CASE STUDY
PA ASSISTED DRAINAGE

NOVEMBER 2019

PA for Profit: Show me the money

Introduction

This is one of five case studies in the Profit First PA communication series derived from 'Assessing the economic value of precision agriculture tools for grain farming businesses in the Southern Region' funded by GRDC. Other project outputs have included:

- a review of existing information on the economics of PA.
- a management guideline to aid growers and advisers decision making in adoption of PA.
- a series of short videos, podcasts and fact sheets to further highlight the economics of PA when done well.

This case study compares the experiences of two growers who are using precision agriculture tools to help overcome waterlogging issues and improve drainage, thereby improving their farm gross margin.

The project has identified a 5-step process (Table 1) to make sound financial decisions for adoption of PA.

TABLE 1 PROFIT FIRST PA QUESTIONS

FIVE PROFIT FIRST PA QUESTIONS
1. What are the profit gain opportunities for the farm business using the profit driver's framework
2. Does PA have a role in addressing those constraints/opportunities?
3. What is the cost and benefit of implementing the PA practice as determined using a partial budget approach.
4. Are there other benefits or barriers to consider?
5. Does the business have the capacity to usefully implement the technology?

The following table is a broad guide to where PA assisted drainage is likely to have fit (questions 1 and 2).

TABLE 2 AREAS OF LIKELY RESPONSE FOR DRAINAGE

RAINFALL ZONE	SUBREGION	DRAINAGE
LOW	Upper EP	
	Western EP	
	Upper North	
	SAVIC N Mallee	
	SAVIC S Mallee	
	Vic C Mallee	
MEDIUM	Lower EP	
	Central YP	
	Lower YP	
	NorthYP/Mid North	
	Wimmera-Bordertown	
	SA Upper SE	
	Central Vic	
	Nth Central Vic	
HIGH	SA Lower SE/KI	
	Southern Vic	
	NE Vic Slopes	
	Tas Grain	

Key: Green = highly likely, yellow = sometimes likely, orange = unlikely

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This case study assumes that the profit opportunity has been correctly identified, and that PA is an appropriate way for the farm to tackle it (questions 1 and 2). We focus on answering the remaining 3 questions.

Details of each participant and their involvement in this survey are listed in Table 3. Several other growers were also interviewed but did not provide economic analysis. Their insights also form part of the background discussion.

Doing you own numbers is a critical part of the decision making process with PA. The examples shown here are not universal, and are intended as examples of what is possible.

QUESTION 3: What is the cost and benefit of implementing the PA practice as determined using a partial budget approach. (Do the economics stack up?)

For a project like drainage PA is a tool and an enabler, rather than necessarily being the benefit itself. It becomes difficult to separate the financial benefits associated with PA rather than the actual drainage. This case study treats it all as a whole, and demonstrates the use of PA within drainage, rather the sole benefit of PA.

Financial benefits

TABLE 3 BACKGROUND INFORMATION FOR CONTRIBUTING FARMS

	FARM 1	FARM 2
Location	Southern VIC	Wimmera, VIC
Annual rainfall (mm)	525	500
Property size (ha)	1,960	1,400
Crop mix	Wheat, Canola, Faba Beans	Wheat and Canola
Participant description of farming system	Mixed farming operation.	No-till.
Profit opportunity	Increase yields and improve soil by reducing waterlogging on sodic clays	Increase grain yield and quality through reduced waterlogging on sodic clays
PA Assistance	Use elevation maps to look at drainage options, and GPS enabled earthmoving equipment to build drains	Create drainage maps using a drone topography survey, combined with yield maps
Assumptions on benefits	An increase in yield of 0.5t/ha in wheat, 0.3t/ha in canola and 0.2t/ha in faba beans over the total area that will benefit. This will repeat each year.	An increase in yield of 1t/ha in wheat and 0.6t/ha in canola over the total area that will benefit. This will repeat each year.
PA Skills/Team	The grower hired a PA consultant to use a drone to create elevation maps and work out where the drains will go. This information was then handed to a contractor with GPS enabled earthmoving equipment who built the drains.	The grower hired a PA consultant to use a drone to create elevation maps and work out where the drains will go. The construction of the drains was then done by the grower. The $5,000 spent on hardware was for GPS equipment in the scraper.

TABLE 4 ECONOMIC ANALYSIS FOR CONTRIBUTING FARMS				
	FARM 1		FARM 2	
Location	Southern VIC		Wimmera, VIC	
Annual rainfall (mm)	525		500	
Property size (ha)	1,960		1,400	
Area that will benefit (ha)	190		200	
GAINS[3]	**TOTAL**	**PER HA**	**TOTAL**	**PER HA**
Yield increase[1]	$20,912	$110.07	$45,411	$227.06
Labour cost saving				
Variable cost saving				
Total Gains	$20,912	$110.07	$45,411	$227.06
CAPITAL				
Hardware purchase price			$5,000	$25.00
Software purchase price				
Total Capital Investment			$5,000	$25.00
OPERATING COSTS[2]				
Additional Variable Costs	$9,940	$52.32	$22,000	$110.00
Finance cost (5% of purchase price)			$250	$1.25
Depreciation (15% of purchase price)			$750	$3.75
Total Costs	$9,940	$52.32	$23,000	$115.00
DISCOUNTED ANNUAL COSTS[3]	$1,411	$7.43	$4,143	$20.71
Net Annual Benefit (discounted for 7-year life)	$19,501	$102.64	$41,268	$206.34
Payback Period (years)	0.4		0.4	

[1]Yield gains were derived from grower estimates over time, and inherently account for a level of seasonal variability
[2]Operating costs are the total costs of the operation to begin with in the first year
[3]The discounted benefits and costs listed are averaged over a 7-year period that has been discounted to account for the net present value of money

This shows that the drainage work had a large benefit for both farms and they were both able to recover all costs within the first year. The net annual benefit ranged from $103/ha to $206/ha which shows how much extra income will be generated over the next 7 years. In reality this will continue to accrue beyond 7 years as the changes are thought to be permanent.

The benefit varies depending on the amount spent on drains in relation to the area improved by the drains. In these two farms the benefit was widespread with some areas improving from almost no production and others just improving slightly. In other cases, it might be a distinct low point in the topography that would benefit with little benefit on the surrounding areas.

Whilst these drainage techniques were done without any other soil work, it is common to use a few tools at the same time. These include applying gypsum and deep ripping, which can be targeted to specific problem areas using EM maps. This helps to reduce total expenditure on the constraint without impacting on the benefit.

This analysis captures a response in time based on average yields and treatment differences observed by the participating growers. In other regions where it is more variable, the use of drains may only provide benefit in fewer years which would impact on the net benefit.

QUESTION 4: Are there other benefits or barriers to consider?

Perceived operational and whole farm benefits

Aside from the economic benefits, there were numerous operational benefits noted.

Strategically adding drains into a paddock landscape ultimately increased the total cropping area, and total farm productivity. Problem paddocks and low-lying areas showed more consistent production, particularly in waterlogging, high rainfall years. When water is redirected away from low lying areas, crops benefit through increased water use efficiency, greater vigour and weed competition. Flow on benefits, such as better soil health, increased N fixation of legumes and improved soil structure are also considered.

Improved grain quality is also noted by growers, with less fungal staining of grain due to less water sitting in the soil profile at maturity. Increased grain protein can also be achieved due to greater confidence in urea applications and less nitrogen lost through denitrification.

By reducing wet areas in a paddock, or having less ‘bog holes’, greater machinery efficiency can be achieved. This improves timeliness of operations during the season, which can benefit the whole farming system. Greater machinery efficiency is also increased when drainage techniques are combined with other PA technologies such as controlled traffic.

Investment into this type of improvement, aided by the use of PA technology, is essentially a permanent land improvement. Whilst there will be maintenance required, and drains may need attention a few years down the track, the benefits from reduced water logging will generally be repeated year on year.

Barriers

Analysing the different data layers of elevations maps, EM maps, multiple years of yield and NDVI maps all takes a significant amount of preparation time. A team approach may be required to develop a plan, including the grower, agronomist, PA consultant, and contractors, and getting input in a timely fashion from each party can be difficult. This all comes prior to the physical process of creating drains.

Sometimes getting hold of contractors with earthworks equipment that is compatible with GPS and uses RTK accuracy, can be a challenge. Early planning and organisation is required to overcome this.

Generally, the time frame for this work will be between harvest and seeding which is a limited window. Having an overall farm plan and identifying the highest priorities for attention is required to make implementation happen.

A downside to the drainage process is the creation of drains in the middle of paddocks that require either slowing down or avoidance with machinery at different times of the year. This is offset by the efficiency gain of not having to avoid bog holes.

QUESTION 5: Does the business have the capacity to usefully implement the technology?

Implementation considerations

To work out how much production you are losing in the low-lying areas, it is important you look at it from a big picture approach. In how many seasons is waterlogging experienced - is it most years or only in wet years? How much production is lost each season, and in the long term? Numbers will stack up if in the majority of years, conditions result in significant water logging of cropping areas. If these low-lying areas can achieve a greater production potential, and the improved drainage will have a number of flow on benefits through management and timeliness, then the PA and earthmoving investment is something worthwhile looking into.

The farms in this case study invested in drone elevation mapping along with rainfall simulation software to see if there was the opportunity to create further gains. The simulations done by a PA consultant allowed them to see how beneficial the investment in drains would be, before proceeding. Alternatively, elevation maps can be taken from current machinery where there is RTK guidance systems in place. This removes the need for drone mapping and can make it cheaper to look into drainage work with the simulations provided by the PA consultants, although resolution is likely to be coarser.

Checklist

- Elevation maps with a correlation to yield data
- Software modelling to identify water movement across a paddock and interception points
- Skilled operator and GPS equipped earthmoving equipment to control depth

The bottom line

Did it solve the profit constraint?

Yes. In these cases, PA assisted drainage reduced waterlogging and has increased the productive cropping area. Yield increases caused an annual benefit of $102-$206/ha across the areas that were worked on. It was also believed that the reduced waterlogging delivered a benefit from improved grain quality, however this couldn't be quantified into an economic benefit.

Improved management came from less variability within a paddock and more reliable crops in the low-lying areas. With less boggy areas, the efficiency of machinery and improved timeliness of operations added to a whole farm benefit from this technology.

Works best when....

Drainage maps are prepared well in advance, and there is sufficient time to implement the earthworks and not rush the process.

Traps to look out for:

- Considering the process paddock by paddock rather than at a whole farm landscape level. It may create another issue elsewhere.
- Not accounting for the differences between seasons and over-reacting to a wet year. As a high capital input project there must be regular waterlogging issues to achieve a payback.

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