Smarter Irrigation for Profit 2

RRDP 2011 Scaling Irrigation Management for Dairy Farms

Final Report

Australian Government
Department of Agriculture, Fisheries and Forestry

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AGRICULTURE VICTORIA

Dairy Australia

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Plain English Summary

Water use efficiency technologies addressing engineering, agronomic and scheduling issues are available to irrigators, but their adoption and management continue to be a significant challenge. Water use efficiency technologies typically target a single point (e.g., soil moisture at a location) or part of the farm (e.g., individual irrigation bays) and have rarely been used at the whole-of-farm scale.

This project worked with irrigators in the Goulburn Murray Irrigation District (GMID) to enhance the growth and utilisation of pastures by scaling irrigation management to support whole farm operations. Through irrigation trials it sought to quantify the values of whole-of-farm irrigation scheduling and highlight the benefits of enhanced water management to the farmers and broader industry. The project has delivered an innovative approach to support complex decisions on irrigation scheduling at the farm level and over the season.

The project builds on the success of "Smarter Irrigation" Round 1 project (Rural Research and Development for Profit Programme) that integrated satellite-based irrigation scheduling into a bay-scale water management system. The approach relies on minimal use of in-field sensors and will integrate farm irrigation scheduling with autonomous management of irrigation.

The objectives of the project were:

1. To develop whole farm irrigation management systems model.
2. To lead implementation of a whole farm irrigation management demonstration in collaboration with irrigators and irrigation service providers.
3. To support demonstration of a whole farm irrigation management system.
4. To lead communication of research findings.

The project undertook a methodology that linked with farm extension, Agriculture Victoria Research (AVR) dairy research and irrigation service providers and focused on the key elements and features of a whole farm water management approach including:

- Scheduling module for timing of the next irrigation across all bays on a farm
- System operation module that details flow rate and irrigation duration parameters
- Simple feedback mechanisms to enable rapid customisation of irrigation events.

The Covid-19 pandemic had a significant impact on implementing these trials through restrictions on farm visitation and interaction with irrigators. Despite this, the project was able to implement extensive trialling of the systems across 3 farms in the Goulburn-Murray region.

The project successfully designed and implemented irrigation management modules across 3 irrigation farms in the GMID. These sites represented a range of both pressurised pipe and riser and open channel flood irrigation systems on grazed perennial pasture across a range of light and heavier soil types. This variation provided a robust platform to test the irrigation scheduling and water management approaches developed by this project.

The project has demonstrated, with positive irrigator responses, that consistent and predictable bay scale irrigation performance can be achieved by using the satellite-based irrigation

management approach. The approach was used to manage greater than 400 irrigation events over the life of the project with reductions in irrigation duration by up to 30 minutes per irrigation event.

The progression of the trials for all 3 farms from 2019 - 2022 has seen both scaling up the irrigation management approach to larger units (i.e. blocks of multiple bays and across different parts of the farm) and confirmation of performance on a range of soil types.

The trialled system relies on minimal use of in-field sensors but demonstrated that it can support irrigators in their journey towards autonomous management of irrigation.

Recommendation for future research and development activities include:

- To integrate the farm scale optimisation of autonomous irrigation and grazing
- To investigate how best to manage and deploy autonomous irrigation systems for other crops on dairy farms
- To further engage with manufacturers, service providers and irrigation authorities towards the adoption and integration of satellite–based autonomous irrigation management systems at both a farm and regional scale
- To utilise the methods developed to better understand soil types under gravity irrigation systems
- To assess regional and industry implications of gravity irrigation system on medium and light soils.

In delivering a scalable, consistent, and predictable bay scale irrigation performance through a simple approach to where, when and how much, this project has provided the underpinning requirements to support an autonomous approach to water management. The project has seen the building of confidence and knowledge in participant irrigators in using this approach to optimise irrigation performance. The project demonstrated water savings of around 0.9 ML/ha which represent 10-15% of water use depending on the season. In addition, water and energy saving are also part of the system with estimates of 2.1ML/ha in reduced water reuse.

With dairy irrigators in Northern Victoria managing increasingly large flood irrigation systems, the adoption of the approach developed through this project would represent significant water and financial savings as well as having implications for labour and productivity within the dairy industry.

The project developed strong collaborations with the following commercial and research organisations:

- Rubicon Water supported all 3 trial sites through access to farm connect irrigation management systems, automatic weather stations and in-field sensor networks
- Melbourne University Hydrology and Water Resources participated in and contributed to research collaboration and further research program development
- Department of Primary Industries NSW irrigation researchers in the development and implementation of sensor networks to support irrigation management.

This project was supported by funding from Dairy Australia, Agriculture Victoria and the Australian Government Department of Agriculture, Fisheries and Forestry as part of its Rural R&D for Profit program.

1 Project rationale and objectives

Irrigators in the Goulburn Murray Irrigation District (GMID) experience significant negative impacts on their businesses when water is in short supply or prices are too high (GBCMA, 2017). Dairy Australia (DA) recognises that "water availability and affordability are now the limiting factors on growth in the Murray Dairy region" (DA Strategic Plan, 2016/17 to 18/19). There is an imperative for on-farm water management technologies to lift irrigation efficiencies and industry competitiveness for water.

Water use efficiency technologies addressing engineering, agronomic and scheduling issues are available to irrigators, but their adoption and management continue to be a significant challenge. Water use efficiency technologies typically target a single point (e.g., soil moisture at a location) or part of the farm (e.g., individual irrigation bays) and have rarely been used at the whole-of-farm scale.

This project will enhance the growth and utilisation of pastures by scaling irrigation management to support whole farm operations. It will quantify the values of whole-of-farm irrigation scheduling and highlight the benefits of enhanced water management to the industry. The project will deliver an innovative approach to support complex decisions on irrigation scheduling at the farm level and over the season. A participatory approach will be used that sets up a field to farm scale water management research and demonstration sites in the GMID with supporting industry and farm development programs.

The project builds on the success of "Smarter Irrigation" Round 1 project (Rural Research and Development for Profit Programme) by integrating satellite-based irrigation scheduling into a bay-scale water management system. The approach relies on minimal use of in-field sensors and will integrate farm irrigation scheduling with automated management of irrigation.

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3) To support demonstration of a whole farm irrigation management system.
4) To lead communication of research findings.

2 Method, activities, and project locations

This project aimed to assist dairy irrigators achieve consistently high irrigation efficiencies using a satellite-based whole farm irrigation management system that:

- melds farmers' knowledge of sites with science-based knowledge of processes
- reduces farmer management of individual irrigations
- has minimal requirement for in-field instrumentation and telemetry
- is adaptive to the schedules of other farm operations (e.g. grazing)
- incorporates management of irrigation water reuse systems
- maintains ongoing irrigation performance benchmark data.

The project linked with farm extension, Agriculture Victoria Research (AVR) dairy research and irrigation service providers and focused on the key elements and features of a whole farm water management approach including:

- a scheduling module for timing of the next irrigation across all bays on a farm
- a system operation module that details flow rate and irrigation duration parameters
- simple feedback mechanisms to enable rapid customisation of irrigation events.

The methodology outlined below undertook the setup of on-farm trials that had a focus on scaling the approach to enable management of large numbers of irrigation bays across the farms.

The Covid-19 pandemic had a significant impact on implementing these trials through restrictions on farm visitation and interaction with irrigators. Despite this the project was able to implement extensive trialling of the systems across 3 farms in the Goulburn-Murray region.

Covid-19 restrictions also had an impact on large gatherings for field days which meant much of the extension work was through on-line and video methods.

The 2 key elements of the methodology are outlined below.

Scheduling irrigation date, flow rate and timing

The irrigation management approach uses daily weather data (SILO) to estimate crop water requirement. The model written in 'R' language was used to estimate crop water requirement. To assess the water use capability of pasture, the Normalised Difference Vegetation Index (NDVI) was estimated at the start of the season by using satellite data to estimate the crop coefficient (Kc). The model uses Agriculture Victoria Research Tatura's ET-NDVI relationship to estimate crop-specific values of the crop coefficient. This was used to estimate crop evapotranspiration (ETc) in the period from the date of the last irrigation. The model uses available ETo, rainfall and ETo forecast data to estimate the soil deficit. For the forecast ETo, it was assumed that the previous year's data prevailed in the rain-free conditions. The accuracy of the predicted date will increase as the actual ETo date approaches the predicted data. The following parameters were used to run the model:

- Irrigation dates were suggested to the farmer at a nominal soil deficit of 50 mm.
- Irrigation time was calculated using the following equation.
    - Irrigation time = (area of bay × soil deficit) / (flow rate)

In this approach, bay scale calibration is required to estimate irrigation application losses to ensure that the water reaches to the end of the bay and some runoff occurs. In the calibration procedure, a water depth of 5 mm was also added as a runoff in each irrigation, which accounts for 10% of the nominal deficit.

The procedure for the management of irrigations for the trial sites was:

- Model starts with the previous irrigation date and runs daily predict the next irrigation date
- Text message sent to the farmer with the initial modelled date of the next irrigation
- Text message sent nominating the final irrigation date to the farmer, a few days prior to the next irrigation
- Farmer confirms their irrigation date
- Model calculates the irrigation run incorporating any variation to irrigation date and is texted to the farmer
- Observe the irrigation and surface drainage of the experiment bays (nb. this observation was replaced by the use of sensors as the trials progressed)
- Feedback from the farmer after the irrigation to discuss the irrigation performance
- If necessary, adjust the bay-scale calibration
- Continue monitoring of the irrigations.

Customised bay-scale irrigation management module

To enable the scaling of bay scale scheduling and timing technology to the whole farm we developed a bay-scale irrigation management module approach to automate the irrigation management of a large number of bays on the dairy farms (Figure 1). It is a requirement of the module that the irrigation system is automatic, which means the bay outlets should open and close automatically. The bay-scale irrigation management module has the following parts:

1. Flow data will be acquired from the Goulburn Murray Water (GMW) Magflow supply meter, if an open channel irrigation system supplies water to the bays.
2. A flow meter will be installed on the suction pipe from the storage dam to confirm the flow rate if a pressurised pipe irrigation system supplies water to the bays.
3. Water depth meter/s installed in the farm channel to record water depth fluctuation and to account for changes in the channel water volume during the irrigations.
4. Bay outlets that can open and close automatically during the irrigations.
5. A water depth meter will be installed at the end of each bay to confirm that water reaches the bay end.
6. Measurement of runoff was optional to quantify runoff at the management unit scale.

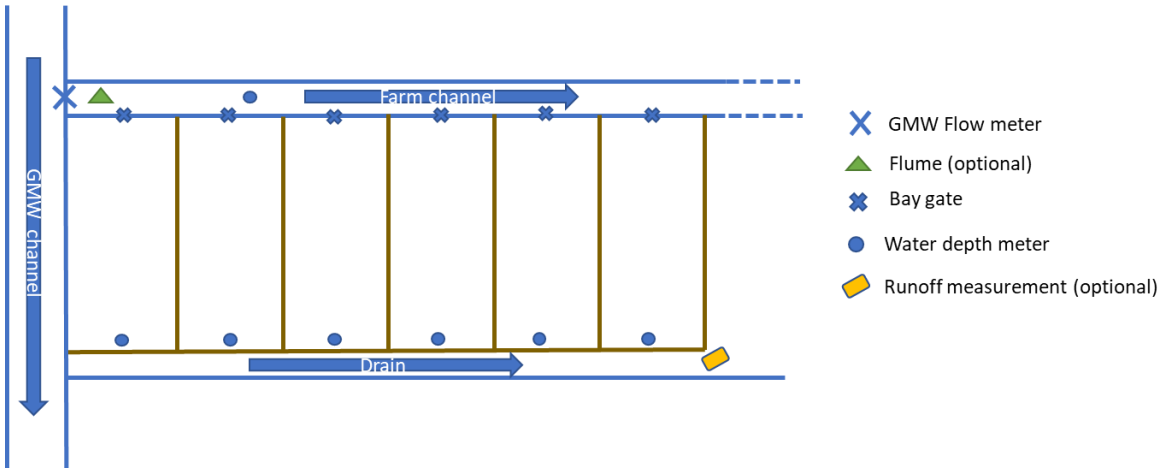

Figure 1. Bay-scale irrigation management module

The intent of the irrigation management modules is to support the development of a whole-farm water management system. The concept of this including dividing the farm into management units is presented in Figure 2 below.

Figure 2. Farm scale implementation of irrigation management modules

Include a list of team members and partners involved in your sub-project (including commercial partners and cooperating producers).

Name	Organisation/Business	Role
Andy McAllister	Agriculture Victoria Research (AVR)	Project leader
Dugal Wallace	AVR	AVR project Sponsor
Des Whitfield	AVR	Agronomy/crop water modelling
Amjed Hussain	AVR	Irrigation hydrologist and field trial coordinator
Faith Githui	AVR	Research analyst
Mohammad Abuzar	AVR	Remote sensing analyst
Mike Morris	AVR	Project science and technical group
Alister Lawson	AVR	Project science and technical group
Rob O'Connor	Agriculture Victoria - Biosecurity and Agricultural Services (AV-BAS)	Farm liaison and extension
Nick O'hallaron	AV-BAS	Farm liaison and extension
David Aughton/Kevin Saillard/Peter Moller	Rubicon Water	Irrigation technology supplier and manager
Nick Ryan	Ryan Dairy	Participant irrigator
Marcus Lang/Owen McReadie)	Lang Dairies	Participant irrigator
Mark and Ann Gardiner	Gardiner Dairy	Participant irrigator

The locations of the project activities including the location of the commercial farms involved during the life of the project are listed below.

Name & type of site (field site, laboratory, project partner sites, RDC headquarters)	**Street Address**	**State**	**Postcode**
Tatura "SmartFarm", AVR	DJPR, 255 Ferguson Rd, Tatura	Victoria	3616
Irrigated dairy property trial site 1 – Ryan's Farm	1220 Davies Rd, Lancaster	Victoria	3620
Irrigated dairy property trial site 2 – Lang Dairies	1065 Dhurringile Rd, Tatura	Victoria	3616
Irrigated dairy property trial site 3 – Gardiner dairy farm	50 Twaddle Lane Bamawm	Victoria	3561

This research has demonstrated that consistent and predictable bay scale irrigation performance can be achieved by using the satellite-based irrigation management approach on flood irrigated pasture systems. This has application not only to flood irrigated grazing systems (i.e. dairy and meat/wool) across Australia but can also inform similar flood irrigation principles as they apply to rice and cotton in particular and irrigated cropping more broadly.

3 Project Outcomes

3.1 Project level achievements

Output and KPI numbers and description	Summary of achievements
Activity output 5.2(i) Conduct experiments to validate a whole farm irrigation management system for gravity fed irrigation (dairy).	The "Scaling Irrigation Management to support whole farm operations" project has successfully designed and implemented irrigation management modules across 3 irrigation farms in the GMID. These sites represent a range of both pressurised pipe and riser and open channel flood irrigation systems on grazed perennial pasture across a range of light and heavier soil types. This has provided a robust platform to test the irrigation scheduling and water management approaches developed by this project. The project has demonstrated that consistent and predictable bay scale irrigation performance can be achieved by using the satellite-based irrigation management approach with positive irrigator responses. The approach was used to manage in excess of 400 irrigation events over the life of the project 2019/20 – 2021/22 irrigation season with reductions of irrigation duration by up to 30 minutes per irrigation event which can represent a water savings of 10 – 20mm per irrigation. The progression of the trials for all 3 farms from 2019 - 2022 has seen both the scaling up of the irrigation management approach to larger units (i.e. blocks of multiple bays and across different parts of the farm) and confirmation of performance on a range of soil types. Outlines and maps of trial activity for each farm are presented below. Nick Ryan Trial Farm 1: Evaluated the irrigation management approach on three management units utilising

Rubicon sensor network and irrigation management systems. This included a mix of pipe and riser and channel systems.

Figure 1. Nick Ryan trial sites for 2021/22

Mark Gardiner trial farm 2: In addition to the implementation of an irrigation management module, trial sites were also established to confirm the results of flood irrigation management on lighter soil types and to provide a comparison with heavier soils. The establishment of Rubicon sensors that integrated with Rubicon automatic weather station were also implemented to test irrigation management approach.

Figure 2. Mark Gardiner trial sites for 2021/22

	Lang Dairies trial farm 3: The project successfully undertook the evaluation and scaling of the irrigation management approach to a management unit scale. Other project activities have included: • The setup of trials across all farms to incorporate on-farm real time rainfall data from Rubicon Automatic Weather Stations (AWS) into the model and investigation improvements in utilising local AWS into irrigation management. • Working with the AVR and DA PastureSmarts program to integrate irrigation planning approaches into grazing management.
KPI Final report. Provide a brief and final report on the economic benefits of the whole farm surface water management system for dairy and potential pathways to	The project worked with the broader SIP2 project staff and Dan Armstrong (D-Arm consulting) to develop a costed case study for the scaling irrigation management technologies. This case study focussed on Nick Ryan's property as it was the longest trial participant and contained a range of irrigation automation (see attached case study). The case study found that the profitability of this technology depends on the capital cost, the amount and value of

commercialisation (Activity output 5.2i).	irrigation water saved, and any associated increases in pasture consumption. It demonstrated that if irrigation water is valued at $120/ML it is likely to be a profitable investment with the 'low end' capital cost investment that has been the main focus of the project. This is based on the findings of the project of a conservative water saving of 0.45 ML/ha/yr. A higher end investment in sensors and integrated satellite-based irrigation management such as that represented by Rubicon Water Farm Connect system was demonstrated to be attractive if irrigation water is valued at $300/ML, at a conservative saving estimate of 0.5 ML/ha/yr (Internal Rate of Return 14%) It was noted that the pasture on the Ryan farm is irrigated with well-developed irrigation infrastructure and that the technology may provide different benefits and challenges when implemented on farms with less developed infrastructure. To this end a further case study is being undertaken for Lang's dairy trial site which represent a lower end irrigation infrastructure development. This case study will be incorporated as part of the final reporting to the Smarter Irrigation for Profit 2 project.
Activity output 5.2(j) Conduct two field days to demonstrate the performance of the whole farm surface water management system for dairy.	The main impact on the project was felt through the restrictions on large gatherings for field days which meant much of the extension work was through on-line and video methods. There were a range of limited farm visits undertaken over the period of the project these included: • Farm visit (1 farms), trial results presentation and 21/22 season planning. Recording of video material for DA media. August 2021 • Farm visits (2 farms), trial results presentation and 21/22 season planning. September 2021 • Farm visits (3 farms) and recording of video material for RRDP smarter irrigation for profit media. March 2022. In addition, presentations to the following farmer and industry groups were given: • Murray Dairy Fodder for the Future online field day – September 2021 • Agriculture Victoria Soils and Irrigation discussion group – May 2022

3.2 Contribution to the SIP2 program objective

This project has demonstrated that the satellited-based irrigation management approach can be scaled up to larger management units and ultimately the whole-farm. Similarly, it could be adopted to manage irrigations for different soil types, bay sizes, flow rates, soil deficits, and for open channel as well as pipe and riser irrigation systems.

Using the satellite-based irrigation management approach irrigators in the trial were able to reduce their irrigation durations by up to 30 minutes which can represent a reduction in water application of 10-20mm per irrigation. This represents a saving of up to 0.9 ML/ha/year once reuse is accounted for as well as a reduction in reuse pumping volume of 2.1ML/ha/yr. The approach was used to manage over 400 irrigation events in the over the 2019/20 - 2021/22 irrigation seasons.

Feedback from all the farmers about the irrigation management approach was positive and encouraging and these irrigators sought to expand the application of the irrigation management system to larger groups of irrigation bays in the 2021/22 irrigation season.

All 3 trial participants were managing flood irrigation systems of more than 200ha which represents a saving in excess of 150ML a year if the approach and system was adopted across the whole farm. This would represent a significant financial saving as well as having implications for labour and productivity.

3.3 Contribution to SIP2 program outcomes

The project has delivered scalable, consistent, and predictable bay scale irrigation performance through a simple approach to where, when and how much irrigation water to apply which in critical to an autonomous approach to water management (Outcome 5). The project has seen the building of confidence and knowledge in participant irrigators (Outcome 1 &Outcome 2) in using this approach to optimise irrigation performance. The project demonstrated direct water savings of around 0.9 ML/ha which represent 10-15% of water use depending on the season. In addition, water and energy saving are also part of the system with estimates of 2.1ML/ha in reduced reuse utilisation (Outcome 1).

Despite the restriction due to the COVID pandemic this project has participated in the collaborative and sharing opportunities provided the SIP2 program which has provided access to a range of research and commercial solutions to improved irrigation automation and sensing (outcome 3). This includes DPI NSW irrigation researchers in the development and implementation of sensor networks to support irrigation management.

4 Collaboration

4.1 Project collaborations

Despite the restriction due to the COVID pandemic this project has developed strong partnerships with commercial and research organisations in particular;

- Rubicon Water who have supported all 3 trial sites through access to FarmConnect irrigation management systems, automatic weather stations and in-field sensor networks,
- University of Melbourne Hydrology and Water Resources who have participated in and contributed to research collaboration and further research program development and
- DPI NSW irrigation researchers in the development and implementation of sensor networks to support irrigation management.

Ongoing project development is being undertaken with these organisations to attract further investment in both farm and regional irrigation systems to improve water management. In particular these projects seek to develop and pilot the next generation irrigation district that makes use of appropriate technology to enable an irrigation industry closely informed through a measurement, modelling, management, feedback paradigm that transforms system and farm-level water management.

4.2 Recommendations for activities to support future collaborations.

There were no unsurmountable significant barriers to collaboration were encountered with this project.

The national and research collaborative nature of the SIP2 program enable collaboration to continue despite the barriers presented through COVID-19. Some of the key factors to this successful collaboration in SIP2 include:

- Having scheduled updates from all research, development and extension (RDE) participants to allow each sup-project to share learnings, discuss how to overcome any barriers and identify opportunities for synergies across industries and regions including sharing extension activities
- Developing mature RDE networks that allows ad hoc engagement across the sub-projects when synergies, opportunities or barriers are identified
- Sharing of external expertise (e.g. commercialisation, video/communication production, quantifying economic benefits) across the sub-projects. For the economic component, this ensures consistency and comparability in findings across the sub-projects
- Project resources, particularly people, who's role is to help facilitate this cross-project engagement and collaboration. In SIP2 both Lou Gall and Cathy Phelps played a key role in facilitating this across all the sub-projects and Dr James Hills played a key role in facilitating collaboration and exchange of research information across the dairy related sub-projects

- Field days that allow all SIP2 RDE participants to see key research sites and meet with industry and commercial stakeholders across the range of industries and regions. While this was limited in SIP2 due to COVID, especially in states such as Victoria, the few face-to-face opportunities that could be taken including the workshop/field day in Tasmania, proved to be invaluable for cross team discussions and being exposed to new ideas.

5 Extension and adoption activities

5.1 Project extension & adoption activities

Due to COVID restrictions face to face and large in-person group extension was highly restricted through the life of this project this meant much of the extension work was through on-line and video methods.

These online and video activities included:

- Murray Dairy Fodder for the Future online field day to present findings and irrigation management approach to Murray Dairy irrigators – September 2021
- SIP2 podcast "Scaling irrigation management to support whole farm operations to present the project to an industry audience - January 3rd 2021
- Workshop with G-MW, Rubicon and AVR to outline RRDP project to GMW irrigation management staff and Rubicon technology and operational staff and managers and engage these organisations in supporting AWS, metering and field sensing instrumentation and data provision. August 2020
- Video production for the Smarter Irrigation for Profit and Dairy Australia showcasing the 3 trial farms and the irrigation technologies developed to an industry audience.
- An online website to support the delivery of regional and local ET0 and rainfall information to support and promote climate and satellite based irrigation scheduling is in development and due to be completed in July 2022. This will be hosted at https://extensionaus.com.au/irrigatingag/home.

A range of limited farm visits and some in person workshops were undertaken over the period of the project to support both the adoption of the project outcomes by the participants involved and engage with a wider research/industry and extension audience these included (number of attendees in Appendix 6.1):

- Farm visit (1 farms), trial results presentation and 21/22 season planning. August 2021
- Farm visits (2 farms), trial results presentation and 21/22 season planning. September 2021
- Farm visits (3 farms) and recording of video material for RRDP smarter irrigation for profit media. March 2022
- Agriculture Victoria Soils and Irrigation discussion group involving industry consultants, researchers and irrigators. May 2022.

5.2 Lessons learnt and recommendations for future extension.

The COVID-19 impact meant this project focussed on larger on-line forums and discussions to inform a broader audience about the project while at the same time having a heavy emphasis on extensive interaction with the farmer trial participants. This emphasis with the participant

irrigators through one-on-one interactions meant that the irrigators involved built a strong confidence in the operation of the system as they had a positive involvement in tailoring the irrigation management recommendations and technology to their operations as well as having direct access to the researchers. They are now able to promote and discuss the irrigation trial results and approaches with their fellow irrigators. This irrigator-to-irrigator exchange of information is often the preferred way for farmers to receive extension information about farming approaches and management changes.

The project therefore demonstrated that while virtual events are effective at building awareness of the project across a large audience the undertaking of on-farm research linked with extension is crucial in building irrigator confidence, understanding and ultimately adoption of these systems.

6 Appendix - additional project information

6.1 Sub-project, media and communications material and intellectual property

Nature of materials / activities	**Number**	**Details** (Please provide details if appropriate (eg links to publicly available documents)
Media appearances – press and TV	1	SIP2 podcast "Scaling irrigation management to support whole farm operations". January 3rd 2021
Brochures, fact sheets, posters and newsletters	2	Fact sheet: Smarter irrigation project background information for Northern Victoria irrigation field trials Fact sheet: Trial information sheet for prospective irrigation trial participants
Web page	1	Website to support the delivery of regional and local ET0 and rainfall information to support and promote climate and satellite based irrigation scheduling is in development and due to be completed in July 2022. This will be hosted at https://extensionaus.com.au/irrigatingag/home.
Field days, expos, field walks	7	Farm visit, trial results presentation and 21/22 season planning. Recording of video material for DA media. August 2021. 5 attendees Farm visit x2, trial results presentation and 21/22 season planning September 2021. 10 attendees. Farm visits (3 farms) and recording of video material for RRDP smarter irrigation for profit media. March 2022. 12 attendees Fodder for the Future Virtual Field Day hosted by Murray Dairy. September 23rd 2021. 30+ attendees
Stakeholder forums, meetings, presentations, workshops, webinars	15	Rubicon Water, Tatura, 8 August 2019 Project presentation to Goulburn-Broken CMA Farm & Environment Working Group. August 2019. 20 attendees Presentation of project to AVR dairy conference, Ellinbank (West Gippsland), 4th September 2019. 30 attendees Irrigation Research Workshop (AVR, UOM, Rubicon Water), Melbourne, 20 September 2019. Smarter Irrigation for Profit-Phase II workshop, Attwood, 15 November 2019 Meeting of AVR with Rubicon Water and Prof Claudio Gandolfi, University of Milan, Italy, Tatura, 16 December 2019. 9 attendees

		Irrigation Research Workshop (AgVIC, University of Melbourne, Rubicon Water) to discuss future directions, Melbourne, 4 May 2020. 6 attendees Workshop with G-MW, Rubicon and AVR to outline RRDP project and discuss G-MW and Rubicon role in supporting AWS, metering and field sensing instrumentation and data. August 2020. 9 attendees. Presentation to AVR Climate Smart Agriculture conference. September 2020. Online – 292 attendees AgVic water/irrigation projects workshop with DA and Murray Dairy February 16th 2021. Satellite Remote Sensing to support irrigation scheduling and benchmarking presentation to SIP2 program. May 4th 2021 AgVIc/Rubicon/UOM irrigation management and scheduling collaboration workshop. May 7th 2021 Agriculture Victoria/Rubicon/UOM irrigation management and scheduling collaboration workshop to discuss current trials and potential future projects. October 29th 2021 Smarter Irrigation Trials and GMID Irrigation Analysis presentation to the Victorian Sustainable Irrigation program quarterly forum. December 8th 2021. Agriculture Victoria Soils and Irrigation discussion group – May 2022. Online 20 attendees
Social media presence	2	Project information provided to Smarter Irrigation for Profit and Dairy Australia social media platforms.
Scientific conference presentations	1	"Whole Farm Automation of Surface Irrigation" abstract submitted for 24th International Commission on Irrigation and Drainage Congress" to be held October 2022