MODERNISATION

Enhancing water supply systems

NATIONAL PROGRAM FOR
Sustainable Irrigation

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About this NPSI Knowledge Harvest document

The NPSI Knowledge Harvest brings together information from across the National Program for Sustainable Irrigation (NPSI) projects, highlighting key findings and promoting wider understanding.

Key themes within the Harvest are:

- Irrigation Overview – facts, figures and key concepts about irrigation.
- Water Delivery Systems – the efficient storage and distribution of water for irrigation.
- On-farm Irrigation Essentials – principles for efficient irrigation.
- Recycled Water – recycling treated effluent and stormwater for irrigation.

This document is part of the On-farm Irrigation Essentials theme. It provides an overview of the approaches being used to modernise Australia's irrifation supply systems and create water savings. It highlights the issues involved and the research required to maintain momentum.

Other documents in the series may be downloaded from www.npsi.gov.au

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Contents

Summary

Source: NPSI

Why modernisation is needed

The redesign, refurbishment and automation of irrigation systems and their management is being driven by the need to:

- improve the water use efficiency of irrigation supply systems by reducing losses, so making more water available for additional irrigation or other uses, including the environment;
- improve the operational efficiency of irrigation supply systems through the rationalisation and automation of distribution, drainage and storage infrastructure; and
- optimise the standard of service to irrigators, which will enable them to improve water use efficiency on their properties and gear up to produce high-value crops.

Modernisation, together with 'water buy-backs' to counteract the over-allocation of water in critical regions such as the Murray Darling Basin, is changing the face of irrigation and laying the foundations for a sustainable future. Without measures such as these, Australia will not be able to:

- redress drastic declines in the condition of iconic water resources such as the River Murray and Lower Lakes;
- tackle threats to the long-term environmental sustainability and economic viability of irrigation areas, including rising or deteriorating groundwaters;
- secure the future of irrigation as a driver of regional communities and economies and the supply chains that rely upon them, in spite of drought and climate change; and
- maintain food security for Australia and contribute to the global effort needed to feed the world's growing population in the face of declining water availability.

The issues

Modernisation is proving effective, but there are several factors that may limit its success:

- Planning and rationalisation – Some irrigators are electing to sell water rights and retire their land from irrigation. In regions with extensive irrigation infrastructure, these *ad hoc* changes can undermine the gains of modernisation, resulting in an over-capitalised system with high overheads per customer.
- Monitoring and measurement – It is difficult to accurately measure the efficiency of irrigation supply systems and to identify and measure current losses. There are low levels of confidence in some catchment and irrigation district water budgets, and hence uncertainty about the extent to which modernisation will curtail the current losses.
- Flexible solutions – The dynamic nature of water supplies, climate change and global produce markets means that modernisation solutions need to be flexible. High-cost systems with long payback periods will fail unless they can adapt to changing circumstances – just as irrigators will have to.
- On-farm improvements – Efficiencies in the delivery of water for irrigation through modernisation often come with improvements in the service to irrigators which can translate into further on-farm efficiency gains. However, the integration of supply system and on-farm change requires a great deal of communication, negotiation and knowledge sharing between numerous and diverse interests.

Future needs

To maintain the momentum of modernisation and ensure investments achieve their full potential, it is essential that research and development is rapidly boosted with an immediate focus on:

- modelling and measuring water budgets and system components;
- technologies to reduce infrastructure costs, and provide greater flexibility and efficiency, while also saving water;
- better ways to integrate on-farm change with modernisation; and
- planning processes to engage irrigators, communities and governments.

Setting the scene

Source: Sarah Leonardi

The redesign, refurbishment and automation of systems that supply water to irrigators is helping make better use of Australia's scarce water resources.

Supported by the Australia Government's Water for the Future program, this modernisation will result in more water for the environment, improved water management and more sustainable futures for irrigation communities.

If Australia is to remain self-sufficient in the supply of fresh food and fibre, and help feed a growing world population, irrigation districts must survive and prosper.

Faced with the uncertainties of climate change and the prospect of even less available water in the future – at a time when cities and the environment will be using more – it is imperative that the storage, supply and use of irrigation water is as efficient as possible.

Modernisation provides the opportunity to rationalise irrigation systems, improve their efficiency and provide a better service to irrigators (enabling them to also improve efficiency). These gains can translate into water savings, freeing water for the environment or other uses.

The companies and organisations that supply irrigation water and the Australian and State governments are applying leading-edge science and technology to the modernisation challenge.

This paper presents information from a national Modernisation Forum, convened in Shepparton, Victoria, in March 2009 as part of the National Program for Sustainable Irrigation (NPSI) Knowledge Harvest. To view presentations from the workshop see; http://npsi.gov.au/products/pn30149 and http://npsi.gov.au/products/pn30150.

Water for the Future

Water for the Future is a $12.9 billion Australian Government initiative, running over a 10-year period. Its objectives cover:

- taking action on climate change;
- using water wisely;
- securing water supplies; and
- supporting healthy rivers.

The Sustainable Rural Water Use and Infrastructure Program ($5.8 billion), Restoring the Balance in the Basin ($3.1 billion) and Improving Water Information ($450 million) promote the 'using water wisely' objective.

The Sustainable Rural Water Use and Infrastructure Program provides assistance with modernisation planning, helps reduce water loss by tackling 'hot spots' and establishes pilot projects that link on-farm changes with delivery system changes, all of which creates an integrated approach to improving water use efficiency. The other programs aim to improve the River Murray environment and the understanding we have of water resources and their use.

These programs are all part of water reform in Australia. Along with measures such as exit grants for small block irrigators, they are changing the face of irrigation districts and the communities they support.

Planning modernisation involves more than rationalising water delivery systems and reducing losses. It requires consideration of future water availability, water markets and trade, crop types, farming systems and delivery requirements, system capacity and automation, and the evaluation of alternative rehabilitation options.

Source: Guy Roth, NPSI

Water savings

Source: Harvey Water

Supply systems can save water through:

- rationalisation – removing unsustainable areas from irrigation supply networks;
- reducing losses such as evaporation, leakage (e.g. at joints) and seepage (e.g. through pervious linings); and
- better measurement and control of flows to reduce end-of-system losses and provide water when and where it is required for more efficient on-farm use.

Integrated planning will generate water savings, improve overall system efficiency, remove under-utilised infrastructure and provide a better service to irrigators by providing water when it is required and in a manner that is most useful.

Rationalisation

Rationalising the supply infrastructure before rehabilitation will lower costs and has the potential to free-up water for other uses.

Extensive consultation with irrigators before the design phase is important and should include an assessment of land capability to understand which areas are most and least suitable for irrigation (e.g. due to soil type or salinity). Unsuitable areas are more likely to be retired from irrigation.

Evaluating system design may also identify ways to supply water more efficiently (e.g. reducing the number of spur lines, allowing focused investment in the 'backbone' of the supply system and delivering more water per kilometre of supply system).

If some irrigators in a region are considering moving out of the industry, it may be desirable to help them make this move before the system is modernised, to avoid over-capitalising the new delivery system.

Reducing losses

Leakage and seepage

Water budgets and physical inspections can identify where losses are occurring through leakage and seepage at various points in supply systems. Once the loss 'hot spots' are identified, remedial works can be targeted to generate water savings.

High-loss stretches of channel systems can also be identified by considering the 'leakiness' of different soil types and can be repaired by installing impervious linings as a priority.

Evaporation

Trials are testing whether evaporation from open channels can be reduced by using polymer surface coatings or shading. Channels can also be 'de-silted' and reshaped to reduce evaporation losses by lowering the surface area/volume ratio. However, piping is the most effective means of reducing evaporation.

Piping

Although expensive, piping also allows the delivery of pressurised water to irrigators, enabling them to adopt more water-efficient irrigation methods, such as sprinklers or drippers, that are easier to manage and control.

Piped systems may require trade-offs between energy and water savings, as piping often uses more energy to pump the water. These trade-offs can be overcome in places where the terrain permits the use of gravity-fed systems (or power generation from hydro-electricity).

Environmental allocations

There may be environmental trade-offs to consider and manage. Converting from channels with end-of-system outfalls to more efficient channel or closed pipe systems may improve efficiency, but, unless a specific allocation is made to the environment, it can remove water that supports local vegetation, wildlife and wetlands, unless an environmental allocation is made. NPSI is researching this issue.

Measurement and control

Automation

Measurement is a crucial precursor to management, but communication and automated controls are also essential in some irrigation supply systems. Some key features of modernised channel supply systems (such as those managed by Goulburn-Murray Water in Victoria) are:

- automated flow measurement devices powered by solar-charged batteries;
- wireless networks to provide instantaneous information;
- computerised management systems transmitting instructions; and
- automated, solar-powered flow-control mechanisms.

Enabling irrigators to order water electronically better integrates its efficient delivery with its on-farm use. Automated metering and flow-controls at the farm outlet ties farm water management into that of the overall supply system, which enhances total system control and performance. The result is better water use efficiency and a better service to irrigators.


Source: Harvey Water

Source: Guy Roth, NPSI

Monitoring for successful irrigation

High levels of automation also enable managers to closely monitor system performance and any improvements made to it. A 'Successful Irrigation Index' (SII) has been developed to monitor the:

- accuracy of flow rates (the goal is to be within 10% of the ordered flow – or 0.5 ML/day, whichever is greater); and
- reliability of the service (the aim is at least 95% accuracy for the irrigation period).

Analysing the cause of deviations from these criteria (e.g. automation problems, operational issues, supply infrastructure or on-farm infrastructure) means problems can be isolated and the system's overall performance fine-tuned. A well-performing system allows irrigators to adopt easier-to-manage irrigation systems and reduces on-farm water losses (and nutrients, etc) into drainage water.

In Victoria's Macalister Irrigation District, up to 40% of initial performance problems were traced back to on-farm issues, such as inappropriate infrastructure. This highlights the importance of making on-farm water delivery and distribution systems as compatible as possible.

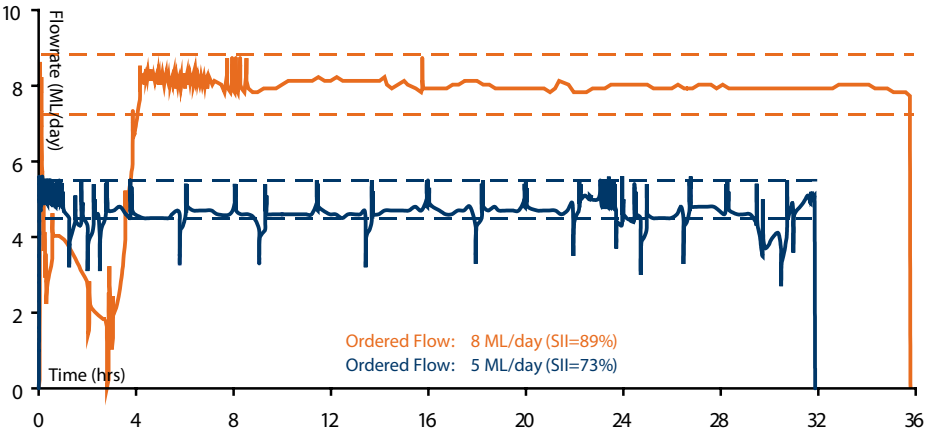
Continuous sharing

Each year, irrigators must decide when and how to use their water entitlement. In some circumstances any allocation that is not used is lost; in others there is the ability to carryover water from one year to the next.

A project by SunWater in Queensland has shown that automated daily water accounting (rather than monthly or annually) makes it is feasible to opt for continuous accounting.

Referred to as 'continuous sharing', the approach involves continuous water accounting (daily water balances) and the sharing of current storage capacity (which is also continually adjusted) to ensure water users retain access to the water they save. There is no annual resetting of water account balances and there is more incentive to be water efficient. System managers can also provide and administer entitlements to the environment in the same manner.

Successful Irrigation Index



Source: Mike Budahazy, Southern Rural Water

Source: NPSI

The issues

Source: Future Flow

The need to modernise Australia's water delivery systems is urgent, but the pace of change brings challenges. Sound planning with all stakeholders is essential, but this can be compromised by tight timelines and shortages of data and information.

Once plans are in place, there are still operational challenges to be met, such as obtaining the right skills and equipment, engaging large work teams at short notice for set periods and managing tight timelines.

Consultation and planning

Consultation and engagement

Infrastructure planning takes a long-term view, but global economic conditions, the climate, commodity prices and social factors can change without warning, bringing uncertainty and volatility to the best-laid plans.

This uncertain environment, coupled with the agonisingly difficult decisions individuals may be asked to make (e.g. whether to sell their water rights and retire their land from irrigation), compound the difficulties of planning in a compressed timeframe.

Engaging water industry staff, irrigators and their communities in planning at the outset is vital, so that there is a common understanding of the need for rationalisation and modernisation, the choices available and their implications for all water users.

Regrettably, the consultation budget is often tight, with the result that communities may

"As an engineer, I've learnt that consultation is more than making a decision and checking with someone to confirm I'm right."

not support planned changes and delay the process of modernising their water delivery systems. This emphasises the need for social engagement, as well as water engineering skills. There may be a need for capacity building among the water planners and managers before the community gives its full approval to the changes proposed. Modernisation is a negotiated outcome and without consumer support water savings will not eventuate.

Future scenarios

Scenario planning – exploring the implications of alternative futures – has proven useful in several irrigation areas. It is a way to engage with stakeholders and help them understand the issues and choices. It also allows them to contribute to, and participate in, decision making about their region's future. This has led to better decisions and plans, and greater support from the communities and industries involved.

The scenarios used, and the process, are documented in the NPSI publications Irrigation Insights 8 and 9, available from www.npsi.gov.au

Planning for flexibility

Irrigation is sometimes the main driver of regional communities and economies, so investment may have far-reaching consequences.

Planning decisions also test some fundamental views and beliefs, such as the relative rights and obligations of individuals versus communities. A common example is the possibility of rationalisation transferring risks and liabilities from organisations to individuals.

Modernisation programs and discussions of 'mutual obligations' are highlighting the importance of linking on-farm operations with system operations to optimise both.

The importance of sound alignment between farm and district water delivery is echoed at the next scale – between the needs of irrigation districts and those of entire catchment or national policies. For example, the movement of water entitlements – through trade to other irrigators or sale to governments, urban or environmental users – may help achieve water reform, but *ad hoc* transfers can prove a nightmare for the efficient design and operation of water supply systems.

How to align small-scale water trade with the rationalisation and planning of entire water systems is still a big challenge. It accentuates the importance of designing for flexibility, low-cost and shorter timeframes than may traditionally be expected for infrastructure planning.

Data and understanding

Difficulties in measuring highly variable factors, such as rainfall, contribute to the 'fog' that bedevils accurate catchment water balances, planning and efficient irrigation system operations.

This lack of sound data means that, in some areas, the catchment water balance and the way surface and groundwaters interact is inadequately understood. This can lead to 'double accounting' of surface and groundwaters. Similarly, the nature and volume of losses in some irrigation supply systems is poorly understood. If the extent of current losses is not known, it is hard to be confident about the savings that can be achieved from modernisation.

There is also not enough known about how to value water savings, beyond the value of the water itself. Savings from modernisation can come with varying ease (and cost) and with various benefits, such as a healthier environment, increased or more efficient farm production, and more resilient regional communities. Many benefits are difficult to quantify or are 'un-priced'. If such benefits do not have an assigned value, it is not possible to truly appreciate the 'returns' achievable through modernisation and to compare alternative investments in water saving.

Steps to address deficiencies in the available water use data include the Commonwealth *Water Act 2007* and its Regulations on Water Information (administered by the Bureau of Meteorology), and the development of a Metrological Assurance Framework for non-urban water metering. They align with the National Water Initiative and its emphasis on evidence-based water planning.

Integrating farms and delivery systems

As system modernisation progresses, it is evident that more effort should be directed to on-farm measures – both in understanding options for rationalisation and in getting a good fit between delivery systems and farm operations. This will lead to an efficient supply system and enhanced farm production options that capitalise on improved delivery. Benefits can be operational (e.g. easier management), as well as increased production and profit.

Ways forward

A workshop for water suppliers, designers and government representatives during the Modernisation Forum drew attention to some key research that is needed to maintain the pace of change in Australia's irrigation supply systems.

The main themes

Important research themes are:

Models of water systems

Taking a systems approach to create models that give a better understanding of whole systems (including catchment water balances linking surface and groundwater) and how they are working.

Measurement and losses

As there is both a shortage of information and a lack of confidence in its accuracy, better ways are needed to measure water losses. This may include field verification of different meters (especially at large flow rates) and a better understanding of how losses vary over time.

Technology to reduce infrastructure costs

At a time of uncertainty and volatility, there needs to be an emphasis on low-cost and flexible infrastructure, ahead of long-lived solutions. Cheaper technology packages are needed for integrated measurement, communications and management.

What workshop participants said:

'The usual message is that the infrastructure needs to be long lasting – infrastructure is designed for 80-year life spans. But we are facing a lot of uncertainty and trying to design for the short term. Flexibility is therefore the key.'

'You tend to have researchers working in isolation. We need to get from research to farm quicker. We've got to get researchers and government and commodity groups together; got to line up what's happening in the system with the farm.'

'What about the people who build the gates, the pipes and other products. We need cheaper and different types of products. We need to talk to them about our problems and let the market come up with solutions.'

On-farm rationalisation

More research is needed about on-farm improvements that are compatible with supply improvements. On-farm improvements are essential if the greatest value is to be gained from improved delivery systems.

Planning, evaluation and knowledge management

The whole irrigation industry will benefit from the development of clear, large-scale scenarios, such as what future global food demand will mean in terms of future water demand. Better processes and capacity are also needed to share this information with all stakeholders, along with better ways of assessing and valuing water savings.

Improved operations – managing drought

There is much to learn by investigating what did and did not work during recent droughts, and then incorporating that understanding into modernisation plans.

Challenges

The modernisation of irrigation schemes in Australia is proceeding at great pace. Some of the challenges faced in order to optimise the effectiveness of change are:

Data and understanding

Whole-of-system water balances can be problematic, due variously to:

- insufficient understanding of the system (e.g. surface water and groundwater interactions);
- lack of confidence regarding current losses and water budgets; and
- difficulties in defining, estimating and valuing savings (including benefits such as improved supply options and reliability for irrigators).

Social engagement and rationalisation

The pace of planning and change threatens to leave people behind unless there is an emphasis on engaging people and sharing information and ideas. Insufficient involvement in the process can result in sub-optimal planning and decision making regarding rationalisation. Whole modernisation programs may be jeopardised as a result.

Uncertainty and investment horizons

Water supply companies, irrigators and communities face numerous uncertainties, e.g. the real quantum of likely water savings and their 'value', the likely quantum and location of water trades or government buy-backs, and commodity markets and production costs. Consequently, flexible, short-term, low-cost solutions are required; but infrastructure planning usually seeks long-term and long-lived solutions.

On-farm change

If irrigation practices remain the same it can undermine the efficiency of enhanced supply systems – and mean that potential improvements in water use efficiency or operational enhancements (e.g. timeliness of applications, options to adopt more manageable irrigation systems etc) are not capitalised on by irrigators.

Research Priorities

The most urgent research needs are:

Models of water systems: developing a better understanding of catchment systems. Taking a systems approach – we need to get a better understanding of whole systems, how they're working and how to model them. Examples are:

- models of groundwater – surfacewater interactions (especially for northern Australia; Burdekin, Gascoyne, NT); and
- river system loss analysis (cross irrigation systems).

Accounting – measurement and losses: generating better data on the components of water budgets and better ways of defining and valuing water savings. Reflecting both a shortage and a lack of confidence in some existing information, better ways are needed of measuring losses and potential gains. Examples are:

- how losses vary over time and with operational changes;
- field verification of metering at large flow rates;
- efficacy of water-saving solutions – their life and reliability; and
- product information – the lifecycle cost of different options.

Low-cost technologies: options that may be packaged together to form integrated modernisation and supply management systems. At a time of uncertainty and volatility, the emphasis needs to be on lower costs and flexibility, ahead of long-lived solutions. Packages of technology (e.g. measurement, communications and management) are needed. Examples are:

- low-cost, high-flow, meters;
- low-cost, remote monitoring and data logging;
- cheaper infrastructure alternatives (concrete, plastic, aluminium) that are transportable and reusable;
- an accepted pattern app-meter;
- on-farm, low-pressure delivery systems (to minimise energy use); and
- product standards for construction and installation.

On-farm rationalisation: methods to assist irrigators in evaluating their future, in choosing and adapting changed irrigation practices to fit new supply arrangements, and in managing new irrigation systems for optimal performance. The technology of delivery systems is well advanced, now we need to be focusing on farms. Farms and supply systems have to match each other for the supply system to be efficient, and on-farm improvements are needed to make better value from improved delivery systems. Examples are:

- on-farm rationalisation options;
- demonstrated benefits of 'best practice' on-farm management;
- improved technology transfer; and
- methodologies for incentives to rationalise delivery systems.

Planning, evaluation and knowledge management: methods to inform and involve communities and irrigators in planning and decision making, from regional down to farm scales.

Some big pictures need painting, e.g. food demand – what will this mean in terms of future water demand? Sharing this information with stakeholders is vital, but we still do not have good ways of assessing and valuing water savings, examples are:

- tangible and intangible prices (costs) of water savings;
- assess food production demands and determine land and water requirements; and
- systems for sharing information between all stakeholders.

Improved operations – managing drought:

- Learn from low allocation years by investigating what worked and what didn't.
- Investigate flexible operating procedures in low-allocation years.
- Capture key learnings from managing during drought.

Source: Peter Day

Appendix 1

The Modernisation Forum and Field Trip

The major suppliers of Australia's irrigation water met in Shepparton early in 2009 to share experiences in the 'modernisation' of irrigation systems.

The 'Modernisation Forum' was convened by NPSI to share information about modernisation and to consider future research needs. It was a timely event, as the Australian Government, State Governments and water supply companies across the nation are earnestly upgrading distribution systems to save water and improve the service to irrigators.

The Australian Government provided funding support from the Water for the Future program for the Forum. The event included a field trip to inspect on-ground works and a meeting with presentations and a workshop about future research needs. It was hosted by Goulburn-Murray Water, which is a partner in the National Program for Sustainable Irrigation.

Fifty-nine people attended at least part of the two-day event. A small number of companies distribute Australia's rural water and 17 of the water supply companies were represented – they account for 11,000-12,000 GL per year of water supply. The Forum brought together the suppliers of the vast majority of Australia's rural water, along with key government agencies and industry. The information gleaned from presentations and the field trip, as well as the informal conversations, were invaluable to all attendees.

Presentations available at http://npsi.gov.au/products/pn30150 from the field trip are:

- Future Flow Field Trip with Peter Walsh
- Rubicon Field Trip with Tony Oakes
- Goulburn Murray Water Field Trip with Bill Heslop
- Goulburn Murray Water Field Trip with Mike Schulz
- Northern Victoria Irrigation Renewal Project, Field Trip with Murray Smith
- Field Trip with Soil Scientist, Bruce Cockroft.

Presentations available at http://npsi.gov.au/products/pn30149 from the Modernising Irrigation Forum are:

- The Lower Burdekin – Andrew Kelly, executive officer of Lower Burdekin Water
- Delivery Systems, Reflections on the tour – Brett Tucker, Murrumbidgee Irrigation
- The context of BoM Water Data Requirements – Carl Daamen, Bureau of Meteorology.
- Sustainable Rural Water Use & Infrastructure (SRWUIP) – David Calvert, Acting Assistant Secretary, Water Efficiency Division Commonwealth Department of the Environment, Water, Heritage and the Arts.
- Metering and Measuring – David Calvert, Acting Assistant Secretary, Irrigation Efficiency Southern Branch, Australian Government Department of the Environment, Water, Heritage and the Arts.
- Goulburn-Murray Water Modernisation Status and Challenges – Darren Nabbs, General Manager Business Modernisation, Goulburn-Murray Water.
- Consultation & Decision Making. participation, scenarios & learnings. Irrigation Futures of the Goulburn Broken catchment – Leon Soste, DPIV
- Performance Reporting Using the Successful Irrigation Index – Mike Budahezy, Macalister Irrigation District, Channel Automation Project.
- National Water Initiative Implications for Irrigation Modernisation – Matt Kendall, General Manager, Water Science Group.
- SunWater, Making Water Work. The Queensland experience with capacity sharing – Steve Goudie, for Tom Vanderbyl, SunWater.
- Trangie Nevertire Irrigation Scheme – Simon Hunt, Trangie Nevertire.
- Harvey Water, Helping our irrigation industries to grow from Waroona to Dardanup – Steve Iceton, Harvey Water.

Appendix 2

About NPSI

The National Program for Sustainable Irrigation provides research and innovation to improve the environmental and productive performance of irrigation in Australia.

The program funds and manages research projects across Australia, working at the property level with farmers, at catchment level with policy makers and planners, and at scales that cross state and territory borders.

Our vision

Australian irrigation that is valued for its environmental, economic and social contribution.

Our mission

To invest in research, development and its adoption to improve the productivity and sustainability of irrigation in Australia.

Outcomes

- Improved irrigation water use efficiency and enhanced ability to respond to changing levels of resource availability over time.
- Reduced environmental impacts, more sustainable ecosystems and more prosperous communities.
- Improved skills, knowledge and decision making of end users, which leads to practice change, and more efficient and sustainable use and management of water.
- A national approach to irrigation related to R&D in Australia, which includes a strong focus on a skilled human resource base and enhanced R&D capacity and collaboration.

Our values and guiding principles

- Scientific innovation and excellence.
- Practical knowledge ready for adoption.
- Leadership, integrity and collaboration across the irrigation industries.
- Commitment to sustainable irrigation industries, communities and management of natural resources.

Partners

NPSI is a collaboration between 14 funding partners. Investment Partners include irrigator groups, water authorities, commodity groups, state government agencies, Research and Development Corporations, Cooperative Research Centres and the Australian Government.

- Cotton Research and Development Corporation;
- Australian Government Department of Environment, Water, Heritage and the Arts;
- Gacoyne Water Cooperative, Western Australia;
- Goulburn-Murray Water, Victoria;
- Horticulture Australia Limited;
- Harvey Water, Western Australia;
- Land & Water Australia*;
- Lower Murray Water Authority, Victoria;
- Ord Irrigation Cooperative, Western Australia;
- Grains Research & Development Corporation;
- Sugar Research & Development Corporation;
- South Australian Research and Development Institute; and
- SunWater, Queensland;
- Western Australian Department of Water.

* Land & Water Australia was a parner until the end of July 2009.

Resources

To view NPSI research reports and case studies, visit www.npsi.gov.au

NPSI's partners

Australian Government
Cotton Research and Development Corporation

Australian Government
Department of Environment, Water, Heritage and the Arts

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LOWER MURRAY WATER

rd Irrigation Cooperative Ltd

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SARDI
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Australian Government
Sugar Research and Development Corporation

SunWater
Making Water Work

Government of Western Australia
Department of Water