Uncertain Harvest:
The predicted impacts of global warming on Australian agriculture

EXECUTIVE SUMMARY

Global warming is occurring at a rate that will clearly affect biological systems in Australia. The net effect for the majority of Australian agricultural sectors will be significantly negative. Farmers can expect less rainfall on average, increased evaporation, and increased frequency and severity of extreme events. These effects will combine to decrease productivity in many parts of the nation. Many commercial crops and livestock in Australia are already at the limit of their natural range and are vulnerable to this added stress. The annual costs in gross revenue due to climate change could be as great as $152 million per annum for the Macquarie Valley region of New South Wales alone by around 2030. The severity of the 2002 drought has been clearly linked to climate change and has led to a forecasted 21% decline in the gross value of farm production for 2002-03. The worst drought on record, it may be considered an insight into future droughts as El Niño-Southern Oscillation (ENSO) events intensify with global warming.

A. THE KEY EFFECTS WITH REGARD TO AGRICULTURE ARE AS FOLLOWS:

1. Unprecedented warming:

The climate is warming at a rate unprecedented in the last 1,000 years, a warming which can already be seen in climate records. According to the World Meteorological Organisation (WMO), a United Nations agency, the 10 warmest years have all occurred since 1987, nine of these since 1990. This rate of temperature increase is unprecedented in the last 1,000 years, and this warming, along with related weather events, is already having an impact on natural systems around the world.

Between 1910 to 2000, the average surface temperature in Australia increased by 0.76ºC. Looking to the future, most of Australia will experience temperature increases of 0.4–2.0°C in 2030 and 1.0–6.0°C in 2070 relative to 1990. Even with a relatively small average temperature change, the number of days of extreme temperatures increases disproportionately. For example, there will be 20% more days exceeding a maximum of 35°C by 2050 with an average temperature increase of only 1.7°C in the north-west of NSW. These temperature increases will affect other climatic variables, for example rainfall and soil moisture content, alterations which are also expected to affect agricultural production.

2. Drought intensity

The 2002 drought was the worst on record, and the first to bear the stamp of climate change, as higher temperatures caused a marked increase in evaporation rates. Australia's climate is dominated by the ENSO phenomenon, an event which sometimes culminates in severe drought. Regions such as Australia, which currently experience droughts during El Niño years are expected to experience these conditions more intensely and more often, as ENSO events become extreme, and because higher temperatures will increase evaporation rates during drought. There is also some indication from a number of climate model experiments that global warming will lead to an "average" climate that resembles an El Niño-like state.

Climate models predict that all regions of Australia will experience increased moisture stress. Winter rainfall through the southwest of Western Australia has already decreased to about 85 - 90% of the average observed in the middle decades of the 20th century, and global warming may have contributed to this decline. The combined effect of decreased rainfall and increased evaporation are expected to result in a decreased annual water balance of about 40 to 120 mm per degree of global warming, which represents decreases of 15 to 160 mm by 2030, and 40 to 500 mm by 2070.

Major river systems could be affected. The mean flow of the Murray-Darling is predicted to be reduced by 12 - 35% by 2050. Mean annual runoff to the main water storage on the Macquarie River, the Burrendong Dam, is predicted to decrease by between 12 and 32% by 2030.

3. Floods and rainfall

In many parts of Australia, although average rainfall may decrease or not change, the number and intensity of heavy rainfall events are expected to increase. Some impacts on agricultural production include increased vulnerability to salinity, soil erosion and concomitant nutrient loss, impacted water supply infrastructure through increased siltation, crop damage through heavy rainfall events, and increased insurance costs due to higher potential storm damage.

4. Extreme weather frequency & severity

More frequent and severe extreme weather events in Australia such as hurricanes, tropical cyclones, dust storms, very hot days and fire weather, as well as the droughts and floods already discussed, are predicted due to global warming. Such extreme events will have a direct impact on agricultural production, and will also increase the insurance costs of farm infrastructure.

B: THESE CHANGES IN CLIMATE COMBINE TO CREATE COSTS TO AGRICULTURE

The above factors all combine to decrease productiveness of agriculture and livestock in many parts of Australia. In the Macquarie Valley region of New South Wales alone, taking into account the factors of higher temperatures, higher CO_2 levels, lower irrigation water diversions, lower rainfall and higher evaporation, the potential effect on the local economy was calculated to be a loss in gross revenue of between $38 million and $152 million dollars per year (or 6 - 22%) by around 2030.

While it is possible that some agricultural sectors could benefit from limited increases in CO_2 concentration, the majority will experience significant negative impacts. It appears that many commercial crops and livestock in Australia are already at the limit of their natural range and so are vulnerable to added stress from higher temperatures and changes in rainfall patterns. In addition, most research reviewed in this report does not include the effect of extreme events such as drought, floods, and hail, events also likely to be costly to agriculturalists. The following lists some impacts on certain agricultural crops, sectors and issues detailed in the report.

Some sectors vulnerable to the effects of climate change on agriculture are:

- **Fruit:** Temperature increases exceeding 1.5°C would bring about warmer winters, reducing accumulated chilling required by some fruit trees, and resulting in prolonged dormancy. This may be expected to lower yields and reduce fruit quality. Stone-fruit and apples in southern Australia are particularly vulnerable.
- **Cotton:** Production may be affected by intensified competition for diminishing water supplies.
- **Viticulture:** As a result of higher temperatures, ripening will occur in the hotter months of the year and result in a reduced window for harvesting, lead-

ing to the risk of reduced grape quality. Excessive vegetative development could lead to canopy shading and potential decreases in fruitfulness. Most, if not all, regions will experience decreased water availability. Increased vulnerability to botrytis is likely with higher summer rainfall.

- **High rainfall pastures:** Expected decreases in winter and spring rainfall in southern Australia would greatly reduce plant production, significantly constraining animal production.
- **Rangelands:** A 20% reduction in rainfall at doubled CO_2 is likely to reduce pasture productivity by about 15% and live-weight gain in cattle by 12% and substantially increase variability in stocking. For the Macquarie River region of NSW as much as a 43% reduction in pasture growth in the Trangie and Carinda areas could occur by 2030 with an average annual revenue loss of $186 million.
- **Dairy cattle:** Rising temperatures are likely to lower milk yield from cows. By 2030, annual milk losses are likely to be between 250 and 310 litres per cow, depending on the rate of warming.
- **Beef cattle:** Increased heat stress-related livestock deaths are expected. Heat stress in Australian beef cattle already increased 40% in frequency between 1957 to 1996, and is estimated to increase by a further 138% by the year 2050 because of climate change. Increases in heat stress, water consumption, possible changes in grass distributions, and increased soil water logging and salinity, especially in marginal grazing lands, will offset any initial advantages that increased temperature and atmospheric CO_2 will bring to pasture growth.
- **Water resources:** Estimated stream flow in the east-central Murray Darling Basin could decrease by as much as 20% by 2030, and as much as 45% by 2070. This would result in water shortages, particularly in winter rain-fed systems that are already under stress. This would sharpen competition between different water users. Although there are large uncertainties in these estimates, the results show the potential for climate change to bring about runoff modifications that may require a significant planning response.
- **Eutrophication** (nutrient loading): Eutrophication is already a major water quality problem in Australia, and local climate warming and the potential for reduced streamflow may lead to increased occurrence.
- **Pests and Weeds:** Insect pests are likely to produce some of the earliest and most significant impacts of climate change. Projected warming will increase the ability of pests to survive winters, and accelerate the development of most summer-active species. A warmer climate would enable tropical species, such as the Queensland fruit fly Bactrocera (Dacus) tryoni and the cattle tick, to spread southwards into NSW and threaten exclusion zones established to protect interstate and international trade. Plant pathogens are likely to become more severe in areas with dry summers if the frequency of summer rainfall events increases. This would affect the viticulture industry in particular.

C: EXAMPLES OF AGRICULTURAL IMPACTS ALREADY FELT TODAY

In the eight months from March to October 2002, approximately 70% of the Australian continent received rainfall totals in the lowest 10% of all March to October periods since 1900. Nearly all remaining areas of Australia experienced drier than average conditions, accompanied by higher than average maximum temperatures. The Australia-wide average maximum temperature during the Southern Hemisphere autumn, winter and spring of 2002 was the highest since high quality temperature records commenced in 1950.

The impact on agriculture is clear. Production of Australia's four major winter crops — wheat, barley, canola and lupins — is set to fall to 14.8 million tonnes in 2002-03, down 57% from last season's harvest of these crops of 34.1 million tones. The area sown to cotton is estimated to be down 45% from last season because of a substantial reduction of irrigation water, while the rice area has been cut back by nearly 70%.

D: SOLUTIONS FOR CURBING CLIMATE CHANGE:

Climate change is a global problem, but Australians are among the top three nations in the world in terms of per capita emissions of greenhouse gases. Australia is also positioned to become a world leader in clean energy solutions due to resource availability, regional positioning, and the skills and technology base available.

Such solutions, including renewable energy like wind and solar, are readily available. Wind power, for example, not only has the capability to deliver electricity with virtually no emissions, but wind development would also provide a drought-proof cash crop to farmers and others in economically hard-hit rural and regional areas in Australia. For more information, see the AusWEA report "Driving Investment, Generating Jobs". This report also makes the point that supportive policies are crucial to the growth of new industries and that an increased Mandatory Renewable Energy Target (MRET) provides the best legislative tool for expanding and developing Australia's clean, green energy industries. Such growth would drive employment and investment in rural areas.

The full report and executive summary of this report, as well as the AusWEA report "Driving Investment, Generating Jobs" are available electronically at:

www.thewind.info and www.auswea.com.au

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