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Standing Committee on Primary Industries and Resources
PO Box 6021
House of Representatives
Parliament House
Canberra ACT 2600

16th March 2009

RE: Submission on the role of government in assisting Australian farmers to adapt to the impacts of climate change.

To whom it may concern

This submission is made on behalf of partners of the national Climate Change Research Strategy of Primary Industries (CCRSPI) network hosted by Land & Water Australia.

CCRSPI is a collaborative partnership, operating under a mandate from Primary Industry Ministerial Council, Primary Industry Standing Committee and the Council of Research and Development Corporation Chairs. CCRSPI was established to deliver a coordinated and collaborative national approach to climate change research programs in the primary industries. CCRSPI partners are the primary industries state agencies, all the rural Research and Development Corporations, the Australian Government Department of Agriculture, Fisheries and Forestry, and the CSIRO.

The enclosed submission encompasses input from the CCRSPI partners and has been endorsed by the CCRSPI Steering Committee. The submission reflects the fact that CCRSPI has a specific remit to identify and address climate change research issues that impact across primary industry sectors and regions. The individual CCRSPI partner organisations may also have provided their own submissions.

Thank you for the opportunity to contribute to the Inquiry by the House of Representatives Primary Industries and Resources Committee.

Yours Sincerely,

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Chair, CCRSPI Steering Committee

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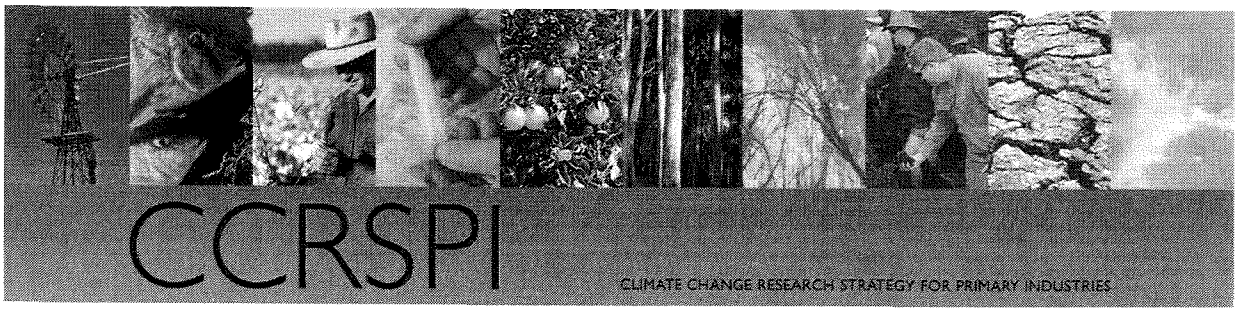
The role of government in assisting Australian farmers to adapt to the impacts of climate change

A submission from the CCRSPI network to the HoR Primary Industry & Resources Standing Committee

17 March 2008



Contents

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ACAD	Australian Council of Agricultural Deans
ACMF	Australian Chicken Meat Federation
AEC	Australian Egg Corporation
APL	Australian Pork Ltd
AWI	Australian Wool Innovation
BoM	Bureau of Meteorology
CCRSPI	Climate Change Research Strategy for Primary Industries network
CPRS	Carbon Pollution Reduction Scheme
CRC	Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
CRRDCC	Council of Rural Research and Development Corporation Chairs
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Dairy Australia
DAFF	Dept of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food Western Australia
DCC	Department of Climate Change
DPI	Department of Primary Industries (NSW, Victoria)
DPIW	Department of Primary Industries and Water (Tasmania)
FFI CRC	Future Farm Industries - CRC
FWPA	Forest and Wood Products Australia
GHG	Greenhouse Gases
GM	Genetically Modified
GRDC	Grains Research and Development Corporation
G&S	Goods & Services – food, fibre, energy and ecoservices
GWRDC	Grape and Wine Research and Development Corporation
HAL	Horticulture Australia Ltd
LCA	Life Cycle Assessment
L&WA	Land & Water Australia
MCV	Managing Climate Variability program
MLA	Meat and Livestock Australia
NACCAP	National Agriculture and Climate Change Action Plan
NCCARF	National Climate Change Adaptation Research Facility
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
QDPI&F	Queensland Department of Primary Industries and Fisheries
R&D	Research and Development
RDCs	Rural Research and Development Corporations
RDE	Research and Development, commercialisation, Extension and training
RIRDC	Rural Industries Research and Development Corporation
SARDI	South Australian Research and Development Institute
SCRRAT	(the Senate) Standing Committee on Rural and Regional Affairs and Transport
SRDC	Sugar Research and Development Corporation
ToR	Terms of Reference

Executive Summary

Australian agriculture has a long history of resilience and innovation; adapting to one of the world's harshest and most variable climates while supplying dynamic global markets.

Productivity growth in Australian primary industries has been driven in large part by innovations flowing from research and development, commercialisation, extension and training (RDE). Rural RDE capacity and funding have fallen in recent times both domestically and globally. Agricultural productivity growth is now falling. Furthermore, the rate of change and magnitude of the challenges associated with drought and climate change is unheralded; it is already impacting significantly on primary industries.

Continued government interventions are required to address market failures in RDE activity, to support innovation, and to protect the contribution Australian primary industry makes to national wealth and wellbeing. Greater levels of RDE spending will be required to meet the challenges of climate change.

Climate change brings new challenges for governments attempting to efficiently regulate Australia's primary industries. Governments need to craft regulatory frameworks and complimentary measures that assist farmers adapt to the biophysical and economic implication of climate change, while avoiding perverse outcomes and minimising negative social and economic impacts.

Simultaneously, governments need to reduce the current regulator burden that impedes the efficiency and flexibility of primary industries. Coregulatory frameworks, such as Farm or Environmental Management Systems, provide governments with a mechanism to achieve widespread and ongoing adoption of rural R&D without excessive regulatory costs.

Primary industries, whilst not initially covered under the proposed CPRS, are exposed both to increased input costs as well as the financial impacts on downstream processing, distribution and retail, being passed back up the value chain.

Significant social pressures will accompany the economic and biophysical impacts of climate change on primary industry – especially when the changes in primary production flow onto labour-intensive primary processing and service industries. Government has a clear role in assisting individuals and communities to adapt to the socio-economic impacts of climate change.

More research is required to support policy development and regulatory formulation.

Australia has small capital markets, relative to competitors, and this increases the need for government investment to assist in the commercialisation of technologies that will help Australian farmers to adapt and generate wealth.

The many successes of existing RDE investments are due to the effectiveness of the partnership between industries and government. Future challenges will require an ongoing commitment to effective partnership from both the government and industries collectively.

Australia's relatively small rural RDE spending must be directed strategically and managed efficiently. A national collaborative approach to RDE is required to avoid duplication and poorly targeted efforts. The Climate Change Research Strategy for Primary Industries (CCRSPI) network is the only body involving all major rural RDE providers and funding bodies including

all the rural R&D corporations, the State primary industry departments, the CSIRO, and the Australian Government via DAFF. CCRSPI also has significant engagement with the University sector.

CCRSPI is uniquely placed to assist the Australian Government in strategically directing RDE investment to help Australian primary industries adapt to the impacts of climate change.

Introduction

CCRSPI, the *Climate Change Research Strategy for Primary Industries* network, is a collaborative partnership between all the rural Research and Development Corporations (RDCs), the primary industry departments of State Governments, the *Department of Agriculture Forestry and Fisheries*, the CSIRO, and a number of experts from the university sector including representatives of the *Australian Council of Agricultural Deans*. CCRSPI is founded on primary industries collaborating, coordinating and communicating with each other so that information can be shared, knowledge generated, and responses developed to deal with climate change.

CCRSPI welcomes this opportunity to make a submission to the House of Representatives Standing Committee on Primary Industries and Resources (the committee) on *The role of government in assisting Australian farmers to adapt to the impacts of climate change.* This submission represents a collaborative effort from partners, endorsed by the CCRSPI steering committee. Individual partners retain the option of making separate submissions.

CCRSPI operates under a mandate from the *Primary Industries Ministerial Council* (PIMC), the *Primary Industries Standing Committee* (PISC), and the *Council of Rural RDC Chairs* (CRRDCC) to establish, develop and deliver a coordinated and collaborative national framework for the implementation of climate change research programs addressing both adaptation and mitigation. CCRSPI has recently received an in-principle commitment from its stakeholders to continue for a further five years.

As noted in the Senate's 2008 *Standing Committee on Rural and Regional Affairs and Transport* report the CCRSPI network has already made considerable contributions to the issues raised by this inquiry. One such contribution is CCRSPI's Phase 1 report: *A National Climate Change Strategy for Primary Industry* (July 2008).

The importance of Australian agriculture

Australian agriculture seeks to provide a combination of food, fibre, energy and ecosystem services (G&S) while sustainably maintaining or enhancing natural resources to increase the wealth and wellbeing of all Australians and our global community.

Australian agriculture directly contributes around 3% of Gross Domestic Product (GDP). However, when post farm-gate value is considered along with the value of supporting industries, agriculture's contribution to GDP rises to 12.1% (Econtech 2005 quoted in CRRDCC 2008). These agriculturally dependent sectors employ approximately 1.6 million people or 17.2% of the Australian work force (*ibid*). The importance of various primary industries to towns and regions can be even more pronounced.

Agriculture, fisheries and forestry contribute some 16.3% of Australia's export earnings, contributing to the national wealth of all Australians (ABARE 2007), while the benefits of affordable fresh food and vegetables along with the national security implications of a strong domestic agriculture sector are invaluable.

Impacts of climate change on Australia's already highly variable climate

There is broad consensus that climate change will involve increasing atmospheric carbon dioxide levels and higher average temperatures. However, there is considerable uncertainty about how climate change will impact Australia's diverse geography and primary production industries.

Australia's climate is already one of the most variable in the world. Climate change is expected to increase this inherent variability with less regular rainfall patterns and increased frequency of extreme events including hot days, floods, fires, frosts, and hail.

Irregular rainfalls, combined with higher evaporation rates and probably some decline in total rainfall, will result in reduced and more variable flows to water bodies, impacting on irrigation supplies and security.

Changes in temperature and rainfall patterns can also be expected to change the prevalence and distribution of weeds and other invasive species.

A comprehensive review of these issues is contained in a CCRSPI funded CSIRO report (Stokes & Howden 2008) which can be downloaded from the CCRSPI website: http://lwa.gov.au/ccrspi/node/21.

ToR 1a: Current and prospective agricultural adaptations

Service Need- Increase the total primary industry RDE spend, this will:

- support and expand existing adaptation activities, such as soil and landscape management, biotechnology, risk management, and irrigation efficiencies;
- enhance the proven ability of Australia's primary industries to identify and commercialise new innovations in response to domestic and international opportunities.

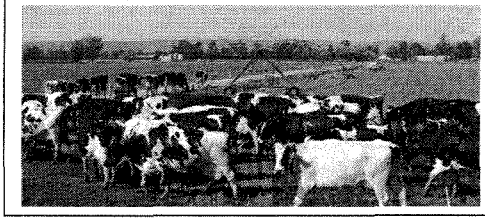
Australian farmers are highly adaptive and resilient, having remained competitive in global markets over the long term through droughts, volatile commodity prices, fluctuating exchange rates, and in the face of various protectionist measures.

CCRSPI has identified a large number of climate change adaptations for Australia's primary industries (Stokes & Howden 2008). Many of these are extensions or enhancements of existing activities that are aimed at managing the impact of existing climate variability and enhancing natural resource management.

Examples include soil conservation practices, such as no-till cropping and stubble mulching as well as risk management practices to reduce a farmer's exposure to climate variability (Price, Stewart, *et al* 2007). Better decision support tools are required to underpin these practices, as well as more suitable cultivars such as fast growing crop varieties that can be opportunistically sown in response to less predictable rainfall events.

Case Study: Biotechnology
GM rye grass, developed by the Victorian DPI, demonstrates what biotechnology can contribute to climate change adaptation.

This pasture produces C4 rather than C5 carbohydrates, which not only greatly increases water use efficiency but improves the feed utilisation efficiency of cattle and reduces their enteric methane emissions.



Similarly cultivars will be required that are more water efficient, more drought tolerant, less nitrogen intensive, and capable of exploiting higher carbon dioxide levels. Permanent horticultural plantings also require these traits, as well as greater tolerance of extreme heat events and resilience to periods of minimal or zero irrigation. Additionally, the development and adoption of more efficient irrigation technologies and practices will be another focus for rural RDE.

Biotechnology, and genetic modification (GM) or molecular plant breeding, offers the potential to increase the rate at which advances in plant breeding can be achieved. The Future Farming Systems CRC is currently plant prospecting – that is, investigating the traits of Australia's vast number of indigenous plant species, seeking traits to enable further breakthroughs in adapting Australian farm production to the pressures of climate change.

Livestock producers will increasingly rely on supplementary feeding to maintain stock numbers and/or production through periods of low rainfall (Garnaut 2008). Additionally, genetic development of livestock to improve heat tolerance and feed conversion efficiency on a wider range of feed sources, while maintaining or improving product quality and yields, will continue

to be a primary imperative for rural RDE eg see the outputs of the Beef, Pork, Sheep and Chicken CRCs.

Appropriate landscape management can also increase the resilience of farms to climate change. Targeted plantings of fast growing trees and woody perennials, such as wattle or oil mallees, can provide wind breaks and shade, reduce dry land salinity and minimise nutrient and salt run off, while also serving as animal corridors and providing habitat. This may increase the farm's resilience while helping conserve Australia's biodiversity resources in the face of climate change pressures. Pyrolysis or gasification, combined with the generation of distributed renewable energy, are technologies that could provide an alternative income stream for farmers adopting these practices.

Adapting to a carbon constrained economy: Australia's sugar industry is now using a "waste" byproduct - bagasse – to cogenerate over 1,000 GWh of electricity per annum plus a similar amount of heat. The heat is used to crystallise the sugar, while most of the electricity is exported to the grid.

Over 70% of Queensland's sugar industry have replaced stubble burning with mulching. This has improved soil carbon storage, water and nutrient use efficiency, and minimised nutrient run off.

This combination of practices has reduced GHG emissions throughout the supply chain and improved economic and environmental outcomes, while creating regional jobs in renewable energy (Park *et al.* 2008).

Pyrolysis provides a stable quantifiable technique to bio-sequester carbon – removing the technical impediments to its inclusion in GHG mitigation regulations (Sohi, Lopez-Capel *et al.* 2009). However, considerable R&D is required not only to commercialise pyrolysis plants but to determine the agronomic benefits of various organic feed stocks in different soils and farming systems (*ibid*).

Other distributed renewable energy technologies show more immediate potential such as heat and power generation from bagasse and aerobic digestion of animal manures to produce biogas for heat, power or cooling.

ToR 1b: Implications for downstream processing

Service Need- Support RDE to:

- inform policy makers and primary producers of the impacts of climate change on production and processing;
- develop processing adaptations such as water efficiency, renewable energy and supply chain optimisation;
- inform and support government assistance measures directed at sector and regional structural adjustment;
- assist individuals and communities to transition from declining industries to emerging ones.

Climate change will have implications for where processing infrastructure is needed as commodity production contracts, expands, or relocates and as new commodities are produced. Some industries will require more processing infrastructure, for example higher temperatures will compress the wine vintage increasing the requirement for harvesting and processing infrastructure.

Processing infrastructure is generally much more capital intensive and often less mobile than the industries that supply it. Furthermore, there will be social challenges associated both with shutting existing processing facilities and staffing new ones.

There is a role for government in assisting individuals and communities to transition from declining industries to emerging ones, while minimising social dislocation and dysfunction.

Less reliable production associated with a more variable climate is likely to reduce returns to capital and increase the difficulties associated with maintaining, operating and staffing processing infrastructure. The cost of future capital investments will probably rise in response to these risks.

Downstream processing of agricultural products, especially animal products, tends to be labour intensive. Processing facilities that incorporate greater flexibility or that use less capital tend to be more labour intensive. While capital costs are high, agricultural labour is scarce.

The global financial crisis and increases in domestic unemployment are unlikely to improve labour supply due to cultural and demographic factors, i.e. there is unlikely to be a substantial shift in labour resources from urban centres to rural jobs such as seasonal fruit pricking or meat processing.

The Commonwealth's 457 skilled work visas and *Australian Pacific Seasonal Workers Pilot Scheme* offer suitable alternatives for labour provision to some primary industries. There is clearly a role for Government in providing appropriate regulatory frameworks to ensure these programs benefit the wealth and wellbeing of all Australians without exploiting the migrant labour force or their communities. Rural RDE networks have a role in providing the training necessary to ensure farmers and agribusiness are equipped to access and effectively work with these new labour pools.

ToR 2: The role of government in Australia's agricultural economy

Service Need 1– The Australian Government should continue to develop R&D that furthers understanding of:

- the economic and social impacts of climate change on Australia's agricultural economy and rural communities;
- the role of RDE in addressing these impacts in an economically efficient manner.

Service Need 2 – The Australian Government should support Australia's agricultural economy through appropriate intervention to address market failures in the provision of RDE services for adaptation, delivered through:

- investment in knowledge services and RDE infrastructure;
- developing lean and efficient regulations that assist farmers adapt to climate change by:
    - reducing the current regulatory burden;
    - support for co-regulatory frameworks that enable continuous adoption of rural R&D and that focus on outcomes rather than record keeping; and
    - ensuring key resource inputs, such as water, are regulated to achieve evidence based policies supported by applied R&DE.

Service Need 3 – To reverse the declining number of undergraduate and post graduate students researching in the field of primary industries.

The impacts of climate change are not just biophysical; they also have economic and social dimensions. There is a role for government to assist individuals and communities moving from declining industries to emerging ones, while minimising social dislocation and dysfunction (Drought Policy Review Expert Social Panel 2008). Such policies can be justified on equity grounds alone; government intervention is also appropriate in this situation to address market failures associated with the re-allocation of labour in a dynamic economy.

The government has a critical role in assisting Australia's primary industries adapt so they can continue to contribute to the nation's wealth and wellbeing. One way governments can do this is to help correct market failures by–

- addressing information failures through:
    - research into new knowledge to strategically filling existing gaps;
    - ensuring the existing information is provided to farms and businesses throughout the supply chain in forms they can readily use;
    - providing frameworks to better share and utilise information, to reduce transaction costs associated with knowledge generation, distribution and utilisation;
- providing appropriate regulatory frameworks to enable the efficient operation of markets;
- correcting externalities relating to the aspects of goods or services that are not adequately captured in their market prices by:
    - subsidising the provision of goods and services which contain a significant element of public good e.g. education and biodiversity;
    - pricing or limiting negative externalities associated with the provision of goods or services e.g. pollution and food safety;
    - assisting in the commercialisation of new or infant industries – particularly those which have considerable potential for public good e.g. biotechnology and distributed renewable energy;

- providing public goods and/or shared infrastructure where a market rent cannot be efficiently levied or captured by an individual firm or entity e.g. biosecurity.

A. Investing in knowledge services & RDE infrastructure

To create world class innovation and maximise resilience and adaptive capacity within Australia's primary industries, there will need to be a much greater investment in rural RDE, including undergraduate and postgraduate education to develop and equip the next generation of researchers, decision makers and leaders in the fields of agriculture, natural resource management, and climate change sciences. Government assistance is needed not only to fund the student places but also to develop the infrastructure required to train these students. This investment will spill over into increased exports and opportunities associated with intellectual property ownership in knowledge economies.

In recognition of the positive wider socio-economic and environmental benefits associated with primary industry RDE, the Commonwealth has matched industry funding of rural RDE under the provisions of the *Primary Industries Levies Act* (1991). Federal co-funding levels to the RDCs are currently capped at 0.5% of an industry's gross value of production (GVP).

In light of the challenges of climate change, serious consideration should be given to lifting the co-funding cap. New funding could be explicitly linked to climate change and natural resource management (NRM) projects – while greater freedom should be provided to the RDCs, in consultation with their levy payers, to focus existing funding on growing productivity and profitability.

New research spending needs to be targeted towards better understanding what climate change will mean within Australia's landscapes and waterways, linking understandings of climate change to impacts on agricultural production systems, and providing decision support frameworks and tools to better inform farmers and policy makers.

Helping to answer the unknowns

Farmers cannot rationally respond to climate change and adapt to its likely impacts without basic information about what changes may occur in their climates and the implications of this for their agricultural practices.

1. Climate change and landscape interactions: further development of global circulation models is required to better understand the drivers of Australia's climate and increase the accuracy of rain forecasts. These models must be "down-scaled" to catchments and agricultural regions to provide more reliable seasonal forecasts and longer term climate predictions for specific regions.

Climate predictions need to be fed into models of landscape hydrology to better understand the implications of climate change for irrigated agriculture and river health. Current efforts will require regular updating as the science of climate change and catchment modelling improves.

2. Interaction between climate and primary production: down-scaled climate models in combination with hydrological models will hopefully enable improved predictions of seasonal soil moisture, frost, heat stress, and irrigation water availability - both seasonally and under expected climate change scenarios. This information is essential to enable farmers to make

informed decisions around the viability of future agricultural enterprise, and for government to formulate rational policy.

3. Tipping points: farmers need to understand the biophysical tipping points of agricultural systems to help them judge when an industry becomes unviable. For example, the number of hot days an orange tree can tolerate, the number of cold days needed for mango trees to flower, or the ocean pH below which crustacean shells will not form.

Providing tools to assist farmers in adapting to climate change

Decision support tools that translate climate data into commodity-specific information are required for improving productivity and profitability. This issue is addressed under ToR 3.

Rigorous ecological Life Cycle Assessments (LCA) of agricultural systems are required - especially around GHG emissions and water use. Such data is critical to avoid perverse policy outcomes. However, LCA findings are only as reliable as the emission data that informs them. Current uncertainties around agricultural emissions, such as nitrous oxide and enteric methane, make informed decision analysis of climate change adaptation and mitigation difficult (Watts 2008).

To rationally assess long term investments in processing and transport infrastructure, economic models of commodity supply chains are required, supported by biophysical predictions around climate change (DAFF 2008).

Social analysis is required to consider the impacts of climate change on rural communities and to better target government's social spending in these communities (Drought Policy Review Expert Social Panel 2008).

Decision analysis, which extends beyond simplistic cost benefit analysis, is required to assist government in considering the economic, environmental and social trade offs associated with policy choices and the community strategies and tactics to adapt to climate change.

B. Creating good regulations to support good policy

Reducing the regulatory burden

Reducing regulatory impediments is critical to helping farmers adapt quickly and profitability to the impacts of climate change. Martin *et al.* (2007) suggest that better environmental outcomes could be achieved at greatly reduced economic costs to government and private industry by using some fourteen pieces of legislation – modelled on the structure of the trade practice laws. This would reduce the current layers of regulation by approximately 90%. The Commonwealth could take a lead role in reducing the regulatory burden on farmers by streamlining and harmonising inter-state regulations through the COAG process.

Supporting co-regulatory approaches and farm management systems

Co-regulatory frameworks such as farm or environmental management systems (EMS) provide governments with a mechanism to achieve widespread and ongoing adoption of best management practices (BMPs) without excessive regulatory costs e.g. Cotton BMP program, *Pathways to Industry EMS* program (Hassall & Associates 2007).

Developing new regulatory regimes to assist climate change adaptation

Climate change brings new challenges for governments attempting to efficiently regulate Australia's primary industries. The most vexing challenges are around water, GHG emissions and carbon sequestration.

New research efforts are required to address uncertainties around water, GHG emissions, carbon sequestration, and the biophysical impacts of climate change, before informed policies and appropriate regulations can be developed (Ford, Gurney, *et al.* 2009).

Governments need to craft regulatory frameworks and complementary measures that help farmers to adopt practices to achieve requisite changes in GHG emissions and carbon sequestration, while avoiding perverse outcomes and minimising negative impacts from these interventions. Ideally, Australia's GHG regulations will link into international trading frameworks that reduce the cost of mitigation globally (Garnaut 2008). The Commonwealth has a role in negotiating international treaties that recognise the contributions primary industries can make to GHG mitigation and carbon sequestration. If measures such as soil carbon are to be included in international frameworks, then significant research is required to collect base line data.

Government's regulatory frameworks and support for biotechnology will be critical to bringing new technologies to market, while maintaining the confidence of the public and export markets in the safety and wholesomeness of Australia's food.

Regulating agriculture water

Water regulations are required to enable efficient harvesting and use of rainfall on farm, as well as access to ground and surface water resources in a manner that does not compromise Australia's natural resources and the ecoservices that primary industries provide.

Enabling appropriate water trading is critical, but this market tool requires frameworks that recognise not only the interconnection of catchments, but also the losses of water along catchments, the interplay between ground and surface water bodies, the implications of individual actions on the use of shared water distribution infrastructure, as well as the need for certainty in planning. More research is required to enhance policy development and regulatory formulation.

C. Improving rural RDE efficiency and effectiveness

It is critical for Australia's relatively small economy to address market failures by strategically investing in RDE, and by coordinating efforts to avoid duplication and to develop sufficient scale to be internationally competitive.

Not only must project scale increase but their length should increase, so there are less projects with terms of 1-3 years and more with 4-7 years. Such measures could reduce administration costs by as much as 50% (CRRDCC 2008) and would better enable the development and retention of scientists and managers who are needed to deliver high quality RDE.

ToR 3: The role of rural RDE in facilitating adaptation to climate change

Service Need 1 –Increase investment in extension activity to accelerate the adoption of rural R&D.
Service Need 2 – Strategically coordinate scarce RDE investment on initiatives that deliver research insights, decision support tools, and that commercialise technologies and practices that enable farmers and agribusiness to adapt to climate change.

Over the last forty years agricultural productivity growth has outstripped that of the wider economy by 30 to 300% (Econtech 2005). The development, commercialisation and adoption of new technologies, cultivars and management practices has been a key factor in agricultural productivity growth through the "green revolution" to the present. This process of innovation, adaptation and productivity growth is inseparable from the rural RDE that has underpinned it.

Mullen & Crean (2007) suggest over 60% of the value created by agricultural activity can be directly attributed to rural R&D – both foreign and domestic (see figure 1). Mullen & Crean (2007) allocate the majority of this value to the impacts of domestic R&D. No matter what foreign R&D has to contribute to agricultural innovation, it requires domestic RDE to facilitate its successful adoption and adaptation into Australian farming systems and communities.

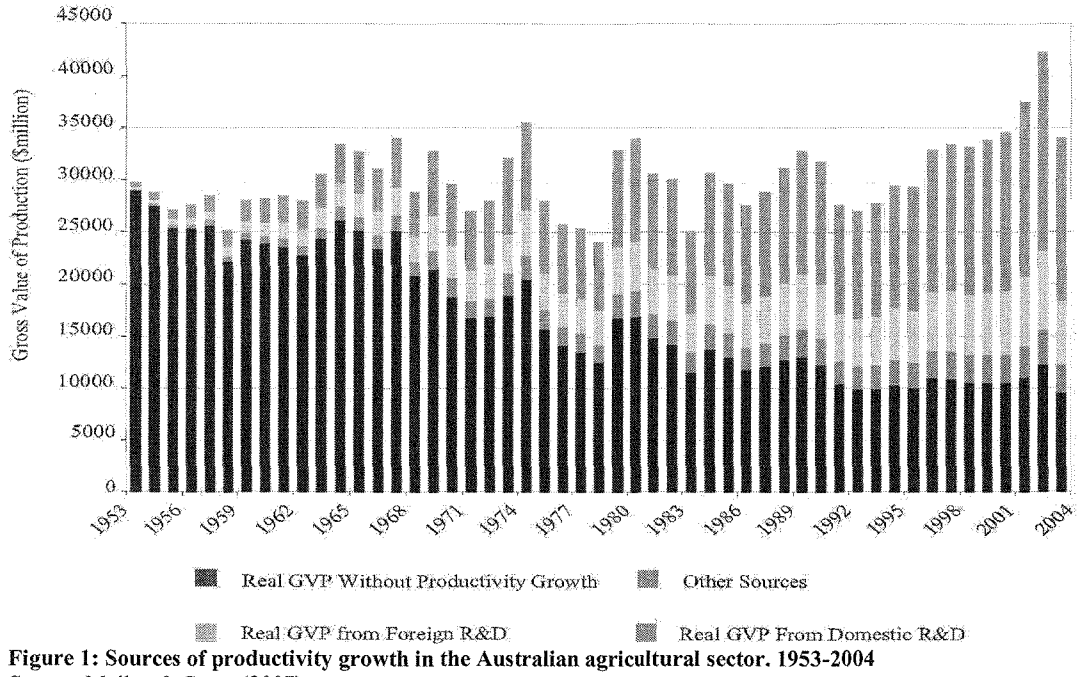


Figure 1: Sources of productivity growth in the Australian agricultural sector. 1953-2004
Source: Mullen & Crean (2007)

Recent declines in the rate of agricultural productivity growth globally have been directly attributed to the decline in rural RDE (NFF 2009). The global reduction in real agricultural RDE spending has been replicated in Australia with funding cuts by a succession of governments (Mullen & Crean 2007). The decline in domestic agricultural productivity growth has been

compounded by the impacts of an unprecedented sequence of droughts and the resulting Murray-Darling water crisis (DAFF 2008)

Climate change will greatly increase the number of challenges, and consequently the rate of adaptation required by Australian farmers. Conversely, climate change may assist Australia's agricultural competitors in parts of the USA and Canada, at least until 2030-2050 (Garnaut 2008).

Rural RDE will need to be greatly increased if Australian farmers are to remain profitable, sustainable and internationally competitive. Some of the areas requiring increased R&D investment are covered in this submission's response to ToR 1&2. A more comprehensive summary can be found in the CCRSPI Phase 1 report (2008) and Stokes & Howden (2008).

Research and knowledge creation will not achieve the rates of change and adaptation required from Australian farmers without mechanisms to ensure its effective communication and adoption.

Providing tools to assist farmers in adapting to climate change

Decision support tools that translate climate data into commodity-specific information are required to improve productivity and profitability. The Managing Climate Variability program (a partnership of DA, GRDC, LWA, MLA, RIRDC, and SRDC) has been developing such tools and training farmers since 1992 (MCV 2008).

Already the overwhelming majority of Australia's farmers and agricultural advisors use regional weather forecasts to help inform on-farm decisions. Those who do not use forecasts cite the unreliability of forecasts or their lack of local application (Econnect 2008).

Tools such as Whopper Cropper, Yield Prophet, and AussieGrass enable broadacre farmers to implement more sophisticated risk management strategies. Animal models, such as AusPig, enable intensive animal farmers to predict the outcomes of diet reformulation or revised management practices on production rates. Production tools need to be combined with economic ones to provide integrated risk management techniques (Barber 2008).

Some of these tools can be used directly by farmers and agribusinesses that have received appropriate training and can access ongoing support. Other tools require consultants or extension officers to facilitate their application to individual farms. Either way, extension networks and mechanisms are critical to the effective use and uptake of decision support tools.

Extension

Over the past decades successive governments, both state and federal, have reduced funding to rural extension networks and shut rural research stations. This has greatly reduced the capacity of governments to assist farmers to adopt new R&D and to be able to demonstrate and commercialise new technologies and practices in the field.

Private agronomists and consultants have partly filled the extension gap, though their focus tends to be limited by commercial considerations. Some RDCs have been effective in developing internal extension mechanisms for their members - the Cotton industry's Best Management Practice program is a good example of this.

Much more investment is required in extension, training, commercialisation and demonstration if Australia's primary industries are to adapt to the impacts of climate change and continue to contribute to Australia's wealth and wellbeing.

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