Appendix K

Impacts of future climate scenarios on nitrous oxide emissions from pasture based dairy systems in south eastern Australia

R.J. Eckard1, B.R. Cullen1

1 Melbourne School of Land and Environment, University of Melbourne, Vic. 3010, Australia

A b s t r a c t

Nitrous oxide emissions account for ~10% of global greenhouse gas emissions, with the vast majority of them (~90%) from agricultural practices. The dairy industry in south-eastern Australia is largely a pasture based grazing system relying on a combination of pasture legumes, N fertiliser, imported feeds and effluent spreading to ensure adequate N nutrition of pastures. Total N inputs to this pasture system can exceed 300 kg N/ha/yr, with N surpluses often exceeding 200 kg N/ha/yr, resulting in high emissions of N2O. Climate change scenarios for south eastern Australia suggest increasing temperatures, declining rainfall and longer dry summer seasons, raising the question of potential impacts of future climate change scenarios on N2O emissions. EcoMod, a biophysical, mechanistic, daily time-step model, was used to model effects of 4 future climate change scenarios (measured baseline of 1971–2000, 2030 high emission scenario, 2070 mid emission scenario and 2070 high emission scenario) on N2O emissions for 4 different soil type, climate and system combinations. Annual N2O emissions increased in the future projected climates at all sites except Elliott, where N2O emissions remained low due to well drained soil. At the remaining sites, the model showed an increase in number of days with soil water filed pore space (WFPS) in the range of 0.6–0.8 during the wetter colder months and fewer days with WFPS 0.6–0.8 during the drier, warmer months. Warmer soil temperatures, coupled with wet but less saturated soils, resulted in an increased opportunity for N2O production during cooler months, while the potential for N2O production during warmer months remained low. Emission factors (i.e., proportion of N inputs lost as N2O) changed in the future climate scenarios, emphasising the need for a more dynamic and mechanistic modelling approach in development of national greenhouse gas inventories. The likelihood of increased N2O emissions from pasture based dairy systems with the progression of climate change emphasises the need for targeted N2O abatement options for intensive grazing systems.

See Eckard RJ, Cullen BR (2011) Impacts of future climate scenarios on N2O emissions from pasture-based dairy systems in south eastern Australia. Animal Feed Science and Technology, 166-167, 736-748. doi:10.1016/j.anifeedsci.2011.04.052