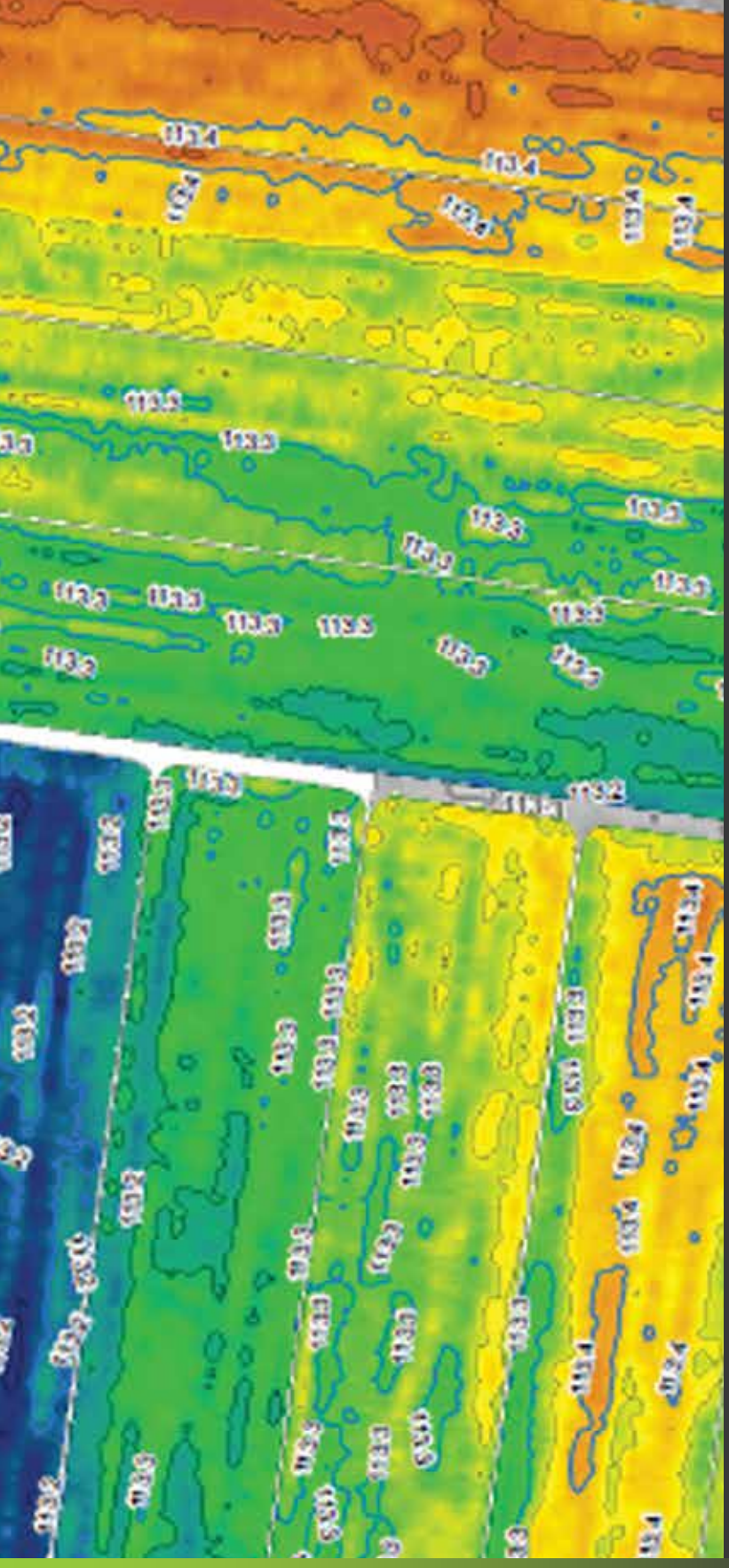


PRECISION AGRICULTURE IN **RICE** PRODUCTION

Grower experience and insights

precision agriculture.com.au

RURAL INDUSTRIES
Research & Development Corporation

Australian Government
Rural Industries Research and Development Corporation

precision agriculture.com.au

This document is part of RIRDC project PRJ-008483 I*mplementing precision agriculture in the Australian rice industry*, being conducted by PrecisionAgriculture.com.au and supported by the Rural Industries Research and Development Corporation and Rice Research Australia.

Acknowledgments: These case studies are only possible due to the enthusiastic input by the six rice growers. The project team thanks and acknowledges the time given by:

- Nathan Pate, Tocumwal
- Richard Sleigh, Jerilderie
- Andrew Hicks, Deniliquin
- Ian Sutherland, Coleambally Demonstration Farm, Coleambally
- Bobbie Arnold, Jerilderie
- Clinton Brill, Griffith.

Written and designed by: Di Holding, AnDi Communications

RIRDC Project PRJ-008483

Published July 2014

Contact: details at PrecisionAgriculture.com.au

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.

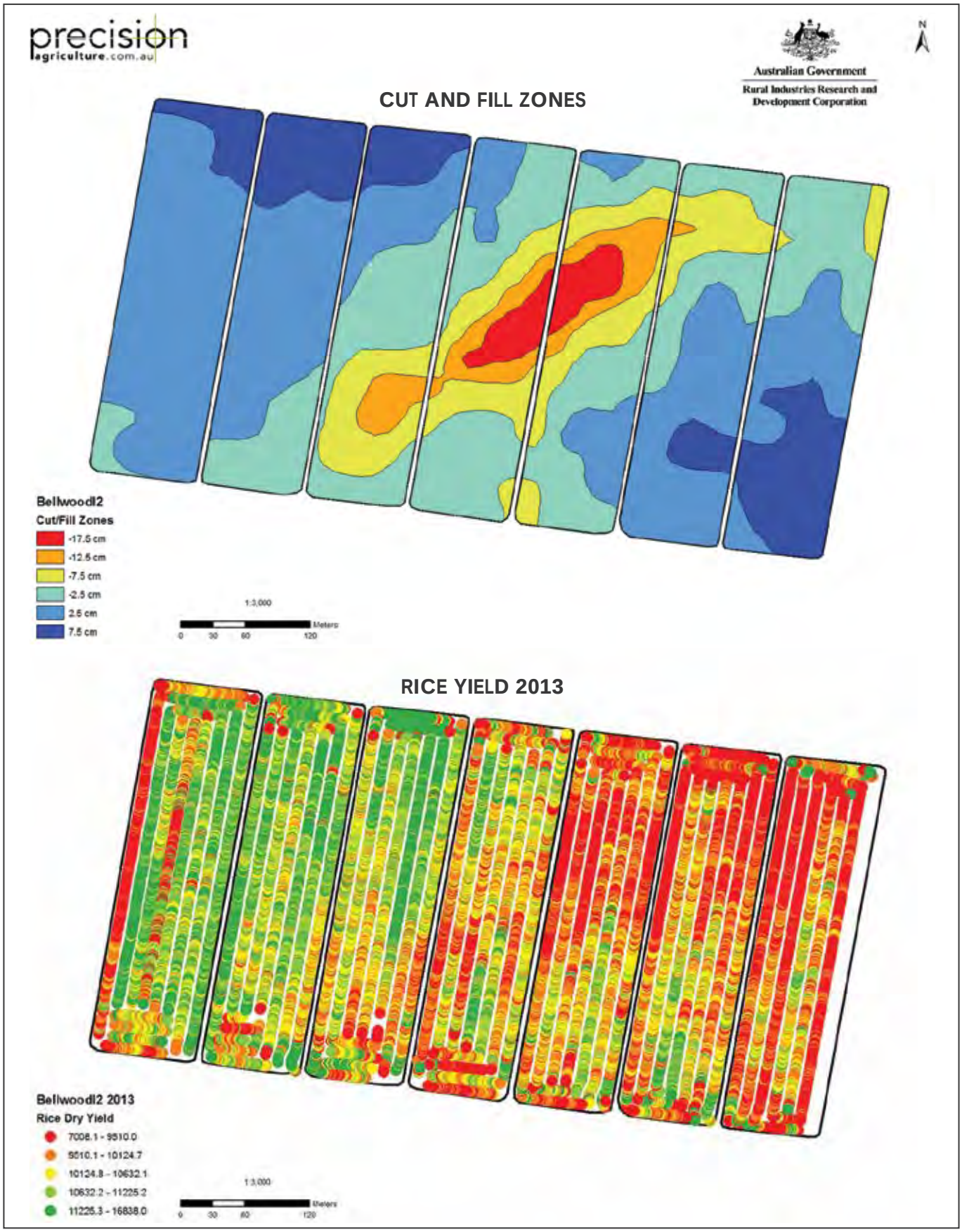
GROWER EXPERIENCES AND INSIGHTS

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.

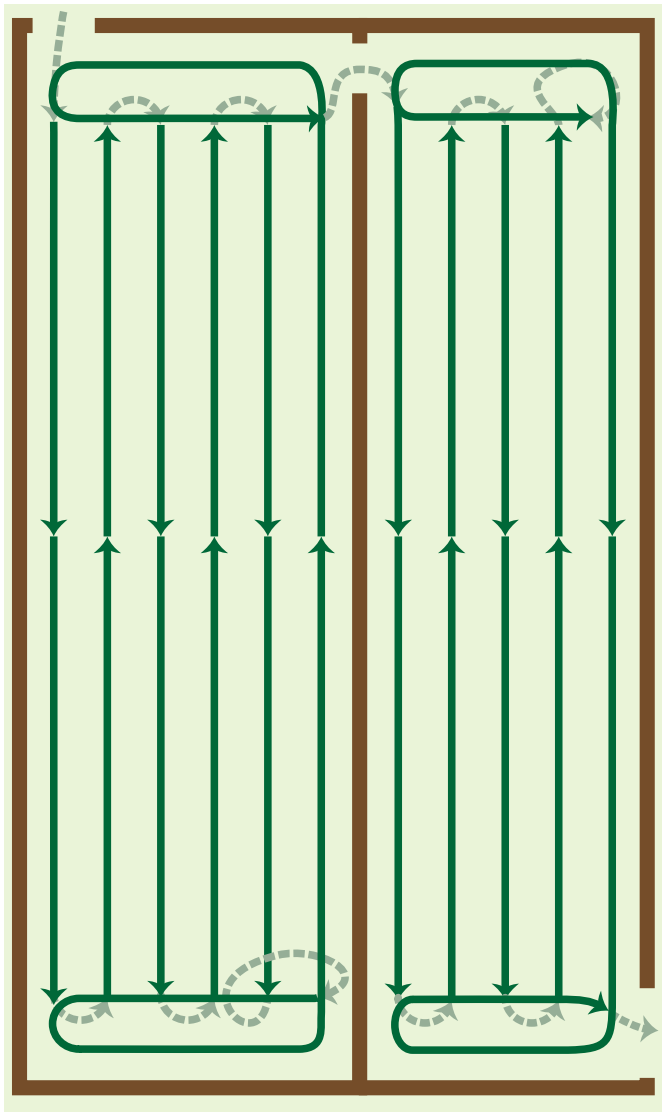
LOCATION	Tocumwal Murray Valley NSW
KEY ENTERPRISES	Wheat, barley, canola, rice
TOTAL AREA	1300 ha
CROPPED AREA	1000 ha
IRRIGATED AREA	250 ha
RICE AREA	200–250 ha
CURRENT PA SYSTEM	9 m CTF with 3 m wheel centres; variable rate seed/MAP/urea at sowing; variable rate topdressing; variable rate lime and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

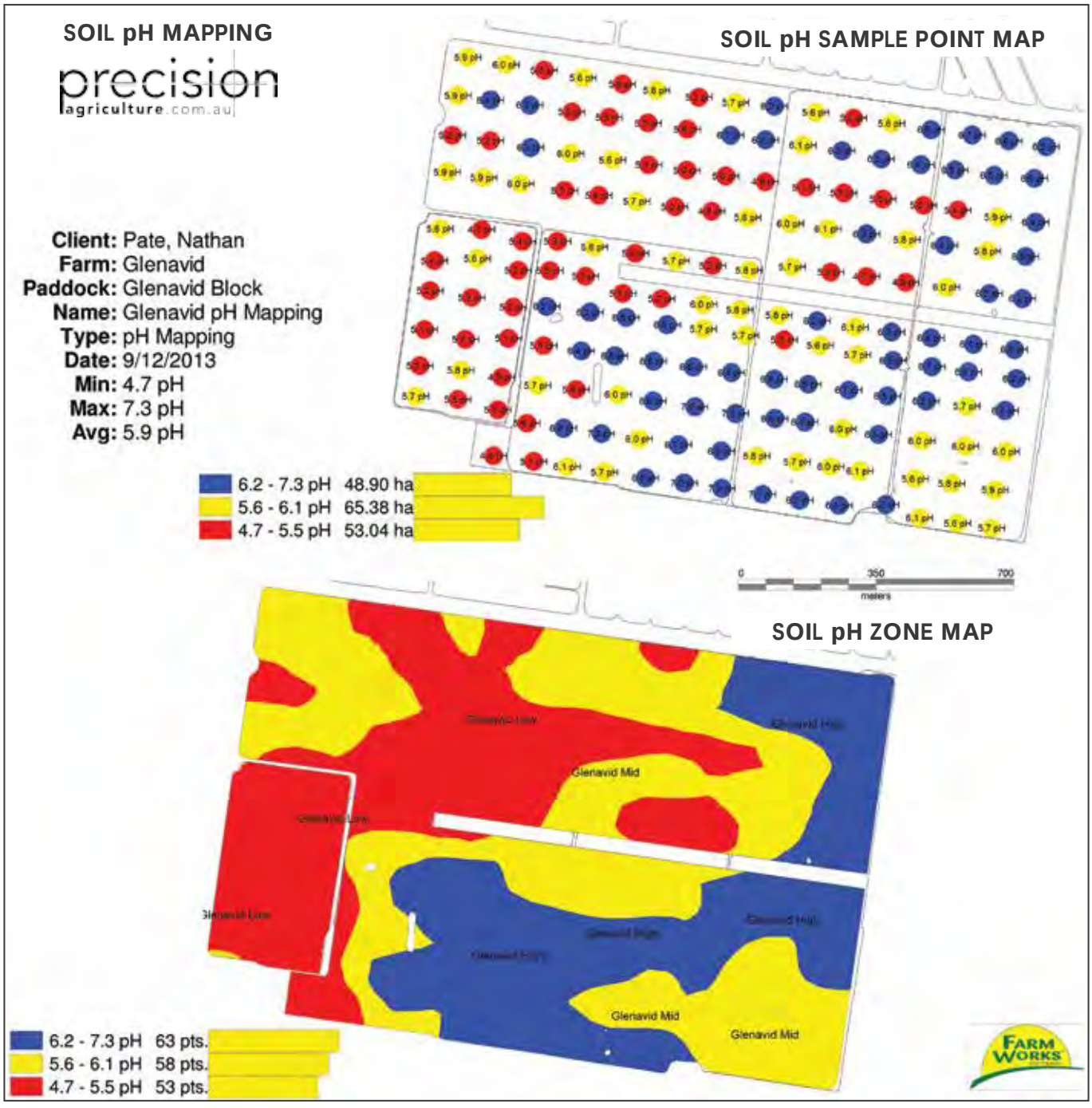
The use of trials and nutrient rich strips will hopefully make it clearer as the years go by.

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.