AgriFutures Australia fosters strong relationships with industry partners, including the rice industry, to ensure RD&E investment leads to practical knowledge and innovation that can be adopted by industry members.

John Smith

General Manager, Research
AgriFutures Australia
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Our vision
To grow the long-term prosperity of Australian rural industries

1. People and Leadership
   Goal: To support the people driving the future prosperity of Australian rural industries and regional communities by providing them with learning opportunities and experiences.
   Priorities: Attracting capable people into careers in agriculture. Building the capability of future rural leaders.

2. National Challenges and Opportunities
   Goal: To identify and nurture research and innovation opportunities that are synergistic across rural industries.

3. Growing Profitability
   Goal: To sustain the profitability and sustainability of our levied rural industries. Regional communities and the broader Australian economy depend on profitable farms.
   Priorities: Engaging industry participants in determining RD&E priorities. Investing in innovation that assists levied industries to be more profitable. Delivering outcomes to maximise industry uptake and adoption.

4. Emerging Industries
   Goal: To support new and emerging industries.
   Priorities: Supporting the early stage establishment of high potential rural industries.

Rural industries are equipped with skilled people and the leadership to grow and prosper.

Challenges and opportunities that are common across rural industries are identified and addressed.

Industry participants are confident that their levy investment is delivering value.

High-potential emerging rural industries established.

Outcome

Goal: To support the people driving the future prosperity of Australian rural industries and regional communities by providing them with learning opportunities and experiences.

Priorities: Attracting capable people into careers in agriculture. Building the capability of future rural leaders.

Goal: To identify and nurture research and innovation opportunities that are synergistic across rural industries.


Goal: To sustain the profitability and sustainability of our levied rural industries. Regional communities and the broader Australian economy depend on profitable farms.

Priorities: Engaging industry participants in determining RD&E priorities. Investing in innovation that assists levied industries to be more profitable. Delivering outcomes to maximise industry uptake and adoption.

Goal: To support new and emerging industries.

Priorities: Supporting the early stage establishment of high potential rural industries.

Executive summary
The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 has been developed in consultation with industry to outline the AgriFutures Rice Program priorities and objectives for research, development and extension (RD&E) for the next five years.

The Australian rice industry has long been recognised as a world leader in production efficiency, however, increasing pressures on water resource availability have raised challenges in relation to the industry’s ongoing profitability, productivity and sustainability. In response to these challenges, the Australian rice industry has clearly expressed that a transformational increase in water productivity is required within the next five years to ensure its future viability.

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 is based on an overarching Program goal of increasing the Australian rice industry’s water productivity to an average of 1.5 t/ML by 2026. The target is ambitious and will rely on whole-of-industry collaboration and investment in targeted breeding traits, agronomic and technological advancements in irrigation management, and accelerated adoption of best practice research and innovation.

While the benefits of Program investment will extend to the whole of the Australian rice industry, the overarching Program goal of achieving 1.5 t/ML by 2026 is necessarily focused on ensuring that rice is a profitable and competitive option for the limited water resources within the irrigated cropping systems of Australia’s temperate rice-growing regions.

The priorities to ensure that the AgriFutures Rice Program’s future RD&E investment achieves this goal have been developed taking into account findings from the review of previous RD&E Plan outcomes and from consultation with industry stakeholders.

The four priorities identified are:

- **Priority 1**: Optimised genetic improvement
- **Priority 2**: Agronomy and farming systems
- **Priority 3**: Coordinated industry extension
- **Priority 4**: Strengthened industry capacity

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 further outlines the objectives, strategies, and impacts and consequences for each of these Program priorities, as well as giving consideration to the types of activities that will be funded and the associated timing and risks of Program investment.

Implementation of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 will be supported by AgriFutures Australia’s well-established frameworks for program management, communication and engagement, and monitoring, evaluation and reporting (MER).
## Objective 1: Optimised genetic improvement

**Objective 1:** To accelerate genetic improvements in rice varieties through investment in a best practice breeding program.

### Priorities
- 1.1 Implement breeding methodologies to accelerate the delivery of improved rice varieties with a focus on increasing the water productivity of bold medium-grain types while maintaining or improving grain quality.
- 1.2 Breed for resistance or tolerance to abiotic and biotic stresses focusing on the measurable genetic improvement of reproductive cold tolerance, other aerobic adaptation traits and disease resistance.
- 1.3 Support the restructuring of governance and operating arrangements of the rice breeding program to enable the implementation of best practice breeding methods targeted at a transformational increase in the water productivity of Australian rice.

### Strategies
- Clear farming and agronomic systems are defined to support 1.5 t/ML.
- The industry has easy access to evidence to support best practice irrigation and crop management.
- Best agronomy, phenology and nitrogen management practices are available for different variety types and key farming systems.
- There is an improved understanding of soil constraints, fertiliser practices and pest and weed management for water-efficient farming systems.
- Decision support tools for real-time decision making are developed.

### Impacts and consequences
- Pre-breeding outputs are delivered to the breeding program in a readily adoptable way.
- There is an increase of at least 7°C in cold tolerance over Reizig as a benchmark by 2026 while maintaining superior grain quality.
- There is a step-change in adaptation to aerobic conditions measured by an increase in yield per ML.
- There is an increase in the rate of genetic gain for important traits in the breeding program, as measured through an increase in selection intensity, an increase in usable genetic variation, a decrease in breeding cycle time, or an increase in selection accuracy.

### Budget
- 50%

## Objective 2: Agronomy and farming systems

**Objective 2:** To increase on-farm productivity through investment in agronomy and crop management R&D.

### Priorities
- 2.1 Increase the understanding of the value of potential water-saving production practices that reduce the period of flooding.
- 2.2 Reduce in-field variability and address seasonal variability by gaining an improved understanding of sources and extent of the variability and the identification and delivery of effective and profitable solutions.
- 2.3 Enhance the profitability of Australian rice production by investing and partnering in the delivery of tools and methods that enable and facilitate evidence-based timely crop management decisions.
- 2.4 Investigate and deliver new and improved tools, systems and strategies for the surveillance, prevention and management of pest, weed and disease threats.
- 2.5 Use digital technologies and data interrogation techniques to deliver improved efficiencies in overcoming constraints to rice production and profitability.

### Strategies
- Decision support tools for real-time decision making are developed.
- Clear farming and agronomic systems are defined to support 1.5 t/ML.
- The industry has easy access to evidence to support best practice irrigation and crop management.
- Best agronomy, phenology and nitrogen management practices are available for different variety types and key farming systems.
- There is an improved understanding of soil constraints, fertiliser practices and pest and weed management for water-efficient farming systems.

### Impacts and consequences
- Pre-breeding outputs are delivered to the breeding program in a readily adoptable way.
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- There is a step-change in adaptation to aerobic conditions measured by an increase in yield per ML.
- There is an increase in the rate of genetic gain for important traits in the breeding program, as measured through an increase in selection intensity, an increase in usable genetic variation, a decrease in breeding cycle time, or an increase in selection accuracy.

### Budget
- 25%

## Objective 3: Coordinated industry extension

**Objective 3:** To drive the increased adoption of R&D outcomes through a well-coordinated and effective industry extension program.

### Priorities
- 3.1 Facilitate on-farm adoption of management strategies that maximise water productivity for all soil types, layouts and farming systems, including fully flooded systems.
- 3.2 Develop regionally tailored extension approaches to maximise the adoption of R&D outcomes that lead to enhanced farm profitability.
- 3.3 Understand and make use of a range of modern extension approaches and communication platforms to effectively demonstrate the benefits of R&D outcomes to industry participants.
- 3.4 Facilitate formal consultation forums and approaches between growers, agronomists and researchers to enable for participatory RD&E.
- 3.5 Work with research partners to improve adoption pathways by supporting them to innovate and become more commercially focused.

### Strategies
- Clear farming and agronomic systems are defined to support 1.5 t/ML.
- The industry has easy access to evidence to support best practice irrigation and crop management.
- Best agronomy, phenology and nitrogen management practices are available for different variety types and key farming systems.
- There is an improved understanding of soil constraints, fertiliser practices and pest and weed management for water-efficient farming systems.
- Decision support tools for real-time decision making are developed.

### Impacts and consequences
- There is an increase in the number of researchers and industry participants supported through scholarships, courses and study tours taking up RD&E and industry leadership roles.
- There is evidence of effective collaborative partnerships and projects across the AgriFutures Rice Program.

### Budget
- 50%

## Objective 4: Strengthened industry capacity

**Objective 4:** To strengthen the scale and scope of capacity of the Australian rice industry to ensure it meets the challenges of the future.

### Priorities
- 4.1 Support career pathways for researchers and rice industry participants through investment in courses and undergraduate and postgraduate scholarships, as well as postdoctoral research fellowships.
- 4.2 Establish greater R&D links outside the AgriFutures Rice Program at both national and international levels.
- 4.3 Establish mechanisms, such as technical working groups or advisory groups, across the AgriFutures Rice Program to incorporate and capture greater value from external technical and strategic expertise.
- 4.4 Support targeted cross-sectoral investment in innovative water-saving technologies and irrigation management to assist in achieving the industry’s water productivity target.
- 4.5 Support investment in critical research infrastructure and/or capital requirements that can proactively contribute to achieving the water productivity goals.

### Strategies
- Clear farming and agronomic systems are defined to support 1.5 t/ML.
- The industry has easy access to evidence to support best practice irrigation and crop management.
- Best agronomy, phenology and nitrogen management practices are available for different variety types and key farming systems.
- There is an improved understanding of soil constraints, fertiliser practices and pest and weed management for water-efficient farming systems.
- Decision support tools for real-time decision making are developed.

### Impacts and consequences
- There is an increase in the number of researchers and industry participants supported through scholarships, courses and study tours taking up RD&E and industry leadership roles.
- There is evidence of effective collaborative partnerships and projects across the AgriFutures Rice Program.

### Budget
- 5%
Alignment with AgriFutures Australia Strategic R&D Plan

AgriFutures Australia invests in research, innovation and learning initiatives that enhance the profitability and sustainability of the Australian agriculture sector.

The AgriFutures Australia Strategic R&D Plan 2017-2022 established four Arenas, which set out higher-level goals and priorities for levied industry investments:

- People and Leadership
- National Challenges and Opportunities
- Growing Profitability
- Emerging Industries

The majority of the objectives and strategies outlined in the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 link directly to Arena 3, ‘Growing Profitability’, however there is the potential for some strategies related to priorities 2 and 4 to link with RD&E investment under Arenas 1 and 2.

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<th>Goal</th>
<th>Priorities</th>
<th>Outcome</th>
<th>Alignment</th>
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<td><strong>People and Leadership</strong></td>
<td>To support the people driving the future prosperity of Australian rural industries and regional communities by providing them with learning opportunities and experiences.</td>
<td>Attracting capable people into careers in agriculture. Building the capability of future rural leaders.</td>
<td>Rural industries are equipped with skilled people and the leadership to grow and prosper.</td>
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<td><strong>National Challenges and Opportunities</strong></td>
<td>To identify and nurture research and innovation opportunities that are synergistic across rural industries.</td>
<td>Informing debate on issues of importance to rural industries. Adapting new technologies for use across rural industries. Working collaboratively on issues common across rural industries.</td>
<td>Challenges and opportunities that are common across rural industries are identified and addressed.</td>
</tr>
<tr>
<td><strong>Growing Profitability</strong></td>
<td>To enhance the profitability and sustainability of our levied rural industries. Regional communities and the broader Australian economy depend on profitable farms.</td>
<td>Engaging industry participants in determining RD&amp;E priorities. Investing in innovation that assists levied industries to be more profitable. Delivering outcomes to maximise industry uptake and adoption.</td>
<td>Industry participants are confident that their levy investment is delivering value.</td>
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With continued improvements in water productivity, the Australian rice industry has the capacity to produce in excess of one million tonnes of high-quality rice each year, playing an important role in domestic and global food security.

Asian rice *Oryza sativa* is the most common rice species grown throughout the world. The species has two main types, both of which are produced in Australia. Indica varieties are generally long grained and grow in tropical and subtropical climates, and Japonica varieties are temperate and subtropical, and short-medium round-broad grained. Japonica-style rice has been established in Australia since the late 1800s and is the most significant and established rice industry in the country.

The Australian rice industry is predominantly found throughout the irrigation areas of the Murrumbidgee and Murray valleys in southern NSW. Additional opportunistic plantings also exist in the Lachlan and Murrumbidgee floodplains, and in northern Victoria. The temperate climate of the Riverina supports the production of short-medium grain Japonica varieties, accounting for over 80% of Australian rice product annually (DAWE, 2019).

Rice plantings also occur in northern NSW in the Northern Rivers region, as well as in tropical regions of Queensland, the Northern Territory and Western Australia. The tropical and subtropical climates of these regions makes them more suited to the production of Indica, tropical Japonica and undomesticated rice varieties.

Yields are dependent on a combination of good crop management practices involving water management, fertiliser application, and weed and pest control. These practices are often specific to a growing region and the growing system used. Armyworms have been identified as an emerging pest threat to rice crops across all growing regions, affecting rice crops from tillering to harvest and impacting productivity throughout most of the season (Troldahl, 2018). In early 2020, the fall armyworm (*Spodoptera frugiperda*) was detected on mainland Australia and is emerging as a major pest to the rice industry; it is now found in Queensland, NSW, Northern Territory and Western Australia (Plant Biosecurity & Product Integrity, 2020; Queensland Government, 2021; Agriculture Victoria, 2021). In December 2020, the fall armyworm was detected in Victoria, but it is not yet known if it will become established (Agriculture Victoria, 2021). The rice industry works closely with Plant Health Australia through contributions in the rice levy to develop risk mitigation measures for exotic pests and diseases.
The Australian rice industry is a global leader in water use efficiency. However, a further step change is required to maintain the industry’s competitiveness.

The Australian rice industry is a global leader for improved water use efficiency, with water use averaging 0.85 t/ML between 2012-2020 across all growing regions (ABARES, 2021a; ABS, 2021). Rice production is, however, extremely variable, due to climate, water-sharing arrangements and competition for available resources. In recent years, this has been compounded by drought, resulting in two consecutive seasons with average General Security water allocations of less than 5% and some of the lowest recorded production levels (NSW DPI, 2020; ABARES, 2021a).

To maximise the return from available resources, many rice producers run mixed farming enterprises incorporating livestock or dryland crops such as wheat, or produce other irrigated crops such as cotton, pasture or perennial horticulture (ABARES, 2021b). Technological developments increasing profit margins in industries such as cotton have also caused producers to opt to use the limited water available on higher-earning irrigated crops. Rice producers may also choose to sell their water allocation to other farmers on the temporary water market when prices exceed the profitability of producing a rice crop.

Increased yield, a higher average price per tonne and decreased water use will drive the continued success of the Australian rice industry. To safeguard the Australian rice industry, RD&E will be focused on the production of new varieties through the rice breeding program compatible with a water productivity target of 1.5 t/ML by 2026. This will be coupled with targeted agronomy and farming systems-focused activities, and extension activities focused on increasing adoption and uptake of technology, and innovation in partnership with adjacent industries.

Australian rice receives a premium on the global market where it is recognised for its quality.

Australian rice is exported to some 60-plus countries across Asia, the Pacific and the Middle East, receiving a premium in global medium-grain markets where it is recognised for its quality. Trade of Japonica varieties is a more niche segment of the global rice trade, accounting for only 5-6% globally. As a smaller portion of global rice trade, Australian rice becomes more robust to the global market response and benefits from supply elasticity (NSW DPI, 2020).

In good years, the gross value of production (GVP) of rice can reach more than $250 million, however variable production results in variable GVP. The reduced plantings in 2018-2020 due to drought resulted in an all-time high price of $750/tonne, with some producers receiving up to $1500/tonne for organic rice varieties on fixed-price hectare contracts (NSW DPI, 2020). Although the water allocations going into the 2021 season were increased from the previous two years, increased volatility in water allocations is expected to continue in the future, making it a priority for the industry to drive a transformational increase in water productivity of Australian rice crops.

The rice industry’s continued efforts to improve water use practices are also paramount to building strong community trust in both domestic and international markets, as information-empowered consumers have increased expectations for production practices. The actual and perceived water requirements for rice crops increasingly affect the industry’s social licence to operate, with limited water availability nationally and the demonstration of sustainable farming practices increasingly playing a role in market access. The Australian rice industry’s priorities for continued productivity, profitability and sustainability align with both national and global-level priorities towards a sustainable future, not only for the industry but the communities it supports. At the national level, the AgriFutures Rice Program Strategic RD&E Plan aligns with the Australian Government Department of Agriculture, Water and the Environment’s objective “to support sustainable management and productive use of Australia’s water resources.” Internationally, the Plan aligns with Target 6.4 of the United Nations’ Sustainable Development Goals, “by 2030, substantially increase water use efficiency across all sectors and ensure sustainable withdrawals.”

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**Figure 1:** Annual paddy production correlated with General Security water allocations in the Murray and Murrumbidgee irrigation areas (NSW DPI, 2020; ABARES, 2021a).

**Figure 2:** Gross value of rice production year-on-year (ABS, 2020; 2019; 2018; 2017; 2016).
Industry profile

SWOT analysis of the Australian rice industry

Factors influencing the industry’s current operating environment informed the development of a SWOT analysis, which was workshoped with the AgriFutures Rice Advisory Panel.

Strengths

• World leaders in rice production efficiency.
• High-quality product.
• Premium prices.
• Mature and respected RD&E investment model.
• Highly valued extension program.
• Strong alignment and partnerships within industry.
• Counter-cyclical production.

Weaknesses

• High reliance on water inputs and allocations.
• Majority of industry dependent on one water resource, i.e. the southern connected system of the Murray-Darling Basin.
• Productivity gap between the top rice producers and the industry average.
• Labour and skills shortages.
• Industry lacking critical mass for influence and investment.
• Access to regulated technologies as a food-based crop.
• Input and commodity price fluctuations impacting decision-making capabilities.
• Lack of push for diversity in high-value rice varieties.

Opportunities

• Increase the productivity and focus the output of the breeding program.
• Collaborate in technological advancement with other industries with common goals.
• Availability or access to strong genetic resources, i.e. international rice diversity panels.
• Access to publicly available genomic data.
• Health-conscious cereal grains consumers.
• Growing interest in sustainable production.

Threats

• Increased water scarcity impacted by climate and water reform.
• Competition for water and other resources from other crops and industries.
• Community expectations and perceptions affecting social licence to operate.
• Ability to meet national and global sustainability targets, including greenhouse gas emissions.
• Government policy, including quotas and interventions, in key export markets.
• Growers removing rice-specific infrastructure on-farm.
• Lack of uptake and adoption of technical and farming systems advancements.

Research

Funding

The AgriFutures Rice Program (previously the Rural Industries Research & Development Corporation) has managed rice RD&E on behalf of the industry since 1991 alongside Plant Health Australia. In 1991, the statutory levy was introduced for rice collected at first point of sale and distributed between AgriFutures Australia and Plant Health Australia.

As of July 2020, the levy was increased to $6/tonne sold, with $5.94/tonne to support ongoing research, development and extension managed by AgriFutures Australia on behalf of the industry. The remaining $0.06/tonne comprises the Plant Health Australia membership. AgriFutures Australia receives the R&D levy allocation to invest in line with the objectives of the Program’s Strategic RD&E Plan. AgriFutures Australia also receives matching funding from the Australian Government, which is allocated to the Program at 50c per dollar of eligible research expenditure. The total Program budget comprises of the R&D levy allocation, Australian Government matching funding and third-party contributions.

Figure 3: Levy explanation

$6/tonne sold

AgriFutures Australia R&D allocation

Research and development

Plant Health Australia

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1AgriFutures Australia receives matching funding from the Australian Government, calculated under the Primary Industries Research and Development (PIRD) Act. Subject to some limitations, this Commonwealth matching funding is capped at the lesser of 50% of eligible expenditure or 0.5% of industry gross value of production (GVP). Industry GVP is calculated on the aggregate of all AgriFutures Australia levied industries.
Research

Rice Program RD&E Plan 2016-17 to 2021-22

The AgriFutures Australia Rice Program RD&E Plan 2016-17 – 2021-22 had an overarching goal to “Invest in RD&E to improve rice industry water use productivity and achieve the Dry Rice target of 1.5 t/ML by 2030”. The goal, which remains as important as ever, was to support the ongoing improvement in water use efficiency and farmgate value to deliver gains in on-farm productivity and contribute to environmental and social sustainability in rice-growing areas. There were four identified objectives for investment:

1. Cross-sectoral research required to achieve Dry Rice 1.5 t/ML water use efficiency target by 2030.
2. Rice breeding – varietal and quality improvement.
3. Farm productivity – crop inputs, crop protection and the farming system.
4. Extension, sustainability and human capital.

During the term of the Rice Program RD&E Plan, AgriFutures Australia invested $16.86 million (Australian Government matching funding and industry levies) in 63 projects.

Impact assessment

During 2020, an impact assessment was undertaken to understand the cost-benefit of projects undertaken as part of the 2016-17 – 2021-22 Plan. The impact assessment aimed to understand the Program successes, inform the development of a new Strategic RD&E Plan, and meet the evaluation requirements of the Australian Government and the Council of Rural Research and Development Corporations (CRRDC).

Thirty projects grouped across four areas of investment, being crop yield productivity, water use efficiency, rice quality and premium-priced markets, and capacity building, were assessed. The results of the analysis showed a strong return on investment, with a forecast net present value of $160 million and a benefit-cost ratio of 4.7 to 1 on a 30-year investment horizon, demonstrating that the Rice Program is delivering value for the industry.

Program reviews

AgriFutures Australia also conducted independent reviews during the 2019-20 financial year into two of its largest investments – the Australian Rice Partnership breeding program and the Rice Extension program. The reviews focused on program performance and identified where efficiencies can be made to guide future investment.

The review of the breeding program found that the partnership between the NSW Department of Primary Industries (DPI), SunRice and AgriFutures Australia is operating effectively. Key recommendations for improvement included the implementation of molecular markers and a fully functional relational database to further improve the rate of genetic gain in the breeding program, which will in turn provide better options for growers.

The review of the Rice Extension program found that the program is held in high regard by many rice growers. The extension team and its activities are seen to be effective in engaging with, and delivering relevant information to, key industry stakeholders. The review identified a number of areas for improvement including strengthening governance and in particular planning; monitoring, evaluation and reporting; options to reduce the program running costs; and minor improvements to the delivery of the program.

Partnerships

AgriFutures Australia fosters a strong culture of collaboration and relies on a number of key partnerships to deliver the Rice Program, including:

- AgriFutures Rice Advisory Panel.
- Australian Rice Partnership with SunRice and the NSW DPI.
- Ricegrowers’ Association of Australia.
- Plant Health Australia.
- Other Rural RDCs including through the Smarter Irrigation for Profit II project and the Plant Biosecurity Research Initiative.

The development of ongoing strategic partnerships has been identified as critical to strengthening the capacity of the rice research community and leveraging the investments in RD&E to maximise the benefits to Australian rice growers.

Figure 4: Major stakeholders of the AgriFutures Rice Program
Industry consultation

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 was developed through extensive consultation with producers and industry stakeholders to understand the key drivers for transformational change in the industry.

Key steps in the consultation process included completion of two surveys by a large group of growers and a diverse range of industry stakeholders, as well as more in-depth scenario planning and review workshops with a group of 18 stakeholders, including AgriFutures Rice Advisory Panel members and industry representatives.

Outcomes

The consultation process allowed for detailed consideration of the industry’s current operating environment as well as the identification of trends and change drivers likely to impact the industry into the future (Table 2). This information was used to conduct a scenario-planning exercise to contemplate and identify a range of plausible futures. From a long list of trends and change drivers identified, more disruptive agritech and innovative advancements, and increasing water scarcity were considered those with the most uncertainty and greatest potential impact.

Consideration of potential future scenarios allowed industry stakeholders to workshop the implications and potential response options for investment through the AgriFutures Rice Program. The themes that the identified options covered include breeding, technology and farming systems, skills and expertise, industry capability, capacity and adoption, R&D investment management, vision alignment, and partnerships and collaboration.

The robustness of the identified options was tested against each of the future scenarios, should they eventuate. The outcomes of this work have informed the development of priorities, objectives and strategies for the AgriFutures Rice Program Strategic RD&E Plan 2021-2026.

Table 2: Change drivers in the rice industry

<table>
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<th>Driver</th>
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<tr>
<td>Water</td>
<td>A changing climate is seeing increased water resource scarcity, with variable rainfall and drought leading to large variability in annual water allocations. Water availability is also being impacted by national water policy reform and increased competition from alternative crop types. Improving rice water use efficiency and best management practices will continue to be high priorities for the industry.</td>
</tr>
<tr>
<td>Technological advancement</td>
<td>Advancement in precision farming technologies, automation and robotics, and breeding technologies are changing the agricultural landscape. The uptake of these technologies is likely to become the key basis of competition increasing productivity, distribution efficiency and innovation. Such technologies will mean on-farm decisions are easier to make, with access to farm management tools and crop information. Breeding technologies upheld by the rice breeding program provide opportunity for risk mitigation, increased productivity and water use efficiency for producers, and improvement in nutrition and quality for consumers.</td>
</tr>
<tr>
<td>Resource use and productivity</td>
<td>Greater demand for product combined with competing uses for irrigation water and arable land place pressure on the industry to produce more with less. The rice industry will continue to lead the way in water use efficiency and reach demanding water use targets through innovation in breeding and technology.</td>
</tr>
<tr>
<td>Informed markets</td>
<td>Information-empowered consumers have increased expectations for ethics, health and provenance. The way employees, stakeholders and the general public perceive the rice industry is built through community trust in industry operations. The relatively large water requirement for rice crops increasingly affects the industry’s social licence to operate with limited water availability nationally. The rice industry continues to improve water use practices to build strong community trust in rice operations.</td>
</tr>
<tr>
<td>Future workforce</td>
<td>The recruitment and retention of staff by the agriculture industry is becoming increasingly difficult. Succession planning, the industry image, lower margins and the shift to a transient casual workforce have all played a role. Consistent shortages of experienced labour increase costs and reduce efficiency.</td>
</tr>
</tbody>
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Figure 5: Timeline of key steps in the development of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026
AgriFutures Rice Program Strategic RD&E Plan 2021-2026

Program goal

To increase the Australian rice industry's water productivity to an average of 1.5 t/ML by 2026.

The Australian rice industry has clearly expressed that a transformational increase in water productivity is required within the next five years to ensure the future viability of the industry. The industry target of 1.5 t/ML represents a 75% increase in water productivity for bold medium-grain rice based on current industry average production and water use data (Groat and Jewell, 2020). While openly ambitious, the target has been assessed as achievable and will rely on whole-of-industry collaboration and investment in targeted breeding traits, agronomic and technological advancements in irrigation management, and accelerated adoption of best practice research and innovation (Groat and Jewell, 2020). While it is recognised that the Program will need to cater for a range of farming systems, RD&E investment is needed to support a transition to more water-efficient farming systems that reduce the period of flooding, which may include Delayed Permanent Water, or transient and fully aerobic production.

Fundamentally, the AgriFutures Rice Program will seek to invest in activities and projects that are able to demonstrate more tonnes per hectare, less ML per tonne and/or more dollars per tonne. While the benefits of Program investment will extend to the whole of the Australian rice industry, the overarching Program goal of achieving 1.5 t/ML by 2026 is necessarily focused on ensuring that rice is a competitive option for the limited water resources within the irrigated cropping systems of Australia's temperate rice-growing regions.
AgriFutures Rice Program Strategic RD&E Plan 2021-2026

1 Priority – Optimised genetic improvement

Objective
To accelerate genetic improvements in rice varieties through investment in a best practice breeding program

Justification
The rice breeding program remains the principal means of investment in genetic gain required to maintain a rice producer’s terms of trade and enhance profitability. Implementation of new breeding technologies supported by best practice breeding methods is required to obtain a step-change in yields and accelerate delivery of new varieties with higher and more stable yield, improved reproductive cold tolerance and higher grain quality parameters.

Strategies
1.1 Implement breeding methodologies to accelerate the delivery of improved rice varieties with a focus on increasing the water productivity of bold medium-grain types while maintaining or improving grain quality.

1.2 Breed for resistance or tolerance to abiotic and biotic stresses focusing on the measurable genetic improvement of reproductive cold tolerance, other aerobic adaptation traits and disease resistance.

1.3 Support the restructuring of governance and operating arrangements of the rice breeding program to enable the implementation of best practice breeding methods targeted at a transformational increase in the water productivity of Australian rice.

Activities
New and existing activities and projects under this priority might include:

- Accelerating delivery of improved rice varieties through removal of re-selection phases, further adoption of Single Seed Descent, consideration of adopting out-of-season nurseries, revised and rationalised germplasm evaluation and variety commercialisation strategies.

- Fast-tracking implementation of high-throughput marker-assisted selection (MAS), with a particular focus on applications in backcross conversions of niche quality types, northern-adapted germplasm and accelerating improvements in cold tolerance through introgression of validated QTL.

- Adopting genomic selection strategies once the phenotyping capacity and scale (population size) of the breeding program has been greatly enhanced.

- Developing and implementing high-throughput reliable and effective cold tolerance phenotyping capacity to enable rapid and transformational improvement in cold tolerance of Australian rice varieties.

- Identifying and gaining an improved understanding of the genetic control of traits of importance in adaptation to water-efficient farming systems.

- Contributing to varietal improvement for rice-producing areas outside the temperate areas of the Murray Darling Basin.

- Research collaboration for pre-breeding support.

Impacts and consequences

- Pre-breeding outputs are delivered to the breeding program in a readily adoptable way.

- There is an increase in the rate of genetic gain for important traits in the breeding program, as measured through an increase in selection intensity, an increase in usable genetic variation, a decrease in breeding cycle time, or an increase in selection accuracy.

Timing
The rice breeding program will continue to require a considerable portion of the AgriFutures Rice Program’s overall investment over the five-year term of the Plan. The need to support the restructuring of governance and operating arrangements, as well as any associated capital investment, is likely to mean that the total investment in this priority will be weighted toward the early stages of the Plan.

Risk management
Funding variability and the retention of technical expertise have been identified as the major risks associated with the rice breeding program.

These two considerations are key components of the work underway to restructure the governance and operating arrangements of the rice breeding program (i.e. Strategy 1.3), with the long-term structure needing to allow for funding variability while maintaining use of the required technical expertise. Strategies to strengthen and deepen the capacity of the rice industry have also been identified under Priority 4, recognising challenges that will arise from the loss of key research personnel and addressing research capacity and succession.

Indicative budget allocation
50%

Photo: Tina Dunn, NSW DPI
Objective
To increase on-farm productivity and profitability through investment in agronomy and crop management R&D.

Justification
Industry analysis shows that the top 20% of rice producers consistently achieve yields and water productivity 30% above the industry average, highlighting the important role that agronomy and crop management will play in achieving the industry's water productivity target. The understanding and management of in-field yield variability and climate variability have been identified as significant limitations to increasing the water productivity of rice. Advancements in digital technologies may offer effective solutions to a range of agronomy and crop management issues, and there is opportunity to explore these in partnership with other agricultural industries and supply chain participants.

Strategies
2.1 Increase the understanding of the value of potential water-saving production practices that reduce the period of flooding.
2.2 Reduce in-field variability and address seasonal variability by gaining an improved understanding of sources and extent of the variability and the identification and delivery of effective and profitable solutions.
2.3 Enhance the profitability of Australian rice production by investing and partnering in the delivery of tools and methods that enable and facilitate evidence-based timely crop management decisions.
2.4 Investigate and deliver new and improved tools, systems and strategies for the surveillance, prevention and management of pest, weed and disease threats.
2.5 Use digital technologies and data interrogation techniques to deliver improved efficiencies in overcoming constraints to rice production and profitability.

Activities
New and existing activities and projects under this priority might include:
• Assessing the relative water savings and profitability of various water-efficient farming systems.
• Developing profitable and sustainable water-efficient rice farming systems, including effective and efficient control of pest and weeds, optimum management of nitrogen and best practice irrigation technology.
• Contributions to agronomic improvement for northern growing regions.
• Smarter irrigation in rice-growing systems.
• Rice weed management in Australia.
• Use of sensors, data and automation to enhance on-farm agronomic management.

Impacts and consequences
• Clear farming and agronomic systems are defined to support 1.5 EML.
• The industry has easy access to evidence to support best practice irrigation and crop management.
• Best agronomy, phenology and nitrogen management practices are available for different variety types and key farming systems.
• There is an improved understanding of soil constraints, fertiliser practices and pest and weed management for water-efficient farming systems.
• Decision support tools for real-time decision making are developed.

Timing
Investment in agronomy and crop management R&D will require ongoing and consistent investment over the five-year term of the Plan. It is expected that timing will be influenced by the timing of the development of improved varieties under Priority 1.

Risk management
The ability to identify gaps in knowledge and target R&D investment across the range of soil types, farming systems and varieties has been identified as a risk under this priority. There is also the risk that the delivery of improved varieties and the potential for the development of an aerobic plant type will make current agronomic information unsuitable. There will be a need for regular monitoring and evaluation of R&D investment in this area.

Photo: Tina Dunn, NSW DPI
AgriFutures Rice Program
Strategic RD&E Plan 2021-2026

Priority – Coordinated industry extension

Objective

To drive the increased adoption of R&D outcomes through a well-coordinated and effective industry extension program.

Justification

This priority will closely link to Priorities 1, 2 and 4, with effective extension essential to the increased adoption of R&D outcomes and the engagement of a broad range of industry participants. Increased adoption of more water-efficient farming systems will be key to achieving the industry’s water productivity target within the required timeframe. This will require whole-of-industry coordination and participation, regionally specific delivery, and use of modern extension and communication strategies and approaches. Program reviews and industry consultation have identified that the Program would benefit from increasing the opportunity to involve independent agronomists, demonstration sites conducted in commercial settings, and the opportunity for growers to learn from other growers and influence R&D.

Strategies

3.1 Facilitate on-farm adoption of management strategies that maximise water productivity for all soil types, layouts and farming systems, including fully flooded systems.

3.2 Develop regionally tailored extension approaches to maximise the adoption of R&D outcomes that lead to enhanced farm profitability.

3.3 Understand and make use of a range of modern extension approaches and communication platforms to effectively demonstrate the benefits of R&D outcomes to industry participants.

3.4 Facilitate formal consultation forums and approaches between growers, agronomists and researchers to enable for participatory RD&E.

3.5 Work with research partners to improve adoption pathways by supporting them to innovate and become more commercially focused.

Activities

New and existing activities or projects under this priority might include:

- Extension for improved efficiency and sustainability in the rice industry.
- Improving the understanding and application of a range of modern communication and extension strategies.
- Production of communication materials and educational tools.
- Regional demonstration sites in commercial settings, agronomy workshops and field days.
- Support for the involvement of regionally based agronomists.
- Understanding and benchmarking grower management practices to identify how to ‘close the gap’ between top producers and the industry average.

Impacts and consequences

- The gap between those producing the highest tonnes/ML and the industry average is reduced.
- Producers report the adoption of, or intention to adopt, R&D outputs, new technologies and/or best practices as a result of the extension program.
- Valuable links between industry researchers, agronomists and growers are maintained.

Timing

While there will be a need for ongoing funding of industry extension, the Program may benefit from an initial investment in better understanding and benchmarking practices and learning preferences of rice producers to assist with targeted Program investment over the period of the Plan.

Risk management

It is recognised that there are a range of factors influencing the extension and adoption of R&D outputs by industry participants and that an effective extension program will need to make use of a variety of modern extension and communication approaches. Year-to-year funding variability and the management of fixed costs is also a considerable risk for the Program, with options to manage these risks being considered in the development of renewed funding agreements.

Indicative budget allocation

20%
AgriFutures Rice Program Strategic RD&E Plan 2021-2026

4 Priority – Strengthened industry capacity

Objective

To strengthen the scale and scope of capacity of the Australian rice industry to ensure it meets the challenges of the future.

Justification

With the increase in competition from alternative crop types and a declining level of production, the Australian rice industry faces a real challenge in maintaining the scale required for the effective investment and influence necessary to achieve its water productivity target. The industry has a strong track record of investing in the capacity of its researchers and industry participants, which will need to be maintained. International and cross-sectoral collaboration will play a key role in maximising the leverage and impact of the AgriFutures Rice Program and will be complemented by ongoing investment in the future capacity of rice industry RD&E.

Strategies

4.1 Support career pathways for researchers and rice industry participants through investment in courses and undergraduate and postgraduate scholarships, as well as postdoctoral research fellowships.

4.2 Establish greater RD&D links outside the AgriFutures Rice Program at both national and international levels.

4.3 Establish mechanisms, such as technical working groups or advisory groups, across the AgriFutures Rice Program to incorporate and capture greater value from external technical and strategic expertise.

4.4 Support targeted cross-sectoral investment in innovative water-saving technologies and irrigation management to assist in achieving the industry’s water productivity target.

4.5 Support investment in critical research infrastructure and/or capital requirements that can proactively contribute to achieving the water productivity goals.

Activities

New and existing investment under this priority might include:

- Rice Industry Leadership Program.
- Horizon Scholarships for university students.
- Nuffield Scholarships.
- Study tours for growers, agronomists, industry stakeholders and researchers.
- Postgraduate top-up scholarships.
- Rice industry graduate program.
- Partnerships and engagement with research in other crops, e.g. cotton for irrigation and winter cereals for genetics, physiology and agronomy.

Impacts and consequences

- There is an increase in the number of researchers and industry participants supported through scholarships, courses and study tours taking up RD&D and industry leadership roles.
- Whole-of-industry technical working groups and/or advisory groups are established with agreed Terms of Reference.
- There is evidence of effective collaborative partnerships and projects across the AgriFutures Rice Program.
- Infrastructure is effective and efficient to allow for best possible outputs of RD&E investment.

Timing

Investment in human capacity will be ongoing throughout the term of the Plan. The timing relating to the need to support critical research infrastructure and/or capital requirements will be closely linked to Priorities 1 and 2.

Risk management

The objective and identified strategies relating to this priority have been developed in response to the identified risks that the rice industry faces as a result of declining scale and the need to address industry leadership, capacity building and succession into the future. The difficulty and challenge of attracting new expertise to the industry was highlighted, and there is a need for succession planning for key researchers to be put in place.

Indicative budget allocation

5%
Communication, extension and adoption of RD&E outcomes

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 has been developed in consultation with key stakeholders to identify the industry’s priorities for RD&E investment and key outcomes sought over the period of the Plan. The Plan will be used to guide and balance AgriFutures Australia’s investment in RD&E activities to promote the productivity, profitability and sustainability of the Australian rice industry.

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 is targeted toward researchers and collaborators for the development of research proposals, and guiding AgriFutures Australia in the investment of Program funds. More broadly, the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 provides rice growers and other key stakeholders with information on the future direction of industry RD&E and the investment of their levy funds.

Details of contracted projects, Program updates and the outcomes of projects are published on the AgriFutures Australia website and across a variety of AgriFutures Australia’s communications channels. Stakeholder engagement is primarily through the AgriFutures Rice Advisory Panel and its observers, and key industry partners (i.e. RGA and SunRice). These relationships should be leveraged to improve communications and develop a dialogue with growers and industry participants.

To raise awareness, interest and engagement in the Programs activities, investments and outcomes, as appropriate, the Program will draw on other communications channels and activities, including but not limited to:

- Articles and resources (i.e. fact sheets, project summaries, etc) for the AgriFutures Australia website.
- Industry updates (email newsletters).
- Emails as required to the AgriFutures Rice Program database.
- Annual RD&E update (event).
- Attendance and involvement in the Rice Industry Conference, workshops and field days.
- Media relations targeting rural media and local media in the Riverina.
- Social media, with a focus on Twitter.
- Videos and podcasts.

The AgriFutures Rice Program Strategic RD&E Plan 2021-2026 has identified ‘Coordinated industry extension’ as one of its four priorities for the Program to ensure that there is continued investment to drive an increase in the adoption of R&D outcomes through a well-coordinated and effective industry extension program. An indicative budget allocation of 20% has been made against this priority to implement the identified strategies.

The AgriFutures Rice Program will leverage communications expertise on an as-needs basis to develop communications strategies and plans to demonstrate the overall progress and impact of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 in line with the AgriFutures Australia Communications Strategy.

Plan implementation and governance

Program management

AgriFutures Rice Program RD&E investments are guided by the Rice Advisory Panel. AgriFutures Australia’s Industry Advisory Panels are responsible for developing and ranking priority research proposals within the Strategic RD&E Plan’s framework and providing recommendations on the allocation of RD&E contributions to the AgriFutures Australia Board. The Advisory Panels also play a key role in facilitating information sharing between industry stakeholders and AgriFutures Australia.

AgriFutures Australia has committed resources to the Program, including a Research Manager and a Research Coordinator. The Research Manager is formally a member of the Rice Advisory Panel.

Program investments are made annually in a combination of short, medium and long-term priorities. AgriFutures Australia will request research project proposals via an open call process focused on specific programs and research priorities.

Financial position and investment projections

Following a review of the research and development corporation’s levies legislation, the Department of Agriculture, Water and the Environment advised AgriFutures Australia of changes to the Australian Government matching funding is calculated and paid to AgriFutures Australia. Consequently, the Department has paid the difference in historic unclaimed matching funding to AgriFutures Australia’s levied industries Programs, including a one-off special payment to the AgriFutures Rice Program.

The one-off special payment has resulted in a high level of reserves for the AgriFutures Rice Program. The additional reserves, along with an increase in the rice levy to $5.94/tonne, place AgriFutures Australia in a unique position to be able to drive transformational change in the industry by making strategic investments in RD&E, rather than focusing on cost savings. Modelling of the AgriFutures Rice Program finances for the coming years shows that an annual investment of $5-6 million is sustainable with minimal impact on Program equity.

It is anticipated that to achieve transformational change in the rice industry, Program expenditure will increase throughout the 2021-2026 period. The AgriFutures Rice Program will ensure expenditure is appropriate, fit for purpose and complies with the reserves policy to ensure the Program does not over-commit funds given the variability of rice levy income.

Reserves policy

AgriFutures Australia holds financial reserves to manage risk derived from fluctuations in income. All AgriFutures Australia Programs have a reserves policy as agreed by the Program Advisory Panel to ensure the endurance of the Program when faced with adversity, such as a drop in production resulting in lower levy funding being available to fund current research commitments.

The Program reserves policy is managed to approximately 100% of the annual RD&E budget. The underlying objective of holding financial reserves is to maximise the Program’s investment in RD&E, consistent with its business objectives, while enabling sufficient funds to be available to cover contracted liabilities and to maintain RD&E capacity. The reserves policy is intended as a guideline only, and is subject to change due to extreme circumstances, which may result in changes to the policy.
Monitoring, evaluation and reporting (MER) framework

Alignment with the AgriFutures Australia MER framework

Monitoring, evaluation and reporting of the AgriFutures Strategic RD&E Plan will be undertaken in line with AgriFutures Australia’s Evaluation Framework, developed to support AgriFutures Australia’s overarching Strategic R&D Plan 2017-2022.

Outputs and performance impacts of AgriFutures Australia’s Program investments are systematically evaluated through the AgriFutures Evaluation Framework and summarised in the Annual Report.

Ongoing project evaluation

Projects funded through the AgriFutures Rice Program are evaluated through their life as milestones are assessed to ensure the investment continues to be relevant. This evaluation information is also captured in AgriFutures Australia’s project management system.

Each project has a communication plan, which ensures R&D findings are disseminated effectively and efficiently. Findings are published on AgriFutures Australia’s website, unless there are cogent reasons why publication is not appropriate, such as when a commercialisation opportunity is pursued.

Mid-term evaluation of the Plan

A mid-term evaluation of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 will be undertaken at the commencement of year three of the Plan. The purpose of the mid-term evaluation is to ensure that satisfactory progress is being made to meet the priorities and objectives of the Plan, and to determine if these priorities and objectives are still appropriate. The outcomes of the mid-term evaluation will be formally communicated to stakeholders along with an action plan to be implemented by AgriFutures Australia to progress any specific recommendations.

Final evaluation of the Plan

A final evaluation of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026 will be undertaken in the last year of the Plan. The final evaluation will include a cost-benefit analysis of a selection of projects consistent with the guidelines for the assessment of performance impacts developed by the Council of Rural Research and Development Corporations and will be published on AgriFutures Australia’s website. AgriFutures Australia also participates in the Council’s process for aggregation of performance impact evaluations undertaken across the Rural RDCs.

The final evaluation will inform the development of the next Strategic RD&E Plan.

Figure 6: Life cycle of the AgriFutures Rice Program Strategic RD&E Plan 2021-2026

2021
Strategic RD&E Plan commences

2023-24
Mid-term evaluation of the Strategic RD&E Plan

2024-25
Strategic RD&E Plan evaluation and industry consultation for the new Strategic RD&E Plan

2026
Approval and commencement of the new Strategic RD&E Plan
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