Smarter Irrigation for Profit II

RRDP 2014 Key Learning Sites Southern – Making the most of water

Final Report

Growers and advisors learning about automation at the 2021 IREC field day.

Australian Government
Department of Agriculture, Fisheries and Forestry

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AgriFutures Australia
CRDC
GRDC Grains Research & Development Corporation
NSW Government Department of Primary Industries

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Plain English summary

The Key Learning Sites Southern: Making the most of water project was part of the Smarter Irrigation for Profit phase II body of work and builds upon the previous Smarter Irrigation for Profit phase I project 'Maximising on-farm irrigation profitability'. This was an extension project designed to increase water productivity across the grains, cotton and rice industries. The main irrigation-water challenge being addressed by the project was 'To have growers understand how they best use water across different crops in low water environments. To achieve this the project opted to demonstrate best irrigation practise by collaborating with four grower groups with Key Learning Sites (KLS) across New South Wales and Northern Victoria. Established grower groups were selected to ensure that the project had exposure to a large number of growers through established extension networks and to continue the work from the SIP1 project. Participatory Action Research (PAR) was used to set project objectives to ensure that what was demonstrated was of most value to the irrigators in that area. Through this methodology two sites focused on grains systems on how to either schedule irrigations most effectively (Irrigated Cropping Council) or management strategies to ensure greatest returns given unreliable water supply (Central West Farming Systems). The other two KLS looked at cotton (Irrigation Research and Extension Committee) or rice (Southern Growers) systems and how to improve crop water productivity as well as demonstration full scale automation in these systems. Another component of the project was to assess the feasibility of investing in improvement and change of irrigation systems, to achieve this a consultant was engaged to conduct three case studies looking at the feasibility of three different irrigation operations each with different types of improvement ranging from upgrading surface irrigation system to overhead or the purchase and development of a neighbouring property.

Though none of the work conducted at each of the KLS was replicated, the project was able to show that irrigators are able to use different strategies to improve their water productivity. It was repeatedly demonstrated that scheduling irrigations with soil moisture probes resulted in the highest yields/ha and that when looking to achieve the highest yields/ML in wheat the first irrigation is the most important. Double cropping in a rice system to maximise the soil moisture after rice can be risky particularly in wet seasons, however the KLS did demonstrate the importance of timing and also to not proceed if operations are delayed. With respect to automation, it is a technology that can save water in many industries, but it is most cost-effective at reducing the labour component and has the largest impact on water saving in crops that require more frequent irrigations such as cotton.

Covid-19 had a significant impact on this project, face to face field days and crop walks were seen to be the most effective way of showing growers the demonstrations. Although the project was able to conduct eight field days this is below what was anticipated. The project did attempt to do a virtual field day as well as produce some online content such as videos and a podcast, and although these did work the project found that there was more support for face-to-face extension activities, and this will continue to be the preferred option for the grower groups going forward.

A range of different irrigation management strategies and crops were demonstrated through the project, as well as a variety of automation and technology. By demonstrating the benefits of these best irrigation practises and technologies the project has helped in their adoption amongst irrigated growers, enabling associated industries to utilise water more effectively particularly in low water environments.

This project has joint funding from Cotton Research and Development Corporation, Grains Research and Development Corporation, AgriFutures and the Australian Government Department of Agriculture, Fisheries and Forestry, with in-kind funding from NSW Department of Primary Industries and the four

grower groups of Central West Farming Systems, Irrigated Cropping Council, Irrigation Research and Extension Committee and Southern Growers Inc.

Abbreviations and glossary

CWFS:	Central West Farming Systems
GVIA:	Gwydir Valley Irrigators Association Inc
ICC:	Irrigated Cropping Council
IREC:	Irrigation Research and Extension Committee
KLS:	Key Learning Site
N:	Nitrogen
NSW DPI:	New South Wales Department of Primary Industry
PAR:	Participatory Action Research
PI:	Panicle Initiation
SG:	Southern Growers Inc.

1 Project rationale and objectives

Each of the crops in the project (cotton, rice and irrigated wheat or irrigated canola) are competing for an increasingly scarce resource, that is irrigation water. One way that each of the cropping industry can try stay as a viable option for irrigated growers is to push for continual improvements in water productivity. This project was aimed at increasing irrigated growers' awareness of best irrigation practice and also available tools and technology available to increase water productivity. The goal of the project was to increase long term adoption of both best irrigation practice and technology leading to industry wide improvement in water productivity.

The project also explored the economic feasibility of investing in different irrigation systems or upgrades, this work was done with a view to help growers understand the risk factors and potential down and up sides to making large capital investments in their business.

The objectives of each KLS are shown below:

Central West Farming System:

2019 season: Evaluate in a dry year if it is best to sow wheat crop for hay or grain, budgeting on 3ML/ha of water or sell the water on the temporary market.

2020 season: Demonstrate what income could be generated by grazing a long season crop sown early. Evaluating what is the best grazing strategy and what crop type would be the best choice between canola and cereal?

2021 season: The 2021 demonstration aimed to figure out the best nitrogen (N) delivery strategy in canola.

Irrigated Cropping Council:

2019 season: Evaluate pre-irrigation and spring irrigation strategies on a range of crop types (barley, canola, Faba beans and wheat) and maturities to calculate the best return for irrigation water.

2020 and 2021 season: Demonstrate the effect of timing and quantity of irrigation water on wheat yield and grain quality.

Irrigation Research and Extension Committee: Demonstrate and extend the use of automated surface irrigation layouts to improve efficiency of water use. This was a systems demonstration running continuously over the life of the project.

Southern Growers Inc: Demonstrate the advantages and risks of double cropping in a rice system. This was a systems demonstration running continuously over the life of the project.

2 Method, activities and project locations

At its core this project was designed to engage growers to extend best irrigation practice through demonstrating different irrigation management strategies and technology to help growers reduce water use, increase productivity or both. The project aimed to do this over four growing regions and include cotton rice and grains. The approach taken was to have one KLS in each irrigation region and to leverage off existing Grower Groups using pre-existing sites and extension networks as the KLS. Learnings and information were to be extended through the KLS extensive extension pathways, including access to over 1,400 growers and advisers. The project also capitalised on the KLS pre-existing extension activities and platforms such as social media, newsletters and grower field days. Participatory Action Research (PAR) was used to set project objectives, as each KLS represented different types of irrigation businesses the core objectives were very different at each KLS. Also having flexibility allowed each KLS to change activities from year to year, allowing scope for flexibility to improve KLS demonstrations/activities from previous years learnings. The scale of the demonstrations differed on each site from trial experiment size allowing the KLS to demonstrate a larger number of variations in management or strategies to large full paddock size to enable demonstration of how the technology or strategy could be implemented at scale. For further details on the methods and activities undertaken at some of the KLS (Appendix 6.5.1 – 6.5.6).

Considering Covid-19 the project was very fortunate in the number of face-to-face extension activities that it was able to hold, unfortunately not all sites were able to conduct their usually large interactive field days every year of this project. With restrictions to travel and group gatherings one KLS (ICC) did attempt a virtual field day, and although this was a success, there were fewer registrations and less discussion compared to a field day held in a paddock. Another KLS (SG) were able to hold Covid safe field days, this consisted of having small groups of 20 people or less on the KLS at a time. Running the field day this way allowed for growers and advisers to access the site and talk one on one to the researchers, unfortunately time restrictions did limit the discussions that could be had as well as grower to grower learning which is often a keyway growers gain information. Three of the four KLS were heavily impacted by the Covid-19 restrictions as their large field days are held around the middle of September to fit in with grower availability and crops being at a growth stage that early results of that current season can be discussed. This unfortunately coincided with Covid-19 restrictions in two the of the three years of the project. Attempts were made to extend learnings through other channels such a videos and podcasts as well as a field day magazine. These have the advantage that they have legacy and can be accessed at any time but it is the belief of the project team that field days are still the preferred way that growers receive their information.

Table 1: List of team members and partners involved in project

Name	Organisation/Business	Role
Alex Schultz	NSW Department of Primary Industries	Project leader
Don Griffin	NSW Department of Primary Industries	Technical Assistant
Helen McMillan	Central West Farming Systems	Trials Agronomist
Rajdeep Sandhu	Central West Farming Systems	Trials Agronomist
Diana Fear	Central West Farming Systems	Executive Officer
Iva Quarisa	Irrigation Research and Extension Committee	Executive Officer
Stephanie Chappell	Southern Growers Inc	Executive Officer
Damian Jones	Irrigated Cropping Council	Trials Agronomist
Charlotte Aves	Irrigated Cropping Council	Executive Officer
Tristan Wardley	RM Consulting Group Pty Ltd	Consultant

Table 2: List of locations for all project activities.

Name & type of site (field site, laboratory, project partner sites, RDC headquarters)	Street Address	State	Postcode
NSW DPI Office	449 Charlotte St Deniliquin	NSW	2710
Central West Farming Systems Inc. field site	1 Fifield Rd Condobolin	NSW	2877
Irrigation Research & Extension Committee field site	160 Stott Rd Whitton	NSW	2705
Southern Growers Incorporated field site	Newell Hwy Finley	NSW	2713
Irrigated Cropping Council Inc. office	79 Bendigo Rd Kerang	VIC	3579

Through this project each KLS conducted demonstration activities that were of interest and benefit to the local growers. Although the work was derived for each irrigation region and its growers the knowledge gained from each site is not necessarily specific for that region. CWFS

and ICC were the two sites that focused on winter crops (wheat and canola) but some of the leanings from these two sites are applicable to other irrigation regions that grow the crops demonstrated. Seasonal weather and soils will have influenced results and should be taken into consideration. The other two key learning sites (IREC and SG) included summer crops such as cotton and rice and although these crops are more limited with regards to number of irrigators growing these crops the sites did demonstrate automation and other technology that can be adopted widely.

3 Project Outcomes

More detailed results can be found in the Appendix or online on the Smarter Irrigation for Profit Phase 2 web site https://smarterirrigation.com.au/

Summary of key learnings from each site:

All the results below are from demonstrations and my not be replicated.

Central West Farming System:

- In 2019 the best wheat cropping option was to sow an early maturing wheat variety (Condo) on 10 April and cut for hay returning almost $1500/ha higher GM then the highest earning treatment harvested for grain. Cutting for hay resulted in GM of $677.60/ML, harvesting for grain resulted in GM of $180.05/ML. The average water price over the February to April period was $311.05/ML.
- In 2020 early sown fully grazed canola resulted in the highest GM/ha outperforming both wheat and barley trialled.
- Economic analysis showed that drought years can still provide opportunities to generate income when water markets may appear too high or too risky in invest or participate in.

Irrigated Cropping Council:

- The best response to water is from the first irrigation in the spring, but the crop being irrigated must be sufficiently developed, either with sufficient biomass or tiller numbers, to be able to respond to the irrigation.
- Irrigation has to be on time and the crop not subject to moisture stress. In 2019 'no pre-irrigation' resulted in very little subsoil moisture and crops went from adequate to low soil moisture rapidly. The results obtained in 2019 may be different to those in 2020. 2019 saw a relatively early and above average start to the season, which still suffered from short term moisture stress in June. Crop growth was always lagging in the 'no pre-irrigation' treatments for all crops, but the cereals, maturity dependent, and fabas had some ability to recover in the spring with irrigation.
- In 2019, irrigated cropping did not return positive gross margins with water valued at the market price. If water is valued at the cost charged by the water authorities, broadleaf crops returned the best gross margins, either $/ha or $/Ml, when fully irrigated while the cereals had the best returns with no pre-irrigation and a single spring irrigation. The early maturing wheat variety Axe had reduced tillering and was too committed to grain production rather than vegetative growth to respond to spring irrigation. However, the long season wheat (DS Bennett) could respond as it had continued to tiller through winter and had sufficient shoot numbers to respond to the spring irrigation.
- The decision on when to irrigate is not an easy one, irrigation should be used to target and achieve high yields, but as water becomes more valuable the economics change and irrigation management should aim for highest water productivity in $/ML not $/ha.
- Treatments that used soil moisture monitoring probes to trigger irrigations always resulted in the highest yields per ha but often the highest water productivity was found to come from treatments that only received one irrigation (not fully irrigated).

Irrigation Research and Extension Committee:

- Green manure crop over winter, cultivated in and planted to cotton provided excellent soil conditioning properties.
- Sowing mung beans into weak standing barley stubble was not successful. The volume of lodged barley stubble in furrows restricted drainage to the detriment of mungbean crop, and barley grain on the ground contaminated the mungbean sample.
- Short season crops like mungbeans (90 days) cannot suffer any setbacks, such as poor drainage.
- One metre spacing was too wide for mungbeans. The plant population was too low for a plant with poor stem strength. The crop fell into the furrows and late summer rains reduced grain quality.
- Strong, standing stubble is essential for mungbeans.
- Drainage is king. Clean paddocks and furrows are critical in surface irrigated systems.
- Maintaining winter crop stubble provided a good mouse breeding environment.
- Soil N variability takes effort to even out. Residual nitrogen left from the chicken litter trial, that ran for three seasons, caused yield variation in the following barley and rice crops. The higher the litter rate, the higher the yield one season later. Rice grain yield varied from 3 t/ha to 12 t/ha due to ongoing differences in soil nitrogen from the chicken litter trial despite attempts to compensate at planting.
- Irrigation automation, in-field sensing and more accurate predictive tools are vital in getting the biggest bang for our buck, for dollars spent on irrigation water and all other crop inputs.
- Automated structures and high flow irrigation layouts enable quick filling of rice bays to protect the crop at the critical early pollen microspore stage of growth.
- These technologies allow huge savings in water and reduces the risk of overwhelming banks and drainage capacity in the event of an 'unexpected' 50 mm rain over night.
- Automation of pump stations, doors and level sensing at critical points around the irrigation system enable a prompt response without having to jump in the ute.

Southern Growers Inc:

- In 2019 Winter crops on beds yielded higher then other surface irrigation systems.
- When attempting double cropping late Spring irrigations of the Winter crop to try maximise yield can delay harvest and sowing to the following rice crop. This can push the rice crop back so that Panicle Initiation (PI) occurs outside the optimum window, also the rice harvest is delayed, and subsequent winter crop sowing is also delayed.
- Timing and water height is critical.
- Drive through bank less channel can lead to trafficability issues.
- 'Water height sensors enabled the site to maintain water at lowers level, growers are notorious for holding water at much higher levels than is required' – Russell Ford (rice specialist).
- Automation - Ability to trickle water in through automation and controlling recycling system allowed for less labour time in paddock.

Economic: Below are some of the main points from three economic case studies:

- Upgrading part of the farm from surface irrigation to lateral move fitted with targeted drip irrigation system allowed crop rotation to include cotton over maize. It also reduced labour, water use and water logging which increased yield. The payback for this investment would be five years.
- Investment in changing over to pip and riser and fast flow channels had a payback period of six years. As the crop rotation stayed the same the gains made were through lower water use, this was partly achieved with more consistent flow rates resulting in more predictable irrigations with less run off and water logging which increased yields. Other benefits included the reduced labour of running the upgraded system reducing the labour costs to the business.
- Purchasing new land and developing it to allow it to be irrigated had a payback period of eight years. Same crop rotations as used on existing farm was used, this included oats, Faba beans, canola, sub clover in the winter with maize and fallow in the summer.

3.1 Project level achievements

Provide a description of project achievements against the agreed output 5.3f and KPI 4.29 and Output 5.3 and KPI 4.30. Include graphs, tables and/or images where applicable.

Output and KPI numbers and description	Summary of achievements
Output 5.3f. Demonstrate and validate the productivity benefits of irrigation management strategies, scheduling technology and automation with 4 grower groups (key learning sites) in central and southern NSW and northern VIC (grains, cotton, rice).	The project was able to run demonstrations that showcased many different management strategies to improve water productivity. It did this through its four KLS, Central West Farming Systems (Condobolin), Irrigated Research and Extension Committee (Darlington Point), Southern Growers Inc (Finley) and Irrigated Cropping Council (Kerang). The demonstrations ranged from comparing hay and grain production, grazing compared to grain production, comparing irrigation strategies such as pre-irrigation vs not and no spring irrigation vs part spring irrigation and full spring irrigation. Also demonstrating scheduling strategies such as growth stage vs soil sensors technology. Each of the KLS demonstrated the benefits of soil sensor technology and were all providing live soil moisture data to growers through an online soil sensor network site that made soil moisture date from the KLS publicly available. Two of the KLS also were able to demonstrate fully automated systems in a variety of irrigation layouts and cropping situations.
KPI 4.29 Provide a brief and final report on the economic and productivity benefits of selected irrigation management strategies and scheduling technologies used at each key learning site. Include commentary on the extent of farmer and service provider involvement and the impact of participation on their irrigation management decisions (activity output 5.3f).	Each of the KLS demonstrated different management strategies that have the potential to increase productivity in irrigated farming systems. Management strategies demonstrated included growing hay or grain or grazing the crop verses grain production to identify the highest return of water. Also, different irrigation scheduling techniques and technologies were demonstrated against each other, in each scenario the strategies were validated economically and compared to selling the water on the open market at market rates. As well as this the project conducted three economic case studies that investigated the economic viability of growers to invest in

	improvements, modernisation and/or expansion of their irrigation operation. (Appendix 6.5.10 – 6.5.12)
Output 5.3g. Conduct one field day each financial year at each of the key learning sites in central and southern NSW and northern VIC and two grower field tours (with in the life of the project) (grains, cotton, rice).	The project was not able to conduct one field day at each of the KLS each year of the project. This was due to the restrictions as a result of Covid-19. The project was able to hold eight field days with a total of 561 growers and advisors attended, the project also tried novel extension activities such as a virtual field day with 32 attending. The project was only able to run one grower field tour, this was run in February 2021 and from all feed back was well received by those who took part. Due to Covid-19 the second tour had to be re-scheduled, and when it was able to be run registrations were too low to go ahead with the tour. A quick survey of growers indicated that the main reasons for low interest in the second tour were concerns about Covid-19 as well as the tour occurring at a very busy time of year.
KPI 4.30 Develop extension materials and conduct one field day per site and one grower field tour. Report on farmer and service provider participation in extension activities and the percentage of farmers intending to change their practices (Activity output 5.3g).	The project produced a range of extension material, including newsletters, annual grower reports seasonal updates as well as videos and a podcast. The project also ran one grower tour that had 23 growers/advisors take part. Grower and service provider participation was good, a total of 561 attended the 8 field days that the project was able to hold, also other content that the project produced such as videos has seen a promising number of views. The web site that was hosting the soil moisture data from the KLS had a total of 333 users from 1 July 2020 to 30 June 2021 with 2,862 page views in that time period. Also, at one of the events participants stated in a survey that 64% would change something as a result of the event.

3.2 Contribution to the SIP2 program objective

The project set out to make irrigated growers aware of management practices that could improve the productivity of their farming operation. Through the project a large variety of strategies were demonstrated, including different irrigation scheduling, grazing and crop rotation strategies including novel crops such as mungbeans as well as the use of irrigation technology such as soil moisture probes and automated irrigation systems.

Some of the management strategies although able to increase water productivity do come with risk, for example the double cropping demonstration at SG aimed to show the advantages of double cropping with wheat or canola in a rice system. Although it can have advantages in increasing productivity and using strategies such as using beds opposed to flat irrigation systems can reduce risk. It is a management strategy that is risky and not appropriate in wet seasons. This double cropping demonstration highlighted to growers the importance of timing if this system is to be used. A key learning is that if at any stage a key operation such as sowing is falling behind then it is recommended not to persist with double cropping. It is learnings like this that will save the grower from making costly mistakes. Similar learnings with regard to growing mungbeans, as growers look to increase the variety of crops, they grow it is important for KLS to investigate the fit of different crops in the local area, irrigations systems and soils for that area. This can allow growers to see what works best and what to do or importantly not do to make the crops work in their operation.

Other demonstrations in this project were about exploring the ability of management strategies to make a greater return from the irrigation water used. This is often a dilemma with growers who face high water prices in dry seasons and without factoring in potential returns by using the water on farm see the potential profit from selling the water on the open water market. An economic case study 'Irrigation water in dry years: sell, buy or apply?' used data generated from the CWFS KLS and found that even in dry years where water prices are high there is potential for growers to use irrigation water to achieve high gross margin returns. It also found that water could be purchased to increase yield and offer a high return on investment, the important take home through is that results showed that expected returns declined sharply when water increased above the seasonal average of $311. This points to the importance of each grower doing calculations with their own data and factoring in seasonal prises before making investments. But it does show that there is potential opportunity in dry years to utilise grower's expertise and capital (farmland and equipment) to generate income. ICC demonstrated a range of different irrigation strategies through this project, in the first year four different strategies were demonstrated, ranging from No pre-irrigation + one Spring irrigation through to pre-irrigation + full Spring irrigation where the full Spring irrigations were triggered by soil moisture probes. It showed that the lowest yield was the treatment that also received the lowest irrigation (no pre-irrigation + 1 spring), with the highest being the fully irrigated treatment. The highest gross margin $/ha was the fully irrigated treatment, this was a trend seen throughout all season at the site, with the highest yield and gross margin return $/ha coming from the fully irrigated treatment that used soil moisture monitoring to schedule the irrigations. However, the highest returns $/ML came from the treatment that received that lowest irrigation water. Irrigated growers were shown tools such as soil moisture probes that can successfully identify the best time to schedule irrigations from a plant production aspect and this is a good strategy

when water is more affordable. The project also explored the economics of irrigating in different scenarios, this highlighted the importance of evaluating potential crop yields against achievable returns from irrigating. For example, in 2019 the project found that the fully irrigated treatment had a gross margin of $1,255/ha when valuing water at $60/ML but when using the market values of $500 for pre watering and $750 for spring irrigations this changed to -$1,516/ha.

Throughout this project technology was demonstrated, with soil moisture probes used at each KLS, and two KLS also have fully automated irrigation systems. These systems are able to be operated remotely or set to timers to remove the need for growers to operate the irrigation structures multiple times through the day and night. The advantage of these systems is the obvious advantage to reducing labour and also fatigue from changing structures at night. But also, because they change the water over when needed and not when the grower is able to get to the paddock, crops are irrigated more precisely saving on deep drainage, water logging, runoff all resulting in lower water use and higher yield. The disadvantage is the cost of the technology, this cost and also unfamiliarity of the technology results in slower adoption. Through two KLS sites the project was able to showcase the technology to irrigators removing this unfamiliarity and showing all the benefits that come from its use. Once adopted this automation has the ability to increase farm productivity by increasing yield and reducing water use, but also reduce production costs by reducing the labour required.

From the KLS and demonstrations growers are better able to assess the risks of irrigating crops in high water markets but also aware of potential opportunities to make money in dry years. Being able to assess each season and make sound irrigation decisions ensures growers are better able to capitalise on opportunities. Also knowing what tools are available such as soils sensors and how they can help make difficult day to day decisions will assist growers to maximise these opportunities.

3.3 Contribution to SIP2 program outcomes

This project targeted creating a more knowledgeable and skilled irrigation community with greater confidence in their ability to optimise irrigation performance. It achieved this by showcasing and demonstrating current best irrigation practise along with technology to enable irrigators to improve their operations. At one of the events held by the project, irrigators expressed that they gained knowledge in automation, irrigation sensors and control, digital farmer and how to reduce labour in irrigation (Appendix 6.5.9) with many indicating that they would investigate and/or implement automation after the event.

4 Collaboration

4.1 Project collaborations

Throughout this project the main collaboration has been with the four grower groups and NSW DPI, this collaboration has been through knowledge sharing with regards to grower groups seeking advice from each other and NSW DPI in how to best set up demonstrations this was particularly evident with CWFS leveraging the vast irrigation experience of ICC in helping set up irrigation demonstrations. Also, NSW DPI lending and assisting with the installation of soil moisture equipment. Throughout the project NSW DPI assisted with data collection at the SG site when it was deemed that the yield didn't warrant harvesting with commercial harvester, NSW DPI through their rice team had the expertise and experience to collect meaningful data that could help the KLS evaluate the demonstration. The project also benefited from having expertise in different forms of extension such as organising tours, social media this collaboration and ability to pool experiences was what enabled the project to succeed.

This collaboration would not have occurred without the project. The project also allowed for relationships to be built between the organisations involved. The involved organisations have seen the advantage of working together and would like to continue to do so in the future.

Outside of the Key Learning Sites Southern: Making the most of water project but within the wider Smarter Irrigation for Profit phase 2 project NSW DPI has also collaborated with University of Melbourne to assist in their Smarter Irrigation for Profit phase 2 project which is focused on reducing evaporation of water storages. This again created collaboration between two organisations that would not have occurred with out the project and has the potential to lead to future collaborations and work around increasing natural resource utilisation in agriculture.

The Key Learning Sites Southern: Making the most of water project also had some collaboration with an external GRDC funded project lead by Associate Professor Matthew Harrison from University of Tasmania. This project was developing an economic management tool to help growers allocate resources such as water in identifying the best ratio of different crops to be grown given certain input and commodity prices and grower expected yields. There was already some overlap with this project and the KLS project as three of the four Grower Groups were also involved in this project. But the KLS project was able to utilise one of their project contractors (RMCG) to evaluate the tool and provide independent feedback.

4.2 Recommendations for activities to support future collaborations.

The project team did not experience any difficulties in fostering successful collaborations, a key to this may have been that all organisations had a common goal and in working towards this identified their own strengths and weaknesses.

5 Extension and adoption activities

5.1 Project extension & adoption activities

Extension activities undertaken through this project include field days and crop walks as the main way of demonstrating work conducted at each KLS. The target audience for these extension and adoption activities was irrigators and to a smaller extent advisors. Through the project a total of eight field days were held and a total of 561 growers and advisors attended. The project also developed two short videos, one on double cropping in rice and another on the use of soil moisture sensors for scheduling irrigations. Also, a podcast discussing things to consider when irrigating a wheat crop and how to assess potential returns from the irrigation. The intended audience for these videos and the podcast was irrigators in an attempt to provide extra information around each of the topics discussed.

Another form of extension conducted by the project was a Northern NSW grower tour, this involved taking growers from Sothern NSW and Northern Victoria to Moree to attend the Gwydir Valley Irrigators Association Inc (GVIA) field day. Exposing growers to a different irrigation region and scale of operation. The opportunity to see different systems and technology being used in practice was a very valuable experience for all those that took part.

A novel component of the project was the inclusion of the 'Soil moisture network' website, a site that throughout the project made publicly available the live soil moistures of each of crops at each of the KLS and selected case study properties. The premise of this website was to make available live soil moisture data from each of the irrigation regions, so growers had access to data more applicable to their soil types. The data was not intended to identify when growers should schedule their irrigations but to give growers an idea of the type of information that came from soil moisture probes and educate on how to interpret the information with real data showing how it can be used in a beneficial way. A side benefit was as it was using real site-specific data it could be used to elude when soils were starting to dry out and growers should check their own paddocks. From the analytics (Appendix 6.5.13), it can be seen that there was a spike in early August of users to the website and the site received steady views through September which lines up with when many irrigators are Spring irrigating winter crops. There was a total of 333 users to the site with a total of 2,862 page views indicating that there is significant interest in soil moisture probes to help schedule irrigations.

5.2 Lessons learnt and recommendations for future extension.

The biggest factor for success of the extension activities within this project is the use of grower groups as the KLS. The two main reasons for this are that the grower groups have established extension networks and access to a large number of growers and they also have a rapport with their growers. Having this rapport with growers creates trust and as such growers were more open to the information/work that was being demonstrated.

Grower groups use face to face crop walks and field days as their main form of extending information. It was found through this project that this is still the single best way to engage and extend information to growers. Due to Covid-19 the project did try other forms of extension such as a virtual field day. As part of the virtual field day short videos were created which explained the trials and demonstrations that were being showcased and these videos were available to growers before the virtual field day. The virtual field day itself was a video conference and allowed researchers and the trial manager to discuss the work in further detail with an opportunity for attendees (growers and advisors) to ask questions at the end of each presentation. What was found is that few growers registered for the field day then have historically gone to the paddock field day, but also that the proportion of growers to advisors had changed to more advisors than growers attending. The largest change between the two was the amount of discussion had, attendees were less likely to ask questions at the virtual field day compared to the paddock field day, also due to the virtual format there was no grower-to-grower networking or peer to peer learning as would usually come from face-to-face meetings.

The project did try to run face to face paddock field days when able, in some instances resorting to covid safe field days which required the number of attendees and also the time growers and advisors were on site to be limited. This was more successful than the virtual platform and resulted in many more attending and questions more freely asked of the researchers, the downside again was the peer-to-peer discussion and learning was reduced due to time constraints. An important component of traditional field days is the social aspect and ability for growers to discuss different things that were demonstrated at the field day and it is important that this is facilitated as part of the field day.

Another learning came from the first grower tour, the project team had informal discussions with all participants on the bus on the last leg of the tour, most of the feedback was the same as responses in the survey completed (Appendix 6.5.9). However, it was evident that although information gained from the researchers who presented as part of the tour was good, at times it was at a to higher level for the growers who are more interested in what it means for them. Where the growers gained the most information was from listening to other growers and hearing personal experiences and being able to relate this to their own irrigation businesses and operations. It is this insight that leads to the conclusion that for researchers to better engage with growers, they need to better understand how the end user (irrigator) will be able to use the research in their business and how they can transition it into the business. Growers also have a greater repour with other growers and to an extent have more trust in other growers who also run a farm business and are more willing to take information from those that have tested the research in similar situation to what they will have to if they are to implement the research into their business.

6 Appendix - additional project information

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

6.1.1 Journal papers published/in preparation

6.1.2 **Extension materials** (guidelines, websites, videos, podcasts, reports, tools, economic case studies, fact sheets etc – *please provide links)*

6.1.3 **Extension activities** (workshops, field days, forums etc)

6.1.4 Media/social media activities

6.1.5 Intellectual property

Imagery should be high resolution (at least 5 megapixels), along with caption and credit information, and description for web accessibility requirements.

Nature of materials / activities	**Number**	**Details** (Please provide details if appropriate (eg links to publicly available documents)
Press releases		
Media appearances – press and TV		
Brochures, fact sheets, posters and newsletters		CWFS: two member newsletter articles, one introducing the project and a follow up of the field day the hosted. ICC: a members only article with early results. ICC-. Virtual Field Day. Trial videos, notes and virtual trade hall live ICC – Newsletters (x3). Updates on key learning site and other trials on Kerang trial block ICC - Trial Summary Booklet including results article from 2019 SIP2 demo Jan 21- August 21 Newsletters – reach 832 SIP2 report published in the CWFS newsletter IREC Farmers' Newsletter Spring Edition 206: "Field Station Report" & "The Benefits of Going Green Before a Summer Crop" https://irec.org.au/farmers-newsletter/ IREC Irrigation Research Update booklet- "Practical lessons learnt from the IREC Field Station" ICC Field day magazine. Available at: https://irrigatedcroppingcouncil.com.au/2021-spring-field-day/ Economic Case Studies

		Winter cropping irrigation scenarios. Irrigation water in dry years: sell, buy or apply? A supplementary irrigated wheat scenario, Central West, NSW The economics of irrigated dual-purpose winter crops shows stellar returns. Central West NSW Dual purpose irrigated canola ticks all the boxes Video - Farmer experiences- Double Cropping in a Rice System. Available at: https://smarterirrigation.com.au/double-cropping-in-a-rice-system/ Video - Alex Schultz and growers explaining soil moisture deficits and the use of soil moisture probes: https://smarterirrigation.com.au/soil-moisture-deficits-plant-available-soil-water/ ICC: 2021 summary report CWFS: 2021 summary report RMCG: Economic case study RMCG: Economic case study RMCG: Economic case study
Web page		http://murrayvalleysoilmoisture.site/ Launch of new ICC website including SIP2 page https://irrigatedcroppingcouncil.com.au/research/smarter-irrigation-for-profit-2/ 2020 report published on CWFS website. https://cwfs.org.au/wp-content/uploads/2021/09/SIP2-2020-report.pdf.
Field days, expos, field walks		IREC Field Day, 29 January 2020 – 90 attended CWFS Field day, 17 September 2019 – 50 attended SG Field Day, 13 July – 20 attended SG Annual Field Day, 17 September 2020 – 75 attended SG Grower Group, 9 October 2020 – 14 attended ICC Field Day, 26 September 2019 – 40 attended ICC - 24 September 2020. Virtual field day zoom meeting featuring Alex Schultz, Nick Poole and Damian Jones. - 32 attended. https://irrigatedcroppingcouncil.com.au/2020-spring-field-day/ IREC Field Day, 21 January – 110 attended SG Crop Walk 16th Dec 1920 – 14 attended SG Grower meeting, 15th June 2021 – 11 attended Southern Growers Covid safe field day showcasing the double cropping work done under SIP2 as well as moisture probes used on site. 86 growers/advisors attended. https://grdc.com.au/__data/assets/pdf_file/0032/568643/OIG-Finley-flier.pdf IREC Field Day, 19 January 2022 – 90 attended
Stakeholder forums, meetings, presentations, workshops, webinars		Alex Schultz discusses research into optimising irrigation timing - podcast, https://irrigatedcroppingcouncil.com.au/icc-podcasts/ https://pod.co/icc/how-do-we-use-data-to-make-irrigation-decisions
Social media presence		Life of project;162 dedicated SIP2 tweets and face book posts • https://twitter.com/CeRRF_Griffith

		• https://www.facebook.com/irecnsw/ • https://twitter.com/IRECNSW • https://www.facebook.com/CentralWestFarmingSystems/ • https://twitter.com/CWFS_Condo • https://www.facebook.com/irrigatedcroppingcouncil/ • https://twitter.com/IrrigatedCC • https://twitter.com/SG_NSW • https://www.facebook.com/southergrowers/ Audience reached by social media over life of project: Twitter: 190,519 Facebook: 14,560 Newsletter and email: 6,192
Scientific conference presentations		

6.2 Appendix 2 – Project reports and case studies

6.2.1 Irrigated Cropping Council 2019 trial

Irrigated Cropping Council
Promoting irrigated agriculture

Best Value for Your Water Trial 2019

KEY MESSAGES

If you had allocation available in 2019, broadleaf crops returned the best gross margins when fully irrigated while the cereals had the best returns with no pre-irrigation and a single spring irrigation.
If you cost water at the opportunity cost or purchase water, then only one of the many crops, varieties and irrigation strategies broke even.
If you decide to irrigate, the crop must be irrigated when it needs it in order to maintain yield potential. Delaying irrigation could result in lost potential that cannot be recovered by late irrigation.
When reducing the number of irrigations in wheat consider long-season varieties, under no pre-irrigation BS Bennett (Late) performed best with Beckom (Mid) performing best when pre-irrigating and using one spring and Cobra (Early-Mid) top performer under full irrigation.
Reducing irrigation by not pre-irrigating can have several negative agronomic consequences such as weed control, nutrition uptake and poor establishment.
As with any trial results, treat one years' worth of data with caution. 2019 had favorable breaking rains and above average to average rainfall for the first 3 months at Kerang. If the break was poor or delayed, the results may have been different.
There are many ways to value water and so the gross margins provided are for a certain set of circumstances – your situation will be different to that used in this report.

SUMMARY

Pre-irrigation assisted with better establishment, plant vigour and weed control.

Despite above average rainfall for May and average for June and July, the soil moisture did not improve below 200mm. This also saw a period of soil moisture stress in mid June which affected crop nutrition and vigour.

As the season progressed and rainfall dropped to below average, the developing crops quickly depleted soil moisture. No pre-irrigation treatments were irrigated on August 23rd and used a slightly lower volume of water than the pre-irrigated treatments in autumn. These pre-irrigated areas also needed irrigation soon after on August 30th thanks to the vigorous crop growth.

Maturity made little difference in yields in either the barley or canola. Maturity did affect yield in the wheat, with the late maturing DS Bennett having the highest yield in both no pre-irrigation treatments, mid-season Beckom having the highest yield in the 'pre-irrigation + 1 spring' and Cobra, early mid maturity, the highest yield in the 'pre-irrigation + full spring' treatment.

BACKGROUND

Low or no allocations in the past few seasons has seen water availability decline and is reflected in higher prices in the water market.

The aim of the trial was to look at irrigation strategies more suited to seasons of low or zero allocation and the resultant high prices for temporary water.

Some degree of crystal ball gazing is required when planning for the irrigated winter crop season. Pre-irrigation can use high volumes of water that may prove wasted or at the worst have negative impacts with poor crop establishment, poor weed control and difficulties with N management if rain falls around sowing.

6.2.2 Irrigated Cropping Council 2020 trial

6.2.3 Irrigated Cropping Council 2021 trial

2021 Smarter Irrigation for Profit 2

Irrigation Timing Demonstration

Summary

The demonstration was established to test the yield and grain quality of wheat to various irrigation scenarios. The demonstration was pre-irrigated in April 2021 and this avoided the 'winter drought' that affected the results in 2020.

Overall irrigation did improve yield and grain size, more frequent irrigation resulted in higher yields but not necessarily greater profit (dependent of whether water or hectares are the limiting factor) and the 'no spring irrigation' treatment yielded surprisingly well given the water received.

Moisture stress prior to booting did reduce yield potential, although this loss of grains was compensated by increased grain size.

Objective

Demonstrate the effect of timing and quantity of irrigation water on wheat yield and grain quality.

METHODS

Table 1. Method summary

Sowing Date	12th May
Target Plant Population	160 plants/m^2
Seeding Rate	Scout @ 91 kg/ha based on TGW*
Irrigation	9 April 1.5 Ml/ha All treatments
	27 August 0.9 Ml/ha Timing based on SMM@
	7 September 0.9 Ml/ha Booting Timing
	17 September 0.9 Ml/ha Timing based on SMM@
	24 September 0.9 Ml/ha Flowering Timing
	8 October 0.9 Ml/ha Timing based on SMM@ plus late Flowering Timing
	160.4mm GSR (April – October) Decile 2
N application	13 July 95 kg N/ha 10 August 55 kg N/ha
Harvest	7 December
Average Yield	6.7 t/ha

*: Thousand Grain Weight. @ Soil Moisture Monitoring equipment reading 60-70 kPa

Methodology

The wheat variety Scout was selected as a high yielding variety under irrigated conditions.

Demonstration design and randomisations were produced via DiGGer software. Plot size was 5m by 20m.

6.2.4 Central West Farming Systems 2019 trial

CWFS – 2019 trial results.

Phase two of the ***Smarter Irrigation for Profit*** project is also funded from the Department of Agriculture, Water and the Environment's Rural R&D for Profit program.

This project aims to address the challenge of reduced water availability by improving the water productivity of Australian cropping and pasture irrigators, through developing new precision irrigation technologies, improving existing technologies and facilitating faster uptake through producer led demonstration sites. Phase one of the project found participating Australian irrigators could achieve a 10-30 per cent improvement in water productivity by adopting precision irrigation technologies.

2019 – another challenging year! Dry conditions and expensive water set the scenario for this project in 2019. This site ran the scenario of an irrigator that did have enough allocation for a pre-sowing irrigation and one in-crop, budgeting on 3 ML/ha total water use. The main question asked by this demo was: should I sell my temporary water, sow a wheat crop for hay or take it all the way through to harvest? In this demonstration we also looked at 12 different wheat varieties with a mix of phenology and three sowing dates. Due to a growing season rainfall of just 63 mm, the pre-sow and in-crop irrigations were the only significant water the site received in 2019. Soil moisture sensors were installed to monitor water use, and in a better year, would have been used to help schedule irrigation events.

Site information
Soil type: brown/grey vertosol
Irrigation system: border check (flood)

Time of sowing X variety demonstration
Varieties:

Bolac	LongReach Kittyhawk
Condo	LongReach Nighthawk
DS Bennett	LongReach Trojan
DS Pascal	Longsword
EGA Wedgetail	RGT Accroc
Illabo	Scepter

Sowing dates: 10th April, 24th April and 15th May 2019

Soil moisture monitoring
Figure 1 and Figure 2 below show the soil moisture from July to November 2019. The spike in the graphs represents the flood irrigation event and is expected to be around the soils 'full' point. Figure 1 shows the soil moisture broken down into 10 cm depths and Figure 2 shows the total soil moisture. This technology is vital in irrigation systems to help schedule irrigation events to prevent over watering or moisture stress due to delays in irrigation. This technology also has a place in dryland farming systems, however, this technology is still seen as cost prohibitive by dryland growers.

6.2.5 Central West Farming Systems 2020 trial

Smarter Irrigation for Profit 2020 demonstration activities

About the research

Figure 1: *TOS2 emerging*

How to get the best dollars returned per hectare, considering physical delivery of water was not promised past 31 March 2020 in the Lachlan Valley. The main questions being asked by the 2020 demonstration activities were: If I plant long season crops early and grazed them, what income could be generated? What is the best grazing strategy, what crop type would be the best choice between canola and cereal or would I have been better off selling the water in March?

Figure 2: *Checking moisture sensors in the fog*

The demonstration was designed incorporating four crop types – Hyola 970CL canola, La Trobe barley, DS Bennett wheat and LongReach Kittyhawk wheat with three crop outcomes – grain only (nil graze), biomass only (hard graze, terminated October) and grain and graze (light graze) with two times of sowing (TOS) – TOS1 13th March and TOS2 20th April 2020.

The site received 247 mm 1/1/20-12/3/20 limiting the need for end of March irrigation.

For additional site details see Appendix.

6.2.6 Central West Farming Systems 2021 trial

Smarter Irrigation for Profit 2021 Report

1.0 Background

Smarter Irrigation for Profit (SIP) project was commenced in 2019 by Central West Farming Systems (CWFS) (with funding from Grains Research and Development Corporation, GRDC and the Department of Agriculture, Water and the Environment, DAWE). This project aimed to improve the capability of growers and maximise the profit for irrigators in each of the farming systems regions with a timeframe of 3 years and included 2 phases.

Smarter Irrigation for Profit Phase 1 focussed on improving the water availability for participating Australian cropping and pasture irrigators by adopting precision irrigation techniques.

Smarter Irrigation for Profit Phase 2 was a partnership between the irrigation industries of sugar, cotton, grains, dairy and rice, research organisations and farmer groups and incorporated three key areas of work:

- Developing new and innovative irrigation technologies.
- Optimising the benefits of autonomous irrigation.
- Closing the productivity yield gap via best practice irrigation extension

1.1 2019 Recap

In 2019 CWFS established a demonstration site at The Fettell Centre, Condobolin which involved 12 different varieties of wheat and were assessed against their crop type, grazing treatment and sowing time along with the establishment of a small seed rate demonstration plot. However, due to the 2019 drought, the project could not be carried out to its full capacity although results showed that irrigators could achieve a 10%-30% improvement in water productivity by adopting precision irrigation techniques (GSR: 1 April – 31 October 2019). With Condobolin receiving just one-third of its long-term annual rainfall and less than one-third of its long-term growing season rainfall, this outcome was quite promising.

1.2 2020 Recap

The dry conditions in the Lachlan Valley over 2020 were challenging when trying to determine the best dollars returned per hectare considering the lack of available irrigation water. The main questions being asked by the 2020 demonstration activities were: *If I plant long season crops early and grazed them, what income could be generated? What is the best grazing strategy? What crop type would be the best choice between canola and cereal? Or would I have been better off selling the water in March?* With livestock prices remaining high, the strategy of maintaining livestock production for those growers who still had stock would have been a priority, hence the direction of the project in 2020.

In response to this, CWFS' demonstration incorporated four crop types – Hyola 970CL canola, La Trobe barley, DS Bennett wheat and LongReach Kittyhawk wheat with three crop

Australian Government
Department of Agriculture, Water and the Environment
This project is supported by funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program.
CRDC
AGRICULTURE VICTORIA
AgriFutures
CSIRO
Dairy Australia
GRDC
GVIA
NSW Department of Primary Industries
sfra
tia
SYDNEY

6.2.7 AgEcon – Irrigation water in dry years: sell, buy or apply? Case study

Smarter Irrigation for Profit
PHASE II CASE STUDIES

Irrigation water in dry years: sell, buy or apply?

A supplementary irrigated wheat scenario, Central West, NSW.

KEY MESSAGES

- A seasonal analysis of the temporary water market during a recent period of research showed a gross margin of $319/ML could be achieved if water were sold at a market average price.
- Hay prices and hay production need to exceed the dual economic thresholds of $500/t and 4.5t/Ha respectively, before planting the crop became the preferred option to selling water.
- A sensitivity analysis of purchasing additional 1.5 ML/ha water, assuming a hay yield response of 2t/Ha found Return on Investment was very sensitive to water buy price.
- Central West Farming Systems (CWFS) wheat variety trials found a wide variation in crop yields and suitability of cultivars. Wheat variety selection can help mitigate production risk and firm up crop revenues and subsequent water gross margins.

About the research

Smarter Irrigation for Profit Phase 2 (SIP2) is a partnership between the irrigation industries of sugar, cotton, grains, dairy and rice, research organisations and farmer groups. The aim of the Key Learning Sites, SIP2 project is to optimise the limited availability of water resources to obtain maximum dollars per mega litre across a range of irrigated cropping systems. The information in this case study is taken from the Central West Farming Systems (CWFS), managed site at Condoblin[1].

Central Region, NSW - High water spot prices vs application for hay production

In many years hay can outperform grain in gross value per hectare. This is particularly relevant when crops have some bulk but lack the moisture to attain high yields of grain. Droughts can result in a scarcity of input resources such as irrigation water, and reduced availability of broad acre crop commodities – often relied upon by livestock operations and feedlots to keep their businesses running. In doing so, markets for hay can be inflated to unusual levels, where the decision maker with access to some irrigation water is faced with alternative options. Under this scenario, an economic and risk assessment can inform decisions to optimise the return from water and take advantage of atypical market conditions.

A partial budget approach: irrigated grain / hay production v selling water.

A useful approach for assessing the benefits and costs involved in changing from one irrigation practice to another, is a Partial Budget method. A Partial Budget is a technique used to assess the likely value of introducing a new activity by comparing it with the existing situation. Put simply, you are comparing the extra costs and returns of the new activity with those of the present activity. When investigating these scenarios, the crop Gross Margin (GM) is calculated to identify the contribution the activity

[1] https://smarterirrigation.com.au/industry/grains/

6.2.8 AgEcon – When to irrigate? Case study

Smarter Irrigation for Profit PHASE II
FACT SHEET | GRAINS

When to irrigate? Assessing economic costs and benefits

Winter cropping irrigation scenarios, Northern Victoria

KEY MESSAGES

- Pre-irrigating is a key factor to achieving high per mega litre and per hectare returns for barley, faba beans and canola.
- Irrigation of wheat at booting during late winter produced the highest Gross Margin and optimal use of water.
- Wheat is the most likely crop to offer high per mega litre returns during atypical market conditions during drought years under static input price and yield assumptions.
- Irrigated Cropping Council winter crop variety trials report a wide variation in yields and suitability of cultivars. Crop variety selection can help mitigate production risk and firm up crop revenues and subsequent water gross margins.

About the research

Smarter Irrigation for Profit Phase 2 (SIP2) is a partnership between the irrigation industries of sugar, cotton, grains, dairy and rice, research organisations and farmer groups. The aim of the Key Learning Sites, SIP2 project is to optimise the limited availability of water resources to obtain maximum dollars per mega litre across a range of irrigated cropping systems. Led by growers the SIP2 project is supporting sites in the Lachlan, Murrumbidgee, and Murray valleys. The information in this case study is taken from the Irrigated Cropping Council (ICC) managed site at Kerang (Vic) [1].

Pre-irrigate or wait until spring: a partial budget approach?

A useful approach for assessing the benefits and costs involved in changing from one irrigation practice to another, is partial budgeting. A Partial Budget is a technique used to compare the extra costs and returns of the new activity with those of the present activity. When investigating these scenarios, the crop or water Gross Margin (GM) is calculated to identify the contribution the activity makes to farm total GM. For this case study a custom-built GM model for the ICC growing region around Kerang was used.

Using ICC data, the economics of irrigation and winter crop species were assessed for crop yield and profitability under various irrigation treatments. Irrigation water values at the time of sowing (Feb-Apr) were much higher than the nominal $60/ML used to value the variable costs to licence holders to apply the water to field. These inputs were tabled into the decision matrix, along with market values of growing costs to generate a crop and water GM. Pre-irrigation was included in all optimal GM returns, except for wheat. For wheat irrigation at booting offered strong GM returns[2]. in both 2019 and 2020 years. In the latter wheat experiments, a wide variation among spring irrigation treatments and wheat varieties occurred (not included in this report). This initial analysis is summarised in Table 1.

[1] https://smarterirrigation.com.au/industry/grains/
[2] https://irrigatedcroppingcouncil.com.au/research/smarter-irrigation-for-profit-2/

6.2.9 Northern and Southern Tours report

Smarter Irrigation for Profit PHASE II

Northern and Southern Tours Report

Smarter Irrigation for Profit, Key Learning Sites Southern: Making the most of water

Objective:

To increase irrigators knowledge of other irrigation areas while also increasing exposure to irrigation researchers, techniques and technologies not usually see in local areas, with the goal to increase the adoption of technology and capabilities of individual irrigation businesses. The tours also aimed to expand grower opportunity to network with other growers and increase awareness of other industries and how different growers in these industries/districts have overcome issues to prosper.

Tour 1, Northern Tour:

Overview:

The first tour of the project was a three day tour departing Griffith on the 9 February 2021 traveling north towards Moree stopping at University of Technology Sydney (UTS) facility just north of Narrabri. At the UTS facility the tour was shown through the wheat breading facility with a focus on drought and heat tolerance work, also shown was the CSIRO cotton breading work and a run through how the site has implemented their digital farm tech with Goanna and LoRaWAN across the facility. Day two was a large day starting with the GVIA field day to see how farm automation has been integrated into a large irrigated cotton operation, hearing first hand from different growers there experiences, as well as many technology providers showcasing what they have to offer. After lunch the tour travelled to Deer Park another large scale irrigation operation, were the farmer (and NSW Irrigators' Council chairman) gave a farm tour discussing siphon-less design and personal experience as well as explaining to the group some of the local challenges around water availability which shapes how they farm. The tour then travelled to a pecan development East of Moree, again for a farm tour learning about the development of the farm and the reason for its location. The Final Day saw the tour traveling back to Griffith via 'Burrima', a privately owned property in the Macquarie Mashes, the aim of the owners is for restoration and conservation and also to provide wider access into the mashes. (see Figure 2 for itinerary and Figure 1 for map of tour). A total of 23 people joined the tour comprising of both irrigators and irrigation advisors.

CRDC

6.2.10 RMCG – Draft Economic case study – Investing in overhead precision drip irrigation systems

RMCG

Smarter irrigation for profit – Economic analysis.

DRAFT

6.2.11 RMCG – Draft Economic case study – Investing in fast flow pipe and riser systems with Automatic outlets

Smarter Irrigation for Profit
PHASE II CASE STUDIES

RMCG

Smarter irrigation for profit – Draft case studies.

Overview

The purpose of this project was to undertake an economic analysis of investments in new farm irrigation systems and upgrades. The assessments focused on three key areas.

Performance

- **definition** – changes directly attributable to the infrastructure changes, including production changes and technical performance (of the infrastructure). Also includes factors that contribute to those changes, such as labour efficiency, water and resource use, production costs, outputs (e.g. harvest), etc.
- **measure used** - ratio of the net costs of physical inputs to physical outputs.

Return

- **definition** - the economic performance of a system over a defined period of time
- **measures used**
  - **Net Present Value (NPV)** - the sum of future cashflows (positive or negative) over the life of an investment that are discounted to represent their present value.
  - **Internal Rate of Return (IRR)** - the discount rate that would make the NPV zero. This can be used to compare the returns of one investment with another.
  - **Return On Assets (ROA)** – the ratio of the average annual extra profit (excluding capital gains from land or asset appreciation) to the value of the investment itself. Return on assets indicates how efficiently resources are being used and managed and is an indicator of the attractiveness of an investment.

Risk

- **definition** - the fluctuations in economic performance over a period of time as a result of business risk and financial risk
- **measures used**
  - **Business risk** - fluctuations in:
    - production (climate, pests, genetic variation and disease);
    - prices (in commodity and input prices); and
    - institutional settings (legislation that impacts production including marketing, and environmental regulation).
  - **Financial risk** refers to the variability in returns to owner's equity resulting from meeting interest charges, financial obligations or from servicing debt. Financial risk is a direct result of gearing, the higher the proportion of debt to total capital, the higher the financial risk.

DRAFT

CRDC AgriFutures GRDC

6.2.12 RMCG – Draft Economic case study – Investing in new block with fast flow pipe and riser system with automatic outlets

RMCG

Smarter irrigation for profit – Draft case studies.

DRAFT

Overview

The purpose of this project was to undertake an economic analysis of investments in new farm irrigation systems and upgrades. The assessments focused on three key areas.

Performance

- **definition** – changes directly attributable to the infrastructure changes, including production changes and technical performance (of the infrastructure). Also includes factors that contribute to those changes, such as labour efficiency, water and resource use, production costs, outputs (e.g. harvest), etc.
- **measure used** - ratio of the net costs of physical inputs to physical outputs.

Return

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  - **Internal Rate of Return (IRR)** - the discount rate that would make the NPV zero. This can be used to compare the returns of one investment with another.
  - **Return On Assets (ROA)** – the ratio of the average annual extra profit (excluding capital gains from land or asset appreciation) to the value of the investment itself. Return on assets indicates how efficiently resources are being used and managed and is an indicator of the attractiveness of an investment.

Risk

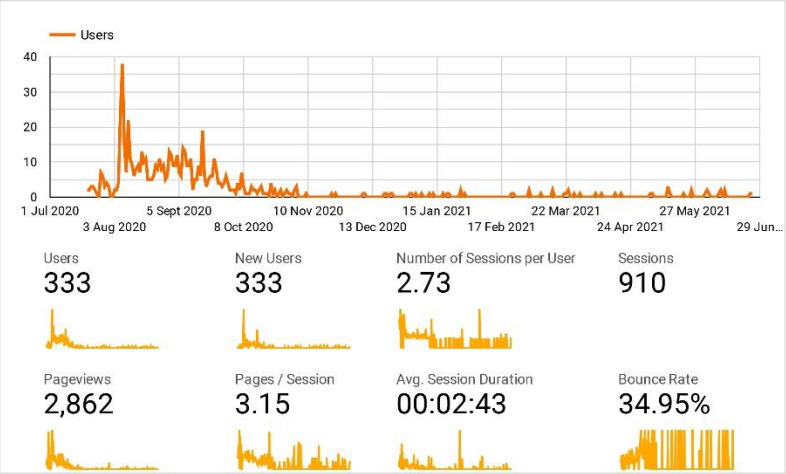
- **definition** - the fluctuations in economic performance over a period of time as a result of business risk and financial risk
- **measures used**

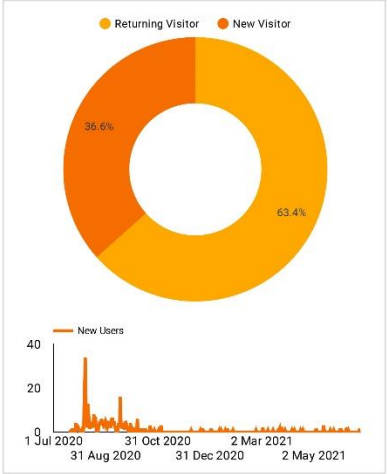
6.2.13 Analytic graphic report for 'Soil sensor network' (1 July 2020 – 30 June 2021)

Google Analytics Audience Overview

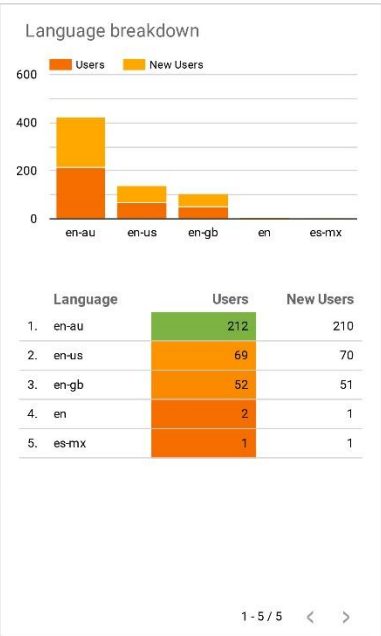
Continent | Region: N... (5) | Channel | Device | 1 Jul 2020 - 30 Jun 2021

Your audience at a glance





Let's learn a bit more about your users!

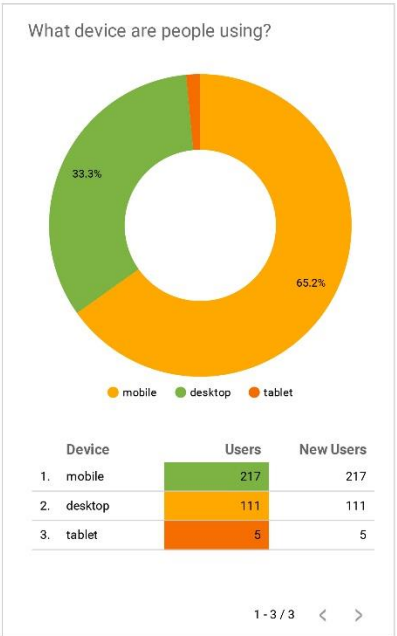


	Language	Users	New Users
1.	en-au	212	210
2.	en-us	69	70
3.	en-gb	52	51
4.	en	2	1
5.	es-mx	1	1

1 - 5 / 5

	Continent	Users	New Users
1.	Oceania	333	333

1 - 1 / 1



	Device	Users	New Users
1.	mobile	217	217
2.	desktop	111	111
3.	tablet	5	5

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