Farmer Case Studies on the Economics of PA Technologies

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INTRODUCTION

One of the major goals of the Southern Precision Agriculture Association (SPAA) is to increase the adoption of precision agriculture (PA) across Australia. There has been a rapid adoption of Global Positioning Systems (GPS) guidance and autosteer in South Australia in the last 5 years. It is estimated that 30% of broadacre crops in SA are now sown and/or sprayed using GPS technology. However, other PA technologies such as yield mapping and variable rate is less common with <1% of adoption across cropping regions in SA. One of the major reasons for this is the lack of evidence that the investment in variable rate technology (VRT) can provide sound financial returns to farmers. The aim of this report is to quantify the economic benefits of PA on 6 farms across SA. The PA technology evaluated included yield mapping and VRT, as well as GPS guidance and autosteer. It is hoped this information will provide farmers and advisors valuable background information in deciding whether an investment in PA will improve individual farm profitability.

METHODS

Six farmers were interviewed from different cropping regions of SA and with varying levels of PA experience (Table 1). Information was collected on:

- area of cropping program, crops grown, crop yields, gross margins, rainfall, soil types (Table 2)
- variable input costs (fuel, fertiliser, seed, pesticides, machinery, labour) per ha
- GPS equipment purchases and purpose
- evidence that PA is working on their farm in regard to less overlap, VRT etc
- other benefits of PA e.g. conducting own agronomic experiments

This information was collated, analysed and a case study written on each individual farmer.

Table 1. Name, location, farm operation size and PA experience of farmers

Farmer	Location	Farm operation	Years of PA experience
Allen Buckley	Waikerie	3000 ha	7
Malcolm and Brian Sargent	Crystal Brook	1600 ha	8
Randall, Jordan and Max Wilksch	Yeelanna	2700 ha	2
Richard and Craig Turner	Snowtown	2340 ha	10
Graeme Baldock	Buckleboo	4475 ha	5
Mark Branson	Stockport	1200 ha	10

Table 2. Rainfall and major soil types

Farmer	Annual Rainfall	Soil types
Buckley	250 mm	Dune/swale formation, sandy loams, shallow red loam over limestone
Sargent	400 mm	Clay loam, sandy loam
Wilksch	425 mm	Red brown earths, sandy loams over sodic clay
Turner	400 mm	Red brown earths, sandy loam over clay
Baldock	300 mm	Gently undulating dune/swale formation, sandy loams, red loam over clay
Branson	475 mm	Black cracking clay, red brown earths

Economic analysis

A relatively simple economic approach was used in this study. The total cost and annual benefit of GPS equipment for each farming operation was calculated and expressed as a total and in $/ha. From this, a "payback period" was determined which is the time taken for the equipment to "pay for itself". The payback period is a function of the annual benefit relative to the initial cost of the GPS equipment and the time taken for the benefit to be instigated. After this payback period, income generated from the GPS equipment becomes profit. The quicker the payback period, the better the investment.

The total cost of equipment for each farmer was simply calculated from the original purchase price (gst exclusive).

Savings on input costs were based on reduced overlap using GPS equipment. This was calculated using the farmers' figures on the individual paddock area that was sprayed, fertilised etc before and after GPS equipment was used (example in Table 3).

Table 3. Example of savings in less overlap using GPS

	Area ha	% overlap
Actual area of paddock	100	-
Area of paddock sprayed, fertilised etc before GPS	105	5%
Area of paddock sprayed, fertilised etc using GPS	102	2%
Saving on overlap using GPS	**3**	**3%**

Savings using VRT were calculated from comparing variable rate fertiliser application with a previous "blanket" rate of fertiliser used before PA was employed (example in Table 4).

Table 4. Example of savings in fertiliser using VRT

Blanket rate of DAP		**Area (ha)**	**Total (kg)**
Rate (kg/ha)	100	100	10000
VRT rates of DAP		**Area (ha)**	**Total (kg)**
Rate (kg/ha)	100	50	5000
Rate (kg/ha)	80	25	2000
Rate (kg/ha)	50	25	1250
Total			8250
Saving in fertiliser			**1750**

Production increases from VRT were calculated from higher yields achieved by increasing fertiliser rates on low fertility areas of paddocks. On-farm trial data was used for this purpose. Production increases from inter row sowing were estimated using trial data. Actual farmer data on grain prices and input costs was used in the majority of calculations. Estimates were used when this was unavailable. Soil phosphorus (P) in this report refers to Colwell P. P fertiliser is expressed as units of P per ha.

RESULTS AND DISCUSSION

Costs and benefits

The costs and benefits from PA in this study are summarised below. For all cases the annual benefit from cost savings and increased production was enough to cover the cost of guidance and autosteer equipment within 3 years on average (range of 1-5 years). The payback period for yield monitoring and VRT equipment was longer, some 7 years on average (range of 1-10 years). This is mainly because of two reasons. Firstly, the initial high price of yield monitoring in the mid to late 90's before the equipment became standard on most modern harvesters less than 10 years old. Secondly, for most farmers it was some years before a VRT program was implemented because farmers were not confident to go full VRT until they had evidence it would work. The first step in gaining confidence was targeted soil testing which revealed that varying rates of P fertiliser was a viable option because low yielding areas were high in P, and high yielding areas were low or adequate in soil P. Some of the farmers were reducing their overall fertiliser input using VRT, while others were increasing production on low P areas within paddocks e.g. sand dunes. Involvement with organisations such as SPAA and PIRSA were important in verifying potential returns from PA. Farmers looking to adopt PA in the future are better positioned to make VRT pay within 2-3 years because of access to lower cost equipment (yield monitor, VRT equipment) and more information on the likely financial returns.

Table 5. Summary of costs and benefits of GPS equipment

Farmer	Capital invested in PA		Annual benefit		Payback period (years)	
	total	$/ha	total	$/ha	Yield monitor and VRT equipment	Autosteer & guidance
Buckley	$ 68,500	23	$ 32,850	11	1	4-5
Sargent	$ 98,500	62	$ 20,180	13	10	1-5
Wilksch	$ 73,000	27	$ 57,240	21*	-	1-2
Turner	$ 34,432	15	$ 35,100	15	6	1
Baldock	$ 52,000	12	$ 47,842	10*	-	5
Branson	$ 73,800	62	$ 44,880	37	9	3
Average	*$ 66,705*	*$34*	*$ 39,682*	*$18*	*7*	*3*

*estimated potential, not proven

Table 6. Breakdown of GPS benefits

Farmer	Annual benefit $/ha			
	Savings in overlap	Savings using VRT	Increased production using VRT	Other production increases**
Buckley	4		7	
Sargent	5	5		3
Wilksch	3			18*
Turner	5	10		
Baldock	2		8*	
Branson	10	9		18
Average	*$5*	*$8*	*$7*	*$13*

* estimated potential, not proven

** includes reduced soil compaction, inter row sowing etc

Other major benefits of PA

The reduction in fatigue was highly rated as a benefit of guidance and autosteer amongst all 6 farmers. The ability to conduct your own agronomic experiments was an important benefit for 2 farmers, which has the capacity to lead to better whole-paddock or whole-farm decisions that increase profit.

Management time spent by farmers on PA

Most of the farmers interviewed spent 3-7 days per year organising yield and variable rate maps. Most used basic software supplied by manufacturers and machinery dealers. Although the software was basic, it is fair to say the level of computer and GPS literacy amongst these farmers was high. This may be a significant barrier for further adoption of VRT. Some farmers used the advice of a PA or agronomic consultant in preparing variable rate maps. In contrast, guidance and autosteer takes very little training and on-going management.

Evaluating the economics of PA on your farm

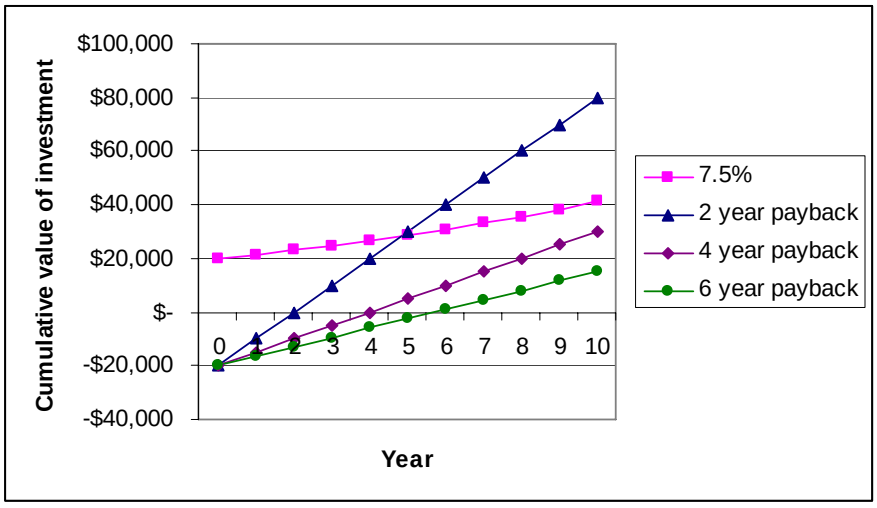
As with any decision to invest capital, farmers need to evaluate the likely returns from PA before investing in equipment. They may engage the services of a PA and/or agronomic consultant to help them with this evaluation. The decision to purchase guidance or autosteer is more straight forward than VRT equipment. An important first step in evaluating the feasibility of VRT will be at least some yield maps and targeted soil testing in different areas of the paddock before purchasing equipment specifically for VRT e.g. electric seed rate controllers. To maximise the return on investment, PA equipment should pay for itself in 2-3 years, particularly given the expected lifespan of PA equipment is likely to be only 5-15 years before it needs replacing. The rapid improvement in "value for money" for new GPS products means that equipment is likely to be worthless after 10 years. The following two examples illustrate the importance of a quick payback period for GPS equipment.

Example A - $20,000 investment in a 10cm autosteer system

Four scenarios are tested in this example,

1. Savings in inputs return $10,000 per year resulting in a payback period of 2 years
Savings in inputs return $5,000 per year resulting in a payback period of 4 years
Savings in inputs return $3,500 per year resulting in a payback period of 6 years
Investing the $20,000 at 7.5% compounding (control)

The cumulative value of the investment is tracked over 10 years. The autosteer after this time is considered to have no value.



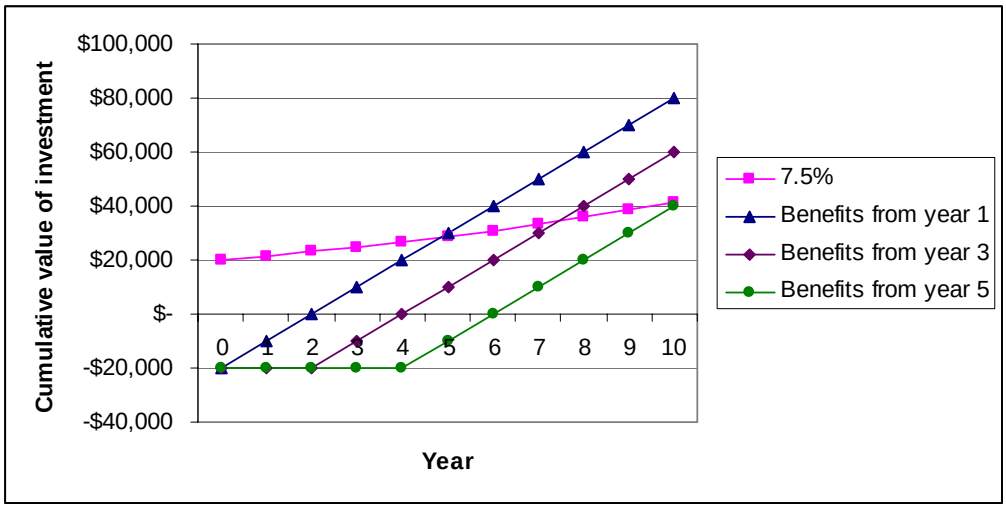
The only scenario to return a greater profit than 7.5% compounding was the first scenario whereby the autosteer returned $10,000 per year in savings on inputs and paid for itself within 2 years.

Example B - $20,000 investment in VRT equipment

Four scenarios are tested in this example,

1. The equipment returns a profit of $10,000 per year, and this profit starts in year 1
The equipment returns a profit of $10,000 per year, and this profit starts in year 3
The equipment returns a profit of $10,000 per year, and this profit starts in year 5
Investing the $20,000 at 7.5% compounding (control)

The cumulative value of the investment is tracked over 10 years, and again the GPS equipment after this time is considered to have no value.



In this example, if the profit generated from the VRT equipment starts in years 1-3 then the investment is reasonably good compared to 7.5% compounding. If the return on investment only starts from year 5 onwards, it is likely to be no better than 7.5% compounding over 10 years.

These examples highlight that the payback period is a function of the annual benefit relative to the initial cost of the GPS equipment and the time taken for the benefit to be instigated. The quicker the payback period, the better the investment. In addition to quick payback periods, other key factors in relation to PA as a good investment are,

Scale of operations. Larger farms can afford to invest more money in PA and will achieve a greater return over time. Smaller farmers should consider syndication or sharing of PA equipment.
Computer literacy. A reasonably high level of GPS knowledge and computer skills are required for successful VRT implementation. This is not the case for autosteer and guidance.
Conduct a feasibility study first to work out a budget, and then shop around the GPS manufacturers for a product that suits your requirements. Consult advisors and other farmers in making this decision.

CONCLUDING REMARKS

PA technology offers farmers opportunities to increase their profitability if they make a sound investment in the equipment required. An initial simple feasibility study is an important first step. In regard to VRT, farmers today are well-placed to take advantage of the knowledge gained from the growers in this study who have been the early adopters of PA technology. Also, the cost of PA equipment has become rapidly more affordable in the last 5 years which will enhance the profitability of adopting PA for many farmers.

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