Attachment A : ABARE research on climate change and adaptation in agriculture

Kokic, P., Heaney, A., Pechey, L., Crimp, S. and Fisher, B., 2005 Climate Change: Predicting the impacts on agriculture: a case study, *Australian Commodities*, vol. 12, no. 1, pp. 161-170.

- The objective in this paper is to explore the impacts of longer term climate change on key production variables in the Australian broadacre industry, and to gain some insight into the nature and extent of pressure to adapt to climate change.
- Under conditions of longer term climate change, adaptation will be important for managing climatic variability and extremes as well as changes in average conditions. While climatic conditions are already variable across Australia and farmers have developed farming systems that have adapted to this variability, this does not necessarily mean that they will be equipped to deal with the longer term impacts of climate change.
- Two climate change scenarios are examined in the paper. Scenario 1 represents the lowest range of projected temperature increase combined with the lowest range of decreased rainfall. Scenario 2 represents the lowest range of projected temperature increase combined with the highest range of increased rainfall.
- Results for changes in land values indicate that farms in the cropping, mixed enterprises and livestock (beef, sheep, beef–sheep) industries are all predicted to experience a substantial decline in land values under scenario 1. Under scenario 2 all industries are predicted to benefit to a greater or lesser extent. Results for changes in wheat yields indicate that the yields in all wheat producing regions are predicted to decline under scenario 1. Under scenario 2 the marginal areas are predicted to become more productive.
- Strategies to reduce vulnerability to longer term climate change are likely to involve longer term investments, such as improving water management practices or research and development of new technologies and crop varieties that are more suited to drier and/or warmer conditions.
- The research also indicates that uncertainty associated with climate change could slow down the rate of long term investment in adaptation strategies.

Nelson, R., Kokic, P., Elliston, L., and King, J. 2005, Structural Adjustment: a vulnerability index for Australian broadacre agriculture, *Australian Commodities*, vol. 12 no. 1, pp. 171-179.

- The objective in this paper is to develop an indicator of the vulnerability to structural adjustment of Australian farm households that are dependent on broadacre agriculture using existing data from ABARE's annual farm surveys.
- This paper does not directly link climate change and farm performance but presents a detailed discussion of the factors affecting the farm sector's ability to adjust to negative shocks, including diversification in farming activities, level of education of farm managers, and farm income. The paper also measures a farm's exposure to external events, although climate change is not dealt with separately.
- The term structural adjustment is used to express the ongoing shift in the distribution of activities and resources within and between individuals and firms in an attempt to improve efficiency, contribute to economic growth and raise living standards.

- The research led to the construction of a vulnerability index, which was then mapped to identify regions where farm households are likely to be most vulnerable to external influences that may force structural adjustment. The vulnerability index can assist in ensuring that government policies enhance the self reliant resilience of farm households in regions at risk.
- The relationship between areas with a high vulnerability index and the sheep industry is prominent.

Kokic, P., Nelson, R., Potgieter, A. and Carter, J. 2004, *An Enhanced ABARE System for Predicting Farm Performance*, ABARE eReport 04.6 Prepared for Land and Water Australia, Canberra, February.

- The objective in this report is to investigate the feasibility of linking output from two well established biophysical models to ABARE's farm survey data to forecast the regional impact of climate variability on farm financial performance.
- Climate variability is a normal part of Australian agriculture, and managing climatic risk is critical to the profitability and sustainability of Australian broadacre farming businesses. Most of Australia's agricultural regions have an extremely variable climate, with climate variability having affects directly through production risk, or indirectly through price risk.
- The results demonstrate that crop, pasture and economic models can be integrated to forecast farm financial performance. This provides a basis for being able to assess the major risks to farming, and the tools available to control these risks, in an environment where seasonal climate variation dominates the productive capacity of broadacre farming.
- The model developed in this report was utilised in the ABARE eReport 04.23 (see below).

Nelson, R. and Kokic, P. 2004, *Forecasting the Regional Impact of Climate Variability on Australian Crop Farm Incomes*, ABARE eReport 04.23 Prepared for the Grains Research and Development Corporation, Canberra, December.

- The objective in this paper is to improve the analytical support for policy makers seeking to reduce the vulnerability of Australian farm incomes to climate variability. A hybrid model developed by ABARE that links the output of biophysical models with ABARE's farm survey data provides the capacity to simulate the regional impact of climate variability on farm incomes.
- The incomes of Australian crop farmers are highly sensitive to climate variability. The sensitivity of farm incomes to climate variability differs between industries and geographic regions, and understanding these differences is essential for improving drought preparedness and improving coping mechanisms.
- Results indicate that it is possible to forecast the income effects associated with seasonal forecasts for the coming financial year. Seasonal forecasting of income variability could improve the timing, and better target the duration, of assistance under drought policies, including exceptional circumstances.
- Results also indicate that the sensitivity of farm incomes to climate variability across Australia's cropping regions is strongly related to the diversity of both on-farm and off-farm income sources. With Australian drought policy focused on enhancing the

self reliance of farmers, enhancing the diversity of farm income sources could be one of the most effective options for reducing the vulnerability of farm households to climate variability.

Beare, S. and Heaney, A. 2002, '*Climate change and water resources in the Murray Darling Basin, Australia*' ABARE Conference Paper 02.11.

- The objective in this paper is to examine the impact that varying greenhouse gas emission paths will have on the hydrological cycle, particularly stream and ground water flows, water quality and irrigated agriculture in the Murray Darling Basin. The paper also examines the extent to which market based options, such as investments to increase water use efficiency and water trading, could be used to offset these impacts.
- In Australia, changes to the hydrological cycle under conditions of enhanced global warming are likely to be complex and spatially diverse. A simulation model is used to examine the potential impact of changes in precipitation and evaporation for two scenarios of climate change developed by the Intergovernmental Panel on Climate Change. Two further simulations for each of the global warming scenarios were undertaken to assess the potential for improved irrigation water use efficiency and water trading to minimise the costs associated with adapting to climate change.
- The study found that improved water use efficiency and water trade can significantly reduce the costs of adapting to a drier climate. However, both will require well defined and secure property rights to achieve the maximum benefit.