

Summary of Achievements

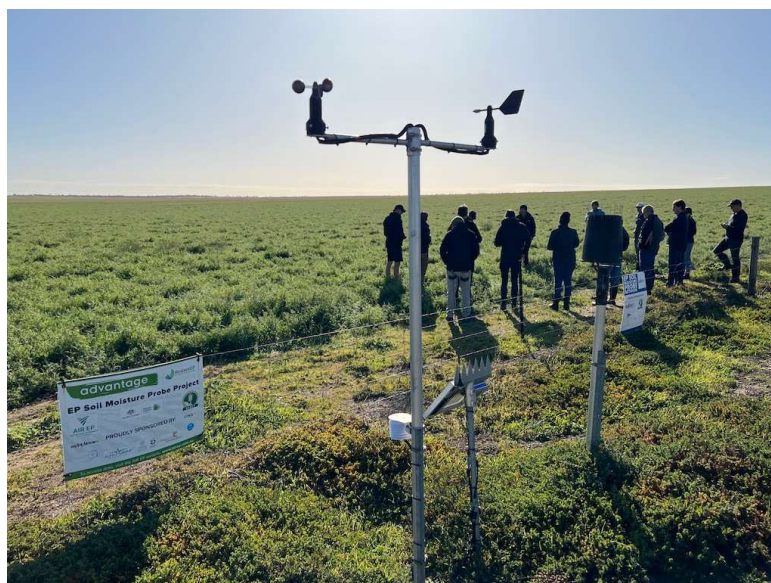
Relationships

A strong feature of the project has been the strengthening of relationships between farmers, consultants and researchers. Feedback from engaged farmers and case studies of impact on focus paddock host farmers showed that this interaction provided the basis for a deeper appreciation of how a better understanding of plant available water and the role (and limitations) of forecasts can improve decision-making around crop and fertiliser management for optimal yields.

Engagement and communication

Project awareness was communicated broadly through the region through the AIR EP Newsletter, dedicated website and social media as well as an internal project newsletter called 'The RIG Report' to update those most closely involved with what was happening and coming out of the project. Bi-annual RIG meetings provided a very effective opportunity for interaction with researchers and developing mutual understanding around soil water management. Broader messaging in relation to taking action was dependant on the findings from the project trials, with limited data available in the early to mid-stages of the project – momentum in this area increased in the final year. Project outcomes will continue to impact on available information and advice and inform future projects and communication to farmers.

Discussion groups around the eight validation sites (focus paddocks) proved to be very effective in stimulating interest and discussion around soil moisture and crop management. The EP Innovation tour to validation sites which involved key farming systems scientists and advisers from across Australia was viewed as a very successful way of bridging the gap between farmer and research knowledge, and the Nitrogen Workshop was described as 'one of the best conversations that has ever been had about our biggest [cropping] input - nitrogen'.



Innovation Tour, Wharminda focus paddock site, August 2022

Research and development

While the intended development of the soil water sensor network did not proceed in the way that was initially envisaged due to technology limitations related to sensors and calibration requirements, the work undertaken was seen to have been successful in improving understanding and use of probes, as well as the challenges and limitations associated with them.

A working product for data visualisation was co-designed and refined by researchers, RIG members, and the product developers. The validation sites were assessed as having added significant value to the project in improving the understanding of technology integration in farming practices and the use of soil moisture probes to make informed decisions. The climate risk team was seen to have successfully supported and liaised with others in the project to improve how climate risk and seasonal forecasts are communicated and understood.

Summary of achievements - planned project outcomes/outputs and achievements against these

Planned Outcome/Output	Extent of Achievement	Comments
Improved understanding of climate risks	Moderate	The project helped participants to understand the climate factors that posed risk to their farm businesses and some steps that could be taken to minimise these.
A better understanding of seasonal climate forecasts	Moderate	Despite some of the forecasts not being consistent with actuals over the course of the project, exposure to climate forecasts, resources and expertise increased the grower understanding of the influences and most effective use of forecasts.
Improved decision making on cropping and grazing management in relation to soil and water.	High	The trials and discussions around plant available water, the role of soil moisture probes and climate forecasts provided a better understanding in engaged growers around the amount and timing of N, control of summer weeds and choice of crops and rotations – as well as the benefits of variable rate application.
Improved profitability	Moderate	Improved decision making around soil moisture and use of N was shown to have a significant impact on optimal productivity and hence profits.
Famers and advisers engaging to work together	High	The RIG approach was a significant factor in the effectiveness of the project and in pioneering how stakeholder input can maximise benefits from projects.
Increased social capital in the EP Farming system	High	All of the different stakeholder groups strengthened their networks, understanding, and social and technical resources for ongoing improvements to their farm and social resilience.
Communications strategy	High	There was good use of communication medium for external and internal stakeholders. The discussion groups proved very effective for those more closely engaged – there was a recognition that there was a need to even

		better communicate with the broader grower group networks.
Regional Innovators Group (RIG)	High	As above, the RIG was made up of regionally based growers, consultants, and researchers and provided a very effective mechanism for adaptive management.
Field Days/walks at trial sites	High	There were a number of field walks and discussion groups around the host farms with positive feedback about the value from participants.
Decision Support Tools developed/improved	Moderate	CSIRO assisted with the analysis and quality assurance of plant available water characterisations and refined APSIM outputs for the Eyre Peninsula and made them available for project use via Yield Prophet.
Review of soil characterisation	Moderate	As above, soil sampling at all probe sites undertaken to determine crop lower limits.
Soil water probes improved	Moderate	Probes outputs were found to be limited in some soil types and summers readings needed calibration to account for warmer temperatures. CSIRO tested a range of methods for extrapolating soil moisture probe data away from the probe location at paddock and potentially farm (and regional) scale. Strength of relationships between soils, PAW, rainfall and probe signals investigated to test reliability of probe signal to soil moisture. Regional gaps in soil moisture probes were identified by the CSIRO and in some instances filled.
User-friendly/mobile application for soil moisture data display	Moderate	Square V delivered a working product that was co-designed and refined multiple times based on RIG feedback – a large amount of time was spent trying to triage data issues caused by the probe hardware. Available on https://probes.airep.com.au/
Maps of production risks based on available soil moisture and production risk.	At farm level	Plant available water (PAW) data used in digital soil mapping to predict PAW across three focus farms at the paddock and farm level. Early project attempts to produce regional real time PAW maps proved to be too difficult due to lack of data.

The project made several significant contributions towards improved understanding and soil management. These are summarised below:

Use of soil moisture probes: Stakeholders reported that the research has helped to better understand the benefits and limitations of using soil moisture probes and resulted in increased accuracy (reduced error to around 20-30mm) of stored water available to plants. Yield Prophet reports, and paddock meetings have increased grower understanding.

Mapping soil moisture: The project aimed to map plant available soil moisture across the landscape and while it did not achieve this project goal, it provided valuable learnings about the limitations and capabilities of available technologies, as well as highlighting the complexities of landscape and farming systems and the importance of understanding paddock variability when making decisions. Techniques for mapping plant available water at the paddock and farm were tested and provided significant direction for future research. The project was seen to have been beneficial for growers and advisers, in lower rainfall areas, “changing their perspective on what they can achieve.”

Formalized management processes, including PAW maps, have been implemented, including some equipment changes. Adjusting inputs into APSIM have resulted in more accurate Yield Prophet® predictions for the region, critical for tracking production potential throughout the growing season.

Improved soil management: Project research has contributed to improved soil and water management on farms, enabling more informed conversations and decision-making about sowing time and techniques, fertilizer rates, and weed management. It has given farmers greater confidence in making decisions about crop management and monitoring plant available moisture throughout the growing season.

Local Soil Characteristics: An additional 31 soils were characterised across the region which have contributed to the understanding of plant available water. While there are still unanswered questions, the project has contributed valuable information about soil characteristics in the Eyre Peninsula, soil types, reducing expenses on less reliable zones in the paddock and helped farmers understand the impact of soil constraints and reduced rainfall on soil moisture.

Improved understanding of climate risk and seasonal forecasts: The project has led to an improved understanding of climate probabilities, forecasting, and the use of tools including Yield Prophet reports. The impact of climate change on plant available water is better understood, and in-season climate information is being used to inform on-farm decisions. There is also an increased understanding of climate drivers and the available models to aid in decision making.

Improved relationships: The project's structure and the involvement of growers, consultants, and researchers from the onset, was seen as one of the strengths of the project. It was agreed to have successfully linked these different groups across the Eyre Peninsula, bringing them together to discuss regional issues and exchange knowledge. This base is an important one to continue on-going momentum towards achieving the longer-term goals of the project.

Decision-making: The project's goal to improve decision-making and nitrogen management in crops was also seen to have met with some success. Moisture probes were reported to have helped farmers make decisions about efficient fertilizer use and gain a better understanding of their soil characteristics and plant available water. After three years of accumulated data across the Eyre Peninsula, farmers interviewed are more confident in their sowing decisions and have made a good start toward determining potential yield using plant available water data from the probes.

Researcher capacity: From a researcher perspective, the continuity of meetings across the three years was acknowledged as "rare" and "extremely valuable" in discussing weather conditions and forecasts. Challenging growing seasons during 2020 and 2021 also highlighted the importance of using imperfect forecasts and communicating results more effectively.

Capacity, practice change and on-farm Impacts

A strong feature of the project has been the strengthening of relationships between farmers, consultants and researchers. Feedback from engaged farmers and Farmer Case Studies of impact on host farmers for trials showed that this interaction provided the basis for a deeper understanding of how a better understanding of plant available water and the role (and limitations) of forecasts can improve decision making around crop and fertiliser management for optimal yields.

RIG members reported having a better understanding of where current research got to and of farmers' perspectives and the benefit of everyone coming together into one room and provided a platform for discussion. It was seen to have provided opportunities for researchers to directly engage with farmers on the Eyre Peninsula. Although seen as very successful in engaging and providing useful information to those directly involved, its impact on a broader constituency *remains to be seen*.

Improved understanding and decision-making

Stakeholders interviewed as part of the final project evaluation overall believed the project had been quite successful in terms of improving decision making in relation to improved understanding of plant available soil water reserves. RIG members in the final workshop reported a number of impacts of the project on their own decision-making including expanding thinking on what wheat yields were possible; better linking soil moisture to projected yields; altering rotations; better understanding of the limits of extrapolation from a single probe; making decisions around summer weed control; finding the ‘sweet spot’ for nitrogen decisions; and increased use of variable rate application and technology.

The farmer case studies provide real examples of where the project and its activities have impacted on individual growers. The table below captures the key features of the cases and the impacts on the producers involved. The cases show how involvement in the project validated some current practices, strengthened understanding and lead to confidence and improved practices around variable rate, nitrogen use and reducing risk in crops.



End of project farmer case studies

Case Study	Impact on awareness and understanding	Impact on decision making
Variable rate inputs on variable soil types based on yield potential		
<p><i>Using moisture probes to understand and manage soil variability across zones, paddocks and whole of farm, to mitigate risk.</i></p> <p>Bruce Hedde's 1600 hectare cropping focus</p>	<ul style="list-style-type: none"> Understanding the variable plant available water capacity (PAWC) across zones within his paddock has been beneficial with the use of VRT to optimise inputs. With the added knowledge of PAW and use of technology such as the soil moisture probe, yields can be optimised in season. The EPAG Research team were seen as thorough and disciplined in their process and Bruce places significant value on this data as a resource. He reported that conversation at farmer group meetings held at the site had been engaging and free flowing with people interested to see what comes of the two replicated trials. He feels the 	<ul style="list-style-type: none"> The Resilient EP project has served to validate his strategies. His move towards variable rate is happening concurrently with the Resilient EP project trial, “not necessarily as a result of it.” - the only major changes being towards variable rate, which have been in response to the zones.

Case Study	Impact on awareness and understanding	Impact on decision making
<p>and livestock – on-farm trial with project – had an existing soil moisture probe</p>	<p>region is gaining a better understanding of the role and limitations of soil moisture probes.</p>	
<p>Variable rate technologies across variable soil types and sustainability impacts</p> <p>Todd Mathew’s 6500 hectares mixed enterprise cropping peas, lentils, canola and barley as well as running sheep – on farm trial on 180 hectares where there is a high level of variation in yield.</p>	<ul style="list-style-type: none"> • The main value Todd has gained from his involvement in the project has been a result of the protein machine installed. While this was not the anticipated outcome, it has been worthwhile, and he has gained an added layer of data across his paddocks. • Todd has a better understanding of soil moisture and when to push more inputs, accounting for deep N levels. • Todd believes this project is contributing to improved understanding about soil constraints, different soil types and variability within paddocks and across farms. He said most growers in the district have visited his paddock and had in paddock discussions about nitrogen, which he believes will impact their nitrogen decisions. 	<ul style="list-style-type: none"> • His involvement in the Resilient Eyre Peninsula project has also given him confidence to use variable rate technologies on his farm. • From an environmental perspective he said this knowledge “helps in making more informed decisions and making sure we are efficient.” He is hopeful that as a result of his involvement he has locked in some higher yields.

Pushing the Benchmark

<p>Pushing the Benchmark</p> <p>Kerran’s farm 6500-hectare mixed farming enterprise, cropping 4500 hectares and running between 2500 and 4000 Merino sheep - deep N trials across his paddock and the impacts on input costs and yields.</p>	<ul style="list-style-type: none"> • just starting to get results in terms of understanding nitrogen levels and soil available water to the plant, but suggested more time is needed to understand how that is driving yields and how the nitrogen is cycling through a whole rotation. He said, “while we are always building a better understanding, I feel like we’ve got a lot more to learn”. • He believes the results will be closely looked at locally, as a lot of growers are seriously looking at their systems and how much it is costing to put crops in. 	<ul style="list-style-type: none"> • Kerran will be looking at how he can use learnings from the harvest of nitrogen test strips to plan nitrogen inputs more broadly. • He said, “if we can get some good data out of this, and I think it’s going to be, then there will be more uptake of variable rate technology to better match nitrogen inputs and be more cost effective. People will see the benefit if they can see the results in the data.”
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Stored soil moisture, yield potential and how to mitigate risk

<p>Understanding stored soil moisture</p> <p>Paul Schaefer’s 4,500 ha property livestock as well as barley, canola, vetch, lupins and medic</p>	<ul style="list-style-type: none"> • The level of information available from the moisture probes was described as unexpected and its value has been “really excellent.” In the past he did not often make changes to set plans, whereas now armed with this type of information he would “base rotations on the moisture available rather than just a guess.” Previously, Paul said he had been caught out, letting pasture die off. He explained that having the two probes on paddocks, side by side, has shown that a wheat crop once it is ripe, stops using moisture, but the 	<ul style="list-style-type: none"> • The moisture probes have given Paul confidence to do summer weed control, knowing that money spent on summer spraying is beneficial. He explained that after spraying a paddock and reviewing the probes data, several days later, he can see moisture has stopped draining out the soil profile. The moisture probes have given him
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Case Study	Impact on awareness and understanding	Impact on decision making
<p>pasture rotations – on-farm mixed farming trial</p>	<p>pastures can continue draining moisture for a long time, sometimes into January, which means a lot of moisture is needed to recharge the system.</p> <ul style="list-style-type: none"> Paul is more likely to spray pastures out earlier, even if there is some feed left, to conserve moisture. “This was something that we thought we knew we needed to do but didn't do as much as we should have in the past,” he said. 	<p>confidence to make these decisions.</p> <ul style="list-style-type: none"> In terms of long-term planning, Paul is hoping to re-introduce canola back into his system after not sowing it for several years. He explained canola had generally been a risky crop in the region and has not been a huge part of his rotations. With the data from his moisture probe, he now has the confidence pre-sowing, to better understand available soil moisture.
<p>Using soil moisture data to make targeted decisions relating to inputs and yield potential</p> <p>Andrew's 8,000 ha property principally cropping wheat and lentils, as well as barley, canola and faba beans.</p>	<ul style="list-style-type: none"> Andrew has gained a lot of insight about his soil type and how to manage his paddocks based on his attendance at the Resilient EP project meetings, where he has had the opportunity to meet with researchers and others involved in the project. He has found the information presented interesting, particularly at the higher level in terms of understanding different models and how to relate and scale information from the soil moisture probes to the rest of his farm. As a result of involvement in the Resilient EP focus paddock, Andrew has gained an improved understanding of soil moisture in absolute terms and the characteristics of the soil releasing it. He said, having the soil moisture probe in the paddock has “reinforced understanding and given us the confidence to install at least one other soil moisture probe on another soil type across our farm.” 	<ul style="list-style-type: none"> In terms of the payoff, he said, “there is no doubt in my mind it has been well worthwhile, and we have got our money's worth back in information, particularly in terms of confidence about nitrogen management.” He explained the investment has enabled more targeted decisions. Using data from the moisture probe has resulted in decisions that have saved on nitrogen applications. He noted this had recently been a valuable piece of information to present to his bank. Understanding there is moisture available meant he could confidently show his lender that there is currently more soil moisture available than has been there in the past 5 years.

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Project Funders



Project Proponents



Project Partners

