FARM BUSINESS FACT SHEET

INVESTMENT IN HARVEST MACHINERY

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN

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Determining the optimum level of investment in harvest machinery

Key points

- It is critical to understand the policy that underpins the decision-making process when considering purchasing machinery
- Understanding the total cost of ownership in $/ha or $/hr is crucial for effective machinery decision-making. This helps when making decisions about the use of contractors versus ownership
- When the cost of owning a new machine is cheaper in $/ha than the existing machine then it should ideally be changed over
- Understand the level of machinery investment across the business and identify ways to get more from your investment

SUMMARY

Harvest machinery is an essential part of any grain-growing business and requires significant investment of capital. Understanding the total cost of ownership, developing policy around decision-making and ultimately how to leverage the investment is a crucial part of machinery ownership. This is also a key driver of farm performance.

BACKGROUND

Machinery can be a contentious subject. Too little or too old can lead to higher repairs and maintenance bills and cause timeliness issues. Too much machinery can see finance costs and overhead structures quickly become disproportionate. A rule of thumb for grain growers is an average machinery investment to income ratio of 1:1 or $1 of machinery assets to every $1 of farm income. High performance farm businesses can maintain a ratio of 0.8:1 or lower without compromising timeliness. Despite this, many farm businesses have a machinery investment ratio of 1.2:1 or higher.

Take a typical example of about $1 million of income for every $1 million of machinery, the difference between running a 0.8:1 ratio and a 1.2:1 ratio represents the investment of an additional $400,000 in capital. In relative terms, when considering the annual costs of depreciation (10 per cent) and finance (5 per cent), this translates into about $60,000 of additional cost per year. The top 20 per cent most-profitable grain growers have consistently demonstrated that they can essentially retain this as additional net profit by maintaining a 0.8:1 machinery investment to income ratio.

Matching machinery assets to requirements involves developing business policy, understanding the true total cost of ownership and being able to leverage the investment.

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How to calculate your machinery investment ratio

Example

Total market value of plant and equipment (A) (4-year average)	$800,000
Total gross farm income (B) (4-year average)	$1,000,000
Machinery investment: income ratio (A/B)	**0.8:1**

AM I OVER-CAPITALISED?
Machinery investment to income ratio

The best way to get a quick gauge on your investment in machinery is a simple machinery investment to farm income ratio. Place a market value on total plant and equipment (recent clearing sale results or insurance values are a good start) and divide that by the total gross income of the farm business.

This ratio should be averaged over at least four years to get an average across farm income and machinery assets. Ideally the result should be a ratio of 1:1 or $1 of machinery invested to every $1 of income. Getting this as low as 0.8:1 is possible and should be aimed for.

MACHINERY INVESTMENT POLICY

Effective investment in harvest machinery comes from well-developed policy. The machinery decision-making process should start with a discussion about policy. Many growers will intuitively have some sort of policy on machinery investment, although it may not be communicated or written down.

When talking about farm machinery, growers all have a very different approach or 'policy'. For example:

- Grower 1 – Buys new harvesters and changes over every 1200 hours
- Grower 2 – Looks for good second-hand harvesters and may take them from 1200 hours out to 2500 hours
- Grower 3 – Buys second-hand harvesters and runs them until they drop.

There is no right or wrong approach and each policy will be different. The decision-making should reflect each businesses approach to risk, the capacity to undertake repairs and maintenance, and the appetite or financial capacity for different levels of initial investment.

Despite this intuitive thinking, a documented policy that is openly communicated within the business allows for greater feedback, depth of thinking and commitment to the overall business strategy when it comes to investing in machinery. Some points to consider when developing machinery policy include:

- upgrade frequency (number of hours, hectares or kilometres);
- functionality;
- strategic business need;
- proactive management of risk;
- occupational health and safety;
- personal productivity;
- employee productivity;
- capacity to manage breakdowns;
- efficiency objectives;
- ease of use and employee understanding;
- brand of machinery (preference, serviceability etc.);
- budget, level of initial investment or capital changeover cost; and
- personal goals.

For a detailed guide on developing a machinery policy and replacement schedule see GRDC Business Management Fact Sheet 'Put a policy around machinery purchases' (www.grdc.com.au/GRDC-FS-PolicyAroundMachineryPurchases)

TABLE 1 Total cost of harvester ownership.

Capital cost	
Purchase price (A)	$850,000
Sale price (B)	$350,000
Life of machine (C)	7 Years
Annual depreciation (A – B) ÷ C = (D)	$71,429
Interest cost	
Interest rate (E)	4%
Annual interest cost ((A + B) ÷ 2) x E = (F)	$24,000
Overhead costs	
Annual insurance cost (G)	$3400
Annual registration cost (H)	$300
Value of shedding (I)	$250,000
Percentage of the shed used by the machine (J)	20%
Annual shedding cost (I * J) ÷ 10 = (K)	$5000
Repairs, maintenance and fuel costs	
Repairs (L)	$30,000
Oil and grease (M)	$3000
Total cost per year (sum of D, F, G, H, K, L, M) = (N)	**$137,129**

UNDERSTANDING THE TOTAL COST OF OWNERSHIP

Being able to identify the total cost of ownership involves a rigorous analysis of the costs associated with a piece of farm machinery. It also involves being able to quantify risks such as harvest timeliness, grain quality and/or yield penalties.

Determining the total cost of ownership of any given machine involves calculating the following (Table 1):

- **Annual depreciation cost**

Depreciation generally accounts for wear and tear and obsolescence on an annual basis for a machine. A straight line depreciation method is sufficient for calculating depreciation for management decision-making purposes.

- **Interest cost**

This is the interest on the capital relating to the machinery purchase amount that could be invested elsewhere and accounts for the opportunity cost associated with the investment.

- **Insurance and registration costs**

These are overhead costs, which will vary according to the size of the machine.

- **Annual repairs, maintenance and fuel costs?**

These are variable costs determined by the annual usage of the machine. It is important to get a realistic idea of these costs before purchases are made.

- **Labour costs**

Consider and cost permanent labour or any casual labour for peak periods that may be required to operate and maintain machinery.

ASSESSING AND QUANTIFYING RISK, PENALTY AND TIMELINESS COSTS

Typical risks that need to be considered when assessing machinery ownership include:

- Grain delivery risk – misclassifications of grain if delivered in a "dump and run" manner by a contract carrier is a significant risk.
- Compliance / obsolescence risk – parts are no longer available
- Timeliness risk – delays in sowing, spraying and harvesting can all have significant impacts on future income. If you lose trust in a machine, it is time to upgrade as timeliness is everything. A maintenance schedule contributes greatly to operational timeliness.
- Workplace health and safety risk – ensuring employees are safe and productive is essential. The financial penalties associated with non-compliance are huge.

Being able to quantify risk is important but being able to measure its **frequency** is the key. For example, the impact of a wet harvest may cause $X reduction in grain quality and take X number of extra days to complete, so the financial risk would be considered 'high'. However, if the likely frequency is for example 1 in 5 years, the rational justification of extra investment in machinery may not provide a sufficient return.

Using tools such as the CliMate app (https://climateapp.net.au) you can develop some rigorous justification and planning around weather risks such as a wet harvest. A good option can be to plan contingencies should the wet harvest occur, without over-extending in terms of machinery investment 'just in case'.

DETERMINING WORK RATES AND WHY THIS IS IMPORTANT

Knowing and understanding the work rate of key operations is an important step in calculating the total cost of ownership. It allows forward planning for key operations and measuring how efficiently an operation is being undertaken.

To calculate work rate in ha/hr:

$$= \frac{\text{(speed (km/hr) x width (m)) x field efficiency \%}}{10}$$

To calculate field efficiency %

$$= \frac{\text{Time spent operating the machine x 100}}{\text{Total time in the paddock}}$$

Field efficiency is highly variable. The total time spent in the field will include travel and turning, fixing any breakdowns, maintenance and unloading. The shape, size and obstacles of the paddock also greatly effect the field efficiency. A small paddock with lots of obstacles such as trees or creeks will require a vastly different work rate to a larger paddock with long clear runs.

Table 2 demonstrates the effect on overall work rate, assuming a harvester with a 12m comb at a harvesting speed of 12km/h but differing field efficiencies.

The difference between 80 and 60 per cent field efficiency may only be 2.88ha/h but this becomes significant when considered over the wider operation. Assuming a 10-hour day, this is approximately 30ha/day. Across a 2500ha program, this results in an extra 8 days just in efficiency risk. Add on other delays due to weather or breakdown, as well as grain quality penalties, and the overall impact can quickly blow out.

In the example worked through in Table 3 the 'break even area' required to economically justify the ownership of the header is 2098ha. The actual program is across 2500ha hence the total cost of ownership is in balance.

WHEN SHOULD I USE A CONTRACTOR FOR HARVESTING?

Once you have calculated the total cost of ownership, the final result can be compared to a contractor rate. Generally, you should consider the use of a contractor if the cost of ownership is higher than that of the contract rate being compared against. Remember to take into account reliability, access to contractors and timeliness risk. Contractors can also be a cost-effective option for high volume harvests, as an alternative to buying an additional header. Alternatively, you could consider machinery syndication (a part-share in a machine to spread the cost) but this relies on strong relationships with other involved parties.

TABLE 2 Effect on work rate with differing field efficiencies.

Speed	Width	Efficiency	Work rate (ha/h)
12km/hr	12m	80%	11.52
12km/hr	12m	70%	10.08
12km/hr	12m	60%	8.64

TABLE 3 Harvester cost per hour and per hectare.

Total cost per year (N)	**$137,129**
Hectares per year (O)	2500
Average crop yield per hectare (P)	3 tonnes/hectare
Total tonnes (O x P) = (Q)	**7500**
Operational speed (km/hr) (R)	12 km/h
Width (S)	12 metres
Efficiency (T)	70%
Work rate per hour ((R * S) x T) ÷ 10 = (U)	10.08 ha/hr
Number of hours per year (O ÷ U) = (V)	248
Cost per hour (before fuel and labour) (N ÷ V) = (W)	**$553/hour**
Horsepower	600
Litres per hour – based on machine usage (X)	67.28
Fuel cost ($/l) (Y)	$1/L
Fuel cost per hour (Y * X) = (Z)	$67.28
Labour ($/hr) (ZA)	$30
Total cost per hour (Sum of W, Z, ZA) = (ZB)	**$650**
Total cost per tonne (ZB * V) ÷ Q = (ZC)	**$21.50**
Total cost per hectare (ZB ÷ U)	**$64.50**
Fuel cost per hectare (Z ÷ U)	**$6.67**
Labour cost per hectare (ZA ÷ U)	**$2.98**
Equivalent contracting rate (based on typical rates, includes fuel)	$75/ha
Breakeven hectares (i.e. The minimum harvested hectares required to economically justify owning the header)	**2098ha**

How to calculate your Total Plant, Machinery and Labour

Grain growers understand that labour and machinery resources are closely linked. Another handy indicator that provides an excellent ground truth on how well a business is utilising their investment in machinery and labour is known as Total Plant, Machinery and Labour (TPML). TPML can be calculated per hectare or as a percentage of total income.

High performance grain businesses can keep TPML to 25% of total farm income where the average is commonly 35% or above. This means that high performance grain businesses are retaining 10 per cent more of total turnover.

If either the machinery investment to income ratio or TPML percentage is too high, consider any "lazy" equipment that could be sold and how you can increase efficiency and get more from your investment in plant and equipment.

First steps

Calculate and understand the level of investment in machinery and labour your business has and identify ways this can be improved to increase machinery utilisation.

When considering investment in new machinery, be that harvesting, seeding etc., have a well-defined and communicated machinery investment policy that is tailored to the needs of your own business. It is important to ground truth any assumptions and seek advice to provide the necessary rigour before making the final decisions.

TABLE 4 Sample TPML calculation.

	Example
Contractor engaged (A)	$10,000
Fuel (B)	$60,000
Freight (C)	$25,000
Plant hire (D)	$5,000
Plant R&M (E)	$45,000
Depreciation (F)	$85,000
Machinery lease (not hire purchase) (G)	$0
Plant & equipment interest (H)	$15,000
Wages & on-costs (I)	$50,000
Imputed labour (J)	$50,000
Total TPML costs (A + B+ C + D + E + F + G + H + I + J = K)	**$345,000**
Total gross farm Income (L)	$1,000,000
TPML costs as % income (K / L x 100)	**34.5%**

Note: Machinery costs include fuel and oil, machinery and vehicle repairs, machinery hire costs, machinery capital costs. Employed labour costs include wages, superannuation, training and other employment costs. Imputed labour adjustment includes allowance for family labour equivalents and superannuation. Contracting, freight and other costs include hired contracting, cartage and freight, harvesting, sowing, fertiliser spreading and so on.

Useful resources

GRDC Fact Sheets

Machinery investment and costs https://www.grdc.com.au/FBM-MachineryInvestmentAndCosts

Is machinery syndication a good fit for your business? https://grdc.com.au/resources-and-publications/all-publications/factsheets/2015/08/fs-machinerysyndication

Opportunity for Profit Management Guidelines RDP00013 – South Australia A Mid-North, Lower Yorke Eyre, Rural Directions Pty Ltd, 2016

Opportunity for Profit Management Guideline RDP00013 – South Australia and Victoria Mallee, Rural Directions Pty Ltd, 2016

More information

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HOW CAN I INCREASE MY EFFICIENCY OF HARVESTING?

There is internal capacity in most farm businesses to better leverage their investment in machinery with management. Those that have a systemised focus on increasing field efficiency can generally manage a larger farm area with the same size plant. Some effective strategies include:

- undertaking preventative maintenance of machinery;
- ensuring all machines are ready well in advance;
- using chaser bins taking grain from the harvester to a central point;
- using mother bins rather than field bins, to reduce time spent shifting between paddocks;
- proactively managing freight (ensuring freight capacity out is adequate to avoid harvest delays due to freight bottlenecks);
- growing commodities in large 'blocks' where possible to reduce movements and travel;
- increasing paddock size;
- utilising laneways;
- ensuring staff training is adequate; and
- using GPS and other associated technology.

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