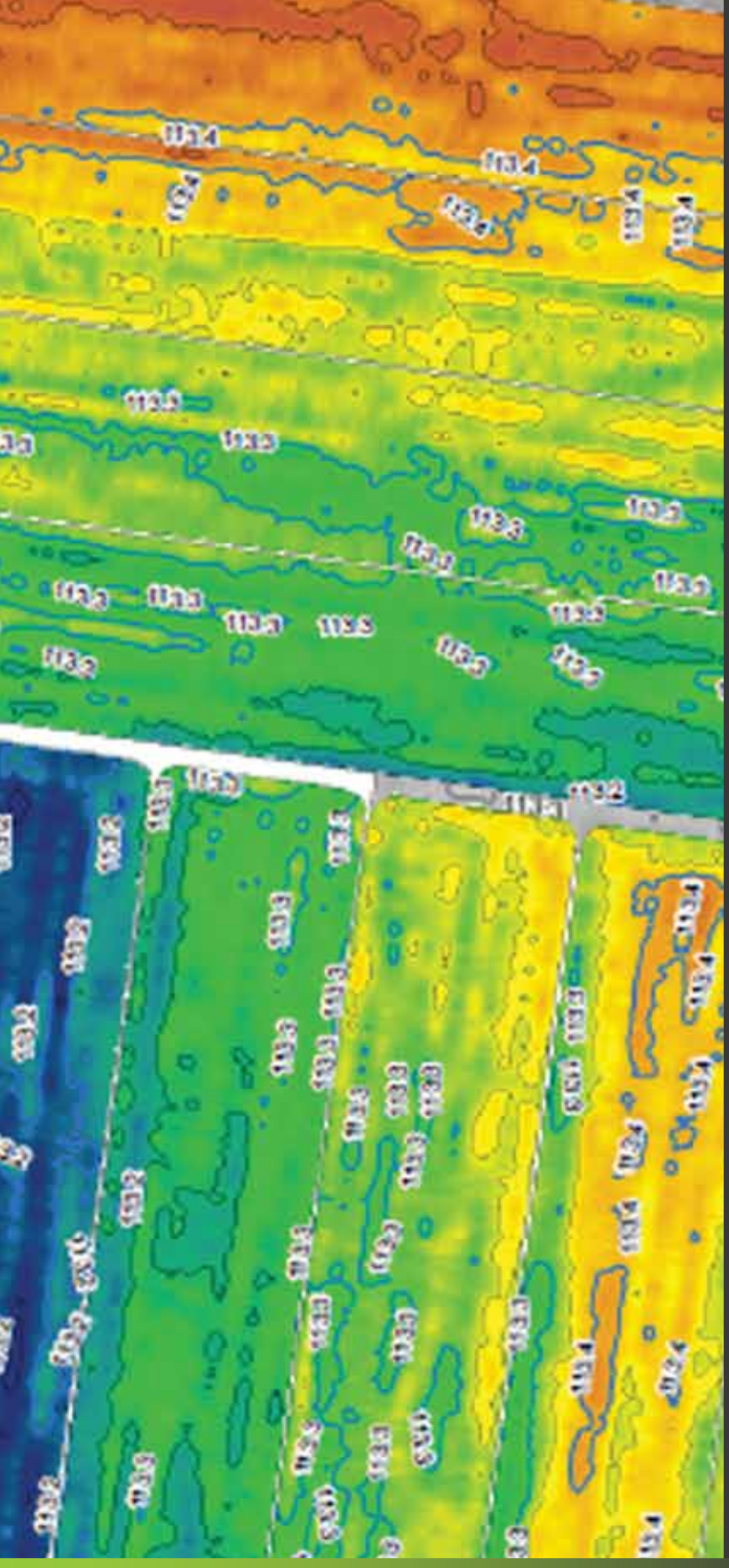

# PRECISION AGRICULTURE IN **RICE** PRODUCTION

## Grower experience and insights

precision agriculture.com.au

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# PRECISION AGRICULTURE IN **RICE** PRODUCTION

## Grower experience and insights

CONTENTS

# PRECISION AGRICULTURE

## BACKGROUND

Precision agriculture (PA) is a broad term used to describe the rapidly developing practices using spatial technologies to measure and strategically manage farming systems from the whole farm to within paddock perspective. The ultimate aim is to deliver economic, management and environmental benefits.

PA provides farmers with enormous (and sometimes overwhelming quantities) of information which enables them to:

- build up a record of their farm;
- improve decision-making;
- target farm input use and improve efficacy;
- foster greater traceability; and
- enhance marketing of farm products.

## PA IN RICE

There has been a considerable amount of PA work conducted in the rice industry, in particular:

- aerial crop imaging;
- managing crop effects from laser guided land-leveling; and
- variable rate nitrogen application.

PA in rice production in Australia is on the verge of rapid adoption and now is the time to consolidate past experiences and build a framework for the successful implementation of PA by the wider industry.

## DEFINITION

Precision Agriculture (PA) is a farming management concept based on observing, measuring and responding to inter- and intra-field variability in crops.

PA aims to optimise field-level management with regard to:

- crop science: by matching farming practices more closely to crop needs;
- environmental protection: by reducing environmental risks and footprint of farming;
- economics: by boosting competitiveness through more efficient practices

PA integrates spatial technologies with the management processes of cropping systems, and enables farmers to strategically respond to the challenges of crop production relative to space and time.

Implementation of PA in rice introduces some additional challenges to those seen in broad-acre crop production, but also opens up some enormous opportunities.

### CHALLENGES

- Permanent infrastructure in irrigation layouts.
- Use of aerial seeding and fertiliser application.

### OPPORTUNITIES

- Address within-field variability resulting from cut and fill when land-forming irrigation bays.

Permanent infrastructure such as roads and channels need to be considered in order to get the most benefit when developing rice paddocks to utilise PA.

- Utilise RTK* satellite navigation systems to collect accurate elevation data across paddocks in order to assess which bays would benefit from re-grading.
- Reduce the incidence of overlap due to part-width passes at the end of a bay. Overlaps add agronomic challenges and input costs.
- Increase returns by matching crop management more closely with crop needs within each rice bay.

## CONTROLLED TRAFFIC FARMING

Controlled traffic farming (CTF) is a system of crop production where wheels are driven on hard permanent tracks. CTF relies on RTK* autosteer to attain operation to operation and year to year repeatability. In grain cropping the wheel spacing and 'lap' width are determined by the header, which cannot be easily modified. Other implements are then modified to be multiples of the header width. Common systems are 9 m and 12 m, with 3 m wheel spacing. The important thing is to do some research on machinery options, decide on a width and stick to it. A 9 m CTF system may work with a 9 m wide seeder and header front, and a 27 m wide boomspray. Spreading could then be 18 m or 27 m depending on the implement capabilities.

Use of CTF in rice production is complicated by the presence of irrigation structures, and where beds are used the widths have to be adjusted to suit.

## THE PROJECT

### IMPLEMENTING PA IN THE AUSTRALIAN RICE INDUSTRY

Many rice growers have made significant investment into PA equipment such as auto-steer, yield mapping and variable rate application technology. The project, *Implementing PA in the Australian Rice Industry,* aims to deliver knowledge to growers on ways to maximise returns on their investment.

The project is focused on engaging growers and agronomists, and working with them to develop skills and knowledge across the industry. It aims to simultaneously:

- build awareness of the capabilities of PA in rice production and the economic benefits;
- use focus farms to Identify yield limiting factors across the industry and develop guidelines for implementing PA in rice;
- up-skill the rice industry (growers, agronomists and others) to enable implementation of PA;
- deliver innovative crop management solutions addressing within paddock variability through on-farm trials; and
- identify crop production knowledge gaps and integrate these into future research.

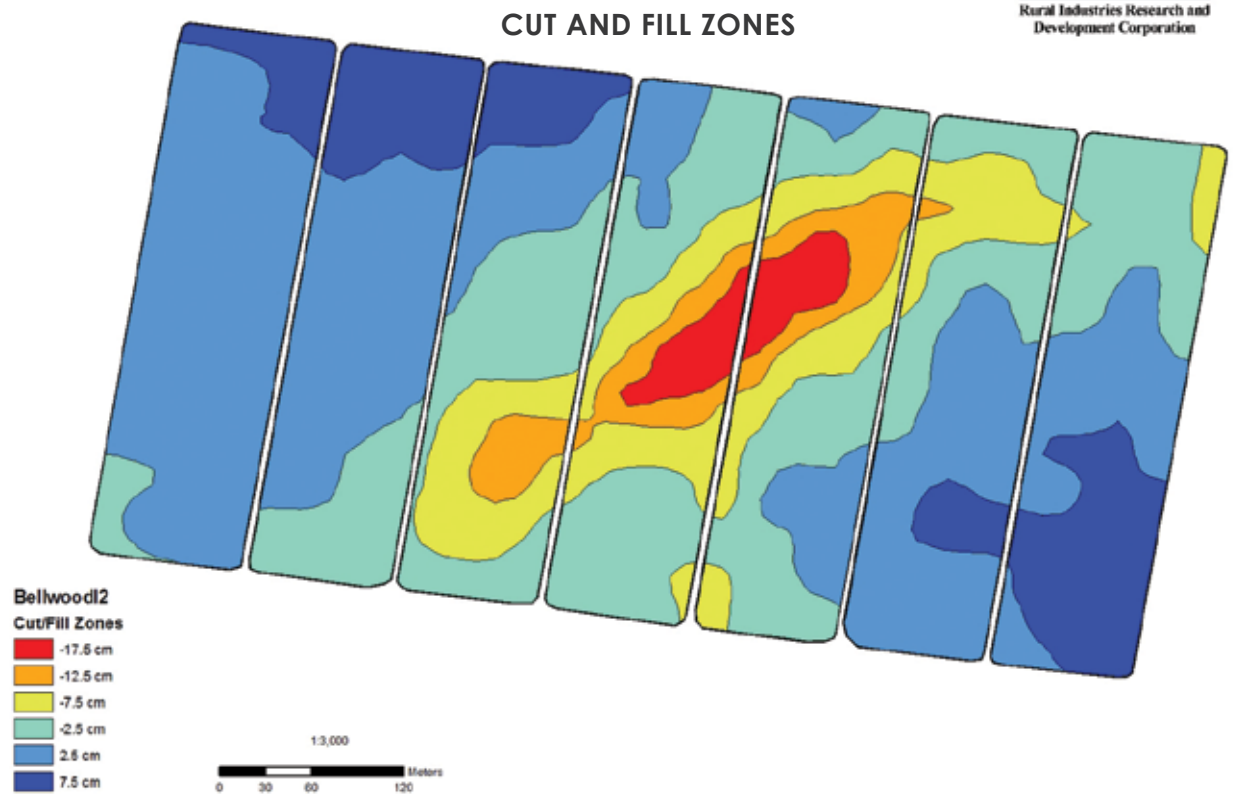
## GROWER EXPERIENCES AND INSIGHTS

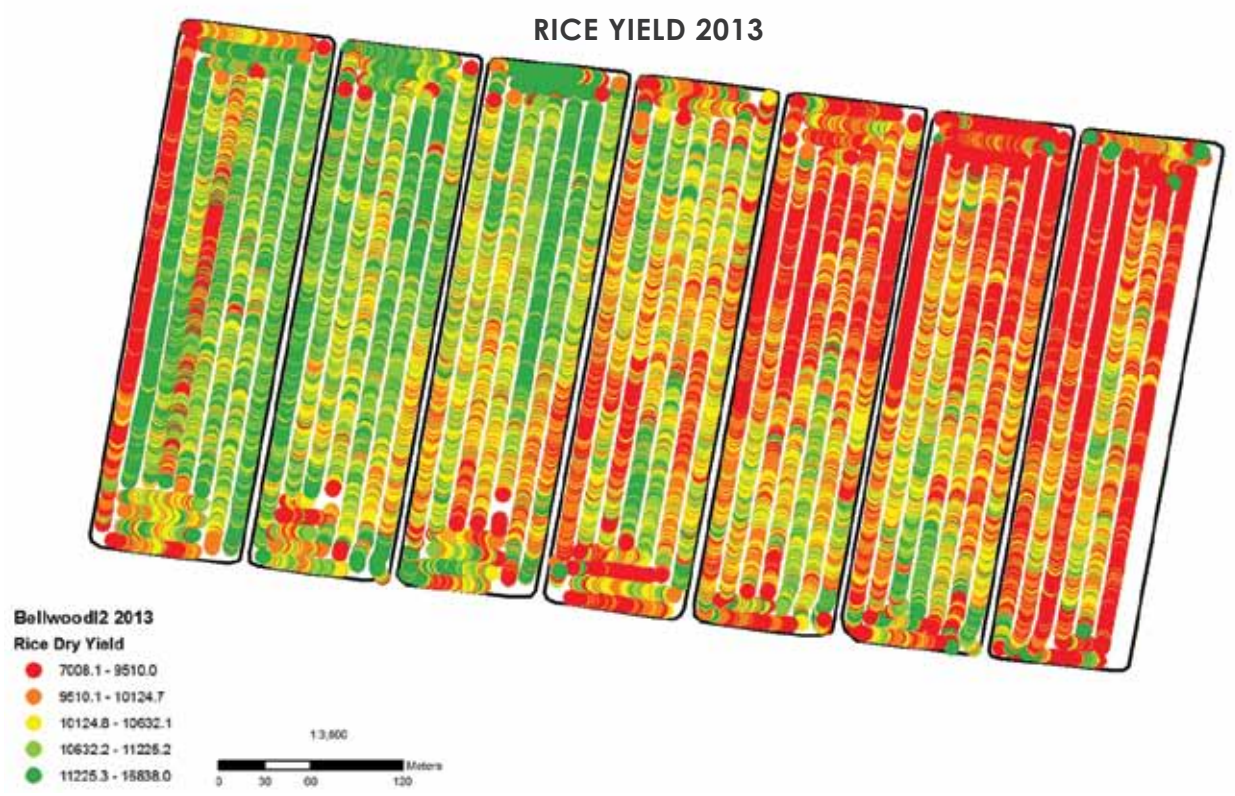
This publication is one of a series to be produced as an output of *Implementing PA in the Australian Rice Industry*. Here, six rice growers have generously shared their ideas and experiences, providing insight into their own adoption of PA so far. It is hoped that this will assist other rice growers in their own process of adopting PA in their production system.

Poor establishment (top) on cut areas and good establishment (bottom) elsewhere in direct drilled rice follows through to differences in yield. PA is highlighting how closely correlated rice yield is to cut and fill areas and also offers an opportunity to effectively ground truth and begin to address the issues.

*Rice Research Australia, Sun Rice, 'Old Coree' Jerilderie, NSW.*

** Real Time Kinematic (RTK) satellite navigation enhances the precision of position data derived from satellite-based positioning systems. It relies on a single reference or base station to provide real-time corrections. In agricultural applications it provides ±2 cm accuracy.*




These maps illustrate the strong relationship between rice yield (bottom) and cut/fill (top). Most yield maps reflect cut/fill as seen in this example, however this is not always the case. This is probably due to a combination of factors such as multiple regrading effects and improved levelling techniques (topsoiling).

*Farmer: Mick Agosta, Paddock: Bellwood l2*

# PATE FARMING
# TOCUMWAL

## ADOPTING PA TECHNOLOGY

Nathan Pate farms with his wife, Leah and his workman Jono (known as Pate Farming in this study). They run a 1000 ha controlled traffic farming (CTF) enterprise based on dryland and irrigated winter crops and rice.

The move into a full CTF system was a gradual process which started in 2000, although at that stage Pate Farming was not really heading towards a CTF system. It all started with the purchase of a new header with yield mapping capabilities. This presented an opportunity, and so began a planned program of machinery replacement, with the end goal a CTF system and the use of variable rate application technology.

A local machinery dealer and friend was one of the key sources of information on, what was then, cutting edge technology. In 2002 Pate Farming invested in an airseeder that had the ability to apply seed and fertiliser using prescription maps and variable rate technology. In 2004 they added sub-metre autosteer.

After a number of years using sub-metre autosteer Pate Farming felt that there would be benefits in more accurate steering with year-to-year repeatability. This would enable greater efficiency of operations, simply by setting up rice bays to remove half-width laps and avoid, where possible, dry runs to get out of the bay.

## MACHINERY

In 2010 Pate Farming made some simple machinery modifications to move to a 9 m wide CTF system with 3 m wheel-track centres, using ±2 cm RTK autosteer. All modifications were done on farm and included:

- removing a tyne from the airseeder to bring it back to 9 m;
- purchasing cotton reels for the front axles and spreading the rear wheels on the existing axles of his FWA sowing tractor and spray tractor; and
- adjusting his boom spray axle to the 3 m wheel spacing (it was purchased in 2009 with this option as part of the plan to move to a 9 m CTF system).

Pate Farming use a community base station, paying an annual subscription. This decision has meant that there is no initial financial outlay and the cost of ongoing maintenance and upgrades is taken care of with the subscription fees.

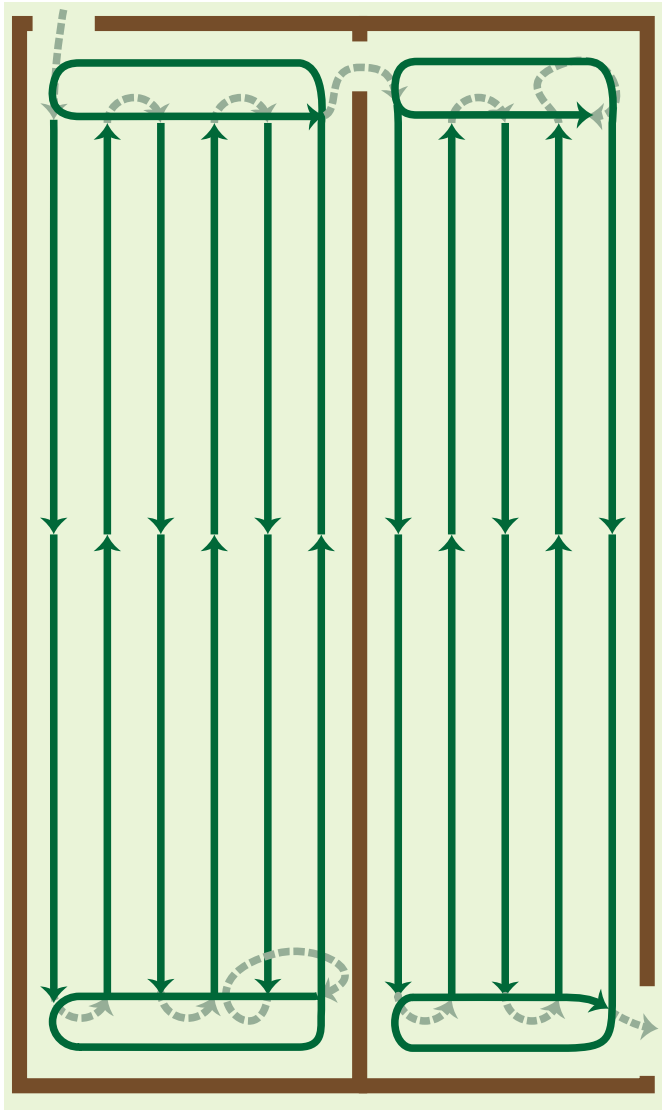
| | |
|---|---|
| **LOCATION** | Tocumwal<br>Murray Valley NSW |
| **KEY ENTERPRISES** | Wheat, barley, canola, rice |
| **TOTAL AREA** | 1300 ha |
| **CROPPED AREA** | 1000 ha |
| **IRRIGATED AREA** | 250 ha |
| **RICE AREA** | 200–250 ha |
| **CURRENT PA SYSTEM** | 9 m CTF with 3 m wheel centres; variable rate seed/ MAP/urea at sowing; variable rate topdressing; variable rate lime and gypsum application; yield mapping |

## IRRIGATION LAYOUT

In parallel with the machinery modifications there has been some planning with the layout of three paddocks most recently set up for rice. The bays were planned with the machinery movement from one bay to the next in mind (see diagram on following page). The ideal is to run bays with even multiples of nine metres. This ensures the start and finish of sowing and harvest operations is at the same end of the paddock. Pate Farming's paddock setup is based primarily upon


Cotton reels were fitted to the front axle and wheels spread on the rear axle of the tractors to move to 3 m wheel centres for the CTF system.


The boom spray was purchased so that the axle width could be easily modified to 3m wheel centres.



Rice bay layouts are designed to be compatible with the airseeder and harvester, and aim to avoid part-width and dry runs.

compatibility with the airseeder and harvester. The boom spray compatibility is not a primary concern as the rice banks are sprayed as part of the paddock hygiene, to stop weeds 'creeping' into the crop zone from the banks.

The aim is to have each bay the same width (where practical), and the last bay becomes 'what's left'. This depends on the location of permanent obstacles, such as drains and channels. Sometimes due to the location of the paddock entrance the pattern is a little more complex, using cross-overs from bay-to-bay to avoid running dry back to the starting end, and to facilitate efficiencies. But the goal is to have a continuous track moving from bay to bay within each paddock.

This optimal layout will be dependent on water movement, and some compromise may have to be made due to slope, bay size or the presence of permanent infrastructure.

## TECHNOLOGY HARDWARE

When investing in the hardware to enable autosteer and variable rate Pate Farming has been keen to make sure that the implement controllers will 'talk' to each other. Using one system for all operations helps reduce problems in the paddock.

Pate Farming uses the John Deere Greenstar™ system, some of which comes with the machinery. When Pate Farming was investing in a spreader they went with a Bogballe, which has its own controller, but is easily operated with the John Deere variable rate system. A few manufacturers now use an ISO (International Organisation for Standardisation) standard which improves compatibility.


Compatibility of implement controllers is essential for PA and variable rate applications. The Bogballe spreader controller is easily operated with the John Deere system.

| TECHNOLOGY HARDWARE | |
|---|---|
| **GPS AUTOSTEER** | John Deere Starfire™ 3 with corrections from community base station (RTK) |
| **SOWING** | John Deere 9800 air-cart with GS2630 display |
| **SPRAYING** | John Deere rate controller (liquid) with GS2630 display |
| **HARVEST** | GS2630 display |
| **UREA SPREADING** | Bogballe monitor with an RS232 connection to the GS2630 display |
| **LIME/GYPSUM SPREADING** | Marshall spreader (10t) with John Deere rate controller (dry) with GS2630 display |
| **GPS LEVELLING** | John Deere iGrade with a portable base (hired) set up in the paddock |

## SOFTWARE AND DATA ANALYSIS

Pate Farming uses Apex™ (John Deere farm management software) to manage yield maps and prepare prescription maps for variable rate applications. They use:

- yield maps predominantly to develop prescription maps for winter cereal inputs;
- EM38 for gypsum and lime application; and
- cut and fill maps for rice inputs (mainly fertiliser).

Pate Farming would consider using another software program to better analyse the data, especially as they have sets of data from a number of years. At this stage the data is looked at in-house, but it can be time consuming and it is becoming hard to allocate the necessary time. They are considering using a specialist PA consultant to help get the most out of the data being collected.

## LESSONS LEARNT

Pate Farming's move to CTF has been rewarding and although it has provided numerous benefits it is not all straight forward. A few key lessons have been learnt along the way and are highlighted in the table at the bottom of this page.

## BENEFITS TO DATE

The key benefits identified by Pate Farming during the adoption of PA and CTF are:

- CTF set up well in rice bays makes operations simple and greatly improves efficiency.
- Cost savings on inputs. For example lime and gypsum applied to the areas of the paddock where they are needed, rather than using a blanket application. In addition there is no overlap when applying products and the improved layout removes double sowing of half laps which reduces input and operation costs.
- CTF enables easy conduct of large-scale, in-paddock trials.
- Yield. Pate Farming has observed a gradual improvement in yield and reduced variability, both within paddock and from season to season, since adopting CTF and targeted seed and fertiliser application using variable rate.

## THE FUTURE

Pate Farming sees the future of PA in rice production and other cropping programs is filled with opportunity but also some challenges.

### VARIABLE RATE APPLICATIONS

One of the biggest dilemmas for Pate Farming and his colleagues using PA technologies is deciding the optimum use of variable rate:

- Should the focus be on improving the highest yielding zones of a paddock or trying to improve the poorer areas?

**Lessons learnt during the adoption of PA**

| Lesson | Description | Solution |
|---|---|---|
| Issues with equipment compatibility | Can be frustrating and time consuming; problems always occur at a busy time | Use one system to minimise problems and down time |
| Operator ability to use the system and trouble shoot | When things don't quite go to plan; hard to get trained operators on a casual basis | Need ability to talk an operator through task over the phone |
| Time and skills to analyse data | Seems to be hard to allocate time | Consider using a PA consultant |

- How do growers determine what input/operation to variable rate and which areas to target?

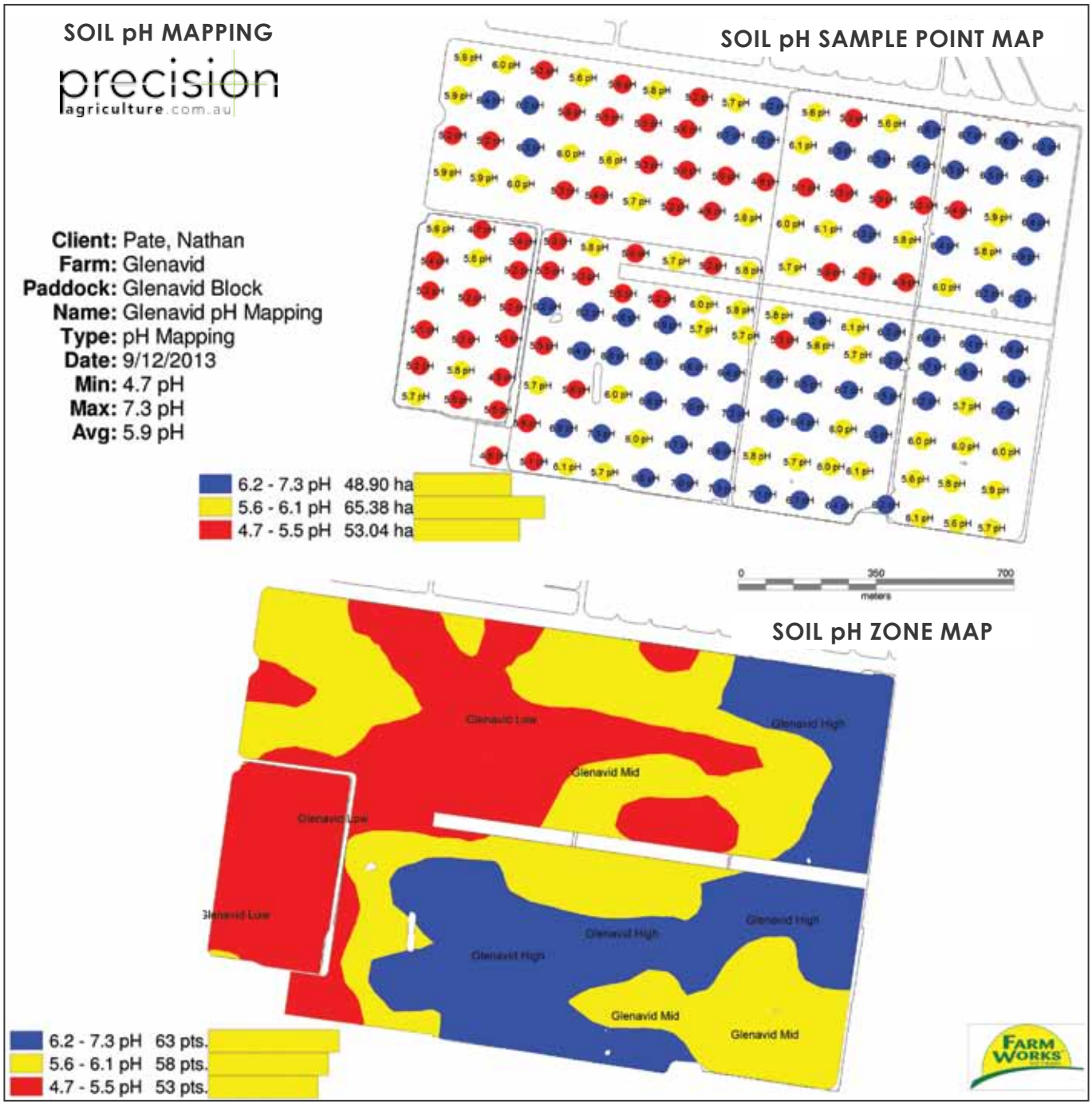
The use of trials and nutrient rich strips will hopefully make it clearer as the years go by.

Employing consultants is integral to the way forward. Pate Farming recently employed Precision Agriculture.com.au to conduct soil pH mapping on paddocks due for lime application. The soil pH maps (see example below) were then used to create prescription maps for variable rate lime application. Pate Farming found this to be very good value for money.

## CHALLENGES

Pate Farming is finding the further they get down the PA road and the more data that is collected, the more questions are raised.

The biggest challenge is to answer some of the questions and confidently set future directions. This issue faces many growers who have invested time, energy and money into PA and can result in a slump in motivation. Pate Farming is confident the Rice PA Project will help answer some of the questions and reinvigorate them and other growers heading down the PA path.




Pate Farming employed consultants to conduct soil pH mapping, a rapid and effective way to produce zone maps for variable rate lime application.

# SLEIGH FARMING
# JERILDERIE

## ADOPTING PA TECHNOLOGY

Richard Sleigh farms in a family business west of Jerilderie with his brothers Andrew and David (known as Sleigh Farming in this study), with Richard managing all the cropping. Sleigh Farming has been using ±10 cm autosteer for five years and mapping operations for the same time. Two years ago they began yield mapping when they purchased a new header with mapping capabilities.

The move to autosteer was initially driven by the desire for efficiency gains (reduced overlap, inputs and fatigue) and as Richard openly admits, he likes innovations. He had been reading about GPS technology in many agricultural publications and machinery brochures and talking about it with other growers. When the cost of implementation came down after the initial release period Sleigh Farming committed, although they were only partially convinced autosteer and PA would really deliver significant benefits. It hasn't taken long to be fully convinced. This year Sleigh Farming has moved to an RTK GPS system (±2 cm) using a community base station on the home block and a loaned mobile base station this season on a remote farm.

## MACHINERY

Sleigh Farming does not run a fully controlled traffic system in rice but matches the in-crop operations of spraying and spreading, both on 21 m. They don't feel it is overly important to match up the airseeder to these operations, nor the header.

## IRRIGATION LAYOUT

Working with various layouts (rice bays and border check winter crop bays), variations in paddock slope and limitations imposed by permanent infrastructure, Sleigh Farming is focused on the airseeder. Where possible bays are being set up in multiples of the airseeder to minimise overlap. This will be an ongoing process as bays are rejuvenated.

## TECHNOLOGY HARDWARE

Investment in technology has been limited to purchasing machinery with autosteer capability and then purchasing the John Deere Greenstar™ controller screen. Sleigh Farming uses this to map and record each in-paddock operation.

| | |
|---|---|
| **LOCATION** | Jerilderie, NSW |
| **KEY ENTERPRISES** | Wheat, barley, canola, rice, seed sorghum, Merino sheep and beef cattle |
| **TOTAL AREA** | 4000 ha |
| **CROPPED AREA** | 1000 ha |
| **IRRIGATED AREA** | 800 ha |
| **RICE AREA** | 200 ha |
| **CURRENT PA SYSTEM** | RTK autosteer, mapping all operations, matched in-crop operations, yield mapping |

The availability of a community base station means Sleigh Farming doesn't have to worry about base station maintenance and there is not a large up-front capital cost, but an annual licence fee which covers usage, upgrades and maintenance.

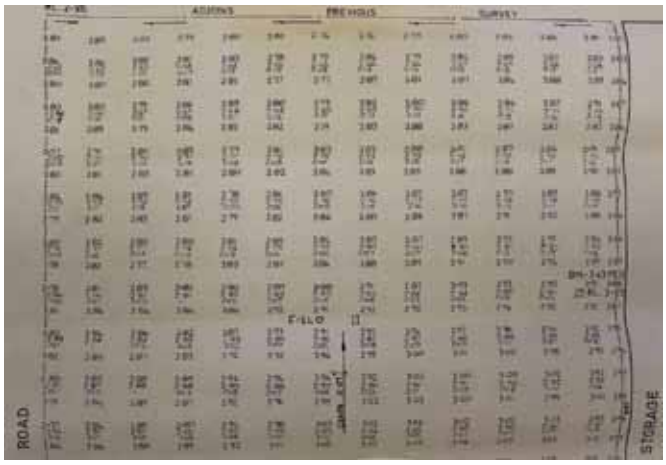
## SOFTWARE AND DATA ANALYSIS

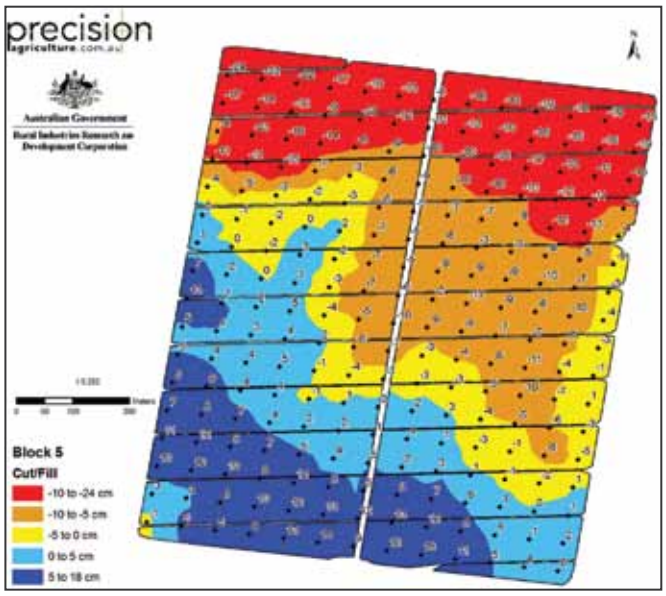
Sleigh Farming is starting to collect quite a bit of data and is now trying to put the yield maps to use. Visual appraisal of the printed maps is used to identify areas within a rice field to conduct targeted in-field testing, particularly of nitrogen top-dressing. Then the yield map from the subsequent harvest is used as a simple way to determine how the crop responded to the treatment.

| TECHNOLOGY HARDWARE | |
|---|---|
| **GPS AUTOSTEER** | John Deere Greenstar™ RTK using community base station |
| **SPRAYING** | Goldacres boomspray using John Deere GS2630 controller |
| **HARVEST** | John Deere header with GS2630 for yield mapping |

## BENEFITS TO DATE

Sleigh Farming is honest about the benefits seen with the use of autosteer in rice. Richard says, "It looks good! But more importantly there is much less fatigue." Sleigh Farming is not sure if the savings on inputs due to reduced overlap are sometimes overstated, but reducing them by any margin is a good thing. Avoiding the risk of rice sterility in double-up areas due to extremely high nitrogen applications is also a good thing.




A hard copy cut and fill 'map' (top) can be converted into an electronic cut and fill zone map and used in the analysis of understanding within paddock variability. Use the grid in the hard copy map, create a matching grid in the GIS software, and add the cut or fill value to each point.

*Farmer: Richard Sleigh, Paddock: Block 5*

## LESSONS LEARNT

Sleigh Farming began with ±10 cm Starfire™2 autosteer and used this to lay out a number of rice fields two years ago. Where possible the bays were made in multiples of the airseeder width to improve efficiency of operations by cutting out part laps and dry runs. After moving to an RTK system it became clear that the drift in the ±10 cm system was much greater than thought and most of the check banks need to be moved.

The distance isn't great but leaving them will mean there is a long narrow strip not sown on one side of the check bank (impacting water movement), and a long strip on the other side which will be double sown. Sleigh Farming recommends, if you are using ±10 cm steering and wish to lay out bays in a field, get a contractor to put the check banks in using a ±2 cm RTK system–especially on border check with winter crops.

## CHALLENGES TO DATE

Sleigh Farming finds the Greenstar™ system used to operate the steering and recording is too complicated, although yield mapping using the same system in the header is quite straightforward. Greenstar™ does a good job of recording and mapping operations once it is set up, but it is not the simplest operating system to use. This has its challenges when using other drivers. Sleigh Farming would like the process to be as simple as the operator putting a data card into the screen and off you go. As it is currently Richard has to spend time himself setting up the job to ensure the recording will go to plan.

## THE FUTURE

Sleigh Farming looks at PA as an innovation that at present is not an essential tool. You can grow crops without it but it is enjoyable and inspiring to be around the innovative side of agriculture. But you need to be passionate about it to persist and succeed in implementing the various components.

- The ability to conduct on-farm strip trials is attractive. Ultimately it would be great to sit down at the beginning of the season and plan a series of test strips or trials to implement. But that never seems to be given priority. It is a big ask to stop an operation in the middle to change things and put down a test strip.

## ADOPTING PA TECHNOLOGY

Andrew Hicks farms with his wife Penny, and parents Geoff and Christine (known as Hicks Farming in this study). The desire of Hicks Farming to move into yield mapping (and PA) was triggered when they observed wild variations in yield when they first had a header fitted with a yield monitor. However although they were able to observe large variation within paddocks, they were unable to record where the variations were. The inability to ground truth after harvest and work out what had caused the yield variations meant that they could not address the problems.

## MACHINERY

In 2002 Hicks Farming purchased a second hand data logger and using a Garmin GPS began basic yield mapping.

Over the years they continued to observe large in-paddock yield variation and believed variable rate fertiliser application could be used to improve yield on poor areas and increase overall productivity. In 2010 Hicks Farming made a substantial investment into receivers and controllers (John Deere Greenstar™ 2630) and their PA journey began.

They went straight to an RTK ±2cm system, using a community base station with an annual licence fee. Hicks Farming had a primary goal, to use variable rate fertiliser application before sowing their rice. For this reason they went straight to RTK to get the repeatability from season to season.

Hicks Farming shares machinery in an arrangement with a neighbour so when it comes time to decide on machinery updates and any move to a controlled traffic farming (CTF) system it has to be a joint one. At this stage the airseeder and header don't match in width, but the aim is to move to a CTF system as machinery is replaced. It is likely they will move to a 12 system, but it is complicated by the need to spray banks in irrigation bays and the share arrangement with machinery ownership.

## TECHNOLOGY HARDWARE

Hicks Farming uses a John Deere Greenstar™ 2630 controller and one day they hope to control each piece of machinery with the one system or controller. The benefits of a single controller are:

- only one software package has to be learned;
- all components communicate with each other once they are set up;
- data is collected in a compatible format; and
- wiring the implements into the tractor cabs is simpler.

| | |
|---|---|
| **LOCATION** | Morago area, north west of Deniliquin |
| **KEY ENTERPRISES** | Rice, winter cropping and agistment livestock |
| **TOTAL AREA** | 2800ha |
| **CROPPED AREA** | 600ha |
| **IRRIGATED AREA** | 1000ha |
| **RICE AREA** | 200–300ha |
| **CURRENT PA SYSTEM** | RTK autosteer, variable rate at seeding, yield mapping, moving towards 12m CTF |

In 2013 fertiliser (nitrogen and phosphorus) was pre-drilled using variable rate maps developed in John Deere Apex™ Farm Management Software. The aim was to increase yield of regularly poor performing areas. The zones were based on yield maps , but also incorporated 'local knowledge'. One thing Hicks Farming finds useful with the GS2630 screen is the ability to flag things, such as duck damage or lodging. They can also make observation notes on the screen on the go, which provides great background information explaining the yield maps.

Harvest of the first rice crops sown with variable rate fertiliser application revealed benefits in just one season. There was an overall yield increase and variation was reduced–a very pleasing result.

Hicks Farming use John Deere Greenstar™ RTK autosteer and John Deere GS2630 with dry rate controller into a Horwood Bagshaw electric drive airseeder for variable rate fertiliser application.

| TECHNOLOGY HARDWARE | |
|---|---|
| **GPS AUTOSTEER** | John Deere Greenstar™ RTK using dealer base station |
| **SOWING** | John Deere GS2630 with dry rate controller into a Horwood Bagshaw electric drive airseeder |
| **SPRAYING** | Home made SP boomspray using Trimble auto boom |
| **HARVEST** | John Deere header with GS2630 for yield mapping |

## SOFTWARE AND DATA ANALYSIS

Hicks Farming uses yield maps to conduct grain testing and soil testing in targeted locations to ground truth what is being observed. At this stage zones have been developed by looking at the yield maps in consultation with their agronomist. Hicks Farming would consider using a PA consultant to help better interpret and use the yield data.

## LESSONS LEARNT

Hicks Farming have three key ideas to help growers adopting any PA in their cropping system.

- Start with a RTK ±2 cm system if possible. The investment is worth it to avoid issues related to ±10 cm systems which suffer from creep and are not repeatable.
- Find a width and stick to it. Even if the process of achieving the ultimate goal of CTF is over years, make an informed decision at the start and stick to it.
- Don't react to a single yield map. Variability could be due to the performance of a variety in a particular season, or another seasonal variation. Look at trends over previous years.

## BENEFITS TO DATE

### AUTOSTEER

Hicks Farming sees one of the key benefits to adopting autosteer is reduced fatigue levels. This is especially important at harvest, when picking up a lodged crop. It also helps when using a recorded curve track along a contour bank, removing the stress of operating close to the banks, and makes each operation repeatable with no misses.

Another benefit is increased efficiency in inputs and time. In an ever tightening cost–price environment efficiency gains and increased productivity are essential to business success. This is particularly important in rice, such a high input crop. Savings can be substantial when overlaps are avoided. The benefit is not only economic. Overlap areas often result in crop lodging and can result in rice sterility, and significant yield loss.

### YIELD MAPS

Hicks Farming is starting to use yield maps combined with EM surveys to identify zones for targeted soil testing and grain quality testing. When in the header the operator stops at the target point in the paddock and collects a grain sample. This allows grain quality attributes to be assessed and related to soil characteristics in zones. Nitrogen, phosphorous and sulphur fertiliser test strips are applied (individually) across these zones and the subsequent yield and grain quality data are used to help make future decisions.

Key zones are identified and 'nil nitrogen' strips are used to quantify yield responses.

## THE FUTURE

Hicks Farming has recently moved to variable rate fertiliser application prior to sowing rice. The results they are getting from the targeted test strips are helping clarify the optimum rates required in different zones and improving their understanding of crop responses. Hicks Farming aims to:

- Increase low yielding zones (often a cut area) by applying sufficient nutrients, mainly nitrogen; and
- Apply maintenance fertiliser rates to high yielding zones.

Hicks Farming would also like to develop a similar plan to apply gypsum and lime using targeted soil testing to develop a zone map and variable rate application. They realise that variable rate applications are an opportunity and a challenge. As the data asks more questions it becomes increasingly difficult to answer them all. But with more data, better analysis techniques and targeted testing they believe the investment will pay off. It is the next step in increasing productivity, and the key to farm business survival.

# DEMO FARM
# COLEAMBALLY

## BACKGROUND TO THE DEMO FARM

Coleambally Demo Farm is managed by an advisory committee, chaired by Ian Sutherland, with support from Secretary Alison Hayes. The Demo Farm operates as a not-for-profit organisation which allows community organisations to grow crops as a means to raise funds. The Demo Farm is run as a commercial farm and includes some demonstrations and trial plots.

The Demo Farm owns no machinery and uses contractors and volunteers for all operations. This is a conscious decision and allows more community ownership. Contractors/volunteers can nominate to support a specific community organisation. There are many checks and balances in place to ensure organisations contribute more than just labour/machinery and are actively engaged in the whole enterprise.

## ADOPTING PA TECHNOLOGY

Colly Demo Farm uses contractors for all operations and as a result has had a gradual introduction to the use of auto steer and mapping technology. For the production of maize and winter crops, the Demo Farm has developed a permanent bed system set up with RTK ±2 cm autosteer, which then becomes a controlled traffic system, with all machinery using the furrows as wheel tracks. The beds have been set up using imperial measurements (6' beds) to match the row-crop implements and tractors which are a standard 24'.

The Demo Farm likes to keep up with technology and adopt local best practice, particularly when advantages have been identified. They also have the privilege to be able to invest in testing and/or demonstrating recently developed best practice. For example, the Demo Farm tested a 15 ha block of beds in bays. The rice bays are flat across the bay and beds are formed up parallel to the contour banks, with a bankless channel at each end of the beds. When the bays are flooded the water runs up the furrows. There is then a 10 cm drop to the next bay. The trial was very successful and a further 70 ha was laid out with beds in bays and there is a plan to set up another 60 ha paddock this summer. Ian describes this production system as "the Mercedes Benz of layouts, with uniform watering and better drainage."

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|---|---|
| **LOCATION** | Coleambally |
| **KEY ENTERPRISES** | Rice, winter cereals and canola |
| **TOTAL AREA** | 250 ha |
| **CROPPED AREA** | 250 ha |
| **IRRIGATED AREA** | 250 ha |
| **RICE AREA** | 50 ha |
| **CURRENT PA SYSTEM** | Use our contractors systems |

At this stage the beds in bays are being used for winter cropping (canola and wheat) but there is potential to leave the beds in place and grow rice, a practice being adopted around Griffith. You harvest the rice then direct drill wheat into the beds.

## MACHINERY AND TECHNOLOGY HARDWARE

In rice, nearly all the tractors are using GPS autosteer now. There is a range of systems being used by contractors, some with ±10 cm steering, but most with RTK ±2 cm. Some bring their own base stations, while others use one of the licenced community base stations available.

## SOFTWARE AND DATA ANALYSIS

At this stage yield maps are used as a source of general information and for discussions with the agronomist. They provide discussion points for further investigation and to bounce ideas around. As more data is collected then professional analysis and interpretation is likely to be beneficial.

## LESSONS LEARNT

In 2012/13 the rice harvest was a joint effort with five harvest contractors working in the same paddock. The Demo Farm got yield maps from three of the five headers, meaning there were strips with no data. After looking at the partial yield map the Demo Farm realised the importance of asking for yield maps. Even the partial map you could still identify good and poor areas which can then be used to apply different treatments.

Ian says, "Yield maps seem to ask more questions than giving answers. Yield maps are so important because there is a lot to learn."

## BENEFITS TO DATE

Convenience rather than economic benefits may be the key benefits to guidance at this stage but you would never go back. There are many small advantages that are hard to put a finger on.

As for yield mapping, the fact that the data raises questions is a great thing which makes you go and look for answers. Identifying what is causing an area of the paddock to under perform and conversely why another area is out-yielding the rest. The next step may be variable rate applications, particularly for nutrients. This is likely to be more beneficial and have greater economic returns in irrigation compared to dryland production.

## CHALLENGES TO DATE

One issue the Demo Farm has is unique to the operation because it uses multiple contractors and the difference between imperial and metric systems. It may seem like the difference is only millimetres but across a paddock it is magnified. This is not a problem in the permanent beds where 6' beds are the industry standard for row crop machinery.

## THE FUTURE

Coleambally Demo Farm is always looking at updating practices and technology to benefit the farm returns, and is used as a trial and demonstration site. Currently two companies have plans to trial automating the concrete stops at each end of the bays in the bankless channel system. This will allow irrigators to open and close the stops remotely and/or at a set time. This will add to the automation already in use with the Coleambally Irrigation System which is fully automated. Water can be ordered from the farm office computer with as little as two hours notice and flow rates can also be monitored remotely.

# ARNOLD FARMING
# JERILDERIE

## ADOPTING PA TECHNOLOGY

Bobbie Arnold is one of the younger members of the Arnold family managing 3500 ha south of Jerilderie. Bobbie works with his Grandfather, Father, two brothers and their families (known as Arnold Farming in this study).

Arnold Farming moved into PA when they updated their header about 10 years ago and it came with yield mapping capacity. Since then they have been collecting yield data and have moved to RTK autosteer for all operations.

Arnold Farming can't pinpoint the major source of information which encouraged the move to PA but admits much of it came through the machinery dealers. The primary aims of the move to PA were:

- reduced overlap which leads to minimising inputs, and
- the option to move to variable rate fertiliser application.

## MACHINERY

Currently all tractors, the self-propelled boomspray and the header use Greenstar™ RTK autosteer.

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|---|---|
| **LOCATION** | Jerilderie |
| **KEY ENTERPRISES** | Rice, winter crops (mainly dryland), sheep and cattle |
| **TOTAL AREA** | 3500 ha |
| **CROPPED AREA** | 3100 ha |
| **IRRIGATED AREA** | 1500 ha |
| **RICE AREA** | 400 ha |
| **CURRENT PA SYSTEM** | RTK auto steer all operations, yield mapping, variable rate fertiliser spreading |

Arnold Farming has used the yield maps to develop hand-drawn zones and then apply in-crop nitrogen at different rates according to the zones.

Recently Arnold Farming invested in a variable rate-capable Amazone spreader to allow targeted application of fertilizer, in particular nitrogen or urea.

Arnold Farming had to invest in their own RTK base station to successfully use iGrade on their land-levelling bucket. The bucket has a receiver fitted to it so that accurate levels can be achieved.

Arnold Farming also has a 16ft Horwood Bagshaw land-levelling bucket, fitted with John Deere iGrade system for GPS land levelling.

## IRRIGATION LAYOUT

The use of auto-steer at sowing has enabled irrigation layouts to be improved to avoid part-width laps where possible. This greatly reduces overlap and issues with lodging and infertility caused by doubling up seed and fertiliser.

## TECHNOLOGY HARDWARE

Arnold Farming use the ±2cm John Deere Greenstar™ GPS system and recently moved from using the community base station to investing in their own John Deere Starfire™ RTK receiver. This was needed when they added a John Deere iGrade feature to their Horwood Bagshaw land-levelling bucket controlled by the GS2630 display. To enable the iGrade feature to be effective the base station needs to be within 1.5km of the paddock being levelled.

Variable rate spreading from prescription maps is what Arnold Farming is moving to with the Amazone spreader. Currently they are using its controller but plan to use the GS2630 display to spread at variable rates from prescription maps.

## SOFTWARE AND DATA ANALYSIS

Arnold Farming has not used any specific data management or analysis at this stage. One thing they have done is use the yield maps in conjunction with cut and fill survey maps (on a purely visual basis) to identify zones and then manually vary fertiliser rates when topdressing urea.

## LESSONS LEARNT

One key aspect of adopting PA with both new and adapted machinery is the challenges faced in linking up different branded units. Arnold Farming aims to run everything with the Greenstar™ display in the future. This will avoid the need to learn how to use multiple controllers and software systems, and simplifies the cable network in the tractor cab.

Arnold Farming has noticed that each piece of machinery is slightly more expensive when you upgrade to GPS/autosteer ready. This may change as GPS ready becomes a standard feature rather than an optional extra.

Successful and profitable adoption of variable rate fertiliser (or other input) application will rely on experimentation. Arnold Farming needs to determine how much you can scale back on cut areas of rice fields, and how far you can push the yield on fill areas. What is the best balance of application to optimise paddock returns?

| TECHNOLOGY HARDWARE | |
|---|---|
| **GPS AUTOSTEER** | John Deere Greenstar™3 RTK with own base station |
| **SOWING** | Air cart GS2630 display |
| **SPRAYING** | John Deere SP boomspray with GS2630 controller |
| **HARVEST** | John Deere header with GS2630 |
| **UREA SPREADING** | Amazone linkage spreader with own controller |
| **GPS LEVELLING** | John Deere 9510R tractor pulls 16ft Horwood Bagshaw bucket, fitted with John Deere iGrade system controlled by GS2630 display |

## BENEFITS TO DATE

### AUTOSTEER

Auto steer is great and has:

- reduced overlap
- reduced overall inputs
- enabled set up of rice bays to multiples of the airseeder width
- improved the accuracy of yield maps

### YIELD MAPS

Arnold Farming has been collecting yield maps for about 10 years but haven't fully utilised them. Even so, they have highlighted the variability within the fields and have given them enough confidence to manually vary urea application rates to cut and fill zones.

## THE FUTURE

Arnold Farming sees the future of PA in rice in prescription maps with the aim of optimising yield to maximise returns on inputs, particularly nitrogen. They hope to be able to develop prescription maps and then use variable rate application of fertiliser with the airseeder rather than the spreader.

The adoption of variable rate all relies on experimentation with crop inputs to identify the best way to manage the zones being identified.

## ADOPTING PA TECHNOLOGY

Clinton Brill operates a diverse irrigation farming business with his wife Kylie, and parents Bruce and Glenda (known as Brill Farming in this study). Brill Farming has 1200 ha of irrigation (winter crops, rice and clover) and also runs sheep, bales fodder, and bales straw (wheat and rice).

Brill Farming properties are set up with gravity feed irrigation with bankless channels. The bays are flat with a 10–15 cm drop to the next bay.

Livestock are excluded from one farm which is gradually being redeveloped with 2 m beds within the bays. As the bays are set up the aim is to have runs in multiples of 8 m to suit the bed former which was purchased in shares with a neighbour. The 8 m then suits the 24 m width of the boomspray and the 24 m wide swath of the spreader. All tractors used for in-crop operations are row-crop and set up on 2 m wheel centres to suit the beds.

Brill Farming grows 200 to 250 ha rice each year, depending on water allocation, and has been adopting PA technologies for the past 10 years. They began in 2003 with yield mapping and a moisture meter on the header. Initially these were installed on the header to monitor grain moisture for harvest timing, and to assist with loading trucks legally using load calibration.

Brill Farming believed PA technologies could help them better manage zones in his rice and winter crops. Over the past 10 years aerial imaging* has been used in rice each year as a management tool. This data highlighted the yield differences within and between fields, particularly those associated with cut and fill areas from bay development.

## MACHINERY

Five years after starting the yield mapping John Deere ATU (auto track universal) steering was installed in two tractors. ATU is a steering column rather than hydraulic-based steering system. It allowed Brill Farming to autosteer two tractors with an investment of $20,000. This was considered to be an economical option compared to retro-fitting hydraulic blocks and wiring to the two tractors. This system uses Starfire™1 GPS and is accurate to ±25 cm.

** Aerial imaging: NDVI or Normalised Difference Vegetation Index used to estimate dry matter and determine nitrogen fertiliser application rates at panicle initiation*

| | |
|---|---|
| **LOCATION** | Griffith |
| **KEY ENTERPRISES** | Rice, wheat, canola, sheep, clover, clover hay, wheat and rice straw |
| **TOTAL AREA** | 1200 ha |
| **CROPPED AREA** | 1200 ha |
| **IRRIGATED AREA** | 1200 ha |
| **RICE AREA** | 200–250 ha |
| **CURRENT PA SYSTEM** | RTK autosteer with in-crop operations on tracks |

Replacement tractors are now purchased autosteer ready. Due to the diversity and geographical spread of the operation and the age of some tractors at Brill Farming, each tractor set up so it is able to be used for both spreading and spraying. This allows tractors to be interchanged if there is a breakdown or timing of operations clashes.

## TECHNOLOGY HARDWARE

In 2013 the boomspray was updated to a Cropland 4024. The local John Deere dealer was employed to set up the boomspray to be operated using the John Deere GS2/3 controller. This reduced the time spent by Brill Farming to get the implement functioning correctly.

When the Kuhn spreader was purchased the Kuhn rep and local dealer helped get the John Deere GS2/3 controller to communicate with the spreader.

In 2014 another PA technology investment was made. John Deere iGrade was purchased to move to GPS land levelling with the All Farm bucket. This involved hydraulics and wiring on the tractor and an RTK GPS system, and the iGrade software. GPS levelling requires RTK GPS and uses two units:

- one as the mobile base which needs to be within 1.5 km of the tractor for accurate operation; and
- one fitted to the laser-bucket.

One advantage with the John Deere RTK system is that the units can easily be converted from an RTK base to a receiver on a tractor. When Brill Farming

| TECHNOLOGY HARDWARE | |
|---|---|
| **GPS AUTOSTEER** | John Deere RTK using GS2/3 controller and John Deere ATU steering using StarFire™1 |
| **SPRAYING** | Cropland 4024 with Cropland controller and Greenstar™ 2/3 |
| **SPREADING** | Kuhn spreader with Kuhn Controller and Greenstar™ 2/3 |
| **HARVEST** | John Deere ATU steering, yield mapping using John Deere brown box |
| **GPS LEVELLING** | John Deere 9430 tractor pulls a All Farm bucket, with a John Deere hydraulic block controlled with GS2630 display (iGrade feature) |

is not land-levelling, both RTK units can be used as receivers on tractors and use the neighbour's base station.

## SOFTWARE AND DATA ANALYSIS

Brill Farming is analysing data at this stage. They look at yield maps in John Deere Apex™ software. In the future land-levelling maps will be loaded as an extra layer. The next step is unclear but it is likely professional assistance will be needed to get the best out of the data that has been collected. The analysis of multiple years of yield data over-layed with cut and fill maps will ensure benefits are gained for the farm business.

## LESSONS LEARNT

Brill Farming can't stress enough the importance of having new implement controllers set up to match your GPS system. They need to be functioning correctly well before they are needed in the paddock. Get a guarantee from the dealer that they will ensure the system is working at or soon after delivery, before you commit to purchase. A commitment of technical support by the dealer is the key. If you are on your own, hours and hours can be spent trying to get controllers to communicate with implements, which quickly becomes very frustrating.

Brill Farming invested in their own RTK base station to use iGrade on their land-levelling bucket. The bucket has a receiver fitted to it so that accurate levels can be achieved.

Brill Farming finds the whole steering and GPS system fantastic when it is working well but it can create problems and chew up a lot of time when things don't work. For example:

- Multiple operators: when the system is used by multiple operators with different skill levels it can take a lot of time to make sure everything is set up correctly before an operation is started.
- Swapping screens (steering controllers): moving from one tractor to another is quite straight forward as long as you remember to change the appropriate settings to the correct tractor and implement, especially implement width and offset.

## BENEFITS TO DATE

The key benefits seen by Brill Farming are:

- no over-spray by the boomspray;
- ease of operation when spraying as you have a coverage map and auto-shutoff;
- confidence when spreading due to the coverage map; and
- convenience of knowing field levels over a whole field with John Deere iGrade.

## CHALLENGES TO DATE

Clinton Brill says, "Knowing the right people to talk to is one of the biggest challenges to adopting any PA technology". Brill Farming's neighbour has shared a lot of ideas and they have spoken to a number of other growers. Finding sound technical advice, particularly on machinery purchases is difficult.

Using or operating the technology can also be quite difficult, which is a problem when employing staff, particularly casuals – the training and troubleshooting can easily become quite time consuming.

Rice yield data will be used to prepare zone maps for variable rate fertiliser applications.

## THE FUTURE

Variable rate fertiliser spreading is the next step for Brill Farming. One of the keys will be developing the application maps. This is where Kylie Brill's computing skills will help greatly to develop the maps. They will start with land-levelling as the initial map layer and overlay yield data, and panicle initiation NDVI data. In the first place they will use the John Deere Apex™ software but Brill Farming is looking into getting SMS (a GIS data management program) if needed. They will also seek advice and assistance from a PA consultant as required.