MURRAY PLAINS FARMERS

Group: Murray Plains
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Soil technology and innovation focus

Variable Rate Technology (VRT) to Optimise Fertiliser Applications on Variable Soils in the Murray Plains

Overview

This project addressed the challenge of managing the diverse and problematic soil types across the Murray Plains, which currently lack effective, tailored management strategies. These constraints reduce productivity and increase risk across significant portions of cropping land. Broader adoption of Variable Rate Technology (VRT) can enable farmers to confidently crop underperforming soils by customising inputs to soil type and seasonal conditions. VRT provides the dual benefit of improving fertiliser input efficiency and boosting profitability through more precise nutrient management.

Barriers to Adoption

Key barriers to the adoption of VRT include a limited understanding of specific problem soils, a lack of decision-support tools to guide economic input strategies, and farmers' ability to successfully apply and utilise these technologies within their own farm machinery and office resources. While farmers have trialled different approaches, outcomes have often been inconclusive or uneconomical. This project aims to bridge that gap by demonstrating and further developing best-practice options, equipping growers with tools to enhance decision-making and return on investment.

Focus of Farmer Participation and On-Farm Demonstrations

The project promoted VRT adoption and improved soil-specific management among Murray Plains. Farmers took part in all aspects of exploring and implementing the VRT processes, including:

- Exploring practical methods for mapping paddock zones with satellite NDVI imaging in relation to specific historic seasonal conditions, and assessing each soil's characteristics in terms of opportunity, safety, and risk.
- By utilising both surface and deep soil testing, along with high and low fertiliser strips across paddock zones, begin to determine which soils respond to specific rates and the reasons behind their responsiveness.
- Utilising and providing practical input into the ongoing development of the Easy VRT tools for fertiliser input decisions and analysis based on soil properties, seasonal factors, and/or crop rotation.

All treatments are assessed under VRT conditions using control strips. The demonstrations showcased “Easy VRT” decision-support tools, highlighting how these platforms integrate local knowledge, soil data, rainfall forecasts, and machinery technology to inform practical decisions. In addition to core activities, the project engaged with non-participating landholders to broaden awareness and benefits of VRT.

Farmer Grant Wagernknecht assisting with deep soil testing of his paddock zones.

Field Work Implementation

Field activities focused on practical demonstrations of zoning paddocks by soil type to enhance input decisions based on zone-specific conditions (moisture, nutrients, constraints). Tools like Your Soil's Potential and the Mallee N Calculator were employed to inform input planning based on soil test results, rainfall deciles, and moisture data.

Each treatment was applied in field strips (generally farmer paddock flat rate, 50% higher, 50% lower, as well as post-N strips at some sites) to validate input strategies across zones. Assessments focused on utilising the farmers' harvested yield maps to compare yields and gross margins of different fertiliser rates by soil zones. Visual assessments, alongside NDVI satellite images, were also reviewed to indicate differences, which are all techniques that farmers can and will use to self-manage in the future.

The extension phases used throughout the project included the following:

- Pre-season farmer meetings.
- Working with participating farmers through all aspects of VRT implementation.
- Individual trial reports were discussed with each farmer.
- A review of the season's learnings (post-harvest meeting).
- Assistance in planning and establishing new VRT paddocks for 2025 to enable expansion of VRT across their entire farm area in the future.

Key extension approaches used

1. This project has been highly participatory in ensuring that the needs of the farming community are met. In December 2023, group leaders convened and decided to focus on directly assisting more farmers to start, expand, and enhance their journey into VRT. A VRT farmer group meeting was held before seeding in 2024, resulting in six farming businesses engaging directly in the project.

2. Spending time "on-farm" with farmers to discuss their individual circumstances regarding soils, machinery, starting points, and specific challenges has proven vital in helping many farmers progress into VRT and overcome various barriers that could not be easily addressed in collective group workshops. The focus of the on-farm discussions included the following elements:

    - Planning trial paddocks with farmers, while they helped conduct soil tests and discussed soil characteristics along with their personal experiences, was a crucial part of zone mapping and targeting effective management strategies.
    - Working through the freely accessible NDVI images from various seasons and times of the year to identify which ones most clearly showcase soil changes for management zones, based on farmers' paddock knowledge of soils, crops, and seasons, has been crucial in developing this tool within the Easy VRT program for effective use by all farmers.
    - By collaborating with the Murraylands and Riverland Landscape Board, farmers could directly engage with a local technical expert who ensured that all machinery technology for seeding and harvesting operated effectively and that results were retrieved for analysis. This often represents the largest barrier for anyone in successfully adopting and progressively improving their VRT strategies.
    - Demonstrating to farmers how to use the various Easy VRT tools and analyse data from their own offices or kitchen tables has fostered strong connections, built capacity, and bolstered their commitment to expanding VRT programs across their farms.

3. A mid-season Zoom meeting was held with participating farmers to review seeding and discuss post-N application. This proved to be a successful way to communicate from home offices instead of having another night out during a busy time. Murray Plains farmers' field days took place in both August and September, where key VRT sites were visited and various issues were discussed. This was particularly relevant during a dry growing season when certain soil types showed a high risk of failure. A final VRT group meeting occurred in March 2025 to present results, discuss key findings and recommended VRT approaches, and to demonstrate some of the EASY VRT tools being further developed as a direct result of working with the participating farmers.

4. The project involved significant community engagement, targeting landholders who had not participated to share outcomes and promote uptake. The aim has been to raise awareness and assess the project's regional impact.

Impact Assessment Approaches

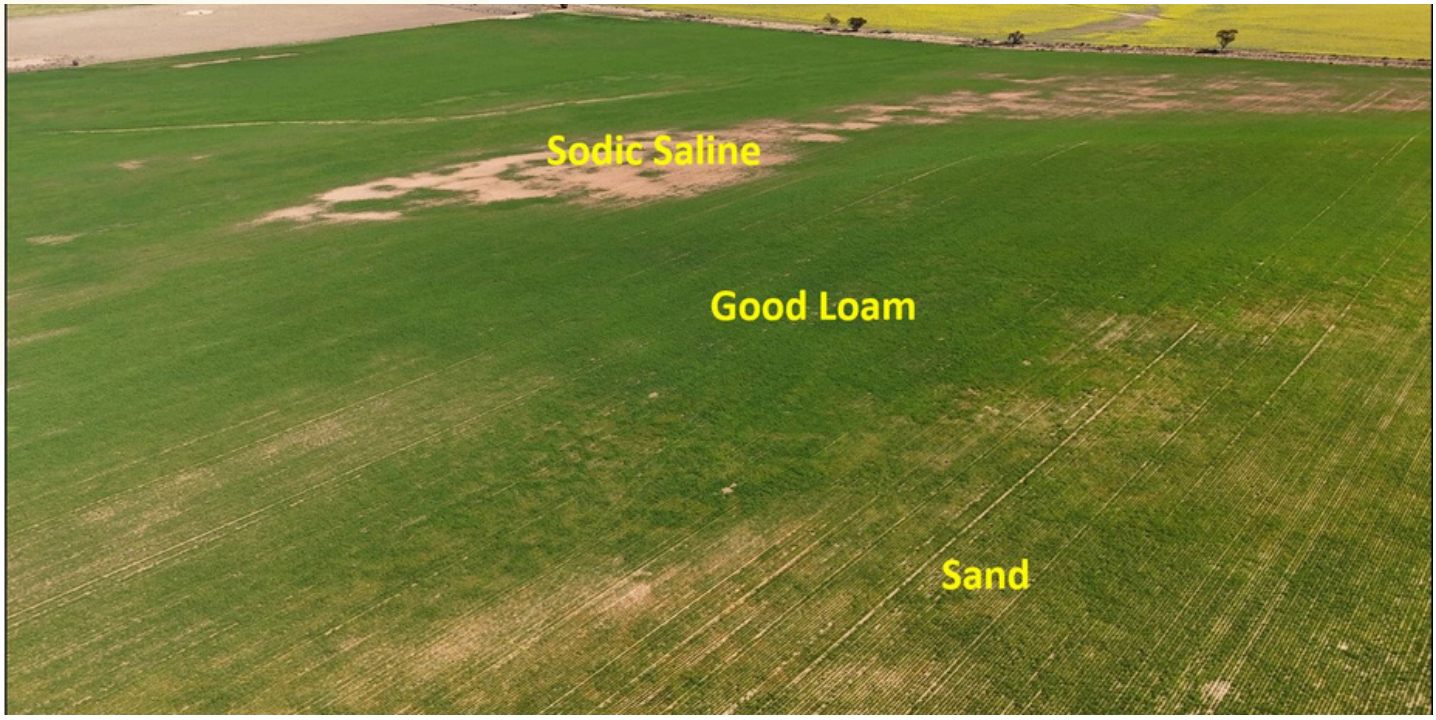
The economic and agronomic impacts were assessed by:

- Analysing header yield maps and treatment strips by soil zone
- Comparing results to initial decision-support inputs and pre-season conditions
- Calculating gross margins ($/ha) by treatment and zone
- Evaluating farmers' support for VRT tools becoming available and their willingness and capacity to expand their on-farm VRT activities in the future.

Targeted Practice Changes

Expected outcomes from the included the following:

1. Improved nutrient efficiency; anticipated increase in crop response to nitrogen and phosphorus, by zone.
2. Acknowledging the varying bucket sizes and shapes across soil zones and how this directly influences yield potentials, risks, and opportunities based on their estimated or measured Plant Available Water (PAW) at the beginning of the season.
3. Higher yields from poor soils; more confident cropping of underperforming areas through refined input strategies.
4. Zonal P agronomy: enhanced phosphorus uptake and return on investment through targeted applications.
5. Recognition of soil mineralisation potential – Understanding natural N supply through improved soil planning is becoming clearer.
6. Better targeting of inputs to align with soil yield potentials and risk profiles, informed by VRT-driven input placement and residue management.



Differing crop growth evident from 3 paddock zones at Adrian Borrmann's farm.

Key Activities

The first major group activity was an online VRT workshop conducted in August 2024, where four farmers and one adviser discussed paddock mapping, seeding strategies, post-N applications, and harvest planning. The session also featured a demonstration of emerging VRT tools, with participants providing feedback based on their on-farm experiences. Engagement was robust and contributed directly to the refinement of the tools.

Later in August, an Easy VRT Crop Nutrition Walk at Punthari brought together six farmers, five advisers, and one agribusiness representative. Participants toured demonstration paddocks showcasing trial strips that illustrated variable input rates, focusing on managing saline soils. Discussions centred on interpreting soil tests and NDVI imagery to identify phosphorus-responsive zones and improve access to Easy VRT tools across cropping environments.

In September, the MPF Spring Crop Walk drew 35 farmers, six advisers, and four agribusiness representatives. A highlight was the Easy VRT demonstration by Chris McDonough and Nathan Paech at Nathan's paddock, showcasing soil mapping, zoning, and input strategies across different soil types. They demonstrated how VRT incorporates local knowledge, BOM rainfall data, soil moisture probes, and on-farm machinery for making data-driven input decisions and yield analysis.

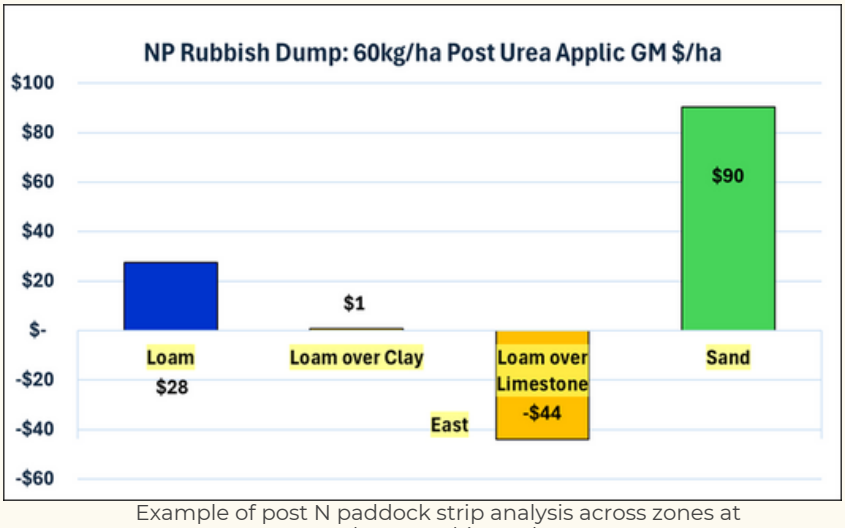
Key Takeaways

- VRT seeding systems yielded positive results, especially where multi-season trial strips facilitated the assessment of soil-crop interactions over time.
- The mixing of any sodic clays to the surface during amelioration should be avoided.
- Deep seeding into moisture-rich layers has been advantageous in dry conditions.
- Online sessions facilitated flexible and effective engagement with farmers.
- The development of Easy VRT tools has advanced to facilitate whole-farm VRT adoption.

Key Discoveries

1. Nutrient & Moisture Management

    - Post-N applications on heavier soil types with shallower buckets had negative gross margins, even after very high rainfall in early summer, due to the extended dry conditions following, while sand over clay soils retained stored soil moisture and excellent post N responses.
    - Pig manure and sand showed promise in improving dry saline soils.



Example of post N paddock strip analysis across zones at Nathan Paech's, Tepko.

2. Soil Profiles & Crop Establishment

    - Fertiliser recommendations that are tailored to soil profiles were valued.
    - Improved root access to moisture was associated with better establishment.

3. Risk Management

    - Strategically managing frost-prone and drought-affected areas can enhance input efficiency.
    - High-input zones frequently underperformed during dry years, underscoring the importance of multi-season evaluation.

Outreach and Impact

The project involved field displays and upcoming video content to share findings more broadly. Collaboration with researchers, including Dr. Sean Mason, facilitated advancements in phosphorus management and VRT tool development. Participants reported increased confidence in interpreting yield maps and applying VRT across various soil conditions.

Challenges and Recommendations

Drought and frost limited the evaluation of some treatments. Sodic soils and inconsistent seasonal responses continued to pose challenges. Ongoing monitoring across multiple seasons is advisable to capture the long-term benefits of VRT. Simplifying VRT tools further will improve usability in variable conditions.

Participatory-driven farmer extension approaches: a critical success factor

Engaging farmers and adopting participatory extension approaches were vital to the success of the Murray Plains VRT project. These strategies recognised that successfully adopting new practices, particularly those as technical as VRT, involves more than just delivering information. It calls for active involvement, co-learning, and tailoring solutions to the real challenges faced by growers on the ground.

Importance of Farmer Engagement and Participatory Approaches

1. **Grounding Innovation in Local Contexts**
   By actively involving farmers in the design, implementation, and refinement of trials and tools, the project ensured that solutions were relevant to local conditions, soil types, and management systems. This enhanced the credibility of the work and encouraged greater ownership of the outcomes.

2. **Building Trust and Confidence**
   Involving farmers as co-investigators instead of merely relying on them as passive recipients helped build trust in both the technology and the project team. Farmers felt more motivated to experiment, give honest feedback, and accept changes because they had a role in shaping the project's direction.

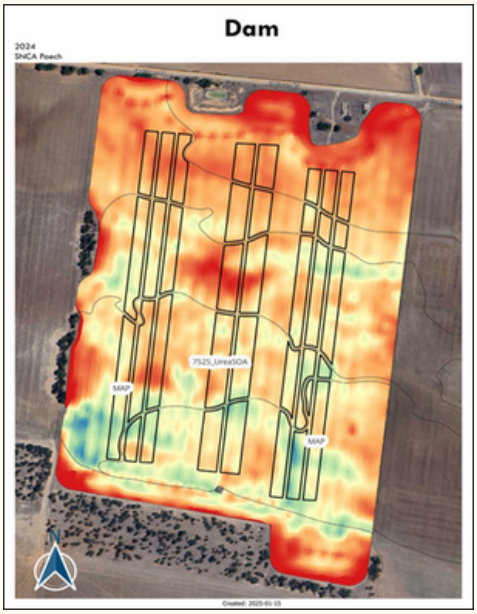
3. **Creating Learning Networks**
   Events such as the Easy VRT Crop Nutrition Walk and the MPF Spring Crop Walk provided platforms for peer learning, allowing farmers to observe results firsthand, ask questions, and share ideas. These interactions fostered a strong sense of community learning and encouraged knowledge sharing beyond individual farms.

4. **Enabling Adaptive Feedback Loops**
   Regular check-ins, online workshops, and field visits allowed the project team to adapt based on farmer feedback, enhancing VRT tools to ensure they were more user-friendly and applicable across various paddocks. This iterative process improved the usability and relevance of the decision-support systems being developed.

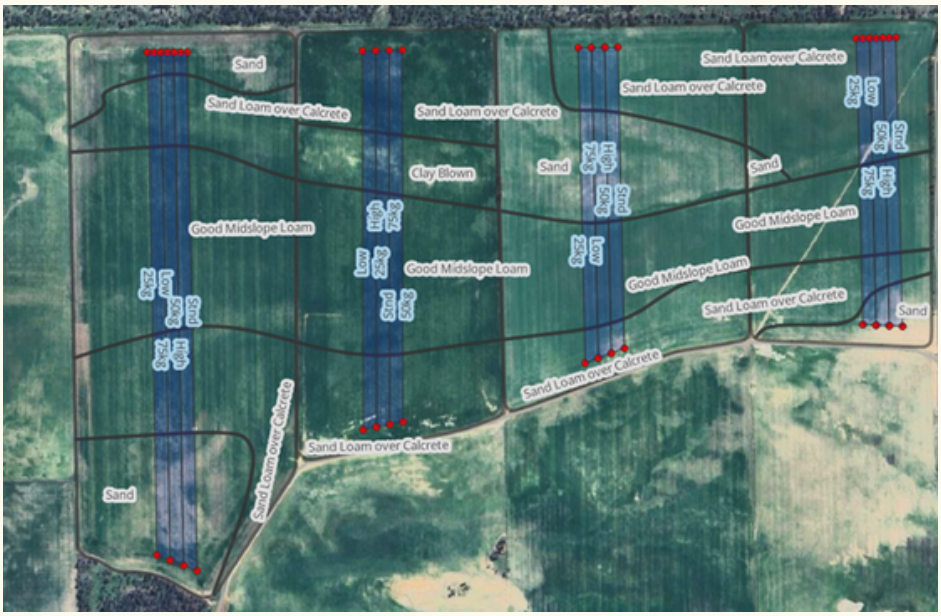
5. **Encouraging Practice Change**
   Participatory extension supported farmers in transitioning from trial to adoption. With guidance from Dr. Chris McDonough and other key experts, participants were better equipped to interpret yield maps, make data-driven input decisions, and apply VRT in practical, low-risk ways. These hands-on experiences were essential for building capacity for long-term change.

6. **Broadening Impact through Peer Influence**
   Farmer presenters like Nathan Paech played a crucial role in demonstrating what VRT looks like in practice. Their insights added credibility to the approach and inspired other growers to consider its adoption. This peer-to-peer influence often has a more significant impact than external advice alone.

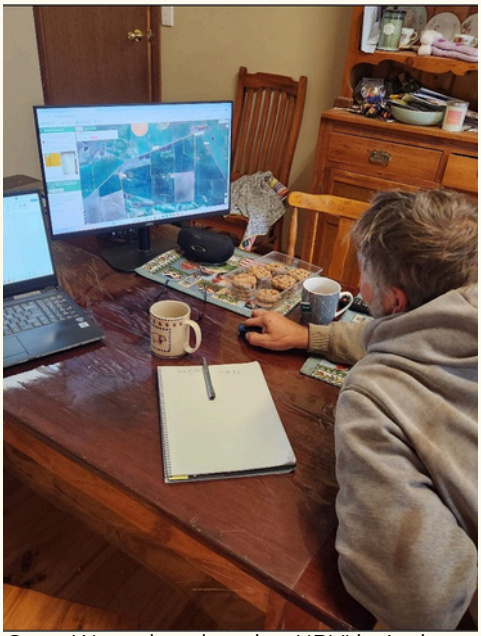
   Participatory extension approaches enhanced the project's collaboration, contextual relevance, and impact. By emphasising the importance of building strong farmer engagement, the project not only improved technical outcomes and fostered a culture of innovation and continuous learning within the Murray Plains farming community.



Zone, test strip and yield map of Nathan Paech's paddock.

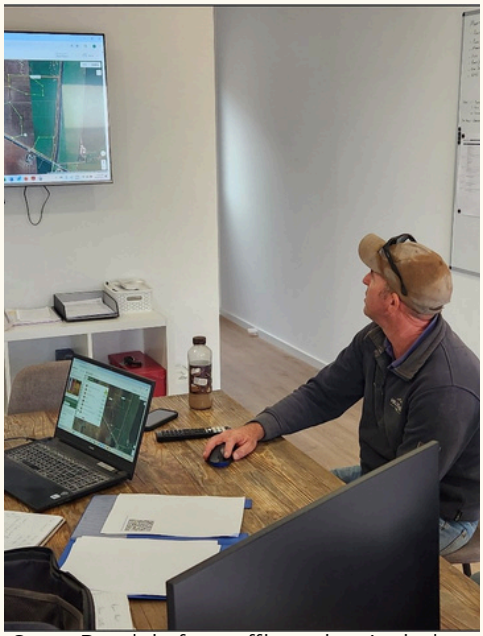


New 2025 paddocks mapped and zoned for VRT on Adrian Borrmann's Punthari fam.



Grant Wagenknecht using NDVI in Agrisove to help map his paddock zones

Chris McDonough explaining VRT to Sept group field day at Nathan Paech's trial paddock.



Steen Peach in farm office using Agrisolve to map his paddocks and assign soil types to zones

Summary and Conclusions

This project demonstrated how the targeted use of Variable Rate Technology (VRT), supported by decision tools and tailored field trials, can help farmers in the Murray Plains manage challenging soils more effectively. Throughout workshops, crop walks, and on-farm demonstrations, participants explored ways to adjust fertiliser inputs based on soil type, constraints, and seasonal conditions. Early results suggest improvements in crop vigour, input efficiency, and farmer confidence in using VRT across variable paddocks.

Despite the challenges posed by dry seasonal conditions and soil limitations (e.g., sodicity), valuable insights emerged regarding phosphorus management, the limited effectiveness of post-nitrogen applications during dry years, and the benefits of organic amendments like pig manure. Demonstrations of new tools, including Easy VRT, played a crucial role in enhancing grower capability and fostering discussions on further improvements.

Ongoing multi-season monitoring, streamlined VRT tools, and targeted extension efforts are crucial for sustaining momentum and promoting wider adoption. By integrating local knowledge, digital technology, and practical agronomy, the project is establishing the foundation for more precise, profitable, and resilient crop management throughout the region. It is expected that all participating farmers will soon expand their VRT operations from trial paddocks to whole of farm.

Outcomes from the project indicate that strategic engagement with VRT and soil management practices can yield tangible benefits, even in challenging seasons. While issues such as drought, frost, and soil limitations persist, the commitment of farmers, advisers, and researchers to trial, evaluate, and adapt innovative methods has established a strong foundation for future success.

Ongoing collaboration, long-term monitoring, and clearer decision-making tools will be crucial in promoting broader adoption and ensuring these innovations lead to sustained productivity gains across the region.

Australian Government
Department of Agriculture, Fisheries and Forestry
Future Drought Fund

This project emphasised the value of targeted soil management practices to improve the performance of producing lentils on sandy soils. The opportunity to transform sandy soils from challenging, often low-producing assets into highly productive soils was demonstrated, which will provide further incentives for farmers to manage such soil types better. Through workshops, field trials, and collaborative efforts with agronomists, outcomes from the project will help foster sustainable practices and enhance regional agricultural resilience.