Appendix D.

Climate change effects on pasture systems in south-eastern Australia

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Abstract. Climate change projections for Australia predict increasing temperatures, changes to rainfall patterns, and elevated atmospheric carbon dioxide (CO2) concentrations. The aims of this study were to predict plant production responses to elevated CO2 concentrations using the SGS Pasture Model and DairyMod, and then to quantify the effects of climate change scenarios for 2030 and 2070 on predicted pasture growth, species composition, and soil moisture conditions of 5 existing pasture systems in climates ranging from cool temperate to subtropical, relative to a historical baseline. Three future climate scenarios were created for each site by adjusting historical climate data according to temperature and rainfall change projections for 2030, 2070 mid- and 2070 high-emission scenarios, using output from the CSIRO Mark 3 global climate model. In the absence of other climate changes, mean annual pasture production at an elevated CO2 concentration of 550 ppm was predicted to be 24–29% higher than at 380 ppm CO2 in temperate (C3) species-dominant pastures in southern Australia, with lower mean responses in a mixed C3/C4 pasture at Barraba in northern New South Wales (17%) and in a C4 pasture at Mutdapilly in south-eastern Queensland (9%). In the future climate scenarios at the Barraba and Mutdapilly sites in subtropical and subhumid climates, respectively, where climate projections indicated warming of up to 4.48C, with little change in annual rainfall, modelling predicted increased pasture production and a shift towards C4 species dominance. In Mediterranean, temperate, and cool temperate climates, climate change projections indicated warming of up to 3.38C, with annual rainfall reduced by up to 28%. Under future climate scenarios at Wagga Wagga, NSW, and Ellinbank, Victoria, our study predicted increased winter and early spring pasture growth rates, but this was counteracted by a predicted shorter spring growing season, with annual pasture production higher than the baseline under the 2030 climate scenario, but reduced by up to 19% under the 2070 high scenario. In a cool temperate environment at Elliott, Tasmania, annual production was higher than the baseline in all 3 future climate scenarios, but highest in the 2070 mid scenario. At the Wagga Wagga, Ellinbank, and Elliott sites the effect of rainfall declines on pasture production was moderated by a predicted reduction in drainage below the root zone and, at Ellinbank, the use of deeper rooted plant systems was shown to be an effective adaptation to mitigate some of the effect of lower rainfall.

See Cullen, BR, Johnson, IR, Eckard, RJ, Lodge, GM, Walker, RG, Rawnsley, RP, McCaskill, MR (2009) Climate change effects on pasture systems in south-eastern Australia. Crop Pasture Science 60, 933-942.