Management Strategies" (George et al 2007a). This may be an attractive option to many existing people in the grains industry and also to those contemplating a career in agriculture.

Media communications should continue into the future with a focus on disseminating results from the project. In particular these communications should:

- Encourage growers to improve their management of climate risk
- Use the standards identified in the module as specific examples of how this can be achieved
- Focus the timing of communications to when growers are receptive to climate risk issues.

Future extension processes in the Northern Grains Region should:

- Adopt the standards specified in the Grains BMP Climate Risk Module as appropriate benchmarks for improving grain production practices.
- Target risk management , record keeping, business management and practices to develop knowledge and skills regards weather information and climate forecasts as high priorities
- Focus attention across all of the major climate risks and recognise that growers place most emphasis on catastrophic events and low and variable rainfall
- Aim to hold climate related activities at times when climate risk is a central issue of importance (e.g. during dry spells) and to avoid times when growers have busy work-loads due to wetter conditions.
- Recognise personal contact as the primary way to open communication with potential participants.

Key messages for Communication to Industry

The recommendations above and the following are some key messages from the project for continuing communications with industry. In addition, the quotes from grain growers provide succinct and relevant key messages.

Variable weather patterns are a great challenge to sustainable and profitable grain farming in the Northern Grains Region.

Managing climate risk is about effective management of seasonal conditions. It aims to increase the chance for grain growers to maximise opportunities, reduce threats and overcome challenges.

Developing management skills to address strategic and tactical operations at paddock, whole-farm and off-farm levels is a key part of managing climate risk. Similarly, making best use of historical weather records and skills to assess current weather patterns, seasonal forecasts and long-range climate change forecasts are important.

The most important climate risks to manage as perceived by grain farmers are low and variable rainfall, and catastrophic events such as drought, intense storms, flood and unseasonal severe frost. Managing opportunities such as the perfect weather for grain production and other risks such as heat waves, windy conditions wet weather impacts on pests and pathogens can be important. This finding supports previous work in this field (Stokes and Howden, 2010; George et al. 2007b).

Global warming and climate change are likely to have significant long-term impacts on the Northern Grains Industry that are likely to be most felt through the jolts of extreme events such as drought, flood, and heatwave rather than smooth transitions that can be difficult to perceive.

Best practices for managing climate risk in grain production should focus on managing the climate variability evident in continuously updated historical weather and climate data. Continual refinement of decisions with continuously up-dated weather data provides the mechanism needed for climate change adaptation. Growers usually support on-going research on long-term adaptations that may be needed for climate change but often reject immediate adoption of adaptation practices when expected impacts are beyond a short-term outlook.

Priorities for management include use of a robust risk management framework and process. Similarly, a healthy lifestyle to mitigate climate stresses, business planning and skills in using weather/climate forecasts are important. On-farm priorities are strategic investments in machinery (such as zero till, controlled traffic and effective planting equipment), seasonal adjustments to agronomic practices, maintaining natural resources, diversification and periodic reviews of changes in climate on land capability. Off-farm investments and activities can be an important hedge in managing climate risk.

Research development and extension programs should accelerate and incentivise the focus on developing and promoting robust, flexible management systems for managing the variability of seasonal conditions as the key approach for adaptation to climate change.

Recommendations to update other modules in the Grains BMP Package

The following recommendations are made on ways to update the first five modules of the existing Grains BMP package so that they are consistent with the concepts and content of the “Managing Climate Risk” module.

Recommendations to Update Grains BMP Module 1: Property design and layout

Recommendations are proposed for the following key areas of this module.

Key Area 1: Mapping and Use of Maps. Add the following to the preamble where the list of uses for the base map is discussed “*Define areas of paddock that are prone to climate risks such as frost, water-logging, flood or erosion damage from storms with high intensity rainfall*”

Key Area 2: Land Capability Assessment. Add the words “*climate risk*” to the minimum standard so that it reads “*Land capability for grain production has been assessed (considering climate risk, soil type, slope,*

.....)” and also add the words “including possible impacts of climate change” to the above standard so that it reads “Impacts of land capability and/or suitability assessment for grain production is understood including potential impacts of climate change, and has been

Key Area 3: Farm design and paddock layout. Add the following to the preamble where issues to consider are listed: “Use of ley pasture systems to maintain soil health by building soil organic matter and enhancing soil structure.”

Key Area 3: Topography and drainage. Add the words “at an acceptable level of climate risk” to the minimum BMP standard so that it reads “Topography is assessed and drainage and layout is planned to an acceptable level of climate risk to safely remove runoff

Key Area 3: Machinery and Layout. To achieve consistency of standards there is a need to add minimum tillage and controlled traffic farming as a minimum BMP standard so that this module is consistent with the rainfall module and the climate risk module.

Key Area 4: Managing paddock erosion, water-logging and pesticide transport. Change the opening sentence of the preamble by adding text in regard to climate risk so that it reads “Paddock erosion management involves identifying acceptable levels of risk associated with climate variability and climate change, and then implementing risk management strategies to reduce the amount of runoff, manage the flow of runoff in the paddock, and reduce the amount of sediment in the runoff.”

Recommendations to Update Grains BMP Module 2: Making the most of rainfall

It is recommended that the following be added to the introduction of the rainfall module: “Broader concepts concerning climate risk and risk management are covered in the Grains BMP module “Managing Climate Risk”. This includes agricultural practices concerning: climate variability, climate change, climate forecasts, drought, low and variable rainfall, excessive rainfall, cool weather and frost, hot weather and heat stress, wind storms and importantly the opportunities arising from ‘perfect’ weather for grain production.”

It is also recommended that the preamble to the key area of “Rainfall Capture” should identify the value of ley pastures systems as an approach to maintaining infiltration through maintaining soil organic matter on the soil surface and enhancing sub-surface organic matter. This would make the module consistent with the minimum BMP standards of the crop nutrition module and the climate risk module.

Recommendations to Update Grains BMP Module 3: Crop nutrition and soil fertility

It is recommended that the following sentence be added to the introduction. “Broader concepts concerning climate risk and risk management are covered in the Grains BMP module “Managing Climate Risk”. It is also recommended that soil organic matter and soil carbon be added to the list of analyses performed in “Soil nutrient characteristics” in key area 1, and that the minimum BMP standard for frequency of testing for soil nutrients in key area 2 includes soil organic matter and soil carbon.

Recommendations to Update Grains BMP Module 4: Integrated pest management

It is recommended that the minimum BMP standard for “Planning to control pests” in key area 3 should be expanded by adding the following sentence. “The planning should include factors such as existing

populations, the potential for populations to increase in view of the seasonal climate outlook concerning rainfall, humidity and temperatures, alternate hosts and control methods, and climate change.” The value of minimum tillage and control traffic farming as carbon efficient agricultural practices should be emphasised.

Recommendations to Update Grains BMP Module 5: Pesticide application

It is recommended that the preamble to the module at the bottom of page 3 be expanded by adding the following sentence. *“It is recommended that risk management practices follow the guidelines specified in the Australian Standards on Risk Management (Standards Australia 2009).”* The Australian Standard on Risk Management (AS/NZS 31000:2009) should then be provided as a reference.

CONCLUDING REMARKS

Over-all, the project was successful on four fronts that are highly relevant to the FarmReady Industry Grant Objectives that focus on promotion, uptake, best practice and integration with industry. Firstly, development of the climate module is significant because it identifies best management practices for grain growers in the Northern Grains Region. The 24 practices in this module for management of climate risk encourage a robust flexible approach to managing seasonal conditions and longer term risks. They were endorsed and accepted by key stakeholders via reference panels in southern and central Queensland, 87 grain growers attending 14 workshops from Narrabri in NSW to Clermont in Central Queensland, and 27 grain industry consultants, researchers and extension officers at three professional development workshops. The standards now provide useful benchmarks for extension programs that can be transferable nationally, and thus should be promoted to agencies such as the Grains Research and Development Corporation, training organisations for vocational education, and State Departments of Agriculture. Improved risk management, better record keeping and development of forecast skills were the main areas where practice change was most evident during the interviews of the longitudinal study.

Secondly, the project was successful because mechanisms were put in place for ongoing interaction and influence on industry to improve the management of climate risk. This includes development of an effective workshop process, registration of this workshop in the FarmReady Training Program, development of communications materials including a video of the climate module, and installation of the Grains BMP Climate Module on the Grains BMP website (www.grainsbmp.com.au). Furthermore, the material is useful to formal training programs such as vocational training to achieve the Unit of Competency “AHCAGB501A Developing Climate Risk Management Strategies” (see www.training.gov.au). These mechanisms enable grain growers to access on-going opportunities to improve management of climate risk in grains production.


Thirdly, the project has successfully developed an effective framework and process for embedding management of climate change adaptation within an overall process for managing climate risk.

Fourthly, a stronger ‘climate risk network’ now exists, that is able to mentor other grain-growers to better manage climate risk in not only grains production, but potentially other rural production and natural resource management systems.

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Appendix 1: Example of the Flyers distributed by Newsletters, Email and Letter box drop



You know you are a good farmer.. but here's how to prove it!

Invitation to an AgForce Climate workshop

Part of the Grains BMP Program

What are the top ten practices for managing seasonal conditions?

AgForce and the Brigalow Jimbour Floodplain Group invites you to the Grains Best Management Practice workshops for grain growers. These workshops focus on:

- **Best practices** for grain farming in the Northern Grains Region
- Actions and skills to manage the **opportunities and challenges** of climate risk
- Practices for coping with **drought, floods, frosts and heat-wave**
- **Making the most** of good, average and poor seasons
- Weather records, **forecasts** and paddock info
- Paddock, whole-farm and off-farm **strategies**
- Using the Australian Standards on **Risk Management**
- Plans to **improve farming practices**.






Speaker:

- Dr Jeff Clewett (Principal Scientist, Agroclim Australia and Adjunct Prof USC).

You can attend either a full workshop at Jandowae or a shorter introductory version at Jimbour:


| Workshops | | | | |
|--------------------------|------------------------------|-------------------------|-----------------------------------|---|
| Tuesday 29 November | Cultural Centre, Jandowae | 10am for 10.30 start | 5.30 pm Close and light drinks | Lunch, morning and afternoon teas provided |
| Wednesday 30 November | Jimbour Hall, Jimbour | 7 for 7.30 am start | 10.30 am Close and morning tea | Breakfast at 7am provided |

RSVP to Lisa Cleary (0427 664 940; email bjfglandcare@bigpond.com) or
Nina Murray (0427 472 467)
General enquiries: Jeff Clewett 0408 071 482
Handy but not essential to bring a laptop PC.



Visit www.grainsbmp.com.au for more information on the Grains BMP program
These workshops are supported by a FarmReady funded project led by AgForce Queensland.

Appendix 2: Example of Agforce media releases to promote workshops



Advancing Rural Queensland

AgForce media release: 21 April, 2011

Grains best practice heads to the south east

Grain growers in south east Queensland can discover ways to boost the long-term profitability of their businesses when the highly successful Grains Best Management Practice (BMP) workshops come to Dalby, Chinchilla and Brookstead.

Agroclim Australia director and principal scientist Dr Jeff Clewett said Agroclim has partnered with AgForce Queensland, Fitzroy Basin Association Inc., the Queensland Department of Employment, Economic Development and Innovation and the federal government to deliver a new Grains BMP module throughout Queensland.

"Modern grain growers operate under constant pressure to boost productivity while protecting the environment, and the challenge of balancing sustainable practices, managing risks and maintaining a profitable, efficient business can often be difficult," Dr Clewett said.

"To address this, the Grains BMP process assists broadacre grain growers to identify improved practices in farm layout and design, managing rainfall and climate risk, crop nutrition and pest management, which all aim to improve profitability of their enterprise in the long term.

"Previous Grains BMP workshops in Central Queensland attracted 186 grain growers who have lifted the management of their cropping enterprises using practices equal to or above minimum industry standards.

"This momentum will continue at workshops in Dalby on Wednesday 4 May, Chinchilla on Thursday 5 May and Brookstead on Friday 6 May, where opportunities and challenges in managing climate risks are considered. Four key areas will be covered:

- **Linking climate and crop performance:** What actions and priorities are needed to achieve sustainable and profitable grain production, and how do you make the most of climate and paddock information regards climate variability and climate change?
- **Risk management:** Benefits of the GRDC framework and the Australian Standards.
- **Management strategies:** What are the key practices needed to make the most of good, average and poor seasons and what are the right machinery selections, agronomy and genetics, layout, enterprise mix, off-farm investment and financial approach for your enterprise?
- **Management skills:** Balancing strategic and tactical needs within your enterprise.

"We invite all grains growers in the south east to come along to find out more about boosting your business into the future."

Grains BMP workshops will be held from 8.30am to 3.30pm at the Dalby RSL on Wednesday 4 May, Chinchilla RSL on Thursday 5 May and Brookstead Hall on Friday 6 May. Workshops are provided free-of-charge and include morning tea, lunch and afternoon tea.

To find out more or to RSVP for catering, contact Nina Murray 0427 472 467.

For comment, contact Jeff Clewett on 0408 071 482
AgForce media manager: Rebecca Jennings 0418 733 102 or jenningsr@agforceqld.org.au
AgForce communications officer: Grace Reck 0427 626 853 or reckg@agforceqld.org.au

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Appendix 3: Details of Workshop Program for Grains BMP Climate Module

| Session start | Title and Aims | Notes |
|---------------|---|---|
| 8:00 am | Set Up | <ul style="list-style-type: none"> Set up participant laptops, load PDF and check operation Set up front laptop with modem, connect to website Set up data projector, screen, and butcher's paper/white board Set up modems for best signal – need to be at least “medium” Handout evaluation sheets as people enter, complete section 1 Organise name tags, attendance book, hard copies of module, butcher's paper, spare pens |
| 8:30 | Welcome (30 mins) | <ul style="list-style-type: none"> Welcome and intro of facilitators Round the room self-introduction by growers (may not be needed) WHS: Fire exits, location of toilets, times for smoko and lunch Outline plan for the day and hand out hard copies Run <i>rules-of-thumb</i> ice-breaker exercise for managing climate risk check for any other aims from group Use butcher's paper to record any important issues raised but not covered during the day – will revisit at the end |
| 9.00 | Introduction to BMP (10 mins) | <ul style="list-style-type: none"> Overview of Grains BMP program describe aims of the Grains BMP program <ul style="list-style-type: none"> growers to assess their practices against industry standards and how to improve help growers improve the way they do things Brief Introduction to the web site and how it works Brief 5 minute demo on-screen (make sure everyone is logged in) |
| 9.10 | Intro to Climate Risk Module (10 mins) | <p>Technical Discussion</p> <ul style="list-style-type: none"> Overview of Managing Climate Risk module with slides define risk in terms of opportunities and challenges Clarify aims of climate risk module and the four key areas |
| 9.20 | Key Area 1: Linking Climate and Crop Performance (5 mins) | <p>Technical Discussion</p> <ul style="list-style-type: none"> Introduce Key area 1 Outline of terms and key issues for questions 1, 2 and 3 ask for any questions of clarification |
| 9.25 | Key Area 1: Intro to Self-Assessment Process 15 mins for question 1 5 mins Q2 5 mins for Q3 | <ul style="list-style-type: none"> Explain use of the PDF file for use in today's workshop Fill out data page, make sure everyone has PDF file working Consider question 1: describe the rationale for the three levels Explain how to use the additional notes Explain need to hit the save button once questions are answered Explain that it is their data, and is designed to help them improve. It is not a race to see who can finish first or to judge where you are against other growers! Explain process for completing action plans Explain that technical people are here to help ensure action plans are realistic so please ask for assistance if needed Growers complete self-assessment and action plans for Key Area 1 Consider all questions on page 5 (question 2 and then question 3) |
| 9.50 | Key area 1: Complete questions 4, 5 and 6. 20 mins for intro, 5 mins per | <ul style="list-style-type: none"> Technical discussion: Introduce key concepts, terminology and use of weather, climate, and crop forecasts re MJO, ENSO and climate change (20 mins but often questions will extend this session to over 60 mins and hence time needs to be made up in key areas 3 and 4). Consider question 4, then 5 and then 6 Go through each BMP question on the screen and describe the rationale for the three levels |

| | | |
|---------|---|--|
| | question | <ul style="list-style-type: none"> Complete the self-assessment and action plans |
| | Key area 1: Evaluation | <ul style="list-style-type: none"> Complete Section 2.1 (5 mins) |
| 10:30 | Morning tea | |
| 11.00 | Key Area 2: Risk M'ment 20 min Intro, 5 mins for each of the 4 questions and 5 mins for evaluation | <ol style="list-style-type: none"> Technical discussion intro to key area 2 <ul style="list-style-type: none"> outline benefits, principles, terms and key issues of risk management Describe Australian Standards on Risk Management Describe risk assessment process, work through Appendix 1 Describe evaluation of options and action planning Describe main elements of seasonal review Ask for any questions of clarification Complete self-assessment & action plans Evaluation: Complete section 2.2 |
| 11.45 | Key Area 3 – Management Strategies (60 mins) | <ol style="list-style-type: none"> Technical discussion: introduce key areas, highlight important issues (15 mins) Complete self-assessment and action plans (40 mins, 5 mins/quest'n) Evaluation (5 mins): Complete section 2.3 |
| 12:45 | Lunch | |
| 1:30 | Key Area 4 – Strategic and Tactical M'ment Skills (40 mins) | <ol style="list-style-type: none"> Technical discussion: introduce 4 key areas, highlight important issues (15 mins) Complete self-assessment and action plans: 20 mins, 5 mins/quest'n) Evaluation (5 mins): Complete section 2.4 |
| 2.10 | Review Discussion (20 mins) | Facilitate discussion around the following points: <ul style="list-style-type: none"> What key areas/ questions were most important for your enterprise? Did you recognise particular issues that need to be addressed? |
| 2.30 | Prioritise action plans (30 mins) | <ul style="list-style-type: none"> Review all action plans and assign a priority order to them Explain that technical assistance is available if required |
| 3.00 | Recap on Grains BMP website (10 mins) | <ul style="list-style-type: none"> Review key points on use of the web site and updating actions Explain how to get a username and password for later use |
| 3.10 | Future Plans (10 mins) | Briefly discuss group's need for: <ul style="list-style-type: none"> Further training on climate issues, risk management and other BMP modules. Seek feedback on suitable dates Review any issues from butcher's paper and discuss how they can be addressed |
| 3:20 | Wrap up (10 mins) | <ul style="list-style-type: none"> Provide information on feedback to group Complete evaluation section 3 and collect once completed Thanks for your time |
| 3:30 pm | Close | |

Appendix 4: Climate Workshop Feedback and Evaluation Sheet

| Feedback: Grains BMP Climate Workshop | | | | |
|--|-----------------|--|----------------|-----------------|
| Section 1 | | <i>Springsure/Capella 19 & 20th July 2011</i> | | |
| Q1 How did you find out about today's workshop ? (circle all sources that were relevant) | | | | |
| (1) Flyer in post (2) Email (3) Phonecall (4) Newspaper (5) Radio (6) Friends (7) Other | | | | |
| Q2 How important is the management of climate risk in your business? (please circle) | Not important | Average | Very important | |
| | 1 | 2 | 3 | 4 5 |
| Q3 How do you rate your ability to manage the opportunities and challenges of climate risk? | Poor | Average | | Very Good |
| | 1 | 2 | 3 | 4 5 |
| Q4 What is the main thing you hope to achieve from the workshop today ? | | | | |
| • | | | | |
| Q5 What are two important rules of thumb you use for managing climate risk ? | | | | |
| 1. | | | | |
| 2. | | | | |
| Section 2: Feedback on Key Areas of Practice | | | | |
| Key Area 1: Standards and Two Priority Actions in Linking Climate and Crop Performance | | | | |
| Please rate your view of the Minimum Industry Standards: | | | | |
| | Too Low | About Right | Too High | |
| | 1 | 2 | 3 | 4 5 |
| <i>Qstn No</i> | <i>BMP Goal</i> | <i>Keywords for the action</i> | | <i>Priority</i> |
| | | | | |
| | | | | |
| Key Area 2: Feedback on Standards and Two Priority Actions in Risk Management | | | | |
| Please rate your view of the Minimum Industry Standards: | | | | |
| | Too Low | About Right | Too High | |
| | 1 | 2 | 3 | 4 5 |
| <i>Qstn No</i> | <i>BMP Goal</i> | <i>Keywords for the action</i> | | <i>Priority</i> |
| | | | | |
| | | | | |
| Key Area 3: Feedback on Standards and Two Priority Actions in Management Strategies | | | | |
| Please rate your view of the Minimum Industry Standards: | | | | |
| | Too Low | About Right | Too High | |
| | 1 | 2 | 3 | 4 5 |
| <i>Qstn No</i> | <i>BMP Goal</i> | <i>Keywords for the action</i> | | <i>Priority</i> |
| | | | | |
| | | | | |
| Key Area 4: Feedback on Standards and Two Priority Actions in Management Skills | | | | |
| Please rate your view of the Minimum Industry Standards: | | | | |
| | Too Low | About Right | Too High | |
| | 1 | 2 | 3 | 4 5 |
| <i>Qstn No</i> | <i>BMP Goal</i> | <i>Keywords for the action</i> | | <i>Priority</i> |
| | | | | |
| | | | | |

Appendix 4 (continued): Example of Workshop Feedback and Evaluation Sheet

| Section 3: Overall Comments on Workshop Content | | | | | |
|--|-----------------|---|----------------|---|--------------|
| Q6. How would you rate the following (please circle)? | <i>Poor</i> | | <i>Average</i> | | <i>Good</i> |
| Presentation of materials | 1 | 2 | 3 | 4 | 5 |
| The Grains BMP climate booklet | 1 | 2 | 3 | 4 | 5 |
| Use of the laptop computers/internet | 1 | 2 | 3 | 4 | 5 |
| Opportunity to reflect, participate and share ideas | 1 | 2 | 3 | 4 | 5 |
| | | | | | |
| The meeting overall as an investment of tax payer funds..... | 1 | 2 | 3 | 4 | 5 |
| The meeting overall as an investment of my time..... | 1 | 2 | 3 | 4 | 5 |
| Contribution towards improving the sustainability of my farm..... | 1 | 2 | 3 | 4 | 5 |
| Contribution towards improving the profitability of my farm..... | 1 | 2 | 3 | 4 | 5 |
| | | | | | |
| Q7 Comments on Global Warming and Climate Change | <i>Disagree</i> | | <i>Maybe</i> | | <i>Agree</i> |
| • Increasing levels of greenhouse gases will lead to a warmer planet and climate change | 1 | 2 | 3 | 4 | 5 |
| • Good capacity to manage climate variability will give resilience in managing the challenges associated with climate change | 1 | 2 | 3 | 4 | 5 |
| • Emphasis in the workshop on climate change was about right | 1 | 2 | 3 | 4 | 5 |
| | | | | | |
| Q8 Future Activity | <i>No</i> | | <i>Maybe</i> | | <i>Yes</i> |
| • Will you review your action plan on www.grainsbmp.com.au | 1 | 2 | 3 | 4 | 5 |
| • Would you like to maintain contact with Grains BMP | 1 | 2 | 3 | 4 | 5 |
| • Would further training be useful? | 1 | 2 | 3 | 4 | 5 |
| <u>If "yes" then in what area?</u> | | | | | |
| Please contact (optional) | | | | | |
| | | | | | |
| Q9. Are there some concepts, practices or <u>learnings</u> that came out of the meeting that you will consider in your current operation? Yes / No If yes, then please comment? | | | | | |
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| | | | | | |
| Q10. Other comments or suggestions (e.g. what you liked, what could be improved)? | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| <i>Your feedback is important, <u>thankyou</u> for your time and effort!</i> | | | | | |

Appendix 5

Follow-up Survey Regards the Grains BMP Climate Module

Feb 2012

| | |
|---|--|
| Preamble | |
| 1 | In thinking about the workshop, how would you rate the following on a 5 point scale: <i>(please circle the relevant box or write NA in the margin if not applicable)</i> |
| (a) | The venue and food <input type="checkbox"/> terrible <input type="checkbox"/> <input type="checkbox"/> okay <input type="checkbox"/> <input type="checkbox"/> excellent |
| (b) | Conversations with friends <input type="checkbox"/> mmm !! <input type="checkbox"/> <input type="checkbox"/> good <input type="checkbox"/> <input type="checkbox"/> very good |
| (c) | Presentations, booklet, use of laptops & website <input type="checkbox"/> all yuk <input type="checkbox"/> <input type="checkbox"/> okay <input type="checkbox"/> <input type="checkbox"/> all good |
| (d) | Did the "Top Ten" exercise provide a useful summ <input type="checkbox"/> no <input type="checkbox"/> <input type="checkbox"/> maybe <input type="checkbox"/> <input type="checkbox"/> yes |
| Section 1: Review of Climate Risk Workshop Processes and Content | |
| 2 | Since the workshop |
| (a) | Have you read through the booklet ? <input type="checkbox"/> never <input type="checkbox"/> <input type="checkbox"/> twice <input type="checkbox"/> <input type="checkbox"/> often |
| (b) | Used the climate module on the Grains BMP web: <input type="checkbox"/> never <input type="checkbox"/> <input type="checkbox"/> twice <input type="checkbox"/> <input type="checkbox"/> often |
| (c) | Is the Grains BMP website easy or difficult to use <input type="checkbox"/> easy <input type="checkbox"/> <input type="checkbox"/> okay <input type="checkbox"/> <input type="checkbox"/> difficult |
| (d) | If difficult, for what reason? |
| (e) | Have you talked to others about the module ? <input type="checkbox"/> never <input type="checkbox"/> <input type="checkbox"/> twice <input type="checkbox"/> <input type="checkbox"/> often |
| 3 | Please describe your conclusions from the climate workshop (i.e. the take home messages) |
| (a) | |
| (b) | |
| (c) | |
| 4 | In comparison to other Grains BMP modules, how does the climate risk module compare? |
| (a) | The depth and breadth of content is: <input type="checkbox"/> smaller <input type="checkbox"/> <input type="checkbox"/> same <input type="checkbox"/> <input type="checkbox"/> larger |
| (b) | Developing climate risk action plans is relatively: <input type="checkbox"/> simple <input type="checkbox"/> <input type="checkbox"/> same <input type="checkbox"/> <input type="checkbox"/> complex |
| (c) | Completing the climate risk BMP process is: <input type="checkbox"/> easier <input type="checkbox"/> <input type="checkbox"/> same <input type="checkbox"/> <input type="checkbox"/> harder |
| (d) | If harder, for what reason? |
| Section 2: Outcomes from the Workshop | |
| 5 | Since the workshop have you sought to improve your management practices in regard to: |
| (a) | Record keeping ? <input type="checkbox"/> No <input type="checkbox"/> <input type="checkbox"/> a little <input type="checkbox"/> <input type="checkbox"/> Yes, lots |
| (b) | Use of info on weather and climate forecasts ? <input type="checkbox"/> No <input type="checkbox"/> <input type="checkbox"/> a little <input type="checkbox"/> <input type="checkbox"/> Yes, lots |
| (c) | If yes, then in what way? |
| (d) | Use of Australian Standards on Risk Management <input type="checkbox"/> No <input type="checkbox"/> <input type="checkbox"/> a little <input type="checkbox"/> <input type="checkbox"/> Yes, lots |
| (e) | If yes, then in what way? |
| 6 | Please briefly describe how you are seeking to improve climate risk management practices: |
| (a) | On-farm: _____ |
| (c) | Off-farm: _____ |
| (c) | Business planning: _____ |
| (d) | Life Style: _____ |
| (e) | Knowledge and Skills: _____ |
| 7 | Regards future use of the Grains BMP Climate Risk Module , are you planning to: |
| (a) | Review/update action plans on the website ? <input type="checkbox"/> No <input type="checkbox"/> <input type="checkbox"/> possibly <input type="checkbox"/> <input type="checkbox"/> Yes, often |

Thanks very much for your views and cooperation -- much appreciated

Appendix 6:

Paper for NCCARF National Conference, Melbourne, 26-28 June 2012

Priorities for Managing Climate Risk and Adaptation in the Northern Grains Region

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Abstract

A high level of variability in seasonal weather conditions is a key feature of environmental influences on summer and winter crop production in Australia's Northern Grains Region. The most important climate risks to manage as perceived by grain farmers are low and variable rainfall, and catastrophic events such as drought, intense storms, flood and unseasonal severe frost. Consequently, the focus is on managing these challenges and taking advantage of opportunities when seasonal conditions are highly favourable for grain production. Excessive wet weather, severe heatwave and wind can also be important.

The central concept of this paper regards adaptation for climate change is that 'best practices' for managing climate risk in grain production should focus on managing the climate variability evident in continuously updated historical weather and climate data. Continual refinement of decisions provides the mechanism for adjustment. This view is supported by recent evidence gathered from industry via a FarmReady funded longitudinal study in the Northern Grains Region (Narrabri to Clermont). The study included information from two reference panels, fourteen grain-grower workshops, three professional development workshops and a series of follow-up interviews. Growers often reject practices for climate change adaptation when expected impacts are beyond a ten-year outlook.

Priorities for management include developing capacity for informed decision making within a robust risk management framework and process. A healthy lifestyle to mitigate climate stresses, business planning and skills in using weather/climate forecasts are important. Other priorities are strategic investments in machinery (particularly effective planting equipment, zero till and controlled traffic farming), maintaining natural resources, diversification, seasonal adjustments to agronomic practices, off-farm activity and periodic reviews of changes in climate on land capability.

RD&E programs should accelerate and incentivise the focus on developing and promoting robust, flexible management systems for managing climate variability as the key approach for adaptation to climate change.

Appendix 7 Grains BMP *“Managing Climate Risk”* Module

(Starts on next page)



Grains BMP

Managing Climate Risk *(Opportunities and Challenges):*

A self-assessment module for grain growers in the
Northern Grains Region



Published by Agforce Queensland, PO Box 13186, George St, Brisbane, Qld, 4003.

The module is available at www.grainsbmp.com.au and should be referenced as:

Agforce Queensland (2011). *Grains BMP Managing Climate Risk (opportunities and challenges): a self-assessment module for grain growers in the Northern Grains Region* (Ed. JF Clewett). Published by Agforce Queensland, Brisbane, Nov 2011, 30 pp. www.grainsbmp.com.au

First published June 2010, reprinted Nov 2011.

ACKNOWLEDGEMENTS:

The contributions of growers, industry representatives, government staff and consultants to the reference panels in central and southern Queensland were greatly appreciated.

Project staff contributing to the module development: Nina Murray (Grains Policy Officer, Agforce Queensland, Brisbane), Lindsay Kreig (formerly Agforce Queensland), Jason Huggins, Rod Collins and Hayley Eames (Queensland Government, Dept Employment Economic Development and Innovation, Toowoomba and Rockhampton), Dan Hickey (Morgan Rural Tech, Toowoomba, Qld), and Jeff Clewett (Agroclim Australia, Highfields, Toowoomba, Qld.).

Funding for the development of this module was provided by the FarmReady Program conducted by the Australian Government, Department Agriculture Fisheries and Forestry via project GMS – 0506 “*Developing and implementing grains best management practices for managing climate change and climate variability*” lead by Agforce Queensland.

The project draws on material developed in previous projects conducted by the Fitzroy Basin Authority, the Queensland Department of Primary Industries and Fisheries and Agforce Queensland with funding from the National Heritage Trust and National Landcare Program.

This module was prepared by: Dr J.F. Clewett, Director and Principal Scientist, Agroclim Australia, Highfields, Toowoomba Q 4352, 23 Sept 2010.

GROWER INFORMATION QUESTIONNAIRE

This information will be confidentially recorded on the Grains BMP website for compilation of regional statistics as per current practice.

Business Information

| | |
|----------------------|--|
| <i>Business Name</i> | |
| <i>First Name</i> | |
| <i>Last Name</i> | |
| <i>Address</i> | |
| <i>Town</i> | |
| <i>State</i> | |
| <i>Post Code</i> | |
| <i>Email</i> | |

Farm Information

| | |
|---------------------------------------|--|
| Farm Name | |
| Farm area (ha) | |
| Farm area under grain production (ha) | |
| Farm post code | |
| Farm region | |
| Tillage practice | |
| Traffic practice | |

WEB SITE USER NAME AND PASSWORD

User names and passwords for entry to the farm section of the Grains BMP web site www.grainsbmp.com.au are confidential and are defined when you first log into the website and complete the registration process.

WHAT IS GRAINS BMP?

The Grains BMP program is a voluntary, industry led process which helps broad acre grain growers in the GRDC Northern Grains Region to identify improved practices which can help improve the long term profitability of their enterprise. It also helps identify the steps you need to take to incorporate best management practices into your enterprise. In time it will also allow the grains industry to demonstrate good environmental management to the wider community.

Grains BMP was developed with two key objectives. Firstly, it allows grain growers to assess their current farming practices against industry standards and identify areas for improvement which lead to improved profitability and sustainability for their business. Secondly, it will allow the grains industry to report the level of adoption of sustainable production practices which is becoming more important with community and customer interest in how their grain is being produced. This will allow the grains industry to be proactive in dealing with issues affecting the industry by showcasing the sustainable production practices being used by many grain growers.

How does it work?

The program consists of a series of self-assessment modules that are available online and cover the major production and resource management components of modern farming systems. The modules are:

- Farm design and layout
- Managing Climate Risk
- Making the Most of Rainfall
- Crop Nutrition and Soil fertility Management

- Irrigation
- Integrated pest management
- Pesticide application
- Grain Storage

Each of these modules use a self-assessment process which helps to identify practices that could be incorporated into your system. The action plan attached to the self-assessment helps you rank the most important of these and the steps required to implement the highest priorities for your enterprise. Reviewing changed practices and identifying new priorities for change will help keep your enterprise focussed on improving productivity as well as sustainability.

How long will it take to complete?

We know that growers are busy people, so each module has been designed to be able to be completed in a few hours, depending on how many action plans you develop and how quickly you work through each part. Facilitators can help you along the way if assistance is required.

Standards

Agricultural practices identified as at the “minimum” standard, and those that are “below” and “above” standard have been considered and identified by Reference Panels of growers, industry representatives and consultants in Central Queensland and Southern Queensland (see acknowledgements). These standards will be subject to review and be further tested with 12 groups of growers during 2010.

Project format

The format of the self-assessment modules were developed following a review of BMP systems used in other industries, in particular the DairySAT materials developed as part of the Dairying for Tomorrow program. Valuable ideas were also gained from the Cotton BMP program and the Farm“A” Syst concept developed in the United States.

MANAGING CLIMATE RISK (OPPORTUNITIES AND CHALLENGES)

Variable weather patterns are a great challenge to sustainable and profitable grain farming in the Northern Grains Region. Climate has a large influence on the yield of crops, profits, environmental assets, the well-being of farming families and the prosperity of communities. While it is not possible to control the weather, it is possible to adjust farming decisions so that we have the best chance of riding the ebb and flow of weather conditions.

Weather is about continual change in atmospheric conditions such as cloud cover, rainfall, humidity, temperature, pressure and wind. Climate is about the expected weather conditions and is defined by the measurements of weather recorded over long periods. Climate is thus about average conditions and the variability, probabilities, minimums, maximums and frequency of events such as storms or what we might expect regards the severity of frosts, heat waves, dry times and drought. Importantly, it is also about how often we might expect an excellent season for growing grain because climate risk is about opportunities as well as threats. Each risk is defined by the likelihood (or chance) the risk will happen and its impact.

Managing climate risk is about strategies for maximising the opportunities and reducing the threats.

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It is *extremely likely* that human activities through emission of greenhouse gases and land use change have exerted a substantial net warming influence on climate since 1750. Furthermore, it is extremely likely that human activity will cause continuing changes in global climate with slow but significant change expected in climatic patterns in the Northern Grains Region so that it becomes warmer and possibly a little drier. Dealing with this uncertainty is important.

This module addresses best management practices in the northern grains region for managing climate risk and carbon efficiency with emphasis on taking advantage of climatic opportunities while achieving greater resilience to overcome threats. Agricultural practices for managing both climate variability and climate change are an integral part of the module. Minimum industry standards for management of climate risk require practices that adequately cover the range of climate variability that have been observed in the past. Practices that are above the minimum standards need to also consider future climate risks projected from climate change scenarios. The key areas are:

Key Area 1. Linking Climate and Crop Performance. This is about practices for monitoring the current weather patterns and farm situation, analysing historical data and evaluating climate forecasts (short-term, seasonal and climate change).

Key Area 2. Risk Management. The principles, framework and process of risk management are considered including risk assessment (likelihood, impact and treatment priority), communication, monitoring and review. The Australian Standard on Risk Management is used to define standards for management of climate risk.

Key Area 3. Strategies for Managing Climate Risk. The opportunities and challenges of different weather conditions on practices to achieve sustainable and profitable grain production are addressed. This includes strategies for the “perfect” season for grain production, low and variable rainfall, severe and catastrophic events, excessive rain and high intensity storms, cool weather and frost, hot-dry weather, and windy conditions.

Key Area 4. Managerial skills. Strategic and tactical needs within your enterprise, and management of risks at paddock, whole-farm and off-farm levels are considered.

KEY AREA 1: LINKING CLIMATE AND CROP PERFORMANCE

Taking stock of past, present and expected future conditions is a key part of managing climate risk. This section is about practices that are used to:

- assess historical records to identify climate and farm production characteristics
- monitor current weather patterns and farm conditions
- evaluate climate forecasts (short-term, seasonal and climate change) for potential use in management decisions.

Farm records of weather observations, crop production and the response of crops to weather events are helpful in making farm decisions regards management of climate risk. Analysis of long-term weather records from nearby stations (or on-farm records) are helpful in defining how often various weather events are likely to occur.

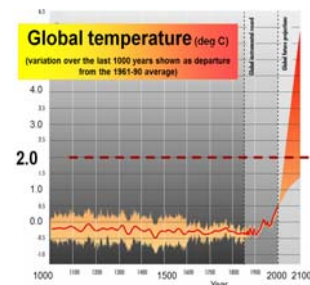
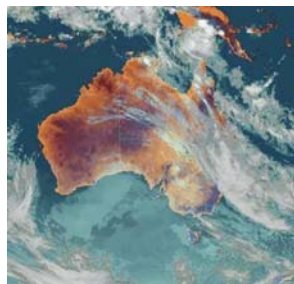
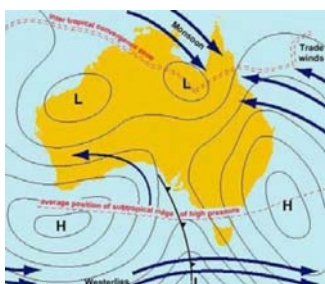
Similarly, knowledge of current conditions is important to risk management. This includes knowledge soil and crop conditions (e.g. soil water levels, nutrient status, crop stubble, frost damage) and the interaction of these conditions with both current weather forecasts and forecasts for the expected seasonal conditions ahead. The most important of these forecasts is gained from the climatology (e.g. expectations of future rainfall or temperatures based on time of year or geographic location). However, the influences of the MJO (Madden Julian Oscillation), ENSO (El Nino Southern Oscillation), SOI (Southern Oscillation Index), SST (Sea Surface Temperature) and IOD (Indian Ocean Dipole) also need to be considered.

Global warming over the next 50 years and beyond due to greenhouse gas emissions is expected to cause substantial changes in the Australian climate. This is not something just for the future as changes in the

climate are already happening. Global mean temperatures are warmer now by 0.8 deg C compared to the mid-1800s and the last decade was the warmest ever recorded by instruments and was 0.4 deg above the 1961-1990 baseline. These changes are likely to continue at about 0.2 deg per decade and to have significant effects on temperature extremes (frost, hot weather above 35 deg C and heat stress in crops) and evaporation.

Atmospheric carbon dioxide levels have increased almost 40% in the last century and this has already provided benefits to plant growth and will provide further significant benefits to crop yields (through improved water use efficiency), additional stubble for soil protection and additional opportunity for carbon sequestration. Elevated CO₂ is also likely to reduce grain protein in crops such as maize, sorghum and sunflower, and may also disrupt ecosystem balances concerning pests and pathogens.

Uncertainty and risk management are key concepts when considering climate change. Two large sources of uncertainty in projecting future rises in global temperature are: (1) the continuing rate of future greenhouse gas emissions, and (2) the consequent change in global temperature. Further uncertainty arises from the effect of global warming on regional and local weather patterns. There is a high level of uncertainty regards changes in rainfall in the northern Grains region. The current best estimate is a 5 to 9 % drop in annual average rainfall by 2070 with a range of -32% to +16% (CSIRO 2007, Queensland Government 2009). Changes in winter and spring rainfall (-17 and -18% respectively by 2070) are likely to be greater than changes in summer and autumn rainfall (-2 and -10% respectively). As global warming increases, the variability of rainfall is expected to increase along with the severity of drought and flood.



Self-Assessment - Linking Climate and Crop Performance

| Question 1.1 Assessing local climate from historical weather records | | | |
|--|---|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Climate records are not available to analyse features of the local climate. <input type="checkbox"/> | Long-term weather records are available and can be analysed to assess key features of the local climate . <input type="checkbox"/> | Key features of the local climate have been analysed using software tools such as spread sheets or tools on the Internet (e.g. BoM and Climate Kelpie) or PC tools such as Rainman, How Often, How Wet. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | Key features of the local climate refers to data such as averages, variability and recent trends in rainfall, temperature and evaporation, and to how often extreme events might occur such as drought, floods, frost and heatwave, or to information about probabilities and the influence of El Nino and La Nina. | | |

| Question 1.2 Reviewing historical paddock and enterprise records | | | |
|--|---|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Written records are not kept of farming methods, crop production and condition of natural resource assets <input type="checkbox"/> | Historical records of farming methods, crop production and the environment are available for comparing with local weather records <input type="checkbox"/> | Enterprise production records have been assessed in relation to local weather records, and decision support tools (such as Whopper Cropper or other tools listed on Climate Kelpie) have been used to assess the impacts of climate on crop production and environmental assets. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 1.3 Recording weather events, paddock conditions and crop performance | | | |
|---|--|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Current weather and paddock conditions are observed but not consistently recorded. <input type="checkbox"/> | Observations including: (a) daily rainfall and other weather events, (b) paddock conditions such as soil health, soil moisture, stubble cover and weeds, and (c) crop performance are routinely recorded. <input type="checkbox"/> | Electronic recording keeping and analysis are routinely used for weather data, paddock conditions and crop performance. Automatic yield monitoring and paddock mapping systems are used. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 1.4 Assessing current weather forecasts | | | |
|---|---|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Developing knowledge about weather forecasting is given low priority. <input type="checkbox"/> | The business has a broad understanding of regional weather systems, local conditions and weather forecasts for use in decision making. <input type="checkbox"/> | A detailed knowledge of weather systems and weather forecasting has been developed to assist in making better business decisions. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 1.5 Assessing short-term (10 day) and seasonal (2 to 4 months) climate and crop forecasts | | | |
|---|---|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Knowledge of short-term and seasonal forecasts is limited, especially their value in decision making. <input type="checkbox"/> | A proactive approach is used to gain a better understanding of short-term and seasonal climate and crop forecasts, especially for those times when forecast indicators (such as the MJO, SOI and SST) have value in decision making and when they don't. <input type="checkbox"/> | Forecast indicators such as the MJO, SOI and SST are routinely monitored and a detailed knowledge of short-term and seasonal climate and crop forecasting has been developed, and is often used to assist short-term and seasonal business decisions. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>A detailed knowledge of short-term and seasonal forecasting includes a capacity to:</p> <ol style="list-style-type: none"> (1) identify reliable sources of information (2) use and interpret data from several forecast websites (e.g. www.bom.gov.au) and climate analysis tools such as the Rainman StreamFlow software and other tools defined by the Climate Kelpie website (3) assess the value of forecasts in terms of reliability and skill at varying lead times and different times of the year (4) use and interpret Seasonal Crop Outlook reports regards forecasts of likely impacts on crop production and markets. | | |

| Question 1.6 Assessing long-range forecast information about climate change | | | |
|--|--|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Global warming and climate change forecasts are either ignored or given superficial attention. <input type="checkbox"/> | The business has a broad understanding of concerns about global warming, climate change and the expected impacts on the environment and agriculture in the Australian region. <input type="checkbox"/> | Knowledge of global warming and climate change is extended to understanding: (1) the cause, uncertainties and likely projections, (2) local impacts that are likely , and (3) how elevated levels of carbon dioxide might affect crops and the environment. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | Local impacts include impacts on crop production and the environment, and possible implications regards preferred management. | | |

KEY AREA 2: RISK MANAGEMENT PRACTICES AND PROCESS

Managing the opportunities and challenges of climate risk in agriculture falls within a much broader platform for over-all risk management that covers other environmental issues, market prices, financial factors (interest and exchange rates), commercial relationships, politics, technology and management (GRDC 2009). GRDC concluded that “*effective risk management is vital to maintaining farm sustainability and profitability for growers in the face of climate risk and rising production costs*”, and that “*risk management is an essential part of all aspects of farm management and key to ensuring the wellbeing of growers, their families and their businesses*” (GRDC 2009). Key benefits of effective risk management include:

- increased likelihood of achieving objectives through proactive management of risks
- increased awareness of the need to identify and treat risks (threats and opportunities)
- improved reliability for decision making, planning and use of resources for treating risks
- improved operational efficiency, minimisation of losses and enhanced health and safety
- improved management of the natural resource base and environmental protection
- improved learning and resilience of the enterprise.

An over-all strategy for managing risk is needed that encompasses the management of climate risk. The

Australian Standard on Risk Management (Standards Australia 2009) meets this need, and its use is highly relevant and widely advocated for managing both climate variability and climate change. It was first published in 1995 and has recently been adopted as an international standard as AS/NZS ISO 31000:2009 (Standards Australia 2009). Important principles of the Standard are that it:

- creates and protects value by addressing the enterprise objectives,
- explicitly addresses uncertainty, is based on the best available information and is tailored to the enterprise and tasks at hand,
- is an integral part of decision making and organizational processes,
- is systematic, structured and timely, and facilitates continual improvement.
- These principles and the following process enable the standard to be useful for managing many forms of risk in a systematic way across a wide range of sectors.

An essential feature of the risk management process is a five step method that firstly defines the context of risk management, and then moves through risk assessment (identify, analyse and evaluate risks) to set priorities for treating the risks (see Figure 1 and worksheet example in Appendix 1) with communication, monitoring and review as parallel tasks. The level of risk is used to set priorities for action and this is determined by analysing the risk likelihood multiplied by its likely impact.

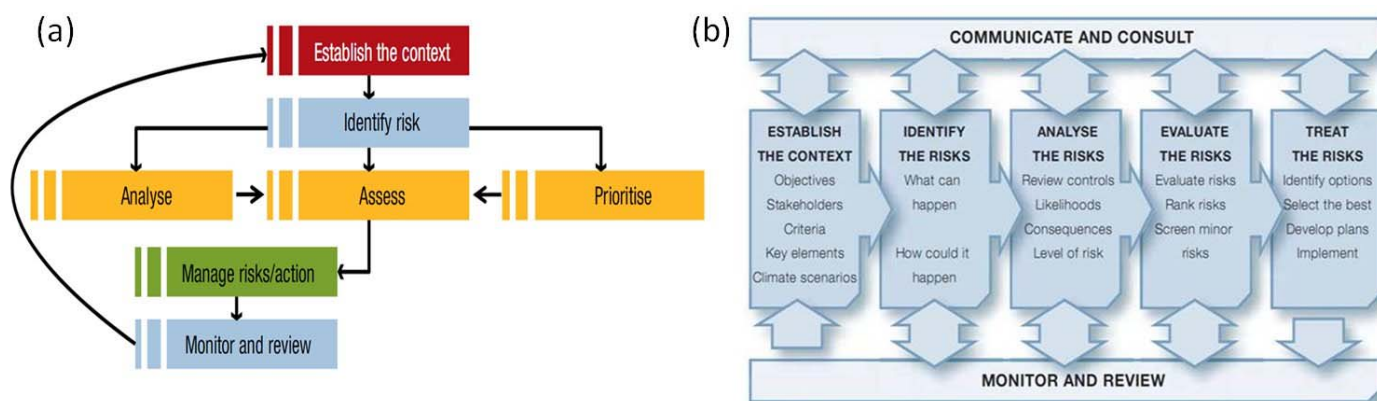


Figure 1. Diagrams of the five step process used in the Australian Standard on Risk Management from: (a: left diagram) GRDC fact sheet on risk management (GRDC 2009), and (b: right diagram) Guidelines for business management of climate change (AGO 2006).

Self-Assessment - Risk Management Practices and Process

| Question 2.1 Over-all risk management practice | | | |
|--|--|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Developing plans to guide decisions on climate risk is seen as low priority. <input type="checkbox"/> | A proactive approach is being taken to developing a plan for managing climate risk that is consistent with the Australian Standards on Risk Management. This includes a framework and criteria for making decisions to achieve enterprise objectives. <input type="checkbox"/> | A risk management plan has been developed and documented which is consistent with the Australian Standards on Risk Management (ISO 31000:2009). The plan has a register of risks and the criteria for making decisions to achieve objectives are clear. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 2.2 Risk assessment | | | |
|------------------------------|--|--|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | The assessment of risk is ad hoc and limited to just the impacts of recent events. <input type="checkbox"/> | Climate risks are prioritised in terms of their likelihood and expected impact on key elements of the enterprise. (see example in Appendix 1). The likelihood of events is based on historical weather records that are being continually updated. <input type="checkbox"/> | Effects of climate change are also considered in assessing risk (see example in Appendix 1) and all climate risks in the risk register have been assessed and given a priority for action. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 2.3 Evaluating options and deciding on action plans | | | |
|---|--|--|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | <p>Planning based on risk assessment is not used to guide farming practice.</p> <p style="text-align: right;"><input type="checkbox"/></p> | <p>Options and likely outcomes have been evaluated, and actions are now being progressed to address the main climate risks for the enterprise with the aim of reducing threats and building resilience whilst maximising opportunities.</p> <p style="text-align: right;"><input type="checkbox"/></p> | <p>Evaluation of options is robust and actions have been implemented to address all risks in the climate risk register. Action plans consider climate variability and climate change, and: (a) on-farm and off-farm options, and (b) farming practices at the paddock level as well as strategic whole-of-enterprise options.</p> <p style="text-align: right;"><input type="checkbox"/></p> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 2.4 Seasonal review of climate risk | | | |
|---|---|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | <p>Seasonal reviews of risk are limited and not adequately assessed, communicated or recorded.</p> <p style="text-align: right;"><input type="checkbox"/></p> | <p>Seasonal changes in climate risk and the practices that need to be seasonally adjusted are regularly reviewed and discussed with other members of the business.</p> <p style="text-align: right;"><input type="checkbox"/></p> | <p>Regular seasonal reviews of climate risk are conducted and include: (a) outcomes from the previous season (b) influence of seasonal conditions on risk, (c) what practices need to be adjusted, (d) the level of risk remaining for the season ahead, and (e) documentation and discussion with other members of the business.</p> <p style="text-align: right;"><input type="checkbox"/></p> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

KEY AREA 3: STRATEGIES FOR MANAGING CLIMATE RISK

Throughout the northern grains industry, the specific practices used on each farm to manage climate risk are quite varied. Choices, chances and consequences are different. Thus “best management practice” should be regarded as a set of guidelines rather than a set of specific details defining agricultural practices. These practices cover:

- structural adjustments to the enterprise such as enterprise mix, machinery selection and adaptation of land use to on-going reviews of land capability particularly for high-risk marginal lands
- adjustments in seasonal tactics such as land preparation, crop selection, cropping intensity, planting methods and marketing
- development of managerial skill, adaptive capacity and off-farm investment.

The key need is a set of robust strategies to build resilience, increase opportunities and reduce threats when managing the following risks:

1. **“Perfect” weather for dryland grains production and care of environmental assets.** The management of climate risk is so often about reducing the impact of threats. However, the opportunity to take full advantage of seasons when the weather is well suited to grain production and the repair of environmental assets is extremely important to achieving farming objectives. Practices that can increase the number of seasons in this category are highly desirable.
2. **Low and variable rainfall.** This risk is a common feature of dryland grains production. Practices are needed to reduce or overcome the resulting variability in accumulation of soil moisture and planting opportunities, and the challenges concerning crop nutrition and weed, pest and pathogen control, harvest conditions, grain yields, grain quality, storage requirements and marketing plans.
3. **Severe and catastrophic events.** This risk includes consecutive crop failures over several years from prolonged severe drought, one-off crop failure from severe frost, heat blast and dry times and wild storms causing severe damage to crops, infrastructure and environmental assets. Each of these widely different risks originate from a different climatic source that has high impact but low likelihood. However, when pooled together the likelihood increases and are combined here because together they place special emphasis on the financial practices needed to meet and overcome these risks.
4. **Storms with high intensity rainfall causing runoff.** Practices needed to offset the risk of damage to environmental assets through soil erosion and damage to contour banks / waterways is the main focus.
5. **Excessively wet conditions with little runoff.** Several risks are involved here and include water logging, soil compaction and development of pest and pathogen populations.
6. **Cold Weather and Expected Frost Regimes.** The risk covered here is about the usual cold weather and frost expectations rather than the risk of severe out-of-season frosts causing almost complete crop failure as this is covered in the extreme events above.
Hot weather, Heat Waves and Heat Stress Conditions. The risk covered here is about average hot weather and heat stress expectations rather than the severe and often out-of-season heat waves causing almost complete crop failure as this is covered in the extreme events above.
7. **Windy conditions.** This is mainly about practices needed to overcome threats from wind on spray operations, hot windy conditions causing high evaporation and soil water losses as well as wild wind storms causing damage to infrastructure

Some climate risks (rainfall threats & opportunities)

How often do these events occur and what are the likely impacts ?

Agroclim Australia

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Self-Assessment - Strategies for Managing Climate Risk

| Question 3.1 Managing “perfect” weather for dryland grains production and care of environmental assets | | | |
|---|--|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | An easy going “laid-back” approach to farming is used during the “good” seasons. <input type="checkbox"/> | The farming system is managed to increase both the frequency and productivity of crops during “good” season opportunities. <input type="checkbox"/> | Maximum effort has been made to make the most of good season opportunities to achieve the production, environment and social objectives of the enterprise. Progress is assessed using indicators such as yield, soil health and water use efficiency. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 3.2 (a) Managing low and variable rainfall: strategic improvements | | | |
|---|---|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Strategic improvements to reduce the impact of low and variable rainfall on productivity are not considered. <input type="checkbox"/> | Progress towards strategic improvements to the cropping system are being implemented so that the business is more resilient and maintains productive capacity over a wide range of seasonal conditions. <input type="checkbox"/> | Strategic improvements to the cropping system have been implemented to reduce the threat of low and variable rainfall to an acceptable level of risk. This includes the impact of climate change that is likely to increase variability and may reduce average rainfall. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>Examples of strategic improvements include:</p> <ul style="list-style-type: none"> (1) Spreading risk by diversifying the enterprise mix (2) Investments in machinery and equipment for zero tillage, controlled traffic farming, and planters with high stubble capacity, moisture seeking capacity and variable rate technology. | | |

| Question 3.2 (b) Managing low and variable rainfall: seasonal adjustments | | | |
|---|--|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Little change is made to cropping practices for adjusting to variable rainfall. <input type="checkbox"/> | Seasonal adjustment of planting operations to optimise water use efficiency is a priority. Several risk management practices are seasonally adjusted to reduce climate threats and increase opportunities. <input type="checkbox"/> | A comprehensive set of seasonal adjustments are considered in making planting decisions. These decisions are supported by seasonal forecasts and locally relevant data from crop models regarding the influence of both climate variability and climate change. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 | | |
| Notes | <p>Examples of seasonal adjustments to improve the water use efficiency of crops include:</p> <ul style="list-style-type: none"> (1) Increased cropping intensity or extending fallow length to build soil moisture (2) Use of opportunity cropping rather than adhering to crop rotations (3) Altering crop and variety choice, and altering soil moisture levels to trigger planting (4) Adjusting sowing depth, planting density, row spacing, crop nutrition and time of sowing. <p>These decisions are assisted by many factors including use of seasonal forecast information (such as data from Rainman and the Bureau of Meteorology web site) and locally relevant data from crop models such as APSIM and Whopper Cropper.</p> | | |

| | Question 3.3 (a) Managing severe and catastrophic events: business plans | | |
|-------------------------|--|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | There are no plans in place for drought and general disaster preparation, management and recovery. <input type="checkbox"/> | The business has a robust plan which includes several strategies to prepare for, manage and recover from severe and catastrophic events such as crop failures, extended drought and severe floods. <input type="checkbox"/> | The threat of severe and catastrophic events to enterprise objectives are understood and have been reduced to acceptable levels of risk by diversifying and implementing a range of financial strategies . The business plan also considers the higher frequency and potential severity of extreme events arising from climate change regards drought, flood, intense rain and heat stress. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>Examples of severe and catastrophic events are:</p> <ul style="list-style-type: none"> (1) complete crop failure from severe frost, heat blast, flood and dry times (2) continual crop failure over several years from prolonged severe drought (3) wild storms causing severe damage to crops, infrastructure and environmental assets. <p>The business plan is supported by several financial analyses such as profit/loss analyses, net cash flow, return on capital and growth in equity. Example strategies to reduce the threat of catastrophic events include:</p> <ul style="list-style-type: none"> (1) Spreading risk by diversifying the enterprise with other components such as livestock or irrigation (2) Developing infrastructure such as constructing levee banks, grassed waterways or contour banks (3) Using a range of crops and/or several varieties to spread the risk (4) Using financial options such forward selling, farm management deposits, insurance, using financial advisors, making good use of government schemes such as interest subsidies, and developing off-farm business interests to spread risk. | | |

| | Question 3.3 (b) Managing severe and catastrophic events: maintaining your health | | |
|-------------------------|--|--|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | There is no time to pursue a healthy lifestyle or effective communication. <input type="checkbox"/> | Good communications and maintaining a healthy lifestyle (including items such as holidays and community engagement) are recognised as priorities to achieve greater resilience and capacity to manage adversity. <input type="checkbox"/> | A healthy lifestyle is practiced and lines of communication are working effectively. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 3.4 Managing flood flows and storms with high intensity rainfall causing runoff | | | |
|--|---|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Farming methods, layout and infrastructure do not safely remove runoff, and do not meet industry standards for protection of environmental assets. <input type="checkbox"/> | Plans are being implemented to reduce the risk of erosion from flood flows and high intensity storms by: (a) avoiding crop production on highly erodible land, (b) adopting farming practices that maintain cover, maximize infiltration and safely remove runoff . <input type="checkbox"/> | Potential damage to environmental assets is reduced to an acceptable level of risk by farming practices that maintain cover, maximise infiltration /minimise runoff , and consider the effects of climate change on the adequacy of existing contour banks and waterways. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>1 Also see practices and standards in Grains BMP modules “<i>Making the Most of Rainfall</i>” and “<i>Property Design and Layout</i>”.</p> <p>2 Examples of practices to maintain cover, maximise infiltration and minimise runoff and soil erosion are:</p> <ul style="list-style-type: none"> (a) control traffic farming and minimum tillage (b) crop rotations and crop sequencing that increase the chance of more cover especially during summer (c) adopting a high cropping intensity and avoiding use of long fallows that increase erosion risks and increase losses of soil carbon (d) contour strip cropping on floodplains and to capture runoff from neighbouring fallow (e) constructing contour banks and grassed waterways for safe removal of runoff (f) livestock are excluded from grazing crop and crop stubbles to maximise cover (g) ley pasture systems to build soil structure and thus increase infiltration capacity. <p>3 A worked example of assessing risk in relation to high intensity storms is shown in Appendix 1.</p> | | |

| Question 3.5 Managing excessively wet conditions with little runoff | | | |
|---|---|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Farming practices and crop production are very susceptible to wet conditions. <input type="checkbox"/> | Several risk management practices such as use of forecasts and controlled traffic farming are being implemented to provide resilience in maintaining productive capacity in wet conditions. <input type="checkbox"/> | A comprehensive set of risk management practices for wet conditions have been implemented to maximise opportunities for crop production, and reduce the threat of crop losses to an acceptable level of risk. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>Examples of risk management practices that are used to reduce the impacts of wet weather include:</p> <ol style="list-style-type: none"> (1) Selecting a property design and layout that reduce exposure to wet weather risks (2) Preventing damage to soils by avoiding operations when soils are too wet (3) Using zero tillage and control traffic farming in preference to random traffic operations to improve infiltration and reduce losses from compaction (4) Using weather and climate forecasts of wetter conditions to adjust planting, spray and harvest decisions. (5) Spreading risk by selecting a range of crops, varieties and times of planting (6) Reducing fallow length and winter cropping in salt affected areas to decrease for the chance of salt movement from deep drainage (7) Minimizing threats of weed resistance by using cropping patterns and herbicide selection in line with IPM recommendations (8) Removing livestock from crops when soils are wet to prevent compaction (9) Reducing the chance of wet weather harvest losses by heading as soon as possible and considering options for grain drying. | | |

| Question 3.6 Managing hot or cold weather conditions including frosts and heat-wave (but excluding severe out-of-season frosts covered in catastrophic events in 3.3 above) | | | |
|--|---|--|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Fixed planting windows are used and changes in crop choice and variety are rare. <input type="checkbox"/> | Crop choice, varieties and planting windows are adjusted each season to reduce the threat of temperature extremes to farming objectives. The incidence of frost, cold weather, hot-dry weather and heatwaves are taken into account. <input type="checkbox"/> | The potential for crop loss from hot or cold weather is reduced to an acceptable level of risk by adjusting crop management practices based on seasonal conditions, field experience and data from crop models that assess impacts of both climate variability and climate change. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | <p>Examples of cropping practice to manage hot and cold weather conditions include:</p> <ol style="list-style-type: none"> (1) Planting windows for summer and winter crops are defined by local temperatures and are tailored to variety and topographic features (particularly in regard to frost incidence). (2) Seasonal changes to planting windows due to ENSO are assessed so that start and cut-off dates are clear. (3) Strategies to manage winter crop frost risk include practices such as: <ol style="list-style-type: none"> (a) hedging risks by using several varieties with different maturity dates and yield potential so that risks are balanced regards frost damage versus a dry finish (b) extending planting windows through use of moisture seeking planting equipment (c) maintaining a close watch on frost damage so that timely decisions on grazing, baling or grain harvest are made. (4) Planting windows for early summer crops are defined by balancing the risk of late winter frosts on seedlings, versus the need to avoid (a) heat-wave or hot dry conditions at flowering and grain fill, and (b) pests and pathogens that build up in warmer weather. Available soil moisture at planting and risks of early cold weather are balanced against the chance of in-crop rainfall and the risk of hot dry conditions and yield loss from lodging at harvest. (5) Planting windows for late planted summer crops are restricted so that risks are acceptable regards the chance of cold weather preventing effective grain fill and prolonged harvest problems. <p>Research Information on climate risk from crop models such as APSIM and Whopper Cropper includes analysis of crop production and profit in relation to the effects of climate variability, climate change, crop type and variety, planting dates and crop management practice.</p> | | |

| | Question 3.7 Managing windy conditions | | |
|-------------------------|---|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Threats from wind not considered. <input type="checkbox"/> | Threats from wind are being managed to minimise: (a) the opportunity for spray drift, (b) the chance of soil erosion, (c) the likelihood of lodging losses, (d) the consequence of wild storms on infrastructure. <input type="checkbox"/> | Threats from wind conditions due to both climate variability and climate change have been reduced by management practices to acceptable levels of risk. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

KEY AREA 4: MANAGERIAL SKILLS FOR STRATEGIC AND TACTICAL MANAGEMENT OF CLIMATE RISKS

Five agricultural practices are covered in this key area.

1. **Education and training to develop management skills.** Proactive approaches are needed to further develop the many skills that are required to effectively manage climate risk. New farming practices, new technologies and new information about climate and climate systems are continually occurring. New knowledge needs to be blended with on-farm experience.
2. **Land capability and land use planning.** Development of business and NRM plans need to include management of climate risk as a specific issue in the overall approach to risk management. These plans need to adequately identify the impacts of climate risk and adaptive strategies on land capability, preferred land use and enterprise mix. This highlights the need for skills in long-term strategic management and short-term tactical management.
3. **Strategic management of resources.** Climate risk management strategies are needed so that the farm is positioned to gain maximum benefits from favourable weather events, and to reduce the chance of negative impacts from adverse weather events to a level that is acceptable.
4. **Tactical management of crops.** Timeliness of operations, benchmarking and marketing are highlighted as important issues rather than the multitude of day-to-day farm practices that are covered in other sections and are essential for effective management of climate risk.
5. **Off-farm investment and use of skills.** This area of managing climate risk is often overlooked until circumstances sometimes force the issue. A planned approach to off-farm investments and use of skills is part of best management practice for managing climate risk.

Key Area 4: Improving management skills (5 areas)



1. Education and training



2. Regular reviews of land capability and land use planning

3. Strategic management of resources: investment in land, machinery and infrastructure






5. Off-farm investment and use of skills

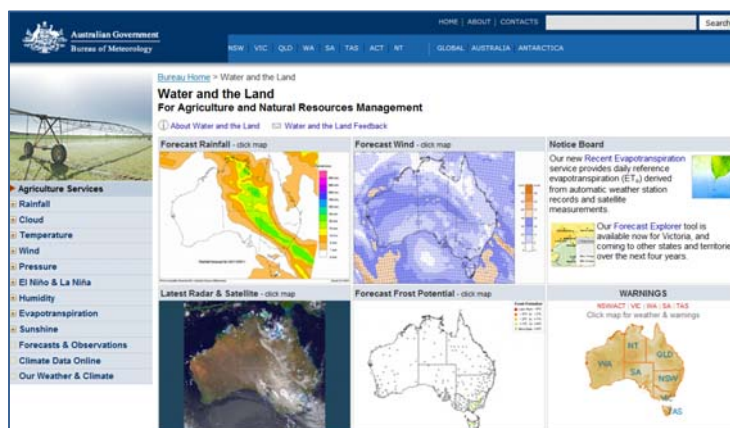
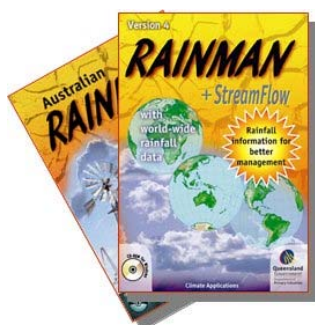
4. Tactical management of the cropping system: grain marketing

Agroclim Australia
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| Question 4.1 Education and training to develop management skills | | | |
|--|--|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Education and training to develop knowledge and skills for managing climate risk is not addressed. <input type="checkbox"/> | A proactive approach is used to develop knowledge and skills of weather systems, climate variability and climate change for both <u>strategic and tactical</u> management of climate risk at paddock, whole-farm and off-farm levels. <input type="checkbox"/> | Management skills are further extended by developing a detailed knowledge of weather systems, climate variability and climate change, and their influence on management decisions. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | Management of climate risk includes: (1) Long-term strategic use of resources that usually involves structural changes to the enterprise such as changes in enterprise mix or investments in land and machinery (2) Short-term tactical management and changes in cropping decisions that are adjusted with the ebb and flow of seasonal conditions (3) Management at paddock, whole-farm and off-farm levels | | |



www.climatekelpie.com.au



| Question 4.2 Land capability and land use planning | | | |
|---|---|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | The influence of climate risk on land capability is not examined. <input type="checkbox"/> | The influence of climate risk (determined from historical weather records) on land capability is continually reassessed, and changing land use is considered as an option to overcome changes in climate risk (such as increases in hot dry conditions with low and variable rainfall). <input type="checkbox"/> | All land use in the cropping enterprise has been adjusted to an acceptable level of climate risk. The influence of both climate variability and climate change is included in assessment of land capability and appropriate land use. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |
| Notes | Changes in land use that may be considered are irrigation, dual purpose crops for grain and grazing, and establishment of permanent pastures or tree crops. | | |

| Q 4.3 Strategic management of resources: investment in land, machinery and infrastructure | | | |
|--|--|---|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Machinery and infrastructure pose significant limits in managing climate risk. <input type="checkbox"/> | Investments in land, machinery and infrastructure to achieve better management of climate risk are proactive, on-going and place priority on maintaining cover, infiltration of rainfall, carbon efficiency, safe removal of runoff, grain storage and diversification. <input type="checkbox"/> | Investment has been largely completed in machinery and infrastructure, but is continually reviewed to identify innovative practices, diversification to spread risk, and timely maintenance to ensure readiness in managing climate variability and climate change. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 4.4 Tactical management of the cropping system: grain marketing | | | |
|---|---|--|---|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Grain marketing is not proactively managed. <input type="checkbox"/> | Seasonal adjustment of cropping practice includes proactive management of grain marketing as a hedge in managing climate risk. Examples include changes in crop choice at planting, forward selling and on-farm grain storage. <input type="checkbox"/> | Impacts of weather and seasonal forecasts on global markets are monitored to provide inputs to grain marketing decisions. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

| Question 4.5 Off-farm investment and use of skills | | | |
|---|---|---|--|
| | Below BMP Standard | Minimum BMP Standard | Above BMP Standard |
| Current Practice | Opportunities for off-farm use of skills and investment are not considered. <input type="checkbox"/> | Opportunities for off-farm investment and/or application of skills are periodically considered as a hedge to managing climate risk. <input type="checkbox"/> | Off-farm activity and investment is routinely used as a significant part of the business plan for managing climate risk. <input type="checkbox"/> |
| BMP Goal | Below <input type="checkbox"/> | Minimum <input type="checkbox"/> | Above <input type="checkbox"/> |
| Action Plans | 1 2 3 4 | | |

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Websites

- Agforce Grains BMP website.** All modules in the Grains BMP program are on www.grainsbmp.com.au
- The Bureau of Meteorology.** This website has a comprehensive range of information related to weather data, climate variability (for specific sites and regions), seasonal forecasts and climate change. www.bom.gov.au.
- Water and Land.** The Bureau's Water and the Land web site aims to provide an integrated suite of climatic information for people involved in primary production and NRM. www.bom.gov.au/watl/.
- The Long Paddock** A Queensland Government website for drought information and maps of seasonal forecasts of rainfall and pasture growth. www.longpaddock.qld.gov.au
- GRDC Climate Kelpie** is a 'one-stop shop' for climate risk management information and tools designed for Australian farmers and farm advisors including information on the 'Climate Champions' program. www.climatekelpie.com.au. For information on Climag visit www.managingclimate.gov.au
- Victorian Dept Primary Industries** produces a monthly climate newsletter (*Fast Break*) and has produced the *Climate Dogs* animation tool to describe climate phenomena in Australia www.new.dpi.vic.gov.au
- Department of Climate Change** An Australian Government website with facts about climate change including predictions and potential impacts for specific regions of Australia as well as factsheets. www.climatechangeinaustralia.gov.au
- CSIRO – Climate Change.** This site contains scientific information about climate change including monitoring, projections, impacts and adaptation. www.csiro.au/org/ClimateAdaptationFlagship.html
- Intergovernmental Panel on Climate Change (IPCC).** The IPCC is the world peak authority on climate change set up by the United Nations and the World Met Organisation. www.ipcc.ch
- Climate Change in Queensland** The Queensland Government's website containing information about the greenhouse effect and climate change including projections for Queensland regions. www.climatechange.qld.gov.au
- National Climate Change Adaptation Research Facility (NCCARF).** This group focuses on developing and communicating information about managing for climate change. www.nccarf.edu.au

Appendix 1: Sample Worksheet for Assessment and Treatment of Climate Risk Using Intense Storms as an Example

| | |
|---|---|
| 1. Description of climate risk: <i>(what, when, frequency): High intensity storms that cause erosion, usually a couple of storms each summer</i> | |
| What is an example? | 50 mm storm in a few hours, likelihood increases marginally with climate change |
| What are the impacts? | Loss of water, top soil and nutrients, gullies form, contour banks break, silt in waterways, loss of production/profit, especially on hill paddocks. Impacts bigger with climate change because of less cover and higher erosive force expected |
| 2. Summary of current management: Maintain cover through minimum till, mainly wheat. Use of contour banks & grass waterways. Grazing is adding to erosion damage on hills. Current adaption strategies give positive cost/benefit ratio | |

| Key Elements | Risk as assessed from historical data | | | | | Risk also includes future climate change | | | | |
|--|---------------------------------------|---------------|--------|------------------------|--------------------------|--|--------------------------|------------------------|--------------------------|----------|
| | Prodn - Profit | Enviro Assets | Social | other | Over-all | Prodn - Profit | Enviro Assets | Social | other | Over-all |
| 3. Risk Analysis | | | | | | | | | | |
| (a) Likelihood (rated on a scale of 1 to 9-- see table 1) This needs to consider the time frame (1 season or 20 years), and for expected climate change also the confidence level of forecasts | | | | | 7 | | | | | 8 |
| (b) Consequence (rated on a scale of 1 to 9-- see table 2) This needs to consider: (1) impacts of single events and cumulative impacts over 20 years, and (2) level of exposure | 3 | 5 | 4 | | 4 | 7 | 7 | 5 | | 7 |
| (c) Level of Risk (Likelihood * Consequence) | | | | | 28 | | | | | 56 |
| 4. Risk Evaluation | | | | | | | | | | |
| (a) Remaining vulnerability (low, medium, high, extreme -- Table 3) | | | | | Medium | | | | | High |
| (b) Industry standards: current management of this climate risk is: | | | | Below minimum standard | <input type="checkbox"/> | At minimum industry standard | <input type="checkbox"/> | Above minimum standard | <input type="checkbox"/> | |
| (c) Is the risk acceptable? : yes or no (if no then consider further treatment) | | | | | | | | | | |
| 5. Treatment Options | | | | | | | | | | |
| (a) Proposed management strategies Increase emphasis on maintaining cover, decrease summer fallows, repair banks/waterways, Change land use on hill paddocks from crops to permanent pasture. Improve grazing. Overcome some constraints with planting gear regards moisture seekers. Further investment will deliver positive cost/benefit ratio | | | | | | | | | | |
| (b) Adaptive Capacity (effectiveness score: low, medium, high) | | | | | | | | | | High |
| (c) Remaining vulnerability (low, medium, high, extreme) | | | | | Low | | | | | Low |
| (d) Is the risk acceptable: yes or no (if no then reconsider treatments) | | | | | yes | | | | | yes |

Appendix 1 (continued)

Table 1. Risk analysis categories concerning the likelihood of events (source: adapted from Table E2 of Standards Australia (1999))

| Likelihood categories (score and description) | | Meaning |
|--|----------------|---|
| 9 | Almost certain | Is expected to occur in most circumstances |
| 7 | Likely | Will probably occur in most circumstances |
| 5 | Possible | Might occur at some time |
| 3 | Unlikely | Could occur at some time |
| 1 | Rare | May occur only in exceptional circumstances |

Table 2. Risk analysis categories concerning the consequence of impacts on production, profit, environmental assets and social criteria (source: derived from Tables 8, 9 and 10 of AGO (2006)).

| Consequence [#] categories (score and description) | | Production and Profit criteria | Environmental assets criteria | Social criteria |
|---|---------------|---|--|---|
| 9 | Catastrophic | The business would contract markedly and may need to be wound up | Major widespread loss of environmental amenity and progressive non-recoverable environmental damage | Great concern regards health and well-being of family and staff |
| 7 | Major | Severe losses in production. Business contracts and requires significant remedial action | Severe loss of environmental amenity and a danger of continuing environmental damage | Major changes in lifestyle needed.. Farm operations severely affected by time and staff available |
| 5 | Moderate | Production reduced to break even. No growth in assets. | Isolated but significant instances of environmental damage that might be reversed with intensive efforts | Shortfalls in capacity to meet lifestyle objectives |
| 3 | Minor | Production is hampered and fails to meet expectations | Minor instances of environmental damage that could be reversed | Minor influences on health and well-being |
| 1 | Insignificant | Insignificant reductions in crop yield and productivity but this would not attract much attention. Strong growth in over-all business | No environmental damage | Almost no impact on family, staff and lifestyle |

[#] In circumstances where the risk is beneficial then substitute negative consequences for positive consequences of the same magnitude. An example is widespread rains and excellent follow-up weather patterns that lead to consequence categories of “remarkably good” and “phenomenal” and result in high crop yields, strong business growth, rebuilding of environmental assets, and provide a sense of well-being in the farming community.

Table 3. Levels of risk used to assess priorities and evaluate vulnerability (risk score = likelihood*consequence) (Source: adapted from Table 12 of AGO (2006)).

| Likelihood (score and category) | | Consequence (score and category) | | | | |
|------------------------------------|----------------|----------------------------------|------------|---------------|-------------|-------------------|
| | | 1 Insignificant | 3 Minor | 5 Moderate | 7 Major | 9 Catastrophic |
| 9 | Almost certain | 9, Medium | 27, Medium | 45, High | 63, Extreme | 81, Extreme |
| 7 | Likely | 7, Low | 21, Medium | 35, High | 49, High | 63, Extreme |
| 5 | Possible | 5, Low | 15, Medium | 25, Medium | 35, High | 45, High |
| 3 | Unlikely | 3, Low | 9, Low | 15, Medium | 21, Medium | 27, High |
| 1 | Rare | 1, Low | 3, Low | 5, Low | 7, Low | 9, Medium |

| Level of Risk (score and vulnerability) | | Meaning |
|--|---------|---|
| 51 to 81 | Extreme | Risks demand urgent attention and cannot be simply accepted as a part of routine operations without deliberate sanction. |
| 27 to 50 | High | High risks are the most severe that can be accepted as a part of routine operations. |
| 9 to 27 | Medium | Medium risks can be expected to form part of routine operations but they will be maintained under continual review. |
| 1 to 8 | Low | Low risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe. |

APPENDIX 2: SUMMARY OF ACTION PLANS

