

Do the sums to check precision pays its way

Matching the amount of money spent on precision agriculture with its expected benefits is the key to making money from the new technology. This article outlines a simple investment analysis, developed by CSIRO, which can be used to determine whether precision agriculture will return a profit.

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The key to making money from precision agriculture is for individual farmers to choose an aspect of the technology that provides rapid and certain benefits across a wide area of their farm.

To achieve this, farmers can use a CSIRO-developed analysis to determine the most profitable investment in precision agriculture technology for their farm.

The analysis indicates that for many farms the value of using zone or variable rate technology to manage fertiliser application is not yet clear and in some situations this aspect of precision agriculture will not return a profit.

But using controlled traffic assisted by precision agriculture technology to reduce spraying costs could pay real dividends through significant reductions in spray overlap.

Benefits of precision agriculture

Precision agriculture uses a global positioning system (GPS) to locate paddock information and management events precisely on a farm.

Such information enables farmers to make targeted management decisions for distinct areas of a property by linking data about yield, soil type and nutrient status with management actions such as fertiliser or sowing rate and the location of machinery traffic.

At a glance

- To achieve the benefits of precision agriculture farmers need to determine the most profitable aspects of the technology for their farm.
- A CSIRO-developed investment analysis can be used to indicate whether precision agriculture will return a profit for an individual farm.
- The analysis suggests that using controlled traffic assisted by precision agriculture technology to reduce spray costs could pay real dividends on many farms.



If the benefits of using precision agriculture technology last only one year, then \$20,000 spent on the new technology will break even only if it increases the gross margin by 13 per cent in the year of purchase. But if the benefits of using precision farming last for 10 years (a more likely scenario), the gross margin required to break even decreases to 2%.

While precision agriculture has been used in Australia for about 10 years, only a small proportion of farmers have adopted the technology.

For example, during 2000, only five per cent of grain farmers and 2% of mixed farmers were using precision agriculture of any description.

A key reason for the poor adoption rate is the understandable reluctance of farmers to invest many thousands of dollars in precision agriculture without knowing if the technology will return a profit.

Unfortunately, it will not be possible to gather evidence to show that precision agriculture is profitable unless more farmers invest in it but this vicious circle can be broken — or at least weakened — using a simple investment analysis.

The analysis indicates whether or not investment in precision agriculture is feasible for an individual farm.

Investment value

A range of factors affect the investment value of precision agriculture including the current farm gross margin, cost of precision agriculture equipment; the area and number of years over which the equipment is used and the rate at which benefits from adoption start to occur.

The CSIRO investment analysis uses a 'discounting' process that recognises that a dollar received today is worth more than a dollar received next year.

How the CSIRO analysis works

Many existing analyses of precision agriculture rely on unsubstantiated estimates of the yield or gross margin benefits precision agriculture will provide.

Rather than guessing how much benefit precision agriculture might provide, the CSIRO analysis determines how much benefit the new technology needs to provide to make the investment in precision agriculture profitable. This value is presented as a 'break even' increase in gross margin, enabling the investor to aim for a gross margin that is realistic for their farming operation and to choose an investment strategy to achieve the profit increase.

Analysis assumptions

The CSIRO analysis has been designed to illustrate factors that affect the investment value of precision agriculture technology.

The analysis assumes all of the costs to implement precision agriculture technology occur in the first year and also that the benefits from using the technology start to occur in the first year of operation.

The analysis also assumes the maximum benefit of using the technology will occur in year 10 and that the benefit from investment lasts until year 10.

Other assumptions are that the benefits apply across 1500 hectares of crop, the current cropping gross margin is \$110 per hectare and the discount rate (interest rate plus risk premium) is 10%.

But these assumptions will not apply equally to every farm and farmers are encouraged to do their own sums using a spreadsheet that can be obtained from CSIRO by phoning (08) 9333 6461.

Technology costs affect returns

The amount spent on precision agriculture technology will determine the increase in gross margin required to make it pay for itself.

For example, a \$20,000 investment in precision agriculture needs to increase gross margins by 4% if it is to break even (see Figure 1A).

If after 10 years, the gross margin from precision agriculture crops is not at least 4% higher than the gross margin from crops grown conventionally, the investment in precision agriculture will have made a financial loss.

Cropping gross margin

For a farm with a current cropping gross margin of \$50/ha, \$20,000 spent on precision agriculture needs to raise the gross margin by 8% to break even (see Figure 1B).

But if the current gross margin is \$200/ha, the required increase in gross margin needed to break even is only 2%.

Start of benefit

Because time erodes or discounts the value of money, the delay between paying for precision agriculture technology and receiving a benefit from the investment has a large impact on whether the investment in precision agriculture will pay.

For example, if benefits start to occur in the year of a \$20,000 purchase, the break even gross margin is 4%. But if the start of benefit is delayed until year five, the break even bar is raised to 7% (see Figure 1C).

Start of maximum benefit

The time taken to reach maximum benefit from an investment also affects its ability to pay.

For example, \$20,000 spent on precision agriculture will break even if it increases the gross margin by 2% in the year of purchase. But if it takes 10 years to achieve maximum benefit from the investment, the gross margin increase required to break even rises to 4% (see Figure 1D).

Duration of payback

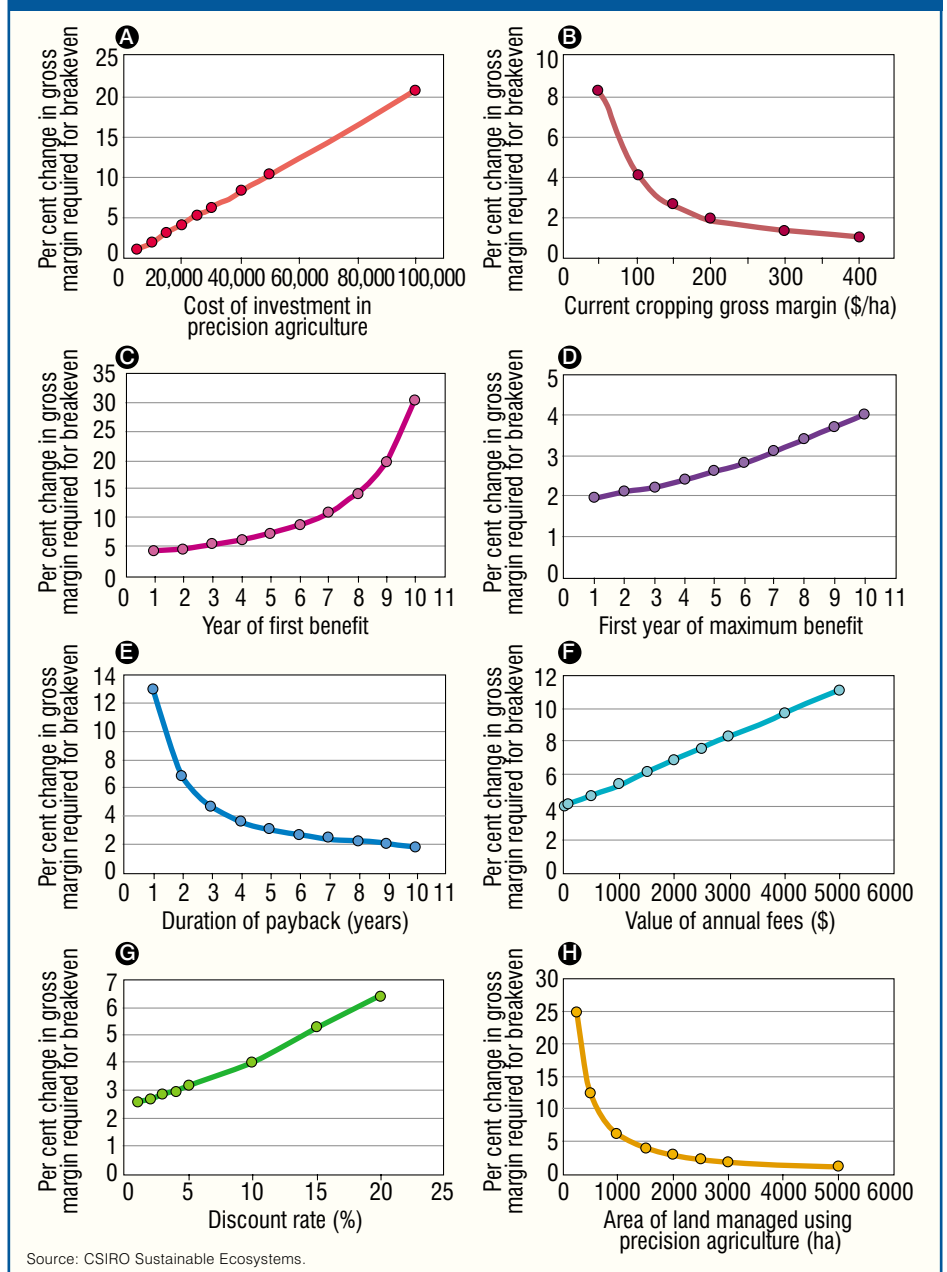
If the benefits of using precision agriculture technology last only one year, then \$20,000 spent on the new technology will break even only if it increases the gross margin by 13% in the year of purchase.

But if the benefits of using precision agriculture last for 10 years (a more likely scenario), the gross margin required to break even decreases to 2% (see Figure 1E).

Annual fees

While the annual fees required to keep using some forms of precision agriculture

FIGURE 1 Factors influencing the profitability of precision agriculture



technology might not seem like much compared with initial set-up costs, they can accumulate and subsequently impact significantly on the value of the precision agriculture investment.

Adding \$1000 of annual fees to the initial implementation costs increases the gross margin required to break even by almost 2% (see Figure 1F).

Discount rate

The discount rate that needs to be applied to economic analyses depends on the level of inflation and the risk-adjusted return on the use of money.

As a result, the discount rate will vary between individuals and also can change for a given individual as their business needs and goals evolve.

As a rule, the 'correct' discount rate lies somewhere between the cost of borrowed

funds and the interest rate that can be achieved on invested funds.

Low-risk investments such as term deposits will attract a lower interest rate than more speculative investments such as venture capital funds.

Investment in precision agriculture probably lies somewhere between these extremes.

A 10% discount rate is commonly applied to on-farm investment and adding 5% to this rate for precision agriculture investment raises the gross margin required to break even by about 1% (see Figure 1G).

Area of crop

Increasing the area of land managed using precision agriculture from 1000–3000ha reduces the change in gross margin required to break even significantly from 6% to less than 2% (see Figure 1H).

On-farm investment scenarios

Figures 1A–1H highlight how return on investment in precision agriculture is sensitive to a range of factors that can be estimated easily for an individual farm.

Using data from ‘typical’ grain farms in Western Australia, the CSIRO analysis was used to determine the required rise in gross margins to break even following a precision agriculture investment of either \$10,000, \$50,000 or \$100,000.

After the gross margin values were established, possible ways precision agriculture could be used to achieve the increased profit were considered.

Northern and eastern WA

Grain growing properties in the northern agricultural areas of WA average 3600ha, of which about 1700ha is cropped each year.

In the eastern agricultural area, average farm size is about 5000ha with just over 1700ha under crop each year.

Given these farm sizes, the range of gross margin increases required to break even from investment in precision agriculture ranged from 1.5% for a \$10,000 investment in farming system achieving \$210/ha in cropping gross margin through to an impossible 46% for \$100,000 investment in a farming system achieving only a \$60/ha cropping gross margin (see Tables 1 and 2).

Central agricultural area

Average farm size in the central agricultural area and the mallee and sandplain country of WA is similar at about 2300–2600ha. About 1000ha of this land is cropped each year.

For these areas, the range of gross margin increases required to break even ranged from 3% for a \$10,000 investment in a farming system achieving \$210/ha in cropping gross margin through to 78% for \$100,000 spent in a farming system achieving only a \$60/ha cropping gross margin.

Realising investment benefits

A typical breakdown of cropping gross margins sees about two-thirds of receipts spent on operating costs such as fertiliser, sprays, machinery, seed, labour and bank charges.

Using precision agriculture to reduce some of these costs is the simplest way to maximise the return from a precision agriculture investment.

Using the investment analysis outlined above, a 1% increase in the gross margin could be achieved in a cropping system operating with a current \$110/ha cropping gross margin, by either increasing grain yield by 0.3%; cutting spraying costs by 1.8%; cutting fertiliser costs by 1.4% or cutting machinery costs by 2.7%.

A 5% increase could be achieved by increasing grain yield by 1.5%, reducing



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spray costs by 9%, cutting fertiliser costs by 7% or cutting machinery operating costs by about 14%.

Yield increase

While a 1.5% increase in grain yield seems relatively small, it is in fact half the current rate of yield increase achieved without precision agriculture (3% per year).

It is unlikely a single technology could achieve half the yield increase achieved by all other technologies combined or that the main financial benefits from precision agriculture will come from increased yield alone.

Reduced spray costs

Cutting spray costs by 9% through the use of precision agriculture is a possibility and because the benefits can be achieved quickly, the saving probably represents the most profitable benefit from precision agriculture.

Spray operators using foam markers typically overlap by about 5% (1m in every 20m) and can overlap by up to as much as 10% (2m in 20m). Use of controlled traffic farming can reduce this to about 1.5% (0.3m in 20m).

Reducing spray overlap from 5–10% down to 1.5% translates to a reduction in spray costs of 4–9%.

When reduced machinery costs are added to these benefits, (2–5% assuming spraying accounts for 50% of machinery costs), the reduced spraying overlap results in an increase in typical gross margins of 3–6%.

This makes spending \$50,000 on controlled traffic capability an attractive investment for a ‘typical’ farm with a current gross margin of \$110/ha and an annual cropping area of 1500ha. In this situation, simply reducing spray overlap within the first year or two of purchase is likely to make tramlining return a profit.

When the benefits of reduced compaction and greater traction are added, tramlining is a more certain investment than the use of precision agriculture for fertiliser zone management.


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TABLE 1 Maximum precision agriculture benefit achieved after five years*

Crop gross margin	Size of precision agriculture investment		
	\$10,000	\$50,000	\$100,000
\$60/ha	6%	15%	27%
\$110/ha	3%	8%	15%
\$160/ha	2%	6%	10%
\$210/ha	1.5%	4.0%	8.0%

* Effect of current cropping gross margin and size of precision agriculture investment in the northern and eastern agricultural areas of Western Australia on the percentage increase in break even gross margin required to make precision agriculture pay. Assumes the maximum benefit from precision agriculture is achieved after five years on 1700 hectares of crop.

Source: CSIRO Sustainable Ecosystems.

TABLE 2 Maximum precision agriculture benefit achieved after 10 years*

Crop gross margin	Size of precision agriculture investment		
	\$10,000	\$50,000	\$100,000
\$60/ha	9%	26%	46%
\$110/ha	5%	14%	25%
\$160/ha	3%	9%	17%
\$210/ha	2%	7%	13%

* Effect of current cropping gross margin and size of precision agriculture investment in the northern and eastern agricultural areas of Western Australia on the percentage increase in break even gross margin required to make precision agriculture pay. Assumes the maximum benefit from precision agriculture is achieved after 10 years on 1700 hectares of crop.

Source: CSIRO Sustainable Ecosystems.

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