

Climate change risk management matrix: a process for assessing impacts, adaptation, risk and vulnerability

Workbook

2011

This is a *ClimateQ: toward a greener Queensland* initiative

Toward Q Tomorrow's Queensland | Queensland Government

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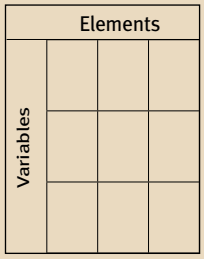

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Managing climate variability is a challenge for all primary industries in Queensland. The impacts of climate change we are currently experiencing and will experience in the future, impose yet another challenge to the way we think about and manage businesses, regions and industries in an uncertain environment.

The science of global climate change is far from settled. Large uncertainties remain regarding the rate of change and the scale and distribution of impacts. Less certain still is how we will respond as individuals and collectively to the problem. Although there is ample cause for concern, such uncertainty also brings the opportunity for new discovery.

The 'risk matrix' is one risk management approach that can help identify the impacts, adaptive responses and risk and vulnerability associated with climate change. Identifying and analysing risks and opportunities, using this risk management approach, can help to plan responses to climate variability and change and can enable organisations to be proactive and more effective in adapting to future uncertainty.

This workbook, based on Australian climate change impacts and risk management: a guide for business and government[1], will assist you through a structured process which identifies:

- impacts of climate change in the context of your organisation or situation
- the level of risk or opportunity presented by those climate change impacts
- possible adaptation responses you could implement
- how vulnerable you are to any risk presented by climate change
- how to communicate the key risks and vulnerabilities to others
- how you can develop an action plan to respond to the risk and vulnerability of climate change.

Armed with this assessment and by revisiting it periodically, you will be better prepared to take action and adapt to our variable climate and climate change impacts.

Climate variability and climate change

Some definitions and terms

Climate is the average weather over time which occurs in a given location.

Weather is day-to-day individual events which make up climate. These are partially determined by the climatic systems and local conditions.

> **Climate** is what you expect;
> **weather** is what you get.[2]

Climate variability is the natural variation in the pattern of the world's weather. This is a naturally occurring process which is currently being accelerated by human activities. Australia has a highly variable climate which varies day to day, year to year and decade to decade.

Climate change is the change in the world's climate over time. This is a process which occurs naturally but which is currently being accelerated by human activities.

The science: Australia is experiencing rapid climate change. Since the middle of the twentieth century, Australian temperatures have, on average, risen by about 1°C with an increase in the frequency of heatwaves and a decrease in the numbers of frosts and cold days. Rainfall patterns have also changed – the north-west has experienced an increase in rainfall over the last 50 years while much of eastern Australia and the far south-west have experienced a decline.[3] The climate in northern Australia is projected to become warmer (0.7–1.2°C), with more hot days (+5 to 40 days/year over 35°C) and fewer cool nights (0 to 12 nights/year under 0°C), higher potential evaporation (2%), higher carbon dioxide concentrations (70–100 ppm) and little change in rainfall (annual, summer and autumn) in the far north, and decreases of 2–5% elsewhere (annual, summer and autumn).

What is climate change?

How is it different to climate variability?

These changes are relative to 1960–1990 values and there are differences between regions and seasons.

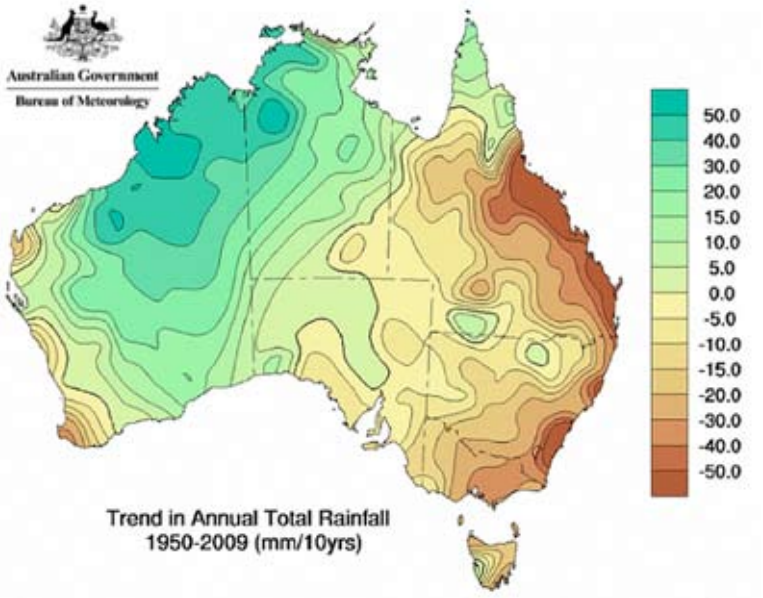


Figure 1. Historical change in annual rainfall across Australia [2]

Consider how climate variability has affected your organisation (business, region or industry) in the past.

Q1

a) Write down one example of a climate event which affected you in the past? E.g. floods in 2010.

b) What was the impact of this event? E.g. reduced access to property and markets.

How have historical changes in climate affected your organisation (business, region or industry)? E.g. tropical grasses are dominating temperate varieties due to higher temperatures.

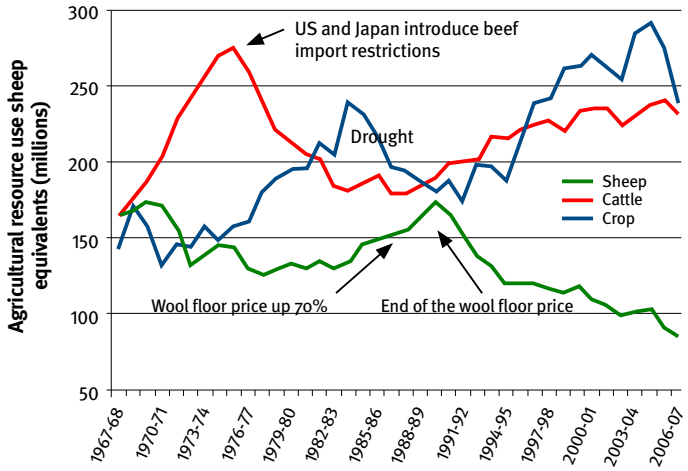
Q2

Adaptation and mitigation

What are adaptation and mitigation?

What are the different types of change?

There are roles for both adaptation and mitigation in climate change. The world is committed to a certain amount of climate change, even if we were to stop emitting greenhouse gases immediately. This means that in the short term we need to adapt to our changing climate. This will also assist in the management of Australia's high climate variability.



Sheep equivalents:
Beef cattle = 8 sheep Dairy cattle = 12 sheep 1 ha crop = 12 sheep

Figure 2. Historical trends in agricultural resource use showing transformational adaptation of rural enterprises to market and climate forces in the mid 1970s, early 1980s and early 1990s. [4]

Some definitions and terms

Adaptation is a process where actions are adjusted to adapt to the impacts of the changing climate. Adaptation actions are immediate solutions to the impacts of a changing climate. These actions may include changing management systems, the mix of enterprises in a business and the type of enterprise (grain, beef, sheep). Adaptation can be either incremental or transformational.

Incremental change is largely maintaining existing activities and building on existing technologies; it is both reactive and proactive.

Transformational change involves major changes in enterprises, land use and human and social capital; it is largely proactive and strategic (see Figure 2).

Mitigation prevents or slows the rate of climate change and contributes to lowering the final level of global warming we experience. Mitigation actions are long-term solutions to global warming and are often based on new technologies and government policies, and include measures such as emissions trading, carbon abatement and carbon sequestration.

Q3 What mitigation activity could you implement in your organisation (business, region or industry) to reduce greenhouse gas levels? E.g. the planting of tree strips to store carbon.

Q4 What responses do you think may be suitable for your organisation (business, region or industry) to adapt to climate change? E.g. building deeper dams with greater capacity; better managing climate variability.

Risk, opportunity, vulnerability and adaptive capacity

Some definitions and terms

Risk is a hazard or the chance of a loss. Risk can be assessed by considering both the consequence of an event occurring and likelihood that the same event occurs.

Opportunity is a benefit that may be identified through the process of risk assessment. Climate change will produce some positive impacts that may provide opportunities to improve economic, environmental and social outcomes.

Adaptive capacity is the ability of a system to adjust to climate change, to moderate potential changes, to take advantage of opportunities or to cope with negative consequences.

Vulnerability is a combination of exposure, sensitivity and capacity to adapt to the changing climate. The degree of exposure and sensitivity gives rise to the potential impact, and the combined effect of potential impact and adaptive capacity gives rise to vulnerability. A risk assessment process such as the 'risk matrix' is a structured way of identifying impacts, adaptive responses and vulnerability to climate change.

Likelihood of a climate change impact occurring can be identified as either almost certain, likely, possible, unlikely or rare. The impact might happen only once, such as the permanent loss of an endangered animal or a plant species but others may be recurring events such as reduced income or ground cover caused by drought. Examples can be used to describe these categories in more detail which helps associate the impact with the most appropriate likelihood category (see page 11).

Consequence of a climate change impact can be identified as either minor, moderate, major, severe or catastrophic. Examples can be used to describe these categories in more detail which helps associate the impact with the most appropriate consequence (see page 12).

Impact is the likely effect of a climate change variable on an element of the relevant organisation (business, region or industry).

What do I find out from the process of risk assessment?

What does the process of risk assessment tell me about my business?

What do you think may be a risk to your organisation (business, region or industry) as a result of climate change? E.g. reduced growth of pasture leading to decreased stock production; reduced persistence of temperate pasture species; decreased quality of tropical pastures. Q5

What may be an opportunity for your organisation (business, region or industry) as a result of climate change? E.g. increased growth of cool season pastures. Q6

Adaptation process

What is adaptation?

How is it related to risk assessment?

Adaptation is a process we undertake throughout our lifetimes in response to change. Businesses use adaptation to reposition themselves to better respond to opportunity and risk. Governments adapt by changing policies and programs to achieve broad societal goals. Likewise, individuals, business, regions, and the community can adapt to climate change and the adaptation process is an effective way of achieving this.

Successful implementation of adaptation responses requires knowledge of the system of interest, assessment of the risk and adaptive responses, briefing policy makers on risks and vulnerability, monitoring and evaluating the relevance, ongoing need and implementation of the responses, raising awareness of the future climate and the risks and opportunities and building capacity of the community to respond to the risks and opportunities that climate change may deliver (see Figure 3).

A risk or vulnerability statement is a means of communicating climate change risks, vulnerabilities and adaptive responses to a range of decision makers who are likely to implement them in management decisions or government policy (e.g. land managers, regional groups, industry bodies, State and Federal Governments). An example of a risk statement follows:

The extreme risk to the grazing industry of more and prolonged drought could lead to lost viability of grazing enterprises in marginal regions and loss of biodiversity in fragile ecosystems.

This level of risk requires an immediate response from the most senior levels of industry leadership, agency management, policy development and government representatives.

This risk can potentially be mitigated through application of seasonal and decadal climate variability technologies, more certainty in regional climate change projections and analysis for policy makers on exceptional circumstance reform, adaptation grants, time limited income support and exit grants to leave the land.

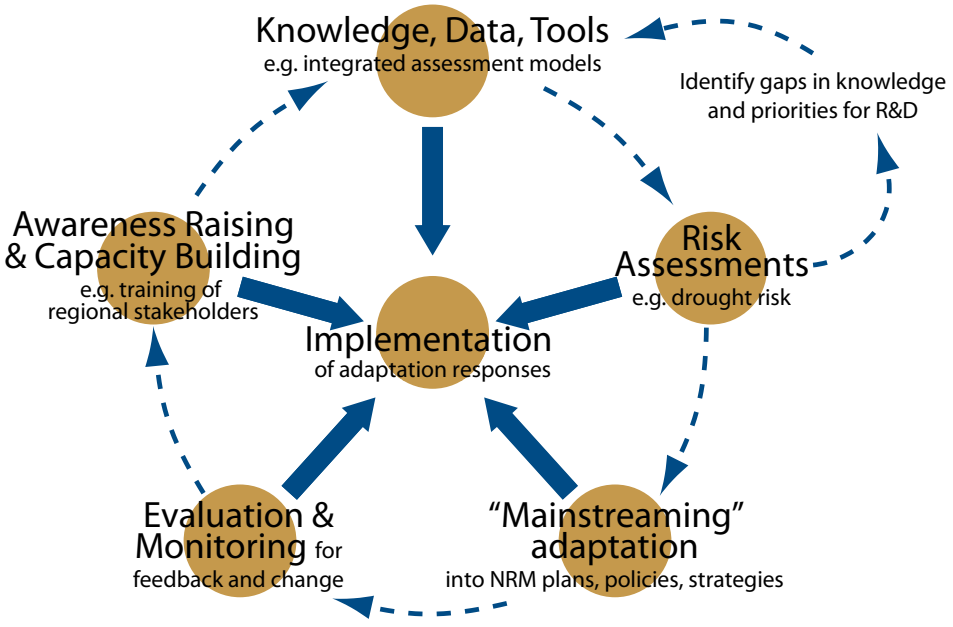


Figure 3. The adaptation process [5]

Impact Risk Matrix

What is an 'Impact Risk Matrix'?

The process of developing the Impact Risk Matrix is a structured way of identifying impacts, risks, and opportunities associated with climate change.

An Impact Risk Matrix (an example for the grazing industry is given in Table 1) describes the impacts of climate change variables (y-axis) on elements of a business, region or industry (x-axis).

The colour coding in each cell shows either the negative (brown) and positive (blue) impacts, or the confidence that scientists place in the projections for the climate variables (red is higher confidence, yellow is lower confidence – see page 9 for definitions). Darker degrees of brown and blue colouring identify impact risk (negative and positive) of greater magnitude, that have been assessed by considering the likelihood and consequence of these impacts occurring.

Table 1. A completed Impact Risk Matrix describing the impacts and showing the risk and opportunities of climate change on elements of the grazing industry [6]. A colour key for red, orange and yellow is given in Table 3, and for blue and brown in Table 7.

Element of the industry	Pasture growth	Surface cover	Plant available water capacity	Wind erosion	Rural human health and well-being	Biodiversity
More days over 35°C	Decrease in pasture growth	Decrease in surface cover	Reduced plant available water capacity due to a reduction in water availability/surface cover	Increased wind erosion due to lower surface cover	Large decreases in rural human health and capacity to cope at current rate of functioning	Changes in plant structure and species composition
More droughts	Severe reduction in pasture growth	Severe reduction in surface cover	Severe reduction in plant available water capacity due to reduction in water availability/surface cover	Increased wind erosion due to lower surface cover	Large decrease in human health, potential for stress related incidence	Major changes in plant and animal species composition
Increased storm intensity – same total rainfall	Decrease in pasture growth	Decrease in surface cover	Decrease in plant available water capacity	Increased wind erosion due to lower surface cover	No change	Changes in insect and plant species composition, siltation of waterholes
Decrease in winter rainfall	Minor decrease in pasture growth	Minor decrease in surface cover	Minor reduction in plant available water capacity due to lower water availability/surface cover	Minor increase in wind erosion due to lower surface cover	Minor decrease in rural human health	Major changes in plant and animal species composition
Decrease in summer rainfall	Severe reduction in pasture growth	Severe reduction in surface cover	Reduced plant available water capacity due to lower water availability/surface cover	Severe increase in wind erosion due to lower surface cover	Large decrease in human health, hardship and welfare, potential for stress related incidence	Changes in plant and animal species composition
More wildfires	Increase in pasture growth	Decrease in surface cover	Decrease in plant available water capacity due to lower surface cover	Increased wind erosion due to lower surface cover	Decrease in human health and welfare related issues	Changes in plant structure and species composition
Higher peak wind speeds	Decrease in pasture growth due to higher evaporation and erosion of topsoil especially in arid and semi-arid regions	Decreased surface cover due to higher evaporation, erosion of topsoil	Decrease in plant available water capacity due to lower surface cover (reduced infiltration into soil)	Increased wind erosion due to higher peak wind speeds	Decrease in human health and increase in welfare related issues	Damage to some tree and animal species
Overall estimate for the risk averse	Reduction in pasture growth	Decrease in surface cover	Decrease in plant available water capacity	Increased wind erosion	Decrease in human health and increase in welfare related issues	General negative long-term effects on ecosystem function

Vulnerability Matrix

What is a 'Vulnerability Matrix'?

The Vulnerability Matrix identifies adaptation responses to the risks of climate change and determines the level of vulnerability. Vulnerability is influenced by both impact risk and adaptive capacity. A completed Vulnerability Matrix (for the grazing industry in Table 2) describes the way in which a business, region or industry could respond to the risks identified in the Impact Risk Matrix.

In addition, the white and pink colour coding in each cell shows the degree of vulnerability (nil, low, moderate or high). White indicates no vulnerability, light pink (low vulnerability), middle shade of pink (moderate vulnerability) and dark pink (high vulnerability). This is discussed further on page 14.

Table 2. A completed Vulnerability Matrix describing the adaption responses and showing the vulnerability to climate change on elements of the grazing industry [6]. A colour key for red, orange and yellow is given in Table 3, and for pink in Table 8.

Element of the industry	Pasture growth	Surface cover	Plant available water capacity	Wind erosion	Rural human health and well-being	Biodiversity
More days over 35°C	Decrease cattle/ sheep in the warm/dry season to maintain pastures; manage utilisation early in the growing season	Decrease total grazing pressure (TGP) to maintain cover	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile for deep-rooted pasture species	Maintain basal area and ground cover to reduce dryness and exposure of surface soil	Increase availability of health services in rural regions; change work-day structure and amenity	Manage invasive plant species; maintain refugia
More droughts	Decrease cattle/ sheep to maintain pastures; manage climate variability to help adjust animal numbers	Decrease TGP to maintain cover; Manage climate variability to help adjust animal numbers	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile	Maintain basal area and ground cover to reduce dryness and exposure of surface soil	Increase availability of health services in rural regions; Counselling services available; Grants for adaptation and further education; Income support	Manage invasive plant species; maintain refugia
Increased storm intensity – same total rainfall	Decrease cattle/ sheep in the warm/dry season to maintain pastures; Maintain biomass for optimal infiltration	Decrease TGP to maintain cover; Use erosion mitigation strategies	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile	Maintain basal area and ground cover after storms to reduce further erosion in the following dry period	No significant action required	Manage invasive plant species; maintain refugia
Decrease in summer rainfall	Decrease cattle/ sheep to maintain pastures; manage climate variability to help adjust animal numbers; Manage non-domestic grazing pressure	Decrease TGP to maintain cover; Manage climate to help adjust animal numbers	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile	Maintain basal area and ground cover to reduce dryness and exposure of surface soil	Increase availability of health services in rural regions; Counselling services available; Grants for adaptation and further education	Manage invasive plant species; maintain refugia
More wildfires	Fire preparedness; Rotate paddocks of heavier grazing as fire breaks	Decrease TGP to maintain cover; Use erosion mitigation strategies; Use controlled fires	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile	Limited ability to manage in wind erosion areas	Increase in need for government support	Increase patchiness and reduce extreme intensity and size; manage refugia
Higher peak wind speeds	Provide shelter belts	Decrease TGP to maintain cover	Maintain basal area and adopt sustainable stocking rate to increase water storage in soil profile	Maintain basal area and ground cover to reduce exposure of surface soil	Tidiness in local amenity and general welfare and safety awareness	Manage invasive plant species; maintain refugia; monitor for invasive insect biota

Risk assessment using the Impact Risk Matrix

Step 1 Define area of interest and timescale boundaries

What physical area do you wish to cover in your risk assessment? E.g. your property/region/state.

What timescale do you wish to address in your risk assessment? E.g. 2030/2050/2070/2100.

Step 2 Identify important climate change variables for your situation

These are listed in Table 3.

The confidence that scientists place on the projection for each climate variable also differs (Table 3).

Record the six most relevant climate change variables and rank them from 1–6 (1 is most important and 6 least important).

Table 3. List of climate change variables and the level of confidence in projections [7]

Your level of priority	Climate change variable	Level of confidence
	Elevated CO_2	Very high confidence (>90%)
	Increased evaporation	
	Higher minimum temperature	High confidence (~90%)
	Less frost	
	Higher maximum temperature	
	More days over 35° Celsius	
	More droughts	Medium – high confidence (>70%)
	Increased storm intensity	
	Decreased winter rainfall	
	Decreased summer rainfall	
	Increased storm frequency	Moderate confidence (>50%)
	More wildfires	
	Higher peak wind speeds	

Step 3 Assign likely changes in climate patterns

Use the climate change summary for your region (see Regional Climate Change Summary [8]) and determine the likely changes in the climate change variables chosen in step 2 based on the spatial and timescale boundaries you selected in step 1.

Determine the likely changes for the 3 most important climate change variables e.g. decreased summer rainfall by five per cent, increased maximum temperature by 1.5°C.

Write these in the space below.

_____

_____

_____

Step 4 Identify elements of the organisation (business, region or industry)

Consider which elements of your business, region or industry that may be affected by the changing climate. These should include issues which affect production, natural resources and social aspects. Examples from the grazing industry include (but are not limited to) pasture growth, surface cover, wool per head, beef per head, gross margins, biodiversity, human health and well-being.

List in the table below these elements of your business, region or industry that are important determinants of production, natural resource sustainability and social well-being, and then prioritise the three most important (1 being the highest and 3 the lowest importance).

Table 4. Elements of the organisation affected by climate change

	Elements	Priority
Production drivers		
Natural resource drivers		
Social or lifestyle drivers		

Step 5 Complete framework of the Impact Risk Matrix

Add the climate variables and elements of the organisation to the Impact Risk Matrix worksheet.

Use the empty Impact Risk Matrix worksheet at the back of the booklet, and

- in cells a, b and c enter the three most important elements of the business, region or industry which were identified in Step 4, and
- in cells d, e and f enter the three most important climate change variables identified in Steps 2 and 3.

Step 6 Describe climate change impacts

Consider and record in the Impact Risk Matrix worksheet the expected impact of each climate change variable for each element of the organisation. Do this independently of the other influences.

Step 7 Determine likelihood category for the impact

Using Table 5, consider the likelihood of the climate change event occurring being in one of the following categories either almost certain, likely, possible, unlikely or rare.

The impact might happen only once, such as the permanent loss of an endangered animal or a plant species but others may be recurring events such as reduced income or ground cover caused by drought (Table 5).

Record the likelihood category in the space provided in each cell of the Impact Risk Matrix worksheet.

Table 5. Likelihood categories describing the occurrence of each impact

Rating	Recurrent events	Single event
Almost certain	Could occur several times per year	More likely than not – Probability greater than 50%
Likely	May arise about once per year	As likely as not – 50/50 chance
Possible	May arise once in 10 years	Less likely than not but still appreciable – Probability less than 50% but still quite high
Unlikely	May arise once in 10 years to 25 years	Unlikely but not negligible – Probability low but noticeably greater than zero
Rare	Unlikely during the next 25 years	Negligible – Probability very small, close to zero

Step 8 Determine consequence category for the impact

Consider the consequence of the impact if the climate change event occurred. Consequence categories range from catastrophic to minor (Table 6).

Write the consequence category in the space provided in each cell of the Impact Risk Matrix worksheet.

Table 6. Consequence categories for assessing impact risk for economic, natural resource and social success criteria

	Profitability and growth	Natural resource sustainability and environment	Supply chain and market	Lifestyle and community	Public safety
Catastrophic	Business would be unprofitable and contract markedly making it unviable. Business would have to be wound up.	Extreme, permanent and widespread loss of environmental amenity and progressive irrecoverable environmental damage	Loss of a key source of supply or market threatening the business	The region would be seen as very unattractive, moribund and unable to support its community	Large numbers of serious injuries or loss of lives
Severe	Business would be unprofitable and contract markedly and would likely become unviable even with significant remedial action	Severe, semi-permanent and widespread loss of environmental amenity and likelihood of irrecoverable environmental damage	Severe disruption of a key source of supply or market having a serious effect on the business	Severe and widespread decline in services and quality of life within the community	Serious injuries or loss of lives occurs routinely
Major	The business would be unprofitable and contract and require significant remedial action to remain viable	Major, semi-permanent loss of environmental amenity and danger of continuing environmental damage	Major disruption of a key source of supply or market having a significant effect on the business	Major and widespread decline in services and quality of life within the community	Isolated instances of serious injuries or loss of lives
Moderate	The business would only be marginally profitable with growth stagnant	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Components of the supply chain and market would require more than normal levels of management attention to protect the business	General appreciable decline in services	Small numbers of injuries
Minor	The business is profitable and growth is achieved but they both fail to meet expectations	Minor instances of environmental damage that could be reversed	Isolated difficulties would arise in the supply chain and market but would be resolved	Isolated but noticeable examples of decline in services	Serious near misses or minor injuries

Step 9 Assign impact risk in the Impact Risk Matrix

Using Table 7 combine likelihood (Step 7) and consequence (Step 8) categories to derive the level of impact risk.

Record the impact risk in the Impact Risk Matrix worksheet. The overall impact of climate change for each organisational element can be derived by adding each of the cells in that column and subjectively coming to consensus on an overall impact (either positive or negative) and an overall impact risk.

Table 7. Level of impact (impact risk) derived by combining likelihood and consequence categories

	Level of negative impact					Level of positive impact				
	Negative consequences					Positive consequences				
Likelihood	Minor	Moderate	Major	Severe	Catastrophic	Minor	Moderate	Major	Severe	Phenomenal
Rare	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Unlikely	Low	Low	Medium	Medium	Medium	Low	Low	Medium	Medium	Medium
Possible	Low	Medium	Medium	High	High	Low	Medium	Medium	High	High
Likely	Low	Medium	High	High	Extreme	Low	Medium	High	High	Extreme
Almost certain	Low	Medium	High	Extreme	Extreme	Low	Medium	High	Extreme	Extreme

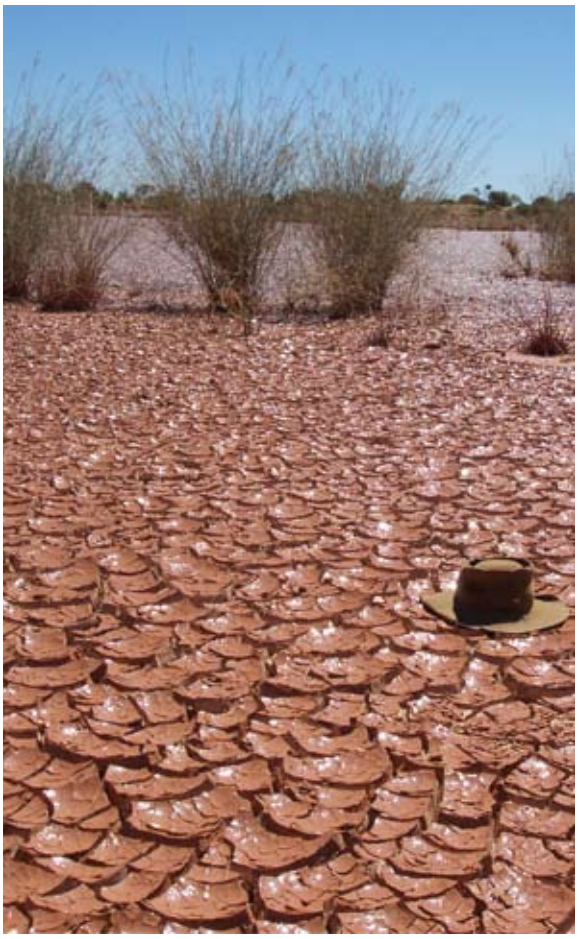
Definitions of the impact risk categories

Extreme – This level of impact risk demands urgent attention at the most senior leadership levels of industry and government. Effective responses are always transformational and not part of routine action.

High – This level of risk needs attention at senior levels of industry executives, agency management and policy development. More senior industry and government representatives need briefing. Effective responses are usually transformational and not generally incremental routine action.

Medium – This level of impact risk needs close monitoring and reporting on at senior levels (industry executives, agency senior management, pastoral company boards, NRM group executives). Effective responses may be incremental and part of routine action.

Low – This level of impact risk requires they be maintained under review but existing controls should be sufficient and no further action is required unless the status changes.



Vulnerability assessment using the Vulnerability Matrix

Vulnerability assessment: steps 10, 11 and 12

Step 10 Describe adaptation responses

Transfer organisational elements and climate change variables from the Impact Risk Matrix worksheet to the Vulnerability Matrix worksheet.

Consider the possible adaptation responses likely to reduce the risks identified in the Impact Risk Matrix. Describe these in the Vulnerability Matrix worksheet.

Step 11 Determine adaptive capacity

Determine and record the level of adaptive capacity for each cell in the Vulnerability Matrix worksheet using the descriptions below as a guide.

Low: A low level of adaptive capacity means it is very difficult and costly for the business, region or industry to implement adaptation activities that are effective (e.g. change in land use).

Medium: A medium level of adaptive capacity perceives some difficulty and expense in implementing change; however it is possible (e.g. changing production systems within the industry to a similar but related activity).

High: a high level of adaptive capacity is where adaptation is feasible and practical (e.g. increasing *Bos indicus* content into a herd).

Step 12 Assign level of vulnerability

Assess the level of vulnerability for each cell and record it in the Vulnerability Matrix worksheet.

Using the impact risk determined in the Impact Risk Matrix in Step 9, cross reference in Table 8 with adaptive capacity determined in Step 11 to derive the level of vulnerability to climate change.

Record the level of vulnerability for each cell in the Vulnerability Matrix.

Table 8. Level of vulnerability derived from combining impact risk and adaptive capacity

	Adaptive capacity		
Impact	**Low**	**Medium**	**High**
Extreme	High	High	Moderate
High	High	Moderate	Moderate
Medium	Moderate	Moderate	Low
Low	Low	Low	Low

Step 13 Prepare a risk or vulnerability statement

Preparing statements can identify the nature and level of risk or vulnerability, the need for, and timing of the response and the nature of useful adaptation responses. There are examples below and on page 6.

The [a]high risk to [b]our cattle enterprise of [c]more droughts and more variable summer rainfall could result in [d]more variable feed supply and movement or sale of animals.

This level of risk requires a [e]planned strategic and tactical response from [f]within our own business.

The risk can potentially be addressed through [g]developing a safe carrying capacity assessment for our property and/or preparing feed budgets and adjusting animal numbers accordingly.

Identify the areas of greatest impact risk OR vulnerability. Choose one. Consider the following and transfer your answers to the relevent blank sections in the statement below.

a) State the level of impact risk (see Step 9) OR vulnerability (see Step 12)
b) State the business, region or industry
c) Identify the climate change variable
d) State potential impact risk or level of vulnerability
e) Identify the timeframe in which the response is required (e.g. urgent, immediate, tactical, strategic, generational)
f) Identify who needs to respond to the statement (e.g. company, regional body, industry, policy)
g) List some of the adaptations which may be able to reduce or address the risk.

The (a) _____ risk/vulnerability (delete one) to (b) _____

of (c) _____

could result in (d)

_____

_____

_____

The level of risk requires an (e) _____

response from (f)

_____

_____

_____

The risk can potentially be addressed through (g)

_____

_____

_____

Step 14 Prepare action plan

Using your identified areas of highest risk and vulnerability complete the table below.

Action 1. What action needs to occur?			
Level of priority?	Who is responsible?	When should it occur?	What is the cost?
Action 2. What action needs to occur?			
Level of priority?	Who is responsible?	When should it occur?	What is the cost?
Action 3. What action needs to occur?			
Level of priority?	Who is responsible?	When should it occur?	What is the cost?

References

1) AGO (Australian Greenhouse Office) (2006). Climate change impacts and risk management, a report prepared for the AGO, Department of Environment and Heritage by Broadleaf Capital International and Marsden Jacob Associates, Canberra.

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Further reading and links

Further reading

McKeon, G.M., Stone, G.S., Syktus, J.I., Carter, J.O., Flood, N.R., Ahrens, D.G., Bruget, D.N., Chilcott, C.R., Cobon, D.H., Cowley, R.A., Crimp, S.J., Fraser, G.W., Howden, S.M., Johnston, P.W., Ryan, J.G., Stokes, C.J. and Day, K.A. (2009) Climate change impacts on northern Australian rangeland livestock carrying capacity: a review of issues. The Rangeland Journal, 31, 1–30.

Stokes, C. and Howden, M. (Eds) (2010). Adapting Agriculture to Climate Change: preparing Australian Agriculture, forestry and fisheries for the future. CSIRO Publishing Collingwood, Victoria.

ClimateQ: Towards a Greener Queensland (2009). http://www.climatechange.qld.gov.au/whatsbeingdone/climatechangestrategy/index.html

Climate Change in Queensland – What the Science is Telling Us (2010). Queensland Climate Change Centre of Excellence, Brisbane.

Websites

Australian Government Bureau of Meteorology – Climate education http://www.bom.gov.au/lam/climate/index.htm

Australian Government Department of Climate Change and Energy Efficiency: http://www.climatechange.gov.au/

CSIRO – Climate Change: http://www.csiro.au/science/Climate-Change.html

Queensland Government Office of Climate Change – http://www.climatechange.qld.gov.au/

LongPaddock – http://www.longpaddock.qld.gov.au/

Impact Risk Matrix worksheet

Date_____

Climate variable	Organisational element		
	a)	b)	c)
d) Level of confidence:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:
e) Level of confidence:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:
f) Level of confidence:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:	Impact: positive/negative Likelihood: Consequence: Impact risk:
Overall impact: **Overall impact risk:**			

Vulnerability Matrix worksheet

Date_____

Climate variable	Organisational element		
	a)	b)	c)
d) Level of confidence:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:
e) Level of confidence:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:
f) Level of confidence:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:	Impact risk: Adaptive capacity: Vulnerability:

Notes