Submission No 35

INQUIRY INTO ASPECTS OF AGRICULTURE IN NSW

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Date received: 7/09/2007

CSIRO

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Aspects of Agriculture in NSW

August 2007

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Introduction

CSIRO is one of the largest and most diverse research agencies in the world. It is focused on addressing national and international challenges and opportunities, drawing on its powerful diversity of disciplines, experience and expertise in close partnership with the wider research community, governments, industry and the community.

CSIRO conducts agricultural research throughout Australia to improve the profitability and sustainability of Australian primary industries and the associated food and fibre-value chains that are built on these industries. CSIRO has a strong track record in improving the quality and yield of Australian grain, horticultural and fibre crops and innovation in the food industry. Increasingly, our agricultural work is assisting rural and regional Australia to continue its stewardship of the land in the face of global change.

CSIRO's focus on agriculture is spread across two Groups. The total Agribusiness Group budget for 2006-07 was $304 million, including external revenue of $114 million. Agricultural research is also conducted by CSIRO's Environment Group (with a total investment of $283 million).

Because CSIRO is an Australia-wide organisation its activities in, and effects on, NSW cannot easily be determined quantitatively. The national scope of CSIRO's operations also makes it difficult to determine the impact of its research specific to NSW.

However it is evident that CSIRO maintains a strong research capability in NSW through capital infrastructure and associated staff. Twelve CSIRO sites, with staff numbers ranging from 25 to 320, are located in NSW. Livestock research conducted at Armidale employs 75 CSIRO staff, while CSIRO's four sites in the neighbouring Australian Capital Territory employ over 1,100 staff. It should also be noted that the economic contribution of CSIRO's work conducted in NSW is not necessarily contained within that state, and research findings developed elsewhere in Australia are often applicable to NSW agriculture.

CSIRO is fully integrated into the agriculture sector of the economy through its contributions to agricultural research, scientific advice (including external and diagnostic services), education and policy advice. CSIRO is an active member of the Primary Industries Standing Committee structure, with Group Executive representation both on the Committee and its R&D Taskgroup.

In this submission CSIRO provides a research-based perspective on issues relevant to the inquiry by providing a general comment on each of the Terms of Reference followed by some relevant examples of CSIRO's work.

Term of Reference (a): Contribution of agriculture and agricultural-based products to the NSW economy

Overview

CSIRO contributes to NSW agriculture and the NSW economy in many ways. Indicators which demonstrate CSIRO's performance and impact nationally (for example, cost benefit analyses, citation rates, participation in the Cooperative Research Centre (CRC) Programme, involvement in specialised technical and analytical services, and patents) are applicable to NSW.

Impact of CSIRO research outcomes

CSIRO and the NSW cotton industry

Some 70% of Australian cotton production occurs in NSW, mostly located on the river systems of the northern Murray Darling Basin. While production areas and returns vary annually in response to water availability and world price, the industry contributes approximately $2.4 billion to the NSW economy through multipliers into regional communities. Ninety per cent of cotton is grown from varieties produced by CSIRO at its Narrabri cotton headquarters.

The industry has been proactive in adopting new research outcomes which help address productivity and sustainability challenges. Research outcomes provided over the last 20 years through the participant organisations – the Australian Cotton Research Institute (CSIRO Plant Industry, CSIRO Entomology, NSW Department of Primary Industries (DPI), Cotton Catchment Communities CRC and preceding CRCs – have directly addressed these challenges through:

- Improved cotton varieties with higher yield potential and fibre quality
- Enhanced soil and nutrient management
- Improved on-farm irrigation management, farm design and water storage options
- Ecologically based Integrated Pest Management systems for key pests
- Integrated weed management systems
- Integrated disease management
- Deployment and management of GM cotton varieties to address insect pest and weed issues.

Examples of large-scale and current research activities of particular relevance

Better Knowledge, Better Bush mega-project (http://www.betterbush.org.au/)

This project aims to understand the impacts of productive land use change on weed invasion and soil nutrient enrichment. Through an understanding of the feedbacks between disturbance levels, nutrients and weeds we will develop better management strategies to control weeds and restore native communities. Knowledge gained from this project on the mechanisms that drive exotic plant invasion will assist in identifying potential sleeper weeds and areas at risk of invasion.

Better Knowledge, Better Bush is a collaborative venture between CSIRO, the NSW Department of Environment and Conservation, Greening Australia, Charles Sturt University, RMIT University and the Southern Rivers Catchment Management Authority. Originally funded by the NSW Environment Trust, this work is now funded through the 'Defeating the Weeds Menace' Program (DAFF funding, managed by Land Water Australia).

CSIRO Agricultural Sustainability Initiative

The CSIRO Agricultural Sustainability Initiative (ASI) aims to tackle the major drivers of change in Australian agriculture through an integrated national approach. ASI seeks to deliver three key outcomes:

- increase the total economic value to Australia from agricultural landscapes;
- reduce the ecological footprint of Australian agriculture; and
- increase the resilience of rural and regional communities by equipping them with the knowledge, planning processes and policy options to prepare for and respond to change.

ASI has adopted a 'participatory engagement' approach to facilitate agriculture adapting to climate change, working with the NSW DPI via the NSW Greenhouse Office and Technology Action Grants. It works with industries in transition by, for example, assisting the rice industry to deal with changing and more variable water availability (NSW DPI, Rice Growers Association, Irrigation Research and Extension Committee). Also in collaboration with NSW DPI, ASI contributes to the Natural Resources Commission 'Recommendations for Statewide Standards and Targets'.

Other projects within this initiative include:

- The impacts of climate variability on the wool industry (AWI).
- Subsoil water use by crops; management of soil-borne diseases; and conservation farming.
- Production and sustainability of wool on the tablelands of NSW; root-soil biology in grassland systems.
- Large-scale revegetation with a focus on use of plant-soil symbiotic interactions to increase revegetation success in agricultural landscapes.
- Breeding and management of dual purpose (grain and graze) wheats – collaboration with producer groups as well as NSW DPI.
- Decision support for the grazing industries.
- Feedbase utilisation in the 'Grain and Graze' project – includes participatory research in NSW and modelling (for example, of grazing wheats).
- Pastures from Space – validating satellite predictions of pasture growth; spatial analysis tools for improving feed utilisation and environmental management.

Examples of collaborative arrangements with NSW-based entities

National Plant Biosecurity Cooperative Research Centre (CRC)

CSIRO Entomology is a key participant in a number of stored grain bulk handling pest management projects run by the National Plant Biosecurity CRC:

- Technologies to overcome inadequate fumigations and resistance selection
- The development of an alternative fumigant for the grains industry
- The development of diagnostic methods to determine phosphine resistance in insects

These projects have a national focus but are particularly relevant to NSW as a major grain producer.

Lippia project

Lippia (*Phyla nodiflora*) is a perennial ground-cover weed from South America that is essentially unpalatable to livestock, and forms vast monocultures in periodically flooded wetlands, to the detriment of the livestock industry and the environment. It is dominant primarily in the north-west of NSW but has implications for south-east Queensland.

CSIRO Entomology has a research project, partly in collaboration with the University of New England and the University of Queensland, looking at a wide range of aspects including biocontrol, ecology, molecular and integrated management. Funding sources include the NSW Department of Natural Resources, Meat and Livestock Australia, South East Queensland Water, the Weed Cooperative Research Centre, and the Queensland Murray Darling Committee.

FD McMaster Laboratories

CSIRO Livestock Industries (CLI) has a major research site at the FD McMaster Laboratories at Chiswick, near Armidale, northern NSW. Also incorporating the nearby Arding field station, Chiswick currently has 80 staff and represents an annual investment of approximately $10.6 million (2006-07 figures). Research activities include:

- Development of technologies and decision-support systems for meat and wool sheep producers to optimise production returns
- Molecular and quantitative genetics of livestock production (sheep and beef), including breeding for alternatives to mulesing
- Development of objective measures of animal welfare, cognition and behaviour in support of industry best-practice standards
- Molecular approaches to development of parasite resistance
- Advanced reproductive technologies (through the Food Futures National Research Flagship) for the meat industries

CLI has key involvement in a number of industry-based CRCs headquartered at Armidale – the CRC for Beef Genetic Technologies (Beef CRC), the CRC for Sheep Industry Innovation (Sheep CRC) and the Australian Poultry CRC. It is also a core participant in SheepGenomics, a joint initiative of Meat and Livestock Australia (MLA) and Australian Wool Innovation (AWI) which in NSW also involves the University of Sydney, University of New England and University of Western Sydney.

CSIRO (CLI through the Australian Animal Health Laboratory (AAHL)) and NSW DPI participates in national biosecurity networks to develop national plans, conduct surveillance and implement national responses to emergency disease outbreaks (e.g. the current equine influenza outbreak). AAHL is also actively engaged in the deployment of a range of disease diagnostic tests with the Elizabeth Macarthur Agricultural Institute (EMAI), and NSW DPI's Centre for Animal and Plant Health.

CSIRO and NSW DPI are both members of umbrella industry bodies engaged in setting national agricultural R&D priorities (e.g. the Southern Australian Beef Research Council (SABRC) and the National Dairy Alliance (NDA)). Both SABRC and NDA have recently conducted studies on the R&D and industry human capacity (current and future needs) for their respective industries.

Collaborative research projects within the Agricultural Sustainability Initiative

- Cotton Research Unit at Myall Vale – a joint facility between CSIRO Plant Industry and Entomology and NSW DPI.
- Grains Research and Development Corporation (GRDC) Eastern Farming Systems Project – a collaboration between CSIRO Sustainable Ecosystems (CSE)/NSW DPI/Queensland Department of Primary Industries and Fisheries/Queensland Natural Resources and Water. Between 1996 and 2007, $5 million from GRDC plus at least $5 million co-investment, has been targeted at improving cropping systems of the northern grains region. There have been significant impacts from this collaboration.
- Northern Grower Alliance – a relatively new industry-led research initiative which contracts research out to NSW DPI and CSE.

- Research on irrigated rice/wheat farming systems in the MIA – co-location at Griffith and collaboration between CSIRO Land and Water and NSW DPI. This collaboration led to the development of DSS products such as MaNage-Rice and MaNage-Wheat.
- Mallee Sustainable Farming Systems grower group – a collaboration between the state agencies of NSW, SA and Victoria and CSIRO SE which addresses cereal production in low rainfall areas. MFS has been very successful in achieving adoption of conservation tillage systems.
- Research Advisory Committees (RACs) – GRDC-funded industry committees which identify new research needs in the central and northern grains regions; both CSE and NSW DPI have representations on each committee in NSW.
- There are many collaborative GRDC projects between the agencies (e.g. canola in the north).

Broader economic impact

CSIRO investment in the NSW rural economy

The benefits from CSIRO activities are not easy to quantify, and those that can be measured are more likely to be returns to private firms. Nevertheless, the available data illustrate the variety of impacts CSIRO has made across a broad range of economic, environmental and social areas.

CSIRO's financial data are collected on a project (rather than a state or site) basis and it is therefore difficult to quantify the level of our investment in NSW. However a study conducted by the Centre for International Economics (CIE) for CSIRO in 2003 suggests that CSIRO delivers major benefits in relation to costs for a number of NSW-based research projects. Cost benefit ratios for these projects ranged from 19:1 to 79:1 (see grains research, cotton production and management, and grazing decision support systems below).

The CIE's analyses highlight the wide variety of pathways through which benefits accrue from CSIRO research. While not all CSIRO research programs in NSW achieve measurable positive net benefits, the value generated by the successful programs 'pays for' the total research investment by the Organisation many times over. CSIRO's research makes a major contribution to NSW industry, society and environment.

Employment of staff and capital infrastructure/research sites

CSIRO has a significant infrastructure investment in NSW. CSIRO maintains 12 sites in NSW, five of which conduct research related to agriculture or the environment: Armidale, Myall Vale (Narrabri), Griffith, North Ryde, and Lucas Heights. CSIRO also has employees working at Charles Sturt University (Wagga Wagga). Three Victorian sites (Merbein, Mildura and Wodonga) and four ACT sites (Black Mountain, Gungahlin, Yarralumla and Ginninderra) deliver economic benefits to NSW.

The Armidale site (livestock research) employs 75 staff, Myall Vale (plant and agriculture research) 78 staff, and Merbein (vines, grapes and other crops) 35 staff.

Local community impact

The presence of CSIRO sites in NSW and adjacent states generates significant flow-on economic activity in the form of employment, support for local suppliers, and expenditure in local communities.

CSIRO provides business to local suppliers of goods and retailers. It also supports local education. Nationally, CSIRO Education involves over 700,000 students, parents and teachers each year in activities that encourage appreciation of science. In NSW in 2006, over 123 000 participants were involved in CSIRO Education programs. CSIRO staff members participate in and support various community activities such as science outreach, sport and rural firefighting.

Term of Reference (b): Impediments to sustaining appropriate levels of productive capacity and growth in the agricultural industry

From CSIRO's perspective, research outcomes can provide solutions to impediments to sustaining appropriate levels of productive capacity and growth in agricultural industries. These impediments may include, but are not exclusive to, the following examples relevant to CSIRO research efforts.

Climate variability and climate change

While the exact impact of climate change is still being debated, a 2001 CSIRO report (http://www.csiro.au/resources/pf5t.html) predicted an annual average warming of 0.4 to 2°C over most of Australia by 2030 (relative to 1990). A 2005 CSIRO study of fire risk in SE Australia (http://www.csiro.au/science/ps17j.html) concluded that Canberra is likely to have an annual average of 25.6 to 28.6 very high or extreme fire danger days by 2020 compared to a present average of 23.1 days. These results could be extrapolated beyond Canberra to south-eastern NSW.

In addition to the two CSIRO reports mentioned above, we refer the Standing Committee to two key reports:

1. The International Panel on Climate Change (IPCC) Working Group 2, Chapter 11 Australia and New Zealand. See the sections on water and agriculture.

2. A report on the latest Australian climate change projections will be released on 2 October at Greenhouse 2007 and will be available at www.climatechangeinaustralia.gov.au. The report will include the latest information about observed climate change, likely causes and regional projections.

Increased incidence of drought

Following from the previous comment, current predictions suggest an increase in the frequency of droughts in south-eastern Australia. This is a continuation of the trend observed by the Bureau of Meteorology from the mid 1970s to the present of decreasing rainfall against long-term averages.

Major outbreaks of plant pests and pathogens

It is difficult to predict the incidence of major outbreaks of plant disease from climate variability and climate change. Currently CSIRO research is exploring the ability of existing pathogens to adapt to changing environments.

The likelihood of a major outbreak is also influenced by the effectiveness of quarantine protocols and practices that are in place. A large-scale outbreak of a new pathogen in the wheat industry, for example, is likely to have a devastating impact on the NSW industry.

Impact of GM moratoria

A number of states, including NSW, introduced moratoria on the commercial production of GM canola in 2003. Since then, CSIRO has experienced a 40% reduction in expenditure on projects specifically aimed at developing a GM food crop, while expenditure on projects aiming to make non-food products has not significantly changed. Our interactions with the private sector indicate some hesitation to invest heavily in GM-based solutions until path-to-market is clearer than in the current climate.

CSIRO has also developed GM technologies for Australian agriculture which are awaiting commercial release. These technologies have potential impact in the sphere of human and animal health, as well as in agronomic performance and production inputs. However there is little interest from Australian industry to commercialise them at this time.

CSIRO has made a separate submission to the NSW review of the Gene Technology (GM Crop Moratorium) Act 2003. This submission, which was also provided to the Victorian review, is available at:
http://www.dpi.vic.gov.au/dpi/nrenfa.nsf/93a98744f6ec41bd4a256c8e00013aa9/15e2c8819e70f2e9ca2573460003331c/$FILE/105-CSIRO.pdf

Term of Reference (c): Initiatives to address impediments to sustaining appropriate levels of productive capacity and growth in the agricultural industry

CSIRO research undertaken with NSW provides important opportunities to address productivity limitations in some agricultural industries. Examples include:

CSIRO Murray-Darling Basin Sustainable Yields Project

Following the Murray-Darling Basin Water summit, convened by the Prime Minister on 7 November 2006, CSIRO was commissioned by the Australian Government to report progressively by the end of 2007 on sustainable yields of surface and groundwater systems within the Murray-Darling Basin, including an examination of assumptions about sustainable yields in light of changes in climate and other issues. The research will provided a catchment-by-catchment assessment of current groundwater and surface water resources and, based on IPCC climate change models, likely availability in 2030.

The project is the first attempt worldwide to estimate the impacts of catchment development, changing groundwater extraction, climate variability and anticipated climate change, on water resources at a basin-scale, explicitly considering the connectivity of surface and groundwater systems. This will be achieved by undertaking the most comprehensive hydrologic modelling ever attempted for the entire Basin, using rainfall-runoff, groundwater recharge, river system and groundwater models, and considering all upstream-downstream and surface-subsurface connections.

The information will be used by policy makers to inform decisions about the development of a new sustainable diversion limit for the river systems of the Basin, a major element of the Australian Government's National Plan for Water Security.

Led by CSIRO the research draws on the expertise of national and state government agencies in Queensland, New South Wales, Victoria, the ACT and South Australia, as well as the Murray-Darling Basin Commission and Australia's leading industry consultants.

National Invertebrate Pest Initiative

The National Invertebrate Pest Initiative (NIPI), funded by the Grains Research and Development Corporation (GRDC) and coordinated by CSIRO Entomology, is working to provide benefit to grains production systems across Australia. These systems include the extensive wheat/canola production regions of NSW and south-eastern Australia more broadly. Through NIPI, NSW DPI and CSIRO are collaborating on research to understand the dynamics of pest species (earth mites, diamond back moth and Helicoverpa) in the wheat/canola rotation system of southern NSW and to identify appropriate sustainable responses.

Wireless sensor networks in agriculture

The CSIRO ICT (Information, Communication and Technology) Centre has partnered closely with a number of groups within CSIRO to drive forward the research program in wireless sensor networks as a means to improve the level of information measured in the agricultural system. As part of the CSIRO Water Resources Observation Network (WRON) initiative, the ICT Centre has been involved in a project on the use of sensor networks to improve management of irrigation techniques where water is sourced from coastal aquifers. Trials in the use of wireless sensor and actuator networks (WSAN) for virtual fencing have also been undertaken in work funded by the CSIRO Food Futures National Research Flagship in partnership with CSIRO Livestock Industries at Armidale. A new project, funded by the Australian Government Department of Environment and Water Resources, is also underway in the use of virtual fencing for environmental protection of areas such as riverbanks or riparian zones.

Grains Research

CSIRO conducts a series of research projects aimed at increasing the productive capacity of the NSW and Australian grains industry. This encompasses our wheat breeding research, plus research on improving crop and land management practices in the grains industry. Our wheat breeding research is aimed at increasing yields, improving drought tolerance, improving salt tolerance and reducing susceptibility to pests and pathogens. There is also a range of research activities aimed at improving management practices. They include among other things the benefits derived from the use of break crops in a wheat rotation. A study by the Centre for International Economics (CIE) for CSIRO in 2003 concluded that the break crop research conducted by CSIRO had yielded a benefit-cost ratio of 19:1. There is also on-going research into the breeding and management of dual purpose (grain and graze) wheats in collaboration with producer groups as well as NSW DPI.

Cotton Production and Management

CSIRO has a major investment in R&D capacity at Narrabri to service the Australian cotton industry. CSIRO is co-located with NSW Agriculture staff at the Myall Vale Research Station. The CIE study referred to above concluded that the cotton research conducted by CSIRO had a benefit-cost ratio of 51:1.

Rice

CSIRO Plant Industry is currently conducting research to improve frost tolerance in rice, which will ultimately lead to increased water use efficiency in the rice industry as water is applied early in the growing season to buffer the emerging rice from frost.

Grapes

CSIRO has been at the forefront of research into improved management systems for the viticulture industry for many years, most notably mechanical harvesting technology, the introduction of partial root-zone drying as a technique for increasing water use efficiency, and the introduction of new table grape varieties into the Australian industry. CSIRO conducts research on grapes at its Merbein site, near Mildura.

Citrus

Citrus rootstock breeding and evaluation involves linkages with NSW DPI. This is an on-going linkage established through an Australian Centre for International Agricultural Research (ACIAR) project with links to China and Vietnam as sources for indigenous germplasm.

Grazing Decision Support Systems (GrazFeed, GrassGro, FarmWi$e and MetAccess)

This is a suite of decision support tools that have been designed to increase the profitability of grazing enterprises in southern and eastern Australia. NSW DPI has made a substantial commitment to training DPI staff across southern NSW to use the new version of CSIRO's GrassGro. Nine beef and sheep livestock officers and agronomists from central NSW to the Victorian border are using the tool to analyse a range of livestock and land management issues and to provide high quality advice to local farmers. GrassGro builds capacity in NSW DPI's advisory network by enabling the knowledge of specialist DPI officers to be shared and applied across regions. Projects in which GrassGro is currently being used include evaluation of complex emerging issues such as climate change impacts. The CIE study referred to above concluded that the GrazFeed research conducted by CSIRO delivered a benefit-cost ratio of 79:1.

Conclusion

NSW agriculture makes a substantial contribution to the economy and to the social infrastructure in rural areas of the state.

Innovation and agricultural research has, over many years, delivered productivity gains to producers and provided options for diversifying production systems that have enabled agricultural industries to prosper as well as maintain resilience in times of adverse climatic conditions.

CSIRO has a broad portfolio of research activities in NSW and in surrounding states that consistently delivers benefits and options for the state's rural communities. This ensures that producers can maintain their competitiveness through enhanced productivity while increasingly being able to deliver better environmental outcomes to the community.

There are a number of significant impediments, such as climate change or the capacity to adopt new technologies, which can have a serious impact on the future capacity of agricultural industries to remain competitive. Current research efforts are directed towards addressing some of these issues. It is nevertheless important that agriculture remains focussed on the role of innovation.

Investment in research can take long time to materialise but economic analysis of some projects included in this submission indicates a substantial cost-benefit ratio.