



Australian Government
**Rural Industries Research and
Development Corporation**

Rice R&D Plan

2006 – 2011

Revised

A wide-angle photograph of a vast rice paddy field under a cloudy sky. The rice plants are golden-brown, indicating they are ready for harvest. The field stretches to a distant treeline on the horizon.

RIRDC *Shaping the future*



Australian Government

**Rural Industries Research and
Development Corporation**

Rice Five-Year R&D Plan

2006–2011

Revised

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Published in July 2008

Foreword

The Rice Research and Development (R&D) Plan 2006–2011, originally published in July 2006, has been revised to match the current changing environmental conditions and policy climate. This is to ensure that the RIRDC Rice R&D Program meets the R&D needs of the industry now and into the future.

This Plan identifies six key objectives for the R&D investments to be made on behalf of the rice industry and Australian Government. Associated with each objective is a set of strategies to be followed in pursuing each objective and a set of performance indicators to give guidance as to how the program can be assessed as it progresses. An indicative share of R&D budget has also been proposed for each plan objective in order to guide investment priorities.

The Plan was first developed in 2006 in consultation with RIRDC's Rice Research and Development Committee and with input from growers, researchers, marketers. The consultants preparing the plan received more than one hundred survey responses and a plan development workshop attracted twenty-five stakeholders from across the industry and its supply chain. There is a high level of satisfaction with RIRDC's management of rice R&D and support for Australian Government matching funds.

The 2006 process occurred in parallel with a comprehensive review of the Australian rice industry funded by the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) as part of their Industry Partnership Programme. The R&D Plan is a better document for the depth of analysis that was possible as part of the DAFF '*Taking Stock and Setting Directions*' report.

By 2008 it became clear that the rice industry was facing significant new challenges that warranted a revision of its research priorities if it was to remain a world class food business, reliant on a sustainable resource base.

A key challenge will be climate change, which will impact on the rice industry in a number of ways. Future predictions for southern Australia indicate that global warming will be accompanied by lower rainfall and more frequent droughts. This will impact adversely on water availability, bringing greater uncertainty to the rice industry. A crucial future research priority for the industry will be to generate knowledge on how to adapt to the impacts of global warming. However, like all industries, the rice industry will also need to research means of reducing its own emissions of greenhouse gases.

The industry has recently experienced the stress of reduced water availability. Recurring drought over the last five years has led to substantially smaller crops and, as a result, research levy funds have also been much lower. It is also likely that changes in government water policy could contribute to future uncertainties about water availability for the industry.

In the light of these developments, and a recent revision of the Australian Government's Rural Research Priorities, RIRDC commissioned a review and revision of the 2006 Plan to update its priorities and strategies to reflect the reality of the situation now facing the rice industry. This review was carried out in March 2008 in consultation with the Rice Research

and Development Committee. The revised Plan also takes account of a set of environmental research priorities developed for the RGA in 2007.

This Plan is consistent with the RIRDC Corporate Plan (2003-2008) and Australian Government Rural Research Priorities. The R&D Plan will be implemented in accordance with the provisions of the *Primary Industries and Energy Research and Development Act 1989*.

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Managing Director
Rural Industries Research
and Development Corporation

Ian Mason
Chairperson
RIRDC Rice R&D Advisory Committee

Snapshot of the Five Year Plan

Goal

To improve the profitability and sustainability of the Australian rice industry through the organisation, funding and management of a research, development and extension program that is both market and stakeholder driven.

Objectives

Plan objectives and expected share of the program budget are:

1. Varietal and rice quality improvement (50%)
2. Crop establishment, agronomy/crop physiology, nutrient management and precision agriculture (10%)
3. Crop protection (10%)
4. Farming systems for whole farm management, profit and sustainability (15%)
5. Technology transfer, communication, policy and communities (8%)
6. Human capital formation (7%)

All objectives address industry economic and environmental sustainability. Program budget allocations are flexible and will be guided by the Rice R&D Committee.

The Plan is consistent with RIRDC's overriding aim of maximising the contribution its investments make to the profitability, sustainability and resilience of rural industries and communities. Alignment of Plan objectives with RIRDC's Corporate Goals and Strategies is shown in Appendix 1.

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research
CIE	Centre for International Economics
CRC	Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
DAFF	Australian Government Department of Agriculture Forestry and Fisheries
DPI	NSW Department of Primary Industries
EMS	Environmental Management System
GA	Giberellic Acid
GMO	Genetically Modified Organisms
GRDC	Grains Research and Development Corporation
IREC	Irrigation Research Extension Committee
IRR	Internal Rate of Return
IRRI	International Rice Research Institute Philippines
NBIR	Net Benefit Investment Ratio
NIR	Near Infra Red tissue test at crop emergence to test nitrogen uptake
NPV	Net Present Value
NRM	Natural Resource Management
OECD	Organisation for Economic Cooperation and Development, Paris
RDCs	Research and Development Corporations
RGA	Ricegrowers' Association of Australia
RIRDC	Rural Industries Research and Development Corporation
RMB	Rice Marketing Board of NSW
RRAL	Rice Research Australia Limited - a company owned by SunRice, multiplies seed
RRDC	Rice Research and Development Committee
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
WTO	World Trade Organisation

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- Dr Laurie Lewin, CRC for Sustainable Rice Production (retired)
- John Lacy and Russell Reinke, NSW DPI Yanco
- Dr Jeff Davis, ACIAR (previously Rice Program Manager RIRDC)
- Michael Clarke, AgEconPlus, Author of the original Rice R&D Plan 2006-11

1. Purpose of the Plan

The purpose of this Five-Year Plan is:

- to outline the rationale for the rice R&D program that the Rural Industries Research and Development Corporation (RIRDC) will manage, in conjunction with the Ricegrowers' Association of Australia (RGA), on behalf of the Commonwealth Government and the Australian rice industry
- to indicate the specific role that RIRDC funded R&D will play in expanding the knowledge base of the industry, and improving its profitability and sustainability
- to provide clear signals concerning rice R&D needs and priorities for the period 2006 to 2011
- to outline the broad priorities that RIRDC will pursue through its investment in the program over the next five years
- to take account of national research priorities, Ministerial guidance and RIRDC policies
- to encourage collaboration and coordination for rice industry R&D, including new joint investment
- to encourage and support discussion between the rice industry, RIRDC and the research, development and extension community, that will enable the future needs of the industry to be identified and incorporated in annual and longer term planning.

The plan is based on consultation with industry via a survey of industry members including growers, researchers, marketers and natural resource managers during February and March 2006, as well as a workshop involving a broad cross section of the industry and the RIRDC Rice R&D Committee held in Jerilderie, March 2006. The Plan was subsequently revised in March 2008 to take account of changed circumstances in the industry and environmental research priorities developed for the RGA in 2007. It was approved by the Rice R&D Advisory Committee in April 2008.

The Plan should be regarded as a living document that will be updated, as circumstances require. All sectors of the rice industry, and providers of R&D support, are encouraged to work towards achieving the objectives of the plan to further enhance the sustainable development of the industry.

2. The Rice R&D Program

The Rice R&D System

Rice industry R&D is facilitated primarily through RIRDC. Rice growers pay a levy for research, which is largely matched on a dollar for dollar basis by the Commonwealth Government. The levy was established in 1991; on 1 January 2006 the rate was set at \$3/tonne for the three years ending 30 June 2009. The levy rises between \$2 million and \$3 million per annum and funds approximately 44 projects each year. However, as a result of the recent fall in rice production, levy receipts are expected to fall to \$1.0 million in 2007-2008 and \$150,000 in 2008-09. Financial reserves will be \$1.6 million and will be used to sustain the Program over the life of the Plan.

Projects are usually completed on a joint funding basis and rice industry R&D is conducted by a range of bodies including universities, State Departments of Primary Industry and other research institutes.

RIRDC managed rice R&D funding is primarily targeted at the parts of the value chain from pre-planting through to milling, and, with the exception of a few early projects, has not provided resources for marketing and commercial issues. R&D in this area has been funded by the Ricegrowers' Limited (SunRice), which focuses on value added products, processing as well as market research. The Cooperative Research Centre (CRC) for Sustainable Rice Production, which was in part funded by the RIRDC Rice R&D program, has directed its investments across most aspects of the value chain, but did not include marketing or market based research (CIE 2004).

Project funding is guided by the RIRDC Rice R&D Committee.

Rice R&D Committee

The RIRDC Rice R&D Committee comprises:

- a chair
- eight grower delegates (elected from the eight branches of the Ricegrowers' Association)
- two delegates nominated by Ricegrowers' Limited/NSW Rice Marketing Board
- three independent technical experts
- the RIRDC program manager for rice
- an appointee of the Central Executive of the Ricegrowers' Association.

The committee is supported by two liaison groups, which play a proactive role in liaising with R&D agencies to develop and manage projects that meet committee and RIRDC R&D plan priorities.

The grower delegates report twice yearly to their Ricegrowers' Association branch meetings on the R&D program. These meetings provide a further opportunity for growers to raise any concerns that need to be considered in both annual and longer term planning.

3. Industry Profile

The following profile was assembled with the assistance of the Department of Agriculture, Fisheries and Forestry (DAFF) Taking Stock and Setting Directions project for the rice industry (Kiri-ganai Research 2006), Australian Agriculture and Food Sector Stocktake (DAFF 2005), relevant literature and industry consultation. It includes information on industry location, industry features, markets, farm businesses, crop management, natural resource management (NRM), employment and infrastructure, institutional arrangements, industry success and outlook.

Location

Rice is produced under irrigation, mainly in the Riverina region of NSW, which includes the Murrumbidgee and Coleambally irrigation areas and the Murray Valley. Small volumes of rice are also produced in northern Victoria.

The rice production system in Australia is fully irrigated and is unusual in that an extended rotation system involving other crops and livestock is used, in contrast to the monoculture based rice systems employed elsewhere.

Between 1993-94 and 2003-04, the area of rice grown expanded by nearly 30% to a maximum of 177,000 ha yielding 1.7 million tonnes in 2000-01. However, areas have been severely affected by drought since 2002-03. A rebound crop of more than one million tonnes was produced in 2005-06 but a crop of 167,000 tonnes will be followed by a forecast crop of less than 20,000 tonnes in 2007-08.

Productivity gains in the rice industry are important for industry competitiveness and for determining the farm-level allocation of resources between rice and other enterprises.

Climate Change and Water Availability

Water availability and cost are significant issues for Australian rice growers.

Growers of annual crops such as rice, wheat, soybeans etc receive “general security” water which is allocated after “high security” requirements (for towns, industrial uses, perennial crops etc) and environmental needs are met.

“General security” water allocations can be highly variable. Drought and associated limits on available irrigation water have had a severe effect on the amount of rice grown in Australia in the first five years of the new century, with well below the previous five-year average production. There was zero allocation to general security users by the end of the summer crop planting window in 2007.

There are significant concerns about the longer term impact of climate change and climate variability on water availability. A recent report by CSIRO and the Bureau of Meteorology predicts that under the current global warming scenario rainfall in southern Australia could decrease by between 0-10% (depending on the model used) by 2030. By 2050, depending on the emissions scenario, the range of change in southern areas could be from a 20% decrease to little change, with a best estimate of around -7.5%. Droughts are predicted to become more frequent (CSIRO and BoM 2007).

It is also significant for the rice industry that global warming will be associated with a projected strong increase in frequency of hot days and warm nights and a moderate decrease in frost (CSIRO and BoM 2007).

Future water availability is also likely to be impacted by Government policy, which will focus on extending water markets and providing water for environmental purposes.

Reducing Greenhouse Gas Emissions

Like other industries, the rice industry also faces the challenge of reducing its emissions of greenhouse gases.

The RGA has developed a Greenhouse Strategy, and it is a member of the Australian Greenhouse Office's Greenhouse Challenge Program, reflecting the RGA's concern to improve the sustainability of rice production in Australia.

At the centre of the industry's Strategy is a Greenhouse Scorecard that provides growers with the basis for assessing the magnitude and composition of their greenhouse gas emissions from their activities.

Industry Features

Table 1 shows the major features of the Australian rice industry, including its size, output, market orientation and position in the global market.

Table 1 Overview of rice production and trade

	Unit	1983/84	1993/94	2003/04
World				
Production (a)	Mt	307	355	389
Trade	Mt	12	21	26
Australia				
Area planted	'000 ha	119	133	65
Average yield	t/ha	5.3	8.2	8.2
Production	kt	634	1,082	535
Share of world output	%	0.2	0.3	0.1
Gross value (b)	\$ m	196	373	162
Domestic consumption	kt	51	99	n/a
Exports				
Volume	kt	241	586	108
Value	\$ m	203	419	68
Share of World Trade	%	2.0	2.8	0.4
Imports	kt	n/a	30	88

(Mt Megatonne 1 million tonnes; kt Kilotonne 1000 tonnes)

Source: DAFF (2005) (a) Milled equivalent (b) in 2003-04 dollars

Markets

In farm-gate value terms, 80% of the rice produced in Australia is exported. Export success has been driven by innovation (i.e. R&D) and a clearly differentiated value proposition based on quality, service, logistics and price.

Major rice exporters around the world include China, Vietnam, Pakistan, Thailand, and the United States. Thailand is the largest exporter by volume.

Australia also imports rice, the largest share of which (70%) is sourced from Thailand.

The international rice market is complicated by subsidies and tariffs in many countries, including the United States, Japan, Korea and the European Union.

The OECD 2004 estimates that in 2003 the monetary value of transfers from consumers and taxpayers to support US rice growers as a result of policy measures was equivalent to 34% of producers' gross incomes; for Japanese growers, the figure was 83%, for Korean growers, 74% and for EU growers, 36%.

Australian growers received assistance equivalent to an estimated 6% of their gross incomes in 2003. This support was largely in such forms as matching grants for industry research and development programs.

The Australian rice industry has single-desk marketing arrangements for export. Sales of paddy rice and milled product are controlled by the Rice Marketing Board (RMB), which was established by the NSW Government. Domestic sales were deregulated, effective 1 July 2006.

The impact of drought on Australian production was severe in 2006-07 and 2007-08. This has resulted in temporary closure of mills in Deniliquin and Coleambally and reduced shifts at the remaining mill in Leeton. This has forced redundancies of around 200 staff and serious revenue implications for growers.

The grower owned marketing company (Ricegrowers' Limited) was able to maintain existing markets and support their excellent brand recognition through an aggressive trading program.

Farm Businesses

Table 2 shows the principle features of the Australian rice-producing farm business.

Table 2 Features of Australian rice-producing farm businesses (average per farm)

	Unit	1983/84	1993/94	2003/04 (a)
Number of businesses	No.	1,737	1,544	974
Average performance				
Area operated	ha	760	907	1,338
Area cropped	ha	204	287	437
Area under rice	ha	71	77	48
Rice produced	t	358	644	390
Rice sales (b)	\$	136,391	191,893	105,746
Wheat sales (b)	\$	39,847	25,538	114,953
Total crop sales (b)	\$	190,436	289,102	354,360
Beef cattle sales (b)	\$	13,557	18,034	14,341
Sheep sales (b)	\$	22,130	28,943	21,428
Wool sales (b)	\$	23,895	30,191	14,728
Net farm cash income (b)	\$	71,091	129,201	139,024
Farm business profit (b)	\$	1,604	54,195	53,221
Capital investment (b)	\$'000	1,448	1,085	2,757
Farm debt (b)	\$'000	212	255	260
Off-farm income (b)	\$	n/a	15,528	7,726
Return on capital	%	1.6	8.4	3.2

Source: DAFF (2005) (a) Rice production in 2003-04 was adversely affected by as shortage of irrigation water (b) in 2003-04 dollars

The Australian rice industry is based on commercially focussed (rather than lifestyle focussed) family farms.

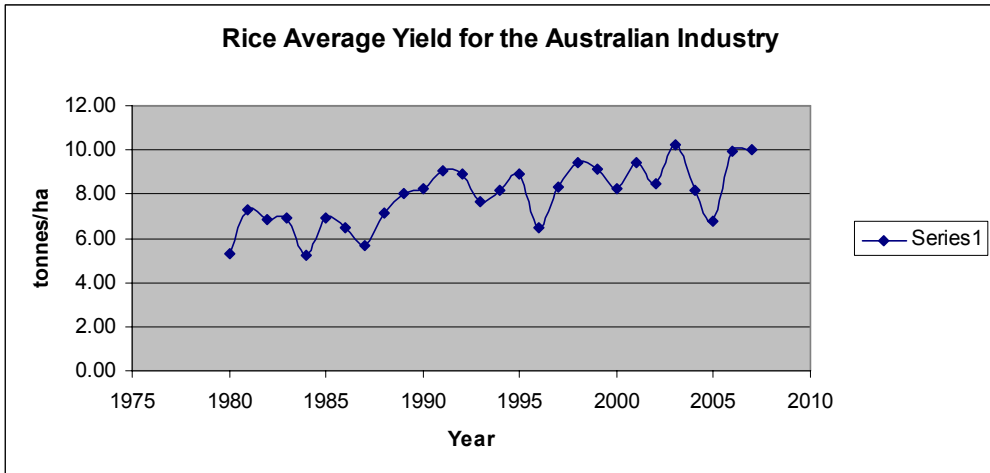
The rice production system in Australia is fully irrigated and is unusual in that an extended rotation system is used in contrast to the monoculture based rice systems employed elsewhere.

Productivity gains in the rice industry are important for industry competitiveness and for determining the farm-level allocation of resources between rice and other enterprises.

Crop Management

Current crop yields average between 8 and 10 tonnes to the hectare, which is very high by world standards (see Figure 1 below). Both the 2006 and 2007 crops reached 10 tonnes per hectare. Understanding and managing genetic diversity in rice is important for future productivity gains. Genetic improvement is focused on adaptation of yield improvement, grain quality attributes and cold tolerance.

Figure 1 Rice Average Yield for the Australian Industry

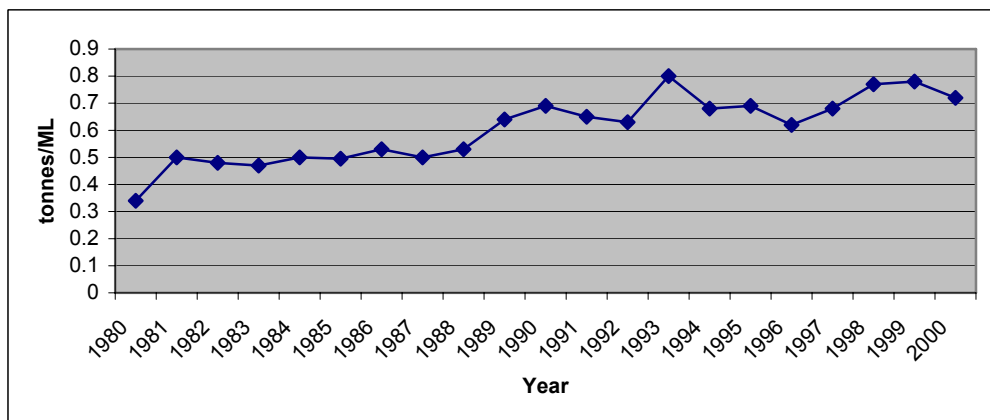


Source: ABARE 2004

Natural Resource Management

Because water is a critical natural resource for rice production, the industry has worked tirelessly to improve water productivity (see Figure 2 below).

Figure 2 Rice Water Productivity for the Murrumbidgee Irrigation Area



Source: RIRDC 2006

Priorities for the industry include ongoing increases in water-use efficiency, reducing net recharge to water tables and preventing salinisation. Other key issues include nutrient management (to produce high yield and marketable grain quality) and biodiversity management to protect threatened species (many of which make use of the modified aquatic habitat found on rice farms) and measures to reduce the industry's emissions of greenhouse gases.

Growers hold drainage water on-farm and nutrients do not enter the riverine system.

It is worth noting that the drought and better groundwater management have impacted on depth to watertable in the rice growing areas. In the MIA, for example, the area with watertable within 2m of the surface has declined from more than 70% in 1996 to 3% in 2007. Similar declines have been recorded in the other areas.

The industry has embraced environmental management and its Environmental Champions Program, based on Environmental Management Systems (EMS) is recognised as one of the most progressive for an Australian industry. Environmental Champions is a five level achievement program that guides growers through a series of activities. Each level contains different actions to gain credit under a program linking on-farm action with catchment improvement. The program design is to connect environmental performance with better farm business performance. There remain a number of knowledge gaps which need to be addressed for this program to be fully effective. In 2007 the RGA commissioned work that developed an R&D Strategy for the Environmental Champions program.

Employment, Infrastructure, Regulation and Institutions

Industry information indicates that rice growing, milling and transport normally provides direct employment for around 8,000 people and a further 37,000 jobs are generated in flow-on activities.

Grower cooperatives are a significant feature of the industry, both in production and in the marketing of rice and rice-based food. The Ricegrowers' Limited (SunRice) has moved from a cooperative to a company structure.

The Ricegrowers' Association of Australia (RGA) is the peak industry organisation for growers and is represented on the Rice R&D Committee, which reports back to RGA members on a six-monthly basis.

The rice industry is the most highly regulated in Australian agriculture. Controls exist on both production (soils, farm area, maximum water application, etc) and markets.

The Rice Marketing Board of NSW was established to control the purchase and sale of all rice grown in NSW, effectively establishing a single-desk selling system. The board has licensed these powers to the Ricegrowers' Limited. Export marketing operates as a single-desk. Domestic marketing is deregulated from 1 July 2006 and R&D implications of this change were canvassed during R&D plan preparation.

Industry Success and Outlook

The success of the Australian rice industry is the result of a combination of factors, including:

- the vertically integrated nature of the industry, where the growers of the raw material (paddy rice) own and control the processing and marketing business and thereby capture the value added return on their production
- a marketing philosophy whereby the maximum tonnage possible of value added milled rice is sold in small branded packs where the brands are grower owned and a high level of customer service is provided
- a commitment to R&D that has driven farm productivity.

The industry's success in the future will depend on how it addresses the changing industry, production and marketing environment. Key factors include:

Changing industry environment

- Potential larger fluctuations in the size of the rice crop and in funds available for R&D.
- The impact of changes in the relative prices of crops grown in the industry's production system.
- The need for investment in the industry's capital infrastructure, leadership and skills.

Changing production environment

- The impact of climate change and government water policy on water availability and access.
- The need for further improvements in water use efficiency.
- The potential for changes in the rice production system to address the uncertainties resulting from climate change.
- The need for the industry to address a number of environmental issues both with respect to its impacts on the environment (e.g. greenhouse gas emissions, biodiversity, salinity) and the environmental benefits of rice farming system (e.g. the benefits of ponding for biodiversity).
- The impact of climate change on rice quality (larger crop variation is likely to lead to longer storage times).
- Industry success in overcoming genetic constraints affecting crop performance.
- Constant on-farm innovation to increase productivity and profitability.

Changing marketing environment

- Policies in major producing, exporting and importing countries that distort world rice markets.
- Managing marketing change and risk.
- Relationship management in supply chains and with service sectors.

These factors are further developed in the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis below.

4. Key Challenges for the Industry (SWOT)

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Highly skilled growers that adopt new technologies, varieties and growing practices. • Geographic concentration of the industry in southwest NSW and northwest Victoria. • Good climate for growing temperate varieties of rice. • Low disease and pest problems compared with other world rice growing areas. • Low chemical use after the early stages of the crop. • Leader in environmental management with demonstrable success e.g. Environmental Champions. • Vertically integrated marketing arrangements backed by an export single desk. • Grower owned company that is a successful marketer in both the domestic and export markets. • Grower owned capital infrastructure. • Successful R&D Program achieving major innovations in rice varieties for specific markets, yield increases, disease/pest management and water use efficiency. • An R&D base that is part of the growers community • Highly committed leaders that are passionate about the future of the industry. • Strong industry organisations. • Unified and loyal growers that have trust in their industry and marketing organisations. 	<ul style="list-style-type: none"> • High susceptibility to climate change and water restrictions. • Geographic concentration – vulnerable to water restrictions and natural disaster • Reliant on varieties that are susceptible to cold weather and introduced pests/diseases • Lack of demonstrated options for farmers to grow their businesses and or ensure successful exit. • Reliance on debt financing for farm development and expansion. • Inadequate research on optimisation of the whole farming system from water allocations and whole farm profitability. • Aging grower population with inadequate succession planning for farm businesses and leadership positions. • Declining numbers of young people wanting to enter the industry. • Skill shortages in the rest of the economy attracting skills away from agriculture. • Inadequate strategies to develop key relationships (eg, with government, consumers, environmental groups, media, general public, etc). • Lack of integrated industry info systems that provide robust, up-to-date data to promote industry and inform. • A small player in corrupt and volatile world markets • Reliance on market information from a single source. • Poor integration of water allocation decisions and crop planning requirements. • Slowing in the rate of potential yield increase – breeding program diverted into other priorities.

Source: Kiri-ganai Research 2006 and project consultation

OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • World consumption exceeding production with stocks at the lowest level since 1982-83. • International demand for quality branded rice products that suit changing cuisines. • Movement on trade liberalisation that can bring increases in export opportunities. • National focus on water and development of more consistent policies under the National Water Initiative. • Potential of R&D and innovation to achieve further major increases in yields and water use efficiency. • Greater flexibility in the rice farming system to address variations in water availability compared to enterprises involving permanent plantings • Reduce the environmental impacts of rice growing • Unrealised opportunities for value adding. • Achieving theoretical on-farm yield potential via more effective management, technology transfer. • Further development of industry's human resources. • Improve harvesting, storage, handling and transport • Utilising the industry's successful processing and marketing system to sell other value added irrigated products (non R&D issue). • Success in environmental and water management providing a strong base for promotion of the industry in the awareness and understanding of Australians (non R&D issue). • Development of improved relationships with Government through participation in initiatives such as the Industry Partnership Programme and Environment Management Systems Pathways Program (non R&D issue). 	<ul style="list-style-type: none"> • Climate variability affecting crop yields and quality • Impact of greater production variability on rice marketing • Impact of production variability on funds for R&D. • Frequent severe drought affecting water allocations. • Other environmental issues – salinity, biodiversity, stubble burning, etc. • Risk of exotic pests and diseases • Perceived low standing of the industry amongst urban people, the media and some environmental groups. • Negative and misinformed comment from prominent individuals and organisations. • Policy inconsistency and unpredictability of government decisions in relation to water and the environment. • Potential inequitable treatment of the industry in government policy making. • Market risk from deregulated domestic market. • Farm input cost increases (fertiliser, fuel, chemicals). • High cost of government regulations. • Negative publicity for export single desks due to 2006 wheat industry problems. • Possible under-investment in handling, storage, milling and processing infrastructure. • Loss of competitiveness in Australia's export markets due to lower cost alternatives. • Non-tariff trade barriers circumventing WTO obligations and further restricting export market access. • Imbalances of rice supply/demand due to depressed prices in other rural industries in southern NSW. • Resistance to herbicides and new pests/diseases. • Risk of a reduction in government funding of R&D.

Source: Kiri-ganai Research 2006 and project consultation

5. Review of the Existing R&D Program

This review of the RIRDC Rice Program was undertaken in 2006 as background to the preparation of a new R&D Plan. It is drawn from the following resources:

- R&D Plan for the Rice Industry Program, 1996-2001 and 2002 to 2006 (draft) together with interim Rice R&D Committee strategies for the period 2002 to 2006.
- Evaluation of the Rice Program: An Overview of All Projects – Stage 1 (CIE 2004).
- Evaluation of the Rice Program: An Assessment of Investment Returns – Stage 2 (CIE 2004b).
- Maximising the Future Pay-Off from Rice Breeding (Brennan, Singh and Lewin 1997).
- Review of Rice Extension: Building Capacity in Rice (Macadam, Drinan and Inall 2002).
- Economic, Environmental and Social Impacts Ricecheck Program (Singh, Brennan, Lacy, Steele 2005).
- Evaluation of the Impacts of the CRC for Sustainable Rice Production (Nesbitt, 2003).

A brief summary of each of these resources is presented in this chapter along with lessons learned that are relevant to a future rice R&D program.

Current R&D Plan for the RIRDC Rice Industry Program

The most recent finalised RIRDC five-year plan for rice R&D covered the period 1996 to 2001 and addressed nine major research objectives:

- Objective 1: Varietal Improvement and Pure Seed Maintenance
- Objective 2: Crop Establishment
- Objective 3: Agronomy and Crop Physiology
- Objective 4: Crop Nutrition
- Objective 5: Crop Protection
- Objective 6: Sustainable Farming Systems
- Objective 7: Technology Transfer and Human Resource Development
- Objective 8: Harvesting, Storage, Handling and Transport
- Objective 9: Milling and Processing

A tenth objective, Human Capital Development, was included in the 2002-2006 R&D plan.

Characteristics of these research objectives are provided below.

Objective 1: Varietal Improvement and Pure Seed Maintenance

Varietal improvement can lead to rapid progress in addressing most of the Australian rice industry's key challenges. The priorities identified for the plant breeding program included: higher yielding varieties with quality meeting consumer needs; early, even maturity; cold weather tolerance; semi dwarf stature; improved seeding vigour; pest and disease resistance and salinity tolerance.

Objective 2: Crop Establishment

Vigorous seedling growth to produce an even plant stand provides the framework for a profitable crop. This objective sought to develop crop soil and water management techniques to improve establishment in areas such as: seedbed preparation; seedling and seed treatment methods; control of muddy water; control of seedling pathogens and insect pests; and optimising seedling nutrition.

Objective 3: Agronomy and Crop Physiology

This objective aimed to optimise the rice farming system through a better understanding of the physiology and agronomy of rice and other complementary crops in the rice rotation. The information and management practices resulting from the research were to lead to optimisation of crop inputs ideally based on objective management systems for improved yield and quality.

Objective 4: Crop Nutrition

Objective four addressed the development of crop nutrition strategies to optimise yield and quality. The program focussed on both macro and micro nutrients required for healthy crops and food products. Emphasis was placed on predicting optimum application (amount and timing) through objective soil and tissue testing as well as identifying management to improve inherent soil fertility and plant response to nutrient availability.

Objective 5: Crop Protection

Objective five addressed the development of integrated weed control and pest management strategies for the rice industry that were both efficacious and environmentally sustainable. Major weeds include barnyard, dirty dora, starfruit, alisma, water couch and silvertop. Major pests include bloodworm, aquatic worms, leaf miner, aquatic snails, armyworm, native waterfowl and rodents.

Objective 6: Sustainable Farming Systems

The sustainable farming systems objective aimed to enhance the use of natural resources (land and water) for sustainable rice production. It focussed on reducing groundwater accessions from rice growing, maintaining and improving the quality of surface drainage water from rice, addressing salinisation and acidification of rice growing soils and maintaining and improving soil physical and chemical structures for rice production.

Objective 7: Technology Transfer and Human Resource Development

The industry has been very successful in achieving rapid adoption of new technology because of its vertical integration and the close links between growers and the providers of rice extension services. To ensure rapid adoption continued, the industry placed high priority on ensuring the government provided extension service is of high quality and is not reduced and that the efficiency and effectiveness of research, development and extension resource use is maintained and improved.

Objective 8: Harvesting, Storage, Handling and Transport

Harvesting, drying, storage, handling and transport processes impact on product quality and industry efficiency and therefore grower returns. Ongoing R&D effort was made in this area by staff of Ricegrowers' Limited and where necessary supplemented by external agencies and projects from within the RIRDC Rice R&D program.

Objective 9: Milling and Processing

This objective aimed to improve milling and processing operations in order to add value to product and increase grower returns. The objective was driven by the efforts of Ricegrowers' Limited. Key activities were to target improvement in whole grain, reduction in low value milling fractions and reduced off-colour and damaged grains.

Objective 10: Human Capital Development

This objective aimed to enhance the participation of people in the rice industry and to enhance their potential to contribute to the well being of the rice industry and general community. Its focus was on encouraging participation by under-represented groups and by encouraging training and development on an industry wide basis.

Other Research Completed

The 1996-2001 RIRDC Rice R&D Plan included funding for basic research on value added products, including new and novel food and industrial products.

The CRC for Sustainable Rice Production was also part funded by the RIRDC Rice R&D Program as part of the 1996-2001 plan.

R&D resource allocation, including the period covered by this plan is summarised in Table 3 below.

Table 3 Expenditure by Rice Program Area (expressed as a % of total)

Classification	1991/02 to 2001/02	1998/99 to 2005/06	2005/06
Varietal improvement and pure seeds	71	41	60
Crop establishment, agronomy and physiology	Included above	14	11
Crop protection	Included above	9	11
Sustainable farming systems	16	4	4
CRC funding - sustainable farming systems	0	16	0
Harvesting, storage through to processing	1.5	2	1
Markets	0.2	0	0
Communications and technology transfer	10	11	13
Human capital	1.3	3	1
Total	100	100	100

Source: Rice R&D Committee and CIE 2004

The table shows the relative importance of varietal improvement, crop establishment, agronomy, physiology, crop protection and sustainable farming systems.

In the period since the last five-year R&D plan a draft of the 2002-2006 plan was prepared, which 'carried forward' previous research objectives. The 2002-2006 plan was not finalised. The 2002-2006 period has been characterised by:

- investment that has been constrained by a reduction in levy income caused by drought
- an even greater reliance on investment in varietal improvement, crop establishment and crop protection
- R&D strategies that have been developed and driven by the Rice R&D Committee
- R&D strategies that have focussed on incorporating cold tolerance research findings into the breeding program
- R&D strategies that have focussed on managing the ecology of key rice pests.

The Centre for International Economics (CIE) reviewed the performance of the Rice R&D program in 2004 using RIRDC's two-stage evaluation process. The process involves a preliminary assessment of the impact of all projects and then a detailed cost/benefit analysis of a sample of completed projects. Results from the two-stage evaluation are presented below.

Evaluation of the Rice Program: An Overview – Stage 1 (CIE 04)

CIE’s Stage 1 evaluation of the RIRDC Rice R&D program covered the period 1991-92 to 2001-02 and included program funding, project classification, stage of R&D and initial assessment results.

Program Funding

The rice program supported 157 projects with an expenditure of \$55.3 million over the period 1991-92 to 2001-02. This included \$2.9 million provided by RIRDC to the CRC for Sustainable Rice Production. Of the total funding provided to program projects, RIRDC contributed 21%, which was made up of levy payer contributions and matching funding by the Commonwealth Government.

Project Classifications

Table 4 shows RIRDC Rice R&D program expenditure over the period of the evaluation. Share of RIRDC funding reflects the extent that RIRDC investment has been matched by other research organisations.

Table 4 Expenditure by Rice Program Area (expressed as a % of total)

Classification	Total (\$'million)	Share of RIRDC funding	Share of total funding
Production - industry competitiveness	39.57	42.4	71.5
Production – sustainable development	8.72	46.4	15.8
Processing	0.61	66.4	1.1
Distribution, storage and transport	0.23	62.0	0.4
Markets	0.11	41.8	0.2
Communication, technology transfer	5.38	41.6	9.7
Industry training and development	0.70	89.9	1.3
Total	55.32		100.0

Source: CIE 2004

The RIRDC Rice R&D program targets that part of the value chain from pre-planting to milling. Very few resources target marketing or commercial issues. SunRice funds marketing/commercial issue R&D.

CIE 2004 concluded that while the majority of funds have been invested in ‘industry production competitiveness’¹, as a share of RIRDC funds less than half comes from RIRDC. This reflects the large investment by industry organisations in this area of research, much of which is undertaken closely with the industry. The high RIRDC share of the very small investments in areas such as processing and markets dates from early projects and would reflect the fact that RIRDC funding is directed only to less commercially attractive investments. Commercially attractive investments are funded by the industry i.e. SunRice.

A high leverage rate on ricegrower funds has been achieved.

Stage of R&D

¹ Industry production competitiveness includes varietal improvement, crp establishment, agronomy, physiology and crop protection

R&D can be thought of as a three-stage process:

- Stage 1: fundamental or basic research, the outputs of which are inputs to further research – the RIRDC Rice program has invested 35% of available funds into stage 1 projects
- Stage 2: specific outcome driven research that can be used in some type of production – the rice R&D program has invested 50% of available funds into stage 2 research
- Stage 3: promoting the adoption of research outcomes – some 15% of funds have been invested in stage 3.

For established industries like rice there tends to be a higher proportion of stage 2 projects. For geographically concentrated industries with strong industry structures, less investment in stage 3 is required. Investment in rice R&D is consistent with these broad R&D principals.

Initial Assessment Results

The RIRDC Rice Program Manager and representatives from the Rice R&D Committee provided an initial assessment of the program. Results are summarised in Table 5.

Table 5 Initial Assessment of Total Funding

Project Impact Ranking	Number of Projects	Total Funding (\$' million)	Share (%)
High	49	26.7	51.0
Medium-high	25	0.7	1.4
Medium	15	2.8	5.3
Low-medium	7	2.5	4.8
Low	26	7.2	13.8
Too early	27	12.3	23.5
Unknown	7	0.1	0.3
Total	156	52.3	100

Source: CIE 2004

From the table it can be seen that high impact projects represent over half of the total investment. High impact projects were concentrated in the 'production industry competitiveness' area with a particular focus on improved varieties, crop establishment, agronomy, physiology and crop protection. For 'production sustainable development' only 22% of projects were assessed as 'high impact'. This reflects the more recent nature of investment as 'too early' accounted for 47% of projects and the inherently greater complexity of the issue and size of the challenge.

Evaluation Rice Program: Investment Returns – Stage 2 (CIE 04b)

Stage 2 of the CIE review of the RIRDC Rice R&D program (CIE 2004b) addressed investment returns from five project clusters, they were:

- fertiliser management
- pest management
- weed management
- EM-31 that minimises water loss by preventing planting in potentially leaky paddocks
- SWAGMAN decision tool that minimises net recharge and maximises gross margins.

Types of benefits considered in the analyses included:

- reduction in cost of production
- expansion in the area of rice under production
- an increase in wholegrain mill out and associated price premiums
- an increase in water potentially released to the environment
- a reduction in potential environmental risks.

Table 6 represents what CIE believe are the most likely pay offs to the R&D. The results indicate that in general the research has had a high payoff. The research has:

- Satisfied the pay off requirements of RIRDC i.e. a Net Benefit Investment Ratio (NBIR) > 8X cost or an Internal Rate of Return (IRR) > 25%.
- From a total investment of \$11 million (excluding SWAGMAN²) return was estimated at \$292 million. Of this return 59% is a return to rice producers and the balance (41%) is in the value of water saved.
- The R&D investment has saved rice growers \$80 ha/pa over an average 15 year analysis period (i.e. average grower would be \$80/ha worse off if the investment had not been made)
- Spray drift and chemical run-off benefits are assessed as minor in the analysis as the base cost is incidents is also minor. The impact of R&D on salinity could not be quantified. Reduction in risk from water saving is highly significant but unquantified. At its maximum the benefit in reduced risk is the value of the industry less alternative land use.
- The social benefit of R&D has been a reduction in the uncertainty over the industry's future.

² At the time of the CIE evaluation it was too early to assess the adoption of the SWGMAN tool by farmers.

Table 6 Cluster Evaluation Results – RIRDC Rice R&D

Rice Research Evaluation Outcomes	NPV (\$'M)	Cost (\$'M)	NBIR (%)	IRR (%)
Fertiliser management	63.0	7.1	8.6	132
Weed management - SCWIIRT	1.5	0.03	70	87
Weed management – resistance	7.8	0.65	13	45
Pest management – bloodworm and snails	28.4	1.7	18	180
Pest management – rotations	23.6	1.1	23	73
EM-31	156.9	0.4	99	81
SWAGMAN	n/a	n/a	n/a	n/a

Source: CIE 2004b using a 5% discount rate

CIE (2004b) concluded that strong returns from R&D had been achieved in the rice industry and that this would be expected. R&D is driven by grower and industry priorities. There is an established history of R&D and a close relationship between growers, the rest of the industry and researchers. Selection of R&D investment is well informed by expected pay-offs and success rates. The industry is geographically concentrated and industrially not lifestyle focussed. Good systems exist for dissemination of information and adoption rates are high and rapid. R&D results apply to a large base; the industry is mature and significant in terms of value.

Maximising the Future Pay-Off from Rice Breeding (Brennan *et al* 1997)

Because of the extensive review of the rice varietal improvement program completed by Brennan, Singh and Lewin (1997), CIE 2004b did not include an assessment of the pay-off from rice breeding in their 2004 cluster analysis.

While now dated the 1997 review demonstrated that:

- breeding is justified on economic grounds
- based on the contribution of new varieties to past gains, the future gains needed through breeding to accomplish satisfactory economic returns are achievable.

An Australian rice-breeding program was justified on economic grounds.

Building Change Capacity in Rice Extension (Macadam *et al* 2002)

Macadam, Drinan and Inall reviewed the extension services of the rice industry for RIRDC in 2002 (Macadam *et al* 2002) and concluded that:

- rice was served by an exceptionally well-resourced and developed extension system
- new extension agents have emerged since the 1990s – first through agribusiness, then through the irrigation companies and most recently via the CRC for Sustainable Rice Production
- SunRice have a role in extension and promoting quality assurance (QA)
- NSW Department of Primary Industries (NSW DPI) has moved from one-on-one to group extension and are recouping the cost of extension through RIRDC
- the Irrigation Research Extension Committee (IREC) is still a substantial rice extension agent but less so since R&D was transferred to RIRDC
- agribusiness agronomists are a significant extension force and are trusted by farmers

- there is little industry wide planning of extension programs³
- growers want extension assistance with Natural Resource Management (NRM), business management, new technology and capacity building.

Macadam *et al* (2002) identified the following gaps in the extension system:

- a lack of integration and coordination of extension
- monitoring and evaluation not embedded in the culture
- a narrow technical focus that impedes whole farm business and environment management
- agribusiness agronomists with a marginal role in R&D despite their salience
- farmers not aware of low cost business and financial management programs
- communication failure: farmers overloaded with printed material and not comfortable with using the internet
- benchmarking impeded by failure of farmers to provide data.

Ricecheck Program Impacts (Singh, Brennan, Lacy, Steele 2005)

An assessment of the economic, environmental and social impacts of the NSW DPI and RIRDC funded Ricecheck extension program was completed by Singh, Brennan, Lacy and Steele in 2005 (Singh *et al* 2005). Ricecheck is an extension program developed in the 1980s by the NSW DPI to improve crop management in the rice industry. The Ricecheck program is based on monitoring crops and setting key benchmarks (or ‘checks’) based on the highest yielding rice crops.

The economic evaluation completed by Singh *et al* revealed that the net present value of Ricecheck over the period 1986 to 2002 was \$64 million and the benefit cost ratio was estimated at 18 (i.e. for every dollar invested eighteen was returned to growers). The evaluation also found that many of the on-farm economic benefits identified had positive social and environmental implications for the community.

CRC for Sustainable Rice Production (Nesbitt 2003)

The CRC for Sustainable Rice Production addressed programs in sustainability, agronomy, products processing and education. Its partners were SunRice, RIRDC, Charles Sturt University, the University of Sydney, NSW Department of Natural Resources, NSW DPI and CSIRO. The RIRDC Rice R&D program contributed approximately \$500,000 pa for eight years to the CRC.

Dr Harry Nesbitt (Nesbitt 2003) completed an evaluation of the economic, social and environmental impacts of the CRC for Sustainable Rice Production in 2003. Nesbitt concluded:

- that a major and appropriate proportion of resources were spent on research (71%). The balance was spent on education, commercialisation and administration
- the CRC was responsible for setting up excellent linkages, which in turn improved cooperation between sectors of research, education and industry
- the CRC supported education through its vocational, undergraduate and post graduate programs

³ The Rice R&D Committee has subsequently addressed this issue.

- approximately 41% of all non-administration projects conducted have an impact on the environment – similarly 40% are considered to have or will contribute to improving the economics of the industry
- a very conservative estimate of the economic contribution of the CRC is \$7 million per annum, but this amount can easily expand into tens or even hundreds of millions per year when CRC developed technologies are adopted or conditions change
- the Rice CRC was indirectly responsible for leveraging a considerable level of funds for rice based research
- the CRC effectively catered for gender specific issues and resulted in a good representation from different ethnic groups working together on rice based research activities.

The CRC was a successful investment for all of its research partners including the RIRDC Rice R&D program.

Lessons Learned

Review of the existing RIRDC Rice R&D program reveals the following lessons:

- the program has been dominated by pre-planting to harvest investment especially in relation to varietal improvement/plant breeding
- an Australian rice-breeding program was justified on economic grounds
- the program targets less commercially attractive investments with an appropriate emphasis on stage 2 (development) projects
- a high leverage rate on grower funds has been achieved i.e. the program has been successful in attracting resources additional to grower levies
- grower and industry priorities have driven R&D – there exists a close working relationship between growers, the rest of the industry and researchers
- selection of R&D projects is well informed by expected pay-offs and success rates
- the Rice CRC was a successful investment for all of its research partners including the RIRDC Rice R&D program
- there are good systems in place for dissemination of R&D results and returns from investment in extension have been favourable; however, there is a need for the program to target whole farm issues, new technology and capacity building
- R&D adoption rates are high and rapid
- there has been a strong return from investment in R&D in the rice industry.

Review of the existing R&D program would indicate that it has been a success and provides a strong basis for guiding future R&D investment.

6. External Priorities and R&D Priorities in Other Industries

Priorities for the RIRDC Rice R&D Plan 2006 to 2011 need to be set against knowledge of:

- the broader national R&D agenda including Australian Government National Research Priorities, Australian Government Rural Research Priorities and RIRDC Corporate Goals
- national research trends – CSIRO National Research Flagships Program and the National Program for Sustainable Irrigation
- international rice research trends – priorities at the International Rice Research Institute (IRRI) in the Philippines
- benchmarked against priorities in sister organisations/industries – Cotton Research and Development Corporation (CRDC) and Grains Research and Development Corporation (GRDC).

A review of research priorities in each of these areas along with a summary of lessons learned is presented in this chapter.

National Priorities and Rural Research Priorities

Australian Government National Research Priorities as outlined by the Prime Minister on 5 December 2002 are:

- an environmentally sustainable Australia
- promoting and maintaining good health
- frontier technologies for building and transforming Australian industries
- safeguarding Australia.

The Government Priorities for Rural Research are (www.daff.gov.au accessed 9 April 2008):

Productivity and Adding Value

Improve the productivity and profitability of existing industries and support the development of viable new industries.

Supply Chain and Markets

Better understand and respond to domestic and international market and consumer requirements and improve the flow of such information through the whole supply chain, including to consumers.

Natural Resource Management

Support effective management of Australia's natural resources to ensure primary industries are both economically and environmentally sustainable.

Climate Variability and Climate Change

Build resilience to climate variability and adapt to and mitigate the effects of climate change.

Biosecurity

Protect Australia's community, primary industries and environment from biosecurity threats.

Supporting the Rural Research and Development Priorities

Improve the skills to undertake research and apply its findings.

Promote the development of new and existing technologies.

The Government Priorities for Rural Research have been incorporated into RIRDC Corporate Goals and the objectives of the rice R&D plan.

RIRDC Corporate Goals

RIRDC's Corporate Goals and strategies, expressed through RIRDC Corporate Plan 2003-2008 are:

To provide the knowledge for diversification in Australia's rural industries.

Invest in R&D for new rural industries:

- that have significant export or domestic market opportunities
- where Australian industry has a competitive advantage, for example in production, seasonality, or market access
- that will be attractive to producers to enter and expand the industry.

To provide the knowledge to increase the profitability, resilience and sustainability of RIRDC's established rural industries

To invest in R&D for RIRDC's established rural industries:

- in areas identified by industry and government as a high priority
- that promote development and uptake of innovative technologies and solutions.

To provide the knowledge to address national rural issues

To invest in R&D to support:

- rural policy priorities of government
- the priorities of rural industries and communities
- topics that are cross-sectoral or multi-industry
- where partners support co-investment.

RIRDC's Corporate Goals are driven by the principle that it will invest in less commercially attractive projects.

CSIRO and the National Research Flagships Program

The National Research Flagships Program, a partnership of CSIRO and other research providers, is addressing six national objectives:

- strong, sustained economic growth, new industries, competitive enterprises, quality jobs
- healthier, more productive lives for Australians
- clean, cost-efficient energy
- more productive and sustainable use of water
- sustainable wealth from our oceans
- growth and prosperity for regional Australia.

Of most relevance to the RIRDC Rice R&D Plan are the Food Futures Flagship and the Water for a Healthy Country Flagship.

Food Futures Flagship will:

- address the international competitiveness of the Australian agrifood industry
- apply frontier technologies to high potential industries
- seek outcomes that benefit all aspects of Australian life
- cover the entire food-supply chain.

Water for a Healthy Country Flagship will tackle technologies and information needed to:

- protect Australia's rural and urban landscapes and ecosystems
- provide safe and clean drinking water
- manage rivers, wetlands and estuaries
- ensure the sustainable use of our water resources.

The combination of new Government funding, redirected CSIRO funding and external revenue will take the total investment in the Flagships Program to close to \$1.5 billion over the seven years to 2012.

International Rice Research Institute, Philippines

International Rice Research Institute (IRRI) is a non-profit international agricultural research and training centre located in the Philippines and established to improve the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes. It is dedicated to helping farmers in developing countries produce more food on limited land using less water, less labour and fewer chemical inputs, without harming the environment.

IRRI is currently in the process of reviewing its strategic plan. Revised plan goals will address:

- Goal 1: Elevating Poverty – reduce poverty through improved and diversified rice-based systems in regions of endemic poverty.
- Goal 2: Environmental Sustainability – ensure sustainable rice agro-ecosystems that balance demands for productivity growth, conservation, and equitable use of natural resources, that are adapted to the effects of climate change.
- Goal 3: Health and Nutrition – improving nutrition and health in poor rice consumers and farmers.
- Goal 4: Creating an Information Portal for Rice – provide equitable access to information and knowledge on rice and help develop the next generation of rice scientists.
- Goal 5: Germ plasm maintenance now and in the future – enhance the ability to respond rapidly and effectively to the genetic resource needs of rice producers and consumers in a changing world.

The research program will be consistent with the United Nation’s Millennium Goals.

While many of the goals IRRI has set for itself are not relevant to the RIRDC Australian rice industry R&D plan, major international trends IRRI will be addressing include maximising the nutritional value of rice:

- unpolished rice – bran on
- rice containing lutein – an antioxidant that benefits eyes, skin and heart health
- GABA – to stabilise blood pressure and decrease fat content in blood
- resistant starch – that acts like fibre in the human gut
- low GI rice – for sustained energy.

IRRI is also concerned with human resources and developing the next generation of rice scientists.

Trends identified by IRRI research staff potentially relevant to an Australian R&D program include:

- functional foods — rice breeding for additional human health attributes — China is investing heavily in this area
- capitalising on the first world’s interest in health/healthy food
- convenience — convenient food that is healthy
- foods with the capacity to address Type II Diabetes.

National Program for Sustainable Irrigation

The National Program for Sustainable Irrigation (NPSI) is a coalition of investors in sustainable irrigation research and innovation. The investors are from all aspects of the irrigation industry including policy, growers, water providers, commodity and extension groups. The program has a Management Committee that provides the priorities, direction and financial management. Land and Water Australia is the statutory authority that provides overall governance and day-to-day management.

The NPSI's commissions research that will:

- enable irrigation industries to be responsible and profitable users of water (e.g. salt, nutrition and soil water movement within and beneath the root zone)
- inform the management of irrigation within a landscape (e.g. ecological impact of reconfiguration or irrigation systems)
- be communicated in readily accessible formats
- be relevant to practitioners, policy makers and planners.

There is a strong emphasis on environmental responsibility, profitability and communication in NPSI's research priorities.

Cotton Research and Development Corporation

The Cotton Research and Development Corporation (CRDC) is the RDC for the Australian cotton industry. Cotton, like rice is a mainly irrigated commodity.

The CRDC vision is a globally competitive and responsible cotton industry. CRDC provides leadership and investment in research, innovation, knowledge creation and transfer.

The CRDC's 2003 to 2008 Strategic Plan is divided into six programs:

- Program 1 - People & Knowledge (e.g. community and economics, extension and HR)
- Program 2 – Integrated Natural Resource Management (e.g. best practice and environment)
- Program 3 - Crop Protection (e.g. insects, diseases and weed management)
- Program 4 - Farming Systems (e.g. soils and water)
- Program 5 - Breeding and Technology
- Program 6 - Value Chain (e.g. processing and market development)

CRDC funding priorities for the period through to 2008 are shown in Table 7. The table includes a summary of actual rice investment for the period 1999 to 2006 for comparative purposes:

Table 7 CRC Funding Priorities 2003 to 08 and Rice Priorities 1999 to 2006

Program	Proposed cotton funding allocation (%)	Actual rice funding allocation (%)
People & Knowledge	15	14
Integrated Natural Resource Management	9	4
Crop Protection	38	9
Farming Systems	18	16
Breeding and Technology	17	55
Value Chain	3	2
Total	100	100

Source: CRDC Annual Operating Plan 2005-2006

Key points of relevance to emerge from the analysis of CRDC funding priorities are:

- The allocation of funds between rice and cotton R&D programs is broadly similar. The rice industry invests a greater percentage of funds in breeding and technology, while the cotton industry invests in crop protection.
- More detailed analysis of cotton priorities reveals that trade and market access is a priority for this industry (grouped into Program 1: People and Knowledge). Markets are given little emphasis under current rice R&D funding priorities.
- The cotton industry is a major investor in GMOs/biotechnology. The rice industry has responded to consumer concerns and believes that GMO free may be an important future point of differentiation for Australian rice. Cotton has also had to invest in consumer confidence building in relation to the safety of cottonseed oil.
- The CRDC is committed to funding a new industry CRC – the Cotton Catchment Communities CRC, which will be wider focus than its predecessor the Australian Cotton CRC.

The cotton industry has approximately \$11.2 million pa to invest in R&D in contrast to the \$2 million to \$3 million available to rice.

Grains Research and Development Corporation

The Grains Research & Development Corporation (GRDC) is responsible for planning, investing and overseeing research and development, delivering improvements in production, sustainability and profitability across the Australian grains industry. GRDC is a statutory corporation, founded in 1990. Annual investments total approximately \$130 million.

The GRDC's mission is to invest in research and development for the greatest benefit to its stakeholders – grain growers and the Australian Government. The Corporation links innovative research with industry needs. The GRDC's vision is for a profitable, internationally competitive and ecologically sustainable grains industry.

GRDC's planned program of investments alongside rice projects 1999 to 2006 are shown in Table 8:

Table 8 GRDC Funding Priorities 2005/06 and Rice Priorities 1999 to 2006

Program	Grains funding allocation (%)	Actual rice funding allocation (%)
Varieties	45.4	55
Practices – sustainability and crop protection	26.0	29
New Products – value chain and business dev.	8.3	2
Communications and technology transfer	7.4	11
Strategic investments in emerging issues	3.0	0
Corporate services, training and human capital	9.9	3
Total	100	100

Source: GRDC Annual Operating Plan 2005-2006

Key points of relevance to emerge from the analysis of GRDC funding priorities are:

- like rice, GRDC place a high reliance on varietal improvement
- value chain and business development receives a higher share of GRDC investment than rice
- GRDC makes provision for strategic investment in emerging issues.

Issues driving GRDC investment include:

- the continued decline in real terms of trade for grains industry
- working with state departments to ensuring there is ongoing research capacity
- consumer influence – food safety, quality, nutrition and diversity
- globalisation of agribusiness and agricultural research
- ongoing need to lift the profile of what GRDC does and achieves.

Lessons Learned

Review of national research priorities along with R&D priorities in other industries reveals the following lessons:

- there is a national emphasis on sustainable use of water, international market access, the applicability of biotechnology to plant breeding and the need to develop skills and abilities
- trends identified by IRRI staff for rice include functional foods and rice with additional human health attributes
- the National Program for Sustainable Irrigation has a strong emphasis on environmental responsibility, profitability and communication
- CRDC invests in market access, building consumer confidence and the communities that rely on the cotton industry
- the GRDC portfolio includes greater emphasis on the value chain, investment in emerging issues/‘blue sky’ and research capacity building.

National research priorities along with the benchmark comparison of R&D priorities in other programs were used to set directions for the rice R&D plan 2006–2011.

7. Consultation Findings

In 2006 consultation to secure broad ownership of future research directions was completed with growers, researchers, resource managers, marketers, government and members of the Rice R&D Committee. A report on the results of this consultation has been retained in this Plan because it continues to provide useful insight into industry views about its knowledge needs.

The consultation used a four-stage process:

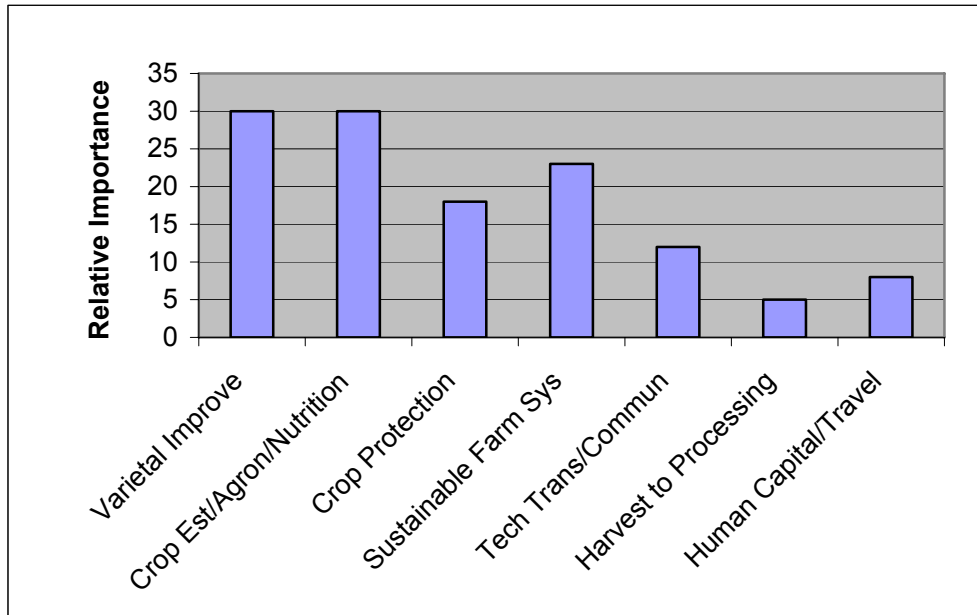
- Stage 1: Collation of detailed Rice R&D Committee survey results – this survey targeted mainly researchers and growers and provided detailed data on future research priorities.
- Stage 2: Collation of Rice R&D Committee surveys distributed during 2006 rice field days – some 106 survey responses were received from this source.
- Stage 3: An R&D Planning Workshop Jerilderie NSW 16 March 2006 - workshop targeted all links in the supply chain as well as resource managers, Land & Water Australia and government. The workshop also addressed industry ‘big picture’ strategic challenges.
- Stage 4: Targeted follow-up with key stakeholders on ‘emerging plan themes’ with additional requests for comment on specific plan objectives and strategies.

Results from the consultation process have been aggregated and reported in the section below.

Overview

Stage 1 survey respondents were asked to identify up to five key issues that require further R&D investment over the next five years and to rank these issues in priority order. The results are summarised in Figure 1.

Figure 3 Future R&D Priorities – Stakeholder Consultation



Source: Stage 1 Rice R&D Committee Survey Results

Clearly Varietal Improvement (encompassing plant breeding for yield, quality, cold tolerance, etc) and Crop Establishment (agronomy, physiology and nutrition) were the highest R&D priority for growers and researchers. Sustainable Farming Systems defined by respondents as including ‘salinity/nutrient balances’, ‘planting systems’ and ‘beds, rows and layout design’ were also important. As was crop protection (new chemicals and integrated weed management) and technology transfer (extension and the employment/retention of research/support/extension capacity). Less important were human capital formation (travel, scholarships, etc) and harvest/post harvest issues (including storage, handling, transport, milling and processing). A glitch in survey design prevented simple aggregation of results from Stage 1 with data from Stage 2. However, Stage 2 data sets confirm that Varietal Improvement and Crop Establishment are the two highest priorities for future R&D investment.

Stage 2 survey results also confirm the future importance of the current allocation of R&D funding to the rice breeding program when asked:

‘What percentage of the total RIRDC research budget should be allocated to the rice plant breeding program?’

The average of survey responses was 57%. Current allocation is approximately 60%. Historical allocation, 1998-99 to 2002-03 was 41%.

Consultation Results – Research Priorities

Consultation provided stakeholders with the opportunity to describe specific areas for future research; research breakthroughs that would make the greatest difference to rice growing in Australia; the current greatest constraint to Australian rice production; and the least adequately covered research area. Consultation results are summarised in the section below.

Varietal Improvement and Pure Seeds

- Improved varieties with enhanced yield, acceptable quality and improved cold tolerance remain the highest research priority.
- Increased focus on breeding for cold tolerance is required to ensure the Australian industry has varieties equal to their major competitors.
- Research on innovative ways to improve water use productivity and milling quality should be a priority area for longer-term research.
- Cold tolerance of rice varieties will need to be covered by the above strategic priorities.
- Functional foods research is not a priority for the Australian breeding program. There is a lot of private sector and international investment in this area.
- Plant breeding to increase salt tolerance is not a priority for the medium term.
- Plant breeding to improve rice establishment vigour is a secondary priority.
- Too many breeding priorities risk dilution of research effort.
- It is not possible to create a breeding program with the proposed resources that addresses more than three objectives – key objectives must therefore be yield, quality and cold tolerance.
- The emphasis of the breeding program must be on new varieties with the capacity to increase yield. The rice-breeding program has not delivered these in the last 10 years. Amaroo, the Australian industry's mainstay was released in the late 1980s.
- Australia cannot be all things in all markets – our strength is in quality medium grain varieties.
- There is a need to leverage scarce resources in a small domestic breeding program through collaboration with international rice breeders.
- There is a need to ensure appropriate tools are available for the Australian breeding program i.e. genetic markers and breeding aids.
- GMOs/biotechnology – further investment awaits consumer acceptance of the technology. At that time learning from other industries and international efforts can be rapidly applied to the Australian breeding program.
- The industry must maintain its pure seed program.
- A risk assessment of breeder's pure seed program is needed and multiple replication sites were suggested.

Crop Establishment, Agronomy/Physiology, Nutrition Management and Precision Agriculture

- Improved seedling vigour through both improved genetics (plant breeding) and pre-sowing treatment was the highest research priority for crop establishment, nutrition and management.
- Precision agriculture for dealing effectively with in-field yield variation was important and potentially a major source of yield and profit gain.
- Knowledge to manage nutrition, salinity and soil interactions was also seen as important.
- Decision-making tools for measuring nitrogen pre sowing are needed.
- Ongoing work on agronomy, physiology and nutrition is always required.

- Plant breeding can only take yield so far, thereafter performance is reliant on excellence in crop management. The R&D program needs to address this issue.

Crop Protection

- Chemical solutions to potential and existing grass and broadleaf resistance are the first order priority.
- Longer-term non-chemical integrated weed management programs are needed – invest now. It is noted that this is a high-risk area for research.
- GMO/biotechnology to manage weeds, while a good idea is not likely to generate commercial outcomes in the medium term.
- What is needed is a ‘weed systems’ approach that will continue to rely on the sustainable uses of the best chemicals available consistent with environment responsibility. This means more linkages to other rice industries to create the critical mass for the interest of chemical companies and more work on the biology of weed management, rotation of chemicals, direct seeding, etc to minimise opportunities for herbicide resistance.

Farming Systems – Whole Farm Management, Profit and Sustainability

- Whole farm planning to maximise profit is needed – appropriate user-friendly models and, potentially, enterprise benchmarking if sufficient grower support could be achieved.
- Whole farm/irrigation layout/crop rotation systems/weed biology research is needed.
- Tools that permit better water accounting and measurement through the system but especially on farm are required.
- Better integration of water allocation decisions and crop planting requirements.
- Innovation to address water sharing with the environment (e.g. current Barmah-Millewa water loan).
- Stubble use strategies that move away from burning would be useful. However this is a relatively minor issue that could be addressed through action research/demonstration projects. Resultant strategies would need to be tested on a cost/benefit basis.
- While there is no potential for upland (non-irrigated) rice except in far northern Australia – there is potential for aerobic rice with less reliance on paddy flooding.
- Joint investment in grain/graze/rice with other R&D corporations is a logical fit for the Rice R&D program but high transaction costs associated with programs across R&D corporations makes joint investment less attractive on a cost benefit basis.
- Successful joint R&D corporation investments have included the ‘rice on beds’ project with joint GRDC, ACIAR and RIRDC funding.

Technology Transfer, Communication, Policy and Communities

- There is a need for a full complement and training of district agronomists in extension methodology, group dynamics and group facilitation. However, this is not a RIRDC R&D responsibility.
- There is a need for an adequate and appropriate research support staff – again not a RIRDC responsibility. Comment also received that we need more innovators not more assistants.
- Ensure commercial agribusiness and agronomist networks are maintained with close liaison between public and private service providers. This point was also raised in the Macadam et al 2002 review of rice extension.
- Access better ways to communicate and transfer technology with farmers and service providers.
- Ensure appropriate community linkages and an understanding of the role rice plays in maintaining the social fabric of the region.
- Water policy research to ensure future irrigation supply – this is core business for a number of other institutions. Possible role for RGA rather than the RIRDC R&D program in this area.
- Innovation to address water sharing with the environment e.g. water loans.
- Succession planning needed for growers – important but not a responsibility of the R&D program.
- Strategies to develop key relationships – government, community, etc.
- Research on institutional structures to manage changing external/internal environment.
- Industry information systems to promote the industry and inform participants – again not a core responsibility of an R&D program.
- A rice water use audit to provide benchmarks for future industry efficiency improvements.

Harvest to Processing

- Less important area of research according to the industry.
- Standardisation of techniques for predicting milling quality is a possible area for research.
- Strategies for on-farm storage to maximise grain recovery – not permitted under current regulations.
- Research on industry infrastructure management and capital replacement.

Market Research, Market Access and Marketing Arrangements

- Target market is affluent consumers who choose to consume rice rather than less well off individuals in developing countries who only have rice to consume.
- Convenience food, health and nutritional product market research was suggested.
- Food and industrial ingredient market research has further potential.
- Value adding research is good for profit but not for using all rice produced by the industry.
- Rice directed into value added products risks becoming a low value manufacturing input. Higher prices can be achieved for quality whole grains.
- Potentially the industry should support a further bid for a Rice CRC for value adding.
- Market information to growers on genuine consumer and market trends, rather than fads was also suggested.
- Objective cost benefit analysis to demonstrate the ongoing community benefits of single desk exporting was suggested and caution was expressed. This is an industry politics

issue that is addressed by NSW DPI as part of the National Competition Policy function. Potentially it is high-risk area of research for RIRDC.

- Market access research and priority setting – has been shown to deliver large gains in other industries. Kiri-ganai Research 2006 indicate large potential payoff for the rice industry.
- Modest trade liberalisation in Taiwan, Korea, and Japan in the short term and the EU in the long term will generate major returns for rice grower. New markets in the US are possible. Additional opportunities present themselves in the Middle East and China.

Human Capital

- Less important area of research according to industry respondents.
- Human resources must be part of the R&D plan given current depletion in human capital. Human capital includes growers, researchers, support and extensionists.
- Suggested areas for research include succession planning for key Yanco staff. While this is not a core responsibility of the RIRDC R&D program, possibly there is a role for the program in securing ongoing support for Yanco from the NSW Government.
- Suggested areas for research included international information exchange – an important tool for leveraging research knowledge and gaining an international critical mass for international issues such as new herbicide registration.
- International information exchange needs to take the form of both travel for Australian researchers and funds to encourage international researchers to visit Australia.
- A stand-alone program of student scholarships was suggested but rejected given limited success in other R&D programs. Historically the rice R&D program has built scholarships into specific R&D projects.

Emerging Issues and ‘Blue Sky’

- The question was posed as to whether a percentage of available R&D funds should be set aside for ‘blue sky’ research and research to address new issues that might emerge during the course of the program. GRDC invests a proportion of its portfolio along these lines.
- Consultation revealed some support for this idea but it was eventually decided that the program was not large enough to support this form of primary research.

Other Research Suggestions

- Other suggestions included a ‘one-stop-shop’ for storing, accessing and retrieving all the outcomes from research, development and extension. It was decided that the program site on the RIRDC web page was performing this role adequately.

Consultation Results – Production Constraints

Consultation also included questions on broader industry context to drive R&D program direction setting. Priority breakthroughs, greatest constrains and least adequately researched areas were:

Research breakthroughs that would make the greatest difference to rice growing

1. Varieties that can handle cold years during the reproductive phases from early pollen microspore to the flowering stage.
2. Varieties that are resistant to midseason sterilisation.
3. Varieties that are water efficient (and policy that ensures water supply).

Greatest Constraints to the Farm Enterprise

1. Water availability and policy.

Least Adequately Covered Research Area

1. Weed control.
2. Precision agriculture.
3. User friendly tools for farm profit.
4. Agronomy, physiology and nutrition.

Consultation results are a further input into rice R&D plan formulation.

8. Industry Commitment to Research

The commercial success of the Australian rice industry is closely linked to its strong commitment to R&D. Questions posed during R&D plan consultation revealed:

- overwhelming support for the RIRDC Rice R&D program — 100% of respondents indicated that the program has played a critical role in ensuring the rice industry remains internationally competitive, profitable and sustainable
- overwhelming support for the role played by government — 100% of respondents indicated that government should continue to match each dollar growers provide to the program
- strong support for a budget of around \$2.5 million to \$3 million over the five years 2006 to 2011 — 94% of respondents indicated a budget in this range was appropriate; others thought budget should be linked to capacity of the industry to fund investment while others indicated a higher budget was appropriate.

Support for the research program has also shaped the proposed five-year plan.

9. Research Directions

The Australian rice industry is facing a more difficult and uncertain future. There is the prospect of more frequent and larger fluctuations in production and research funds. This heightens the need for a well targeted R&D program, focused on priority knowledge gaps, to help the industry maintain and improve its resilience, profitability and sustainability. Key issues in determining future research directions include:

1. The need to integrate climate change considerations into the future research agenda. This includes investigating how the whole rice farming system can adapt to climate change and how its impact on greenhouse gas emissions can be reduced.
2. The continuing crucial importance of further improvements in water use efficiency in the face of potential future limitations in water supplies.
3. The need to investigate the impacts of climate change on rice quality and breeding.
4. The need to maintain the rate of productivity gain on-farm in the face of declining terms of trade.
5. The need to maintain a viable rice-breeding program and adopt expensive technologies to increase the efficiency of new variety research.
6. The benefits of developing a whole farm decision support tool or process.
7. The need to build on the industry's Environmental Champion's Program by addressing knowledge gaps in such areas as biodiversity, soil health, salinity and integrated pest management.
8. The need to objectively demonstrate the benefits of maintaining an export single desk.
9. Recognition of the aging and depletion of the industry's human resource research base and the need to invest in building future human resource capacity throughout the industry.

The R&D program is detailed over page.

10. The R&D Program 2006–2011

Goal

To improve the profitability and sustainability of the Australian rice industry through the organisation, funding and management of a research, development and extension program that is both market and stakeholder driven.

Objectives

Six objectives and expected share of the program budget are:

1. Varietal and rice quality improvement (50%)
2. Crop establishment, agronomy/crop physiology, nutrient management and precision agriculture (10%)
3. Crop protection (10%)
4. Farming systems for whole farm management, profit and sustainability (15%)
5. Technology transfer, communication, policy and communities (8%)
6. Human capital formation (7%)

Objectives should be regarded as complementary, with flexible boundaries to enable key issues to be addressed either simultaneously or sequentially through several components of the program.

Strategies

Strategies indicate specific research areas that will contribute to achieving the seven objectives. Strategies have been defined at a level that gives research providers guidance on where RIRDC is intending to target its investments over the period 2006–2011 and are intended to contribute to the longer term planning requirements of those providers. Strategies will be complemented with more specific research priorities published annually, which give more detailed guidance about the project areas that RIRDC is seeking to fund in the coming year.

Performance Indicators

Performance indicators are provided to assess whether the research strategies have contributed to the R&D objectives. Where possible, performance indicators have been linked to benchmarks for previous rice industry performance.

Budget Allocation

Budget allocation has been prepared following review of consultation findings, historical allocations and reference to other RDC budgets. Chapter 11 of this document provides a consolidated plan budget based on a 'normal case scenario' prepared by RIRDC for levy collection.

Objective 1: Varietal and Rice Quality Improvement Objectives

- To provide improved varieties with enhanced yield, acceptable quality and improved cold tolerance.
- To provide varieties which require less irrigation water and are better able to cope with climate variability.
- To develop a better understanding of the basis of rice quality to aid variety selection and to maintain quality in the light of climate change.

Strategies

- Focus breeding efforts on yield increases, quality, cold tolerance and water productivity
- Focus resources on core products rather than niches such as basmati or fragrant rice.
- Continually improve the efficiency of the rice breeding program/quality evaluation program by evaluating and adopting appropriate biotechnology.
- Evolve the breeding program to integrate the new paradigm of molecular breeding e.g. marker assessment for selection of traits such as cold tolerance.
- Continue to develop improved rice grain quality evaluation techniques.
- Leverage scarce resources in a small domestic breeding program through collaboration with international rice breeders.
- Continue to collaborate with the Rice Industry Variety Evaluation Committee to ensure market signals are passed back to breeders.
- Maintain an adequate district-testing program for promising lines in the breeding program.
- Develop an understanding of the impacts of climate change (elevated carbon dioxide and temperature) on rice quality attributes.
- Ensure pure seed of new varieties is made available quickly to growers through sound seed production strategies.

Performance Indicators and Related Measures

- Rate of release of varietal improvements – number of varietal improvements released in the next five years to be greater than or equal to the last 5 years.
- Level of acceptance by growers and markets of varietal improvements – improvements account for 30% of industry production.
- Indication of continued development of new varieties into the future – isolation of promising lines at the same or greater rate than the last 5 years.
- Increased water use productivity - 1 ML per tonne of grain from the rice based system, currently industry averages 0.7 to 0.8 ML per tonne of grain.
- Varieties with improved cold tolerance – markers identified with the capacity to increase cold tolerance by 4 Degrees Celsius.
- Increased average rice yields - average rice yield to increase from 9 t/ha to 11t/ha by 2011.
- Increased level of collaboration with other international plant breeding organisations - 100% increase in visits by plant breeder personnel from and to Australia, from visits over the last 5 years.
- Incorporation of quality traits in new varieties that guarantee quality in a changing climate and with longer storage times.
- Continued provision of pure seed of new varieties – grower survey to confirm in 2011.

Indicative Share R&D Budget

- 50% of project budget to be allocated to Objective 1.
- Historically this area has received between 41% and 60% of available funds.

Objective 2: Crop Establishment, Agronomy/Crop Physiology, Nutrient Management and Precision Agriculture

Objectives

- To increase average yields through understanding and reducing in-field variability.
- To develop a better understanding of plant/soil/environment interactions including impact on greenhouse gas emissions.
- To provide nutrient management systems for profitable and sustainable rice production.
- To improve the uniformity, reliability and cost effectiveness of rice establishment.

Strategies

- Address in-field variation in crop yield using precision agriculture techniques including identifying and acting on factors limiting rice yield.
- Develop better nutrient prediction tools to maximise nutrient use efficiency.
- Better understand significant nutrients including nitrogen, sulphur phosphorus and zinc, soil physical changes, soil acidity changes and straighthead impact on rice productivity.
- Develop a better understanding of management impact on greenhouse gas emissions from different production systems.
- Develop flexible rice management solutions to fit better into whole farm management.
- Improve the reliability of seedling establishment.

Performance Indicators and Related Measures

- Increased average rice yield – average yield increased from 9 t/ha to 11t/ha by 2011.
- Rice water productivity improved to 1 t/ML on 75% farms by 2011.
- Precision agriculture breakthroughs to provide a suite of tools for rice growers by 2011.
- Nutrient tests used by 80% growers to improve nitrogen use efficiency.
- Accurate information available on greenhouse gas emissions to enable growers to better complete and use the greenhouse scorecard.
- More uniform crop establishment – average plant stands between 200 and 300 plants/square metre on 75% crops by 2011.

Indicative Share R&D Budget

- 10% of project budget to be allocated to Objective 2.
- Historically this area has received between 11% and 14% of available funds.
- The percentage of program funds allocated to this objective has been reduced in order to provide additional resources for whole farm management, market access and human capital formation.

Objective 3: Crop Protection

Objectives

- To provide effective and sustainable control of major rice weeds, pests and diseases, taking account of possible impacts of climate change on their incidence.
- To address herbicide resistance in rice weeds (highest priority).
- To minimise the risk of exotic weeds, pests and diseases.

Strategies

- Identify chemical solutions to potential and existing grass and broadleaf resistance.
- Adopt a 'weed systems' approach that relies on environmentally sustainable chemical use, links to other rice industries to create chemical company interest in new products, work on the biology of weed management and rotation of chemicals.
- Invest in longer-term strategies to increase the effectiveness of non-chemical integrated weed and pest management programs (lower priority).
- Weeds of economic significance to be addressed through the program include barnyard, dirty dora, starfruit, alisma, water couch and silvertop.
- Pests of economic significance to be addressed through the program include bloodworm, aquatic worms, leaf miner, aquatic snails, armyworm, native waterfowl and rodents.
- Minimise the introduction of exotic rice pests, weeds and diseases through the Rice Biosecurity Plan and other measures.
- Minimise the introduction of exotic rice pests, weeds and diseases by educating rice growers and other regional stakeholders in the recognition of threatening species.
- Minimise off target drift from agricultural chemicals by developing improved formulations and application technology.
- Develop objective data on the relative performance of weed control programs.
- Support the Rice Crop Protection Working Group and use their resources to guide crop protection investment.
- Educate commercial and public agronomists to improve expertise in crop protection.
- Ensure that on-farm crop protection measures comply with appropriate Food Safety standards.

Performance Indicators and Related Measures

- Viable chemical solutions to counter current and potential resistance problems – identification of one new chemical by 2011.
- Grower adoption of recommended best practice in weeds, pests and disease management strategies – grower survey to confirm in 2011.
- Maintained current levels of weeds, pests and diseases in commercial rice crops – incursions to be no worse than 2006 levels in 2011 and confirmed by grower survey.
- Reduced weed, pest and disease management costs on a per tonne of production basis – grower survey to confirm in 2011.

Indicative Share R&D Budget

- 10% of project budget to be allocated to Objective 3.
- Historically this area has received between 9% and 11% of available funds.

Objective 4: Farming Systems – Whole Farm Management, Profit and Sustainability

Objectives

- To ensure the profitability and environmental sustainability of the whole rice farm in a situation of greater climate uncertainty.

Strategies

- Establish a strategy for the use or development of decision support tools or processes to assist rice growers address the multiple objectives of profitability and environmental sustainability.
- Revisit financial benchmarking for rice and secure grower support and funding.
- Investigate whole farm/irrigation layout/crop rotation/weed biology systems that can respond to projected reductions, and increased variability, in water supplies.
- Develop tools for better water accounting and measurement through the system but especially on farm. Tools to assist integration of water allocation decisions and crop planting requirements.
- Investigate the impacts on Australian rice production of the changed temperature ranges and frequencies expected to accompany global warming.
- Identify the range of management options available to growers to mitigate greenhouse gas emissions from rice farming systems and revise the current RGA scorecard for measuring greenhouse gas emissions from rice based farming systems to better reflect Australian production methods.
- Develop a better understanding of crop responses to environmental and management factors such as soil types, farm layout, crop density, water depth, and air and water temperatures.
- Investigate opportunities for joint grain/graze/rice R&D with other Research and Development Corporations to leverage program funds and better address whole farm issues associated with climate change.
- Establish objective measures of soil health in rice farming systems and identify management practices and rotations that optimise soil health.
- Identify indicators and management options that will assist growers to preserve and enhance biodiversity on rice farms and lessen negative impacts.
- Investigate the impact on biodiversity of reduced water use in the rice industry.
- Ensure other key sustainability issues remain in focus for the industry i.e. soil productivity, salinisation, acidification, water table recharge and surface drainage.
- Generate objective data on environmental performance and status to better inform the community.
- Support and work closely with the industry's EMS program – Environmental Champions.
- Investigate stubble use strategies managed through action research/demonstration projects on a cost benefit basis (minor).
- Continue to appraise the potential of aerobic rice systems (long term industry opportunity).

Performance Indicators and Related Measures

- Development of a whole farm model and its use by early adopters - 20% of industry adopts by 2011.

- At least one further round of financial benchmarking with strategies in place to ensure uptake of relevant on-farm change – benchmarking commissioned and completed.
- Improved understanding of the whole farm system and options for managing the impacts of climate change, including all phases of crop and pasture rotations – grower survey to confirm in 2011.
- Reduced greenhouse gas emissions from rice production – measured using the revised RGA scorecard.
- Key sustainability indicators described in Land and Water Management Plans continue to be met – grower survey to confirm in 2011.
- Elevate sustainability to the point where the industry is able to manage reasonable community and govt decision maker concern – measured through the number of negative press reports in 2011.

Indicative Share R&D Budget

- 15% of project budget to be allocated to Objective 4.
- Historically the sustainable farming systems area has received 4% of available funds. This climbed to 20% of available funds during the period 1998-99 to 2002-03 with Rice R&D program contributions to the CRC for Sustainable Rice Production.
- This plan places additional emphasis on whole farm profitability research.

Objective 5: Technology Transfer, Communications, Policy and Communities

Objectives

- To facilitate industry awareness and rapid adoption of new and improved technology.
- To ensure communication channels are appropriate for changing operating conditions.
- To contribute to informed policy debate on key issues such as water, the single desk and market access.
- To ensure appropriate community linkages and an understanding of the role rice plays in maintaining the social fabric of the region.

Strategies

- Access better ways to communicate and transfer technology with farmers and service providers (technology transfer).
- Build additional links between agribusiness agronomists and public sector service providers (technology transfer).
- Develop and support proactive extension programs that emphasise both specific and holistic approaches. Coordinate the flow of information and ideas between multiple parties (technology transfer).
- Ensure communication systems, including the transfer of market information, are appropriate for twenty-first century operating conditions (communications).
- Research institutional structures to manage changing external and internal industry environment (policy).
- Clarify ownership in relation to intellectual property (policy).
- Invest in rice community/social research (communities).

Performance Indicators and Related Measures

- Resumption of positive upward trend in rice yields achieved through technology transfer – grower survey to confirm in 2011.
- Adoption rate of technology and change in farmer practices – grower survey to confirm in 2011.
- Feedback from rice growers on success of technology transfer, communication, policy and communities – grower survey to confirm in 2011.

Indicative Share R&D Budget

- 8 % of project budget to be allocated to Objective 5.
- Historically this area has received between 11% and 13% of available funds.

Objective 6: Human Capital Formation

Objectives

- To ensure ongoing Australian rice research and extension capacity
- To optimise participation of people and develop their potential to contribute to the industry
- To proactively develop linkages with other rice researchers and leverage a small R&D program into a worldwide pool of knowledge generation.

Strategies

- Seek and establish NSW Government ongoing commitment to rice research. In the absence of ongoing commitment ensure the provision of alternative research capacity.
- Encourage training and development of growers, the Rice R&D Committee, research and extension officers.
- Encourage participation by under-represented groups – women, youth, ethnic and indigenous groups.
- Encourage capacity to address succession planning for all part of the industry.
- Encourage active participation in programs like the Australian Rural Leadership Program, Environmental Champions Human Resource Capacity Building, Nuffield Scholarships, Churchill Fellowships, Women in Agriculture forums, study tours, etc.
- Develop training programs to meet the needs of industry.
- Build capacity in the Rice R&D Committee including corporate governance, meeting procedures, etc.
- Ensure annually that at least one significant research/extension officer is invited to Australia and one Australian officer views, first hand, an overseas facility with appropriate learning opportunities.

Performance Indicators and Related Measures

- New capacity added to Australian rice research and extension – establish by survey.
- Number of women actively participating in activities – establish by survey.
- Number of training programs - establish by survey.
- Number of visiting scientists and overseas study tours completed – RIRDC data to measure performance.

Indicative Share R&D Budget

- 7% of project budget to be allocated to Objective 6.
- Historically this area has received between 1% and 3% of available funds.
- Additional funds are justified given current industry concern about human capital rundown.

10. Proposed Budget

The budget of the previous 2006-11 five-year R&D plan is shown in Table 9a. The proposed five-year R&D plan budget has been prepared and is summarised in Table 9b (based on a levy of \$3 per tonne).

Table 9a Rice R&D Budget 2006–2011 (old)

Objective	%	Budget as at May 2006				
		2006/07	2007/08	2008/09	2009/10	2010/11
Varietal improvement	50%	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Crop establishment through precision agriculture	10%	240,000	240,000	240,000	240,000	240,000
Crop protection	10%	240,000	240,000	240,000	240,000	240,000
Farming systems	10%	240,000	240,000	240,000	240,000	240,000
Technology transfer, communications, policy and communities	10%	240,000	240,000	240,000	240,000	240,000
Market access	3%	72,000	72,000	72,000	72,000	72,000
Human capital formation	7%	168,000	168,000	168,000	168,000	168,000
Total	100%	2,400,000	2,400,000	2,400,000	2,400,000	2,400,000

Table 9b Proposed Revised Rice R&D Budget 2006–2011

Objective	%	Forecast as at April 2008				
		2006/07	2007/08	2008/09	2009/10	2010/11
Varietal improvement	50%	1,245,000	1,014,000	500,000	500,000	500,000
Crop establishment through precision agriculture	10%	465,000	247,000	100,000	100,000	100,000
Crop protection	10%	252,000	85,000	100,000	100,000	100,000
Farming systems and sustainability	15%	127,000	154,000	150,000	150,000	150,000
Technology transfer, communications, policy and communities	8%	239,000	190,000	80,000	80,000	80,000
Human capital formation	7%	60,000	25,000	70,000	70,000	70,000
Total	100%	2,388,000	1,715,000	1,000,000	1,000,000	1,000,000

11. References

- ABARE (2004) Australian Commodity Statistics.
- Brennan, Singh and Lewin (1997) Maximising the Future Pay-Off from Rice Breeding. A Final Report prepared for RIRDC, RIRDC Project No. DAN 108A.
- CIE (2004) Evaluation of the Rice Program: An Overview of All Projects – Stage 1.
- CIE (2004b) Evaluation of the Rice Program: An Assessment of Investment Returns – Stage 2.
- CRC (2005) Business Case for Value Added Rice Based Systems.
- CRC (2005) Annual Report – via RIRDC website.
- CRC (2005) Strategic Plan– via RIRDC website.
- CRDC (2005) Annual Operating Plan 2005-2006.
- CSIRO and BoM (Bureau of Meteorology) (2007) Climate Change in Australia: Technical Report 2007, CSIRO, Melbourne.
- DAFF (2005) Australian Agriculture and Food Sector Stocktake.
- Kiri-ganai Research (2006) Taking Stock and R&D Planning: A Workshop Discussion Paper, Jerilderie, 16 March 2006.
- GRDC (2005) Annual Operating Plan 2005-2006.
- Macadam, Drinan and Inall (2002) Building Capacity for Change in the Rice Industry: A Report of a Review of the Extension Services of the Rice Industry.
- Nesbitt, H (2003) Evaluation of the Economic, Social and Environmental Impacts of the Cooperative Research Centre for Sustainable Rice Production.
- New South Wales Department of Primary Industries (NSW DPI) Gross Margin Budgets (accessed online).
- OECD (2004) Agricultural Policies in OECD Countries: Monitoring and Evaluation, OECD, Paris.
- RGA Strategic Plan (accessed online).
- RGA Issues to Prepare NSW Rice Industry for Deregulation (single page).
- Rice R&D Committee – Template for Review of Research Programs (green).
- RIRDC (1996) R&D Plan for the Rice Industry Program 1996-2001.
- RIRDC (2001) Draft R&D Plan for the Rice Industry Program 2002-2006.
- RIRDC (2003) Corporate Plan 2003 to 2008.
- RIRDC (2005) Rice Strategies for 2005-2006 (accessed online at www.rirdc.gov.au).
- RIRDC (2005) Induction Kit for New Committee/Panel Members, Notes on Adoption of R&D.
- RIRDC (2005) Annual Report 2004-05.
- RIRDC (2005) Template for RIRDC Five-Year R&D Plans.
- RIRDC (2006) Rice, Reaping the Rewards of Innovation.
- Singh RP, Brennan JP, Lacy J and Steel F (2005) An Assessment of the Economic, Environmental and Social Impacts of the Ricecheck Program.

Appendix 1: Alignment of Plan Objectives with RIRDC'S Corporate Goals/Strategies

RIRDC Goal	Specific RIRDC Strategy	Rice R&D Plan Objective
Goal 1 Develop new opportunities	Utilise advances in science such as biotechnology, genomics, communications and information technology to develop and commercialise new industries and new products.	Varietal and rice quality improvement (Objective 1).
Goal 2 Adopt new technologies and systems for established industries	Foster 'frontier technology' R&D packages as the driver of competitive advantage in established industries.	Varietal and rice quality improvement (Objective 1). Crop establishment, agronomy/crop physiology, nutrient management and precision agriculture (Objective 2).
	Deliver R&D packages that are amenable for adoption by industry and key stakeholders.	Crop establishment, agronomy/crop physiology, nutrient management and precision agriculture (Objective 2), Crop Protection (Objective 3), Farming systems for whole farm management, profit and sustainability (Objective 4).
	Disseminate R&D results through effective demonstration and communication systems and channels.	Technology transfer, communication, policy and communities (Objective 5).
Goal 3 Improve the competitiveness and sustainability of Australian agriculture	Develop and promote alternative cropping and animal husbandry systems which avoid or reduce negative environmental impacts in the rural sector.	Crop Protection (Objective 3), Farming systems for whole farm management, profit and sustainability (Objective 4).
	Augment market access systems through measures to improve scientific analysis and controls over invasive pests and diseases.	Crop Protection (Objective 3).

Goal 4 Underpin innovation and change in Australian agriculture	Ensure wide recognition of the importance of human capacity building in delivering positive changes for rural and regional Australia.	Human capital formation (Objective 7)
	Improve the business and financial risk management skills of Australian producers.	Farming systems for whole farm management, profit and sustainability (Objective 4).
	Facilitate wider availability of information technology in rural Australia to secure and utilise timely data and information for business improvement.	Farming systems for whole farm management, profit and sustainability (Objective 4).
	Examine and design processes to enhance rural learning and practice, including rural extension and education.	Technology transfer, communication, policy and communities (Objective 5). Human capital formation (Objective 7).
	Contribute to the development of the next generation of rural industry leaders.	Human capital formation (Objective 7).
	Investigate processes of social change in rural Australia and options to improve outcomes from industry restructure.	Technology transfer, communication, policy and communities (Objective 5).

Appendix 2: Contacts for R&D Program

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Rice R&D Plan 2006 – 2011 (Revised)

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The Rice R&D Plan 2006–2011 was originally published in July 2006 but has been revised to match current changing environmental conditions and policies. This revision will enable the RIRDC Rice Program to meet the research and development needs of the industry now and into the future.

The original Plan was developed in consultation with RIRDC's Rice R&D Advisory Committee with input from growers, researchers and marketers and occurred in parallel with a comprehensive review of the Australian rice industry funded by the Australian Government Department of Agriculture, Fisheries and Forestry as part of their Industry Partnership Program.

Significant new challenges such as climate change, greenhouse gas emissions and water availability must now be faced by the rice industry if it is to remain a world class food business, reliant on a sustainable resource base.

RIRDC commissioned this review and revision of the Rice R&D 2006 Plan in March 2008 in consultation with the Rice R&D Advisory Committee. It reflects the Australian

Government's National and Rural Research Priorities as well as environmental research priorities developed for the Rice Growers' Association in 2007. It is also consistent with the RIRDC Corporate Plan (2008-2012) and will be implemented in accordance with the provisions of the *Primary Industries and Energy Research and Development Act 1989*.

RIRDC manages and funds priority research and translates results into practical outcomes for industry. Our business is about new products and services and better ways of producing them. Most of the information we produce can be downloaded for free from our website: www.rirdc.gov.au.

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