Potential climate change impacts on beef production systems in Australia

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Introduction There is increasing evidence suggesting that Australia's climate is changing due to enhanced levels of greenhouse gases and that it will continue to change (Pittock 2003). Climate changes are partly established, however the impact on systems, industries and process are unclear. Industry distribution reflects climatically imposed boundaries and the relative profitability of alternative land use. Climate change may negatively impact some existing industries but create opportunities for others. This study provides an assessment of the likely impacts of plausible climate change on the beef industry in central Queensland.

Materials and methods Climate change scenarios based on output from a range of General Circulation Models (GCM) were generated for Emerald (23°31'S, 148°10'E), Brigalow Research Station (near Banana, 24°28'S, 150°08'E) and Gayndah (25°37'S, 151°37'E) in central Queensland. Changes in pasture growth, stocking rate, beef production, runoff, deep drainage, basal area and utilisation of pasture, and pasture growth days were assessed for 2030 and 2070. Each projection was for 30 years and combinations of higher (H) and lower (L) levels of predicted temperature and rainfall were generated to form four combinations that consisted of higher temperature/higher rainfall (HH), HL, LH and LL (Table 1). The most likely climate change scenario for north-east Australia is either HL or LL. A perennial native pasture model called GRASP was used to simulate the range of variables under climate change and CO_2 enrichment circumstances. An average CO_2 enrichment scenario was applied where the base CO_2 level was 355ppm in 1990, 452ppm in 2030 and 603ppm in 2070.

Results and discussion The results are summarised in Table 1. Climate change impact on beef production is likely to be considerable in the absence of adaptation or mitigation strategies. Changes in rainfall will have larger impacts on pasture growth and production of beef cattle than changes in temperature. For 2030, a reduction in pasture growth of between 9 and 14% is most likely, reducing stocking rates and beef production. For 2070, these reductions will increase most likely to around 55 to 64%. Increases in the growing season length and enhanced pasture growth efficiency (higher CO_2) failed to compensate for lower moisture levels. Higher levels of pasture utilisation and lower basal area place added pressure on the natural resource, lower runoff will reduce surface water supplies and large reductions in deep drainage of water may reduce the threat of salinity. The challenge is for scientists and industry to anticipate the impacts of climate change and develop regional adaptation strategies that will allow the continuation of profitable beef production.

Table 1 Average control values across the three locations and percentage change from control for different climate change scenarios for 2030 and 2070. Temperature change is a rise in absolute values

	1990	2030				2070			
	Control	HH	HL	LH	LL	HH	HL	LH	LL
Inputs to GRASP from GCM									
Rain	671 mm	+7%	-13%	+7%	-13%	+20%	-40%	+20%	-40%
Max temp	28.7 °C	0.8-1.1	0.8-1.1	0.1-0.2	0.1-0.2	2.3-3.3	2.3-3.3	0.4-0.5	0.4-0.5
Min temp	14.7 °C	0.9-1.2	0.9-1.2	0.1-0.2	0.1-0.2	2.7-3.7	2.7-3.7	0.4-0.6	0.4-0.6
Outputs from GRASP (% difference from control)									
Growth	4094kg/ha	7	-14	9	-9	15	-64	19	-55
Stock rate	23 hd/km^2	6	-15	10	-9	13	-64	20	-53
Beef prod	49 kg/ha	11	-16	13	-11	25	-70	28	-61
Runoff	31 mm	9	-22	10	-23	29	-62	30	-62
Drainage	31 mm	21	-57	40	-49	54	-96	125	-93
Basal area	3 %	5	-12	5	-11	13	-39	14	-39
Utilisation	23 %	-2	7	-3	6	-3	35	-6	43
Beef prod	185 kg/hd	4	0	2	-2	10	-9	5	-12
Growth days	79 %	5	1	2	-1	12	-3	6	-7

References

Pittock, B. (2003). Climate Change: An Australian Guide to the Science and Potential Impacts. Australian Greenhouse Office.