Calculating Machinery Operating Costs

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138.255

A summary of sections 9 - 13.

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Machinery costs

- When planning we need:
  - An accurate method of calculating the cost of owning machinery.
    - The comparative cost of different machine combinations.
    - The comparative cost of getting the work done through means that do not include ownership
  - To know the effective work we are getting from machinery.
    - The ability to calculate costs per hour and per hectare.
  - The capacity we need to carry.
    - What are the timeliness costs from not being able to get the job done and what are the risks of overcapacity.

Cost Components

- Interest on Capital
- Depreciation
- Tax Insurance and Housing

→ Fixed Costs

- Repair and Maintenance
- Fuel
- Labour

→ Variable Costs

Fixed: because they are fixed regardless of the level of use.
Variable: Because they vary with the level of use. Include labour because we may be comparing machines of different capacity.

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The Importance of Planning

•When buying machinery, planning is important in order to be able to tailor payments to the business cash flows.

- Seasonal payments for different client groups, dairy, sheep and beef, cropping and contractors.

- Most finance companies will use individual contracts but bulk purchase can be advantageous.

- Special deals with low interest may be less flexible in terms of payment schedules.

- Many appear to prefer to buy as opposed to lease, especially if they have their own maintenance facilities.

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Interest on Capital

Always use an interest rate because even if we do not borrow money to finance purchase then we could have investment interest on the money.

This is termed an *"opportunity cost".*

Remember this is an interest only calculation.

In reality a farmer or contractor is likely to pool this funding, but we still need to allocate costs to individual machines.

Depreciation

Reasons:

- Reduction in machine performance due to worn parts.
- Increase in cost for the same unit of output, due to increase in power consumption, labour or repair cost.
- Obsolescence
- Change in farm enterprise so current machinery capacity becomes inappropriate.

Methods of Calculation.

Straight Line: fixed amount depreciated every year. Simple if considering having the asset for a longer period.

Fixed Percentage (diminishing balance): More accurately reflects the value of the asset throughout its life. Useful when looking at ownership alternatives.

Geometrically Adjusted Diminishing Balance: The most accurate, reflects the initial drop in value of the asset.

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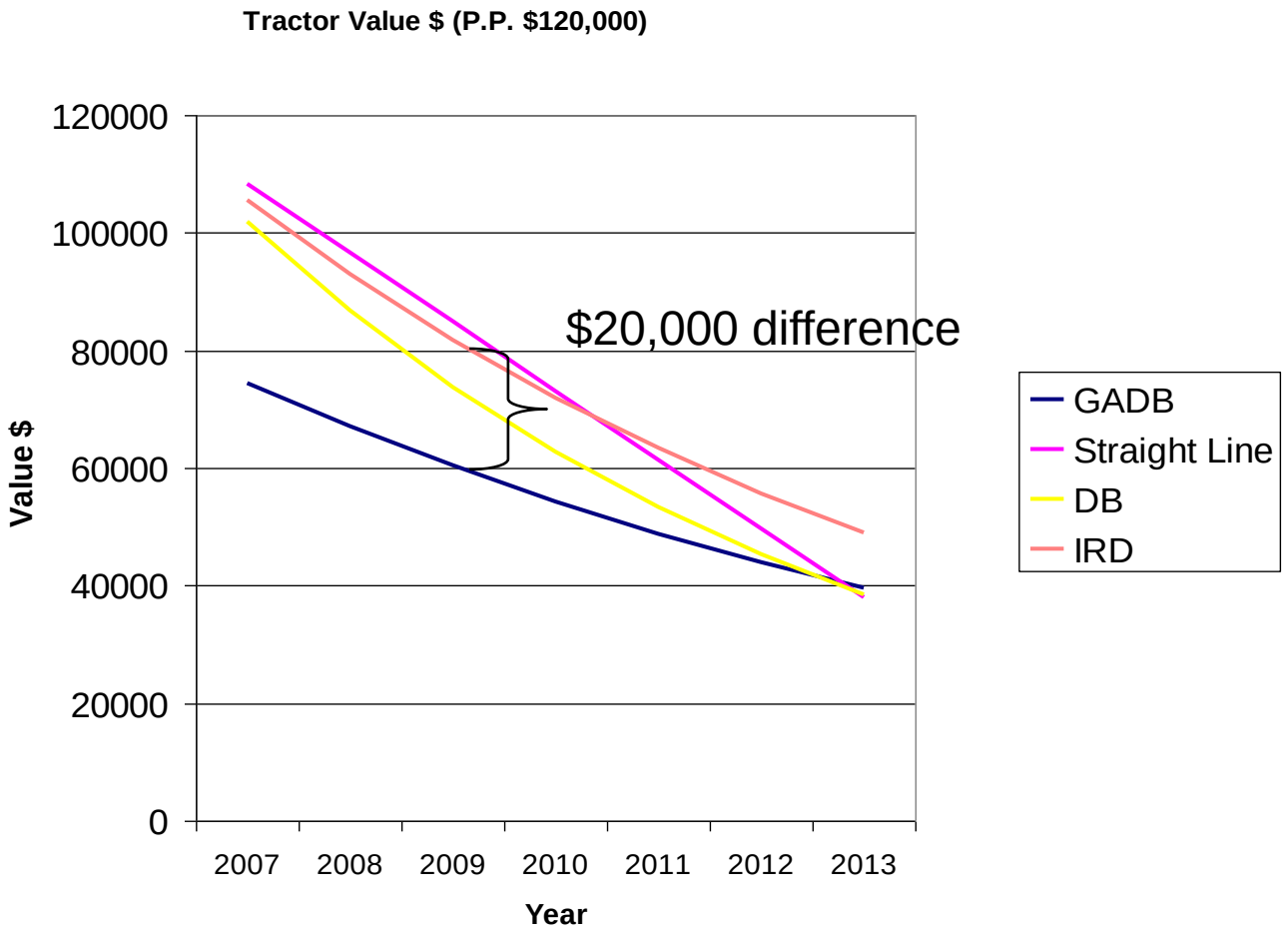
Depreciation



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Tax and Insurance

Licence costs and Insurance.

• Find out actual costs or use a percentage (typically 1.5 % of new purchase price).
• Insurance is usually required when purchased on Hire Purchase.

Housing and Shelter

Many suggest that a housing cost should be included, can be done where appropriate. In terms of depreciation, repair and maintenance it certainly helps to keep machinery inside and out of the weather, for some machinery this should be regarded as essential.

Variable Costs

Repair and Maintenance

- Repair and Maintenance costs can be highly variable and unpredictable for individual machines.
- As machines get older then clearly they are likely to need more repairs.
- Standard methods use the results from surveys to calculate estimated repair and maintenance.
- The more complex the machine the more likely it is that costs will increase as the machine gets older.
- The most common way to express it is as a cumulative cost through the life of the machine.
- The equation used to calculate cost is:

$$TAR = RF1\left(\frac{Accumulated\ Hours}{1000}\right)^{RF2}$$

TAR = Total Accumulated Repair and Maintenance cost

NB. RF1 and RF2 are standard factors for most categories of machine published by ASABE.

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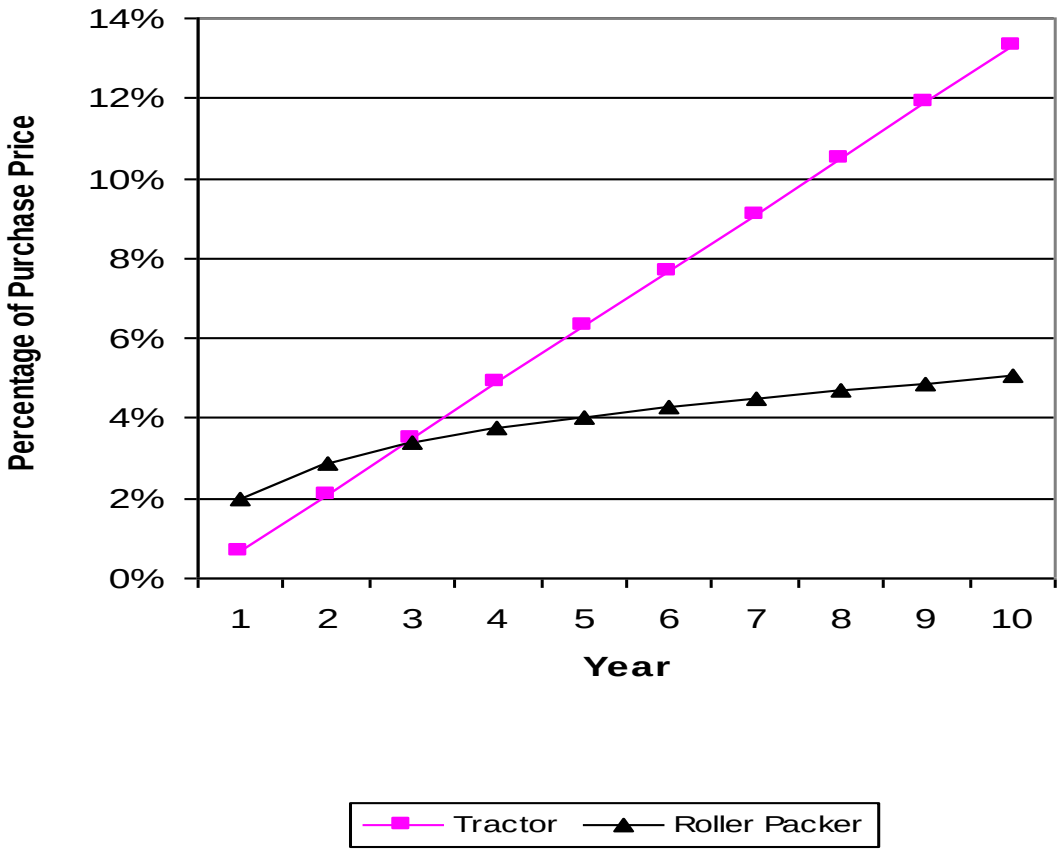
Annual Repair and Maintenance Cost Expressed as a Percentage of Purchase Price.



Tractor Used for 1000 hours

Roller Packer 200 hours per annum

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Fuel

• Need to calculate fuel consumption as it depends on the level of use and the way the machine is driven.

• Fuel consumption can be expressed as:

Specific Volumetric Fuel Consumption (SVFC) expressed in units of $l.kWh^{-1}$ (Litres per kilowatt hour). Typical range is 0.24 to 0.57 $l.kWh^{-1}$.

• Can also be expressed as:

The Specific Volumetric Fuel Efficiency (SVFE), in units of $kWh.l^{-1}$ (Kilowatt hours per litre). Typical range is 2.36 to 4.1 $kWh.l^{-1}$.

The standard equation to calculate SVFC use is:

$$2.64X + 3.91 - 0.203\sqrt{738X + 173}$$

Where X is the ratio of equivalent PTO_{power} to rated PTO_{power}

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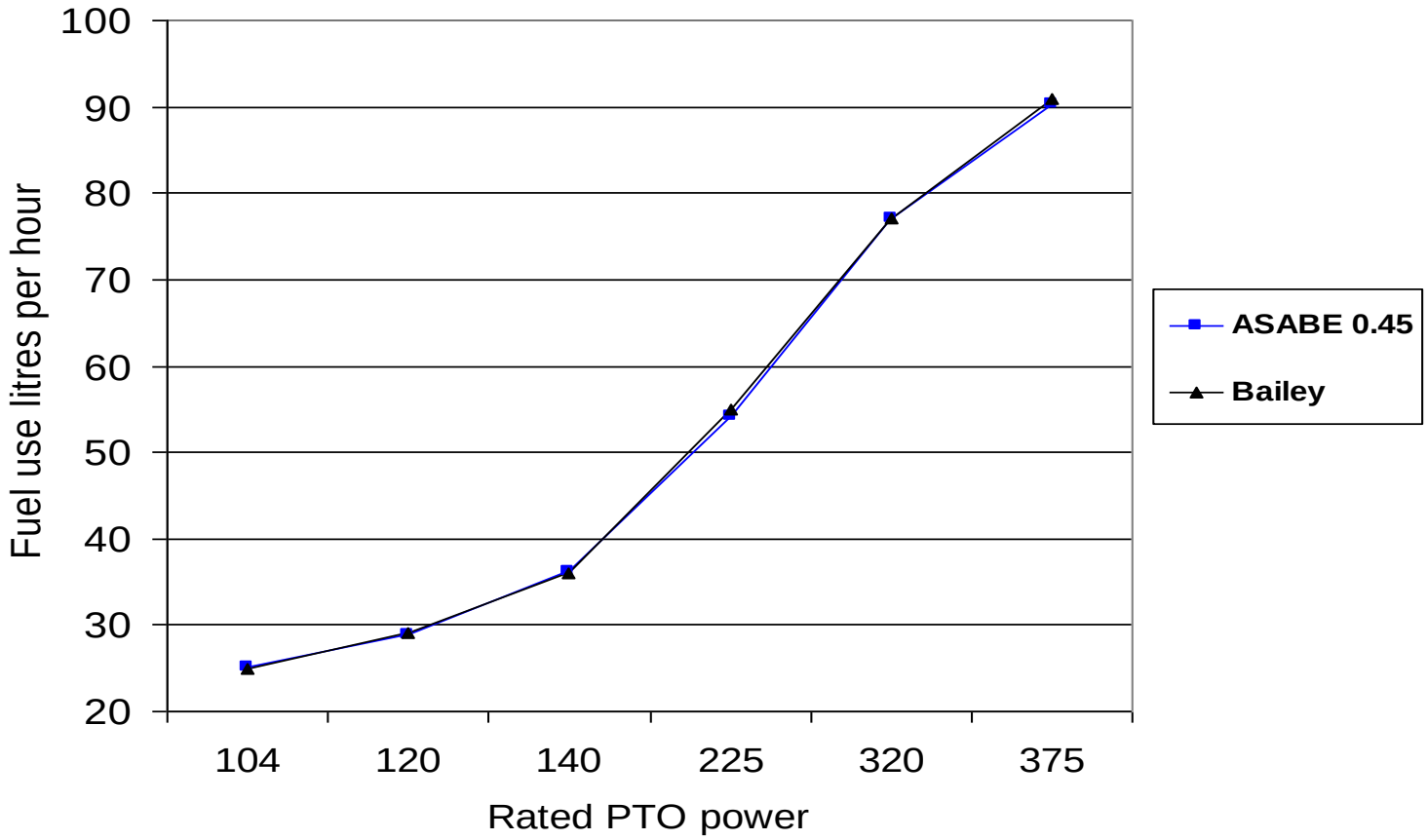
Bailey has used the same formula assuming the ratio (X) is 0.45



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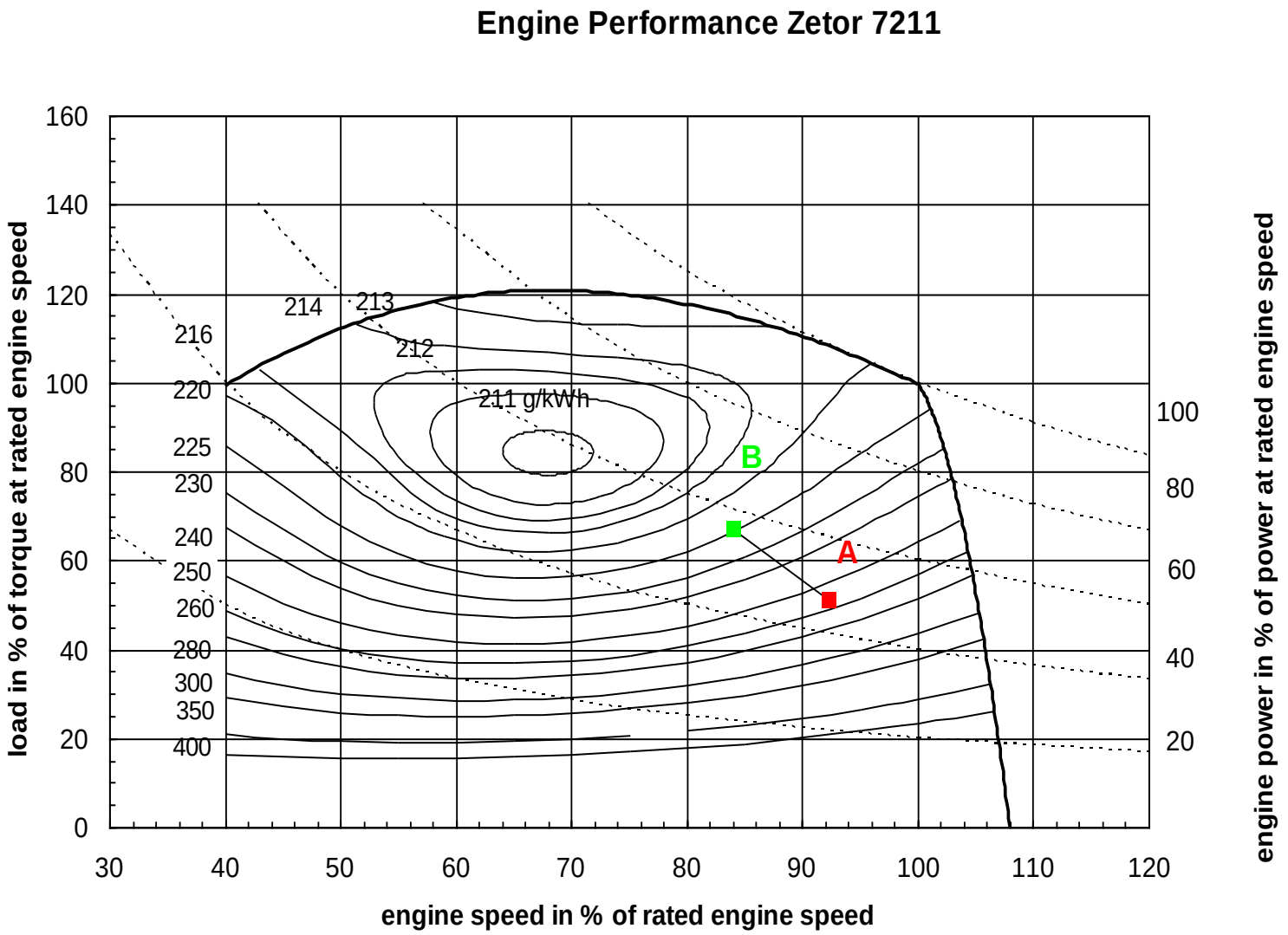
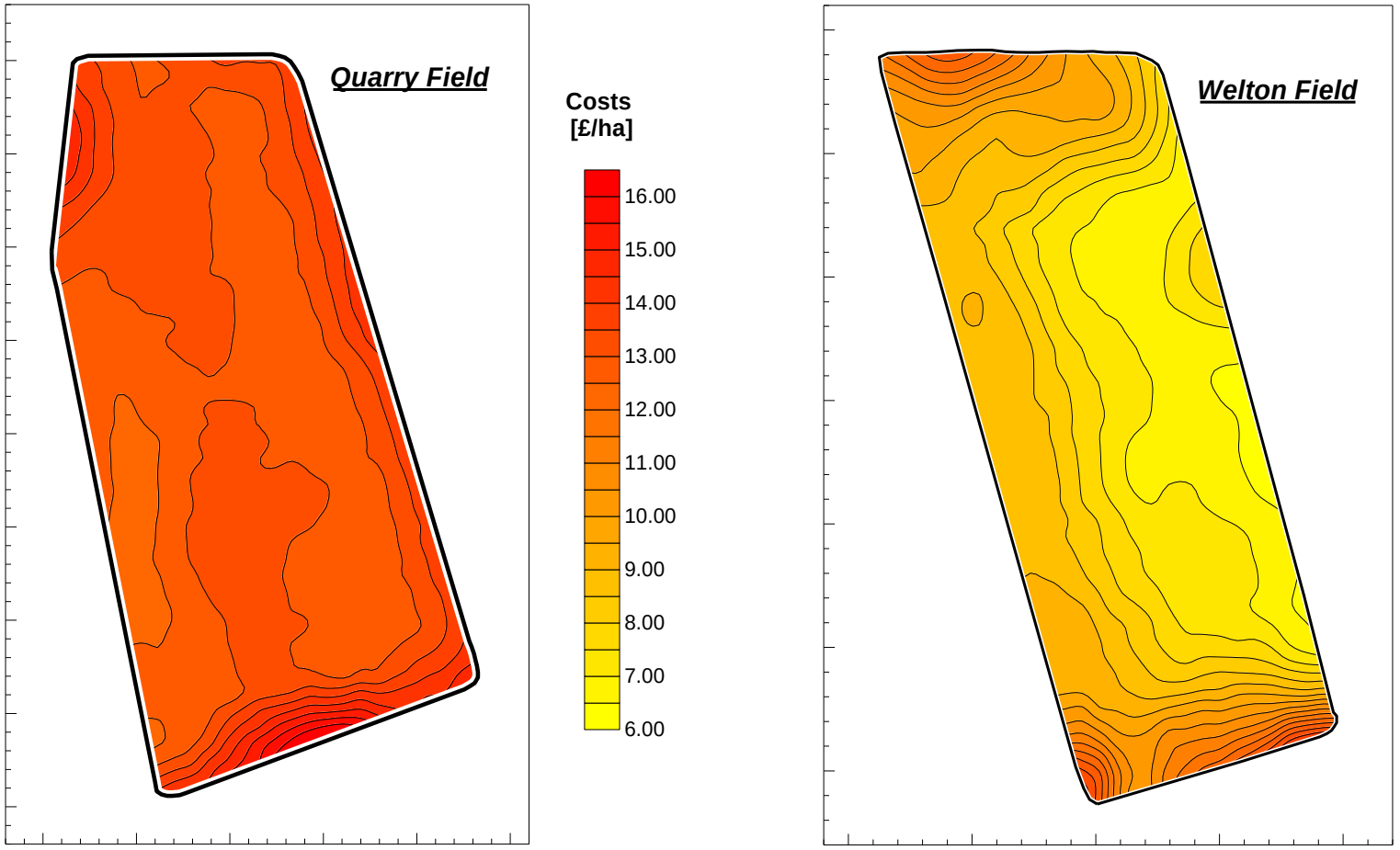
Engine Performance Map of Agricultural Tractor



Effect of Improving Operational Settings on Cost



Better setting of machine leads to a 35% reduction in operating cost, through higher output and reduced fuel use

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Points to consider

Again standard figures are the result of surveys. So there are ways to improve performance.

- Interest in recording fuel use,
  Used to happen but we haven't worried while we had cheap energy but now people are more concerned.

- Fuel consumption figures from tractor manufacturers.
  Selection of tractor with particular reference to transmission system and tasks to be completed.

- Setting of machinery can a make a big difference.
  Matching machinery to tractor.

- The "Gear Up and Throttle Down" message is perhaps an over-simplification.

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Labour

• When comparing systems we put in labour costs because a larger capacity machine will have lower labour charges per unit of area.

• Need to work out machinery capacity. In order to calculate cost on the basis of $ per hour or $ per hectare.

Machine operating speed and field efficiency

Contractors may also have to consider travelling time etc.

Typical Field efficiencies.	%
Ploughing	75 - 85
Fertiliser Broadcasting	45 - 55
Spraying	55 - 65
Harvesting	65 - 75

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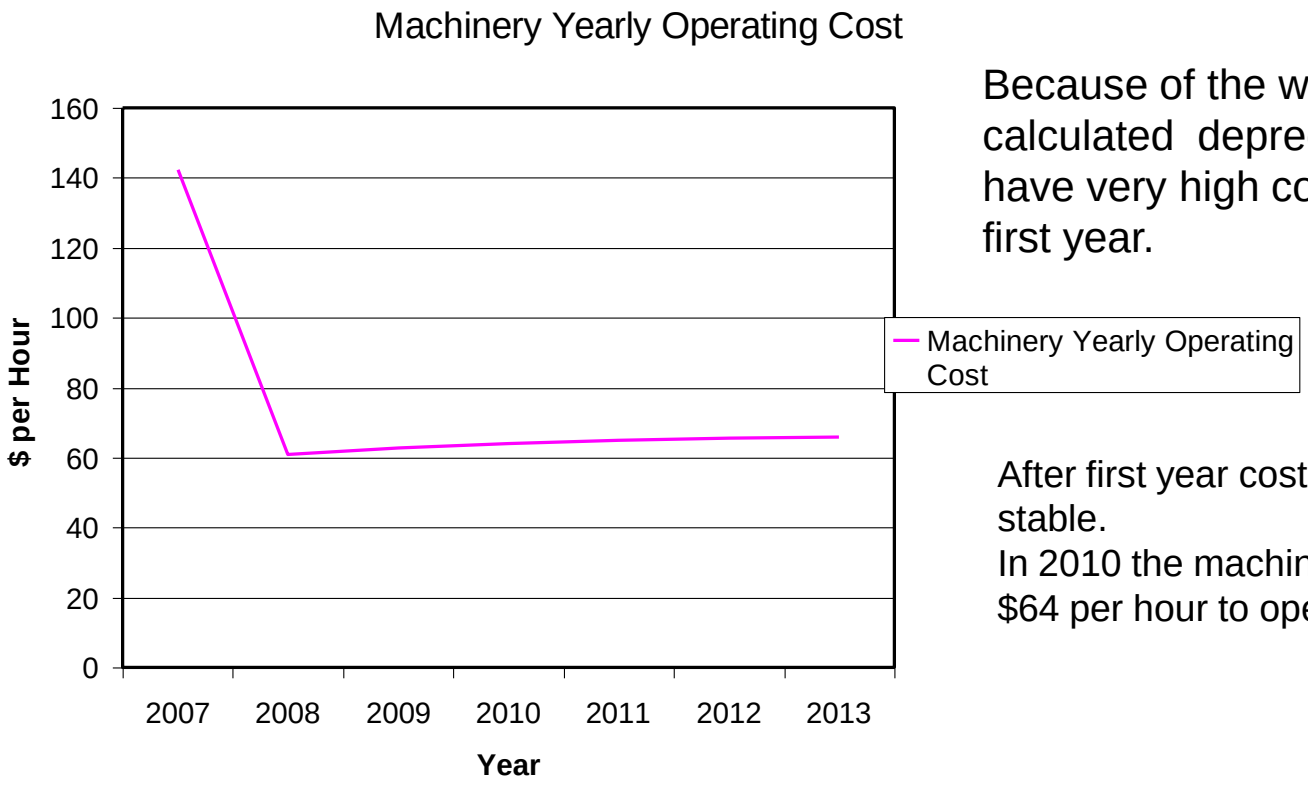
Te Kunenga ki Pūrehuroa

Putting it all together

- 100 kW Tractor *(cost $120,000 and used for 1,000 hours per year)*
- 5 furrow plough *($35,000 used for 300 hours a year. Interest rate 8%)*



Because of the way we have calculated depreciation, we have very high cost in the first year.

After first year cost relatively stable.
In 2010 the machinery cost us $64 per hour to operate.

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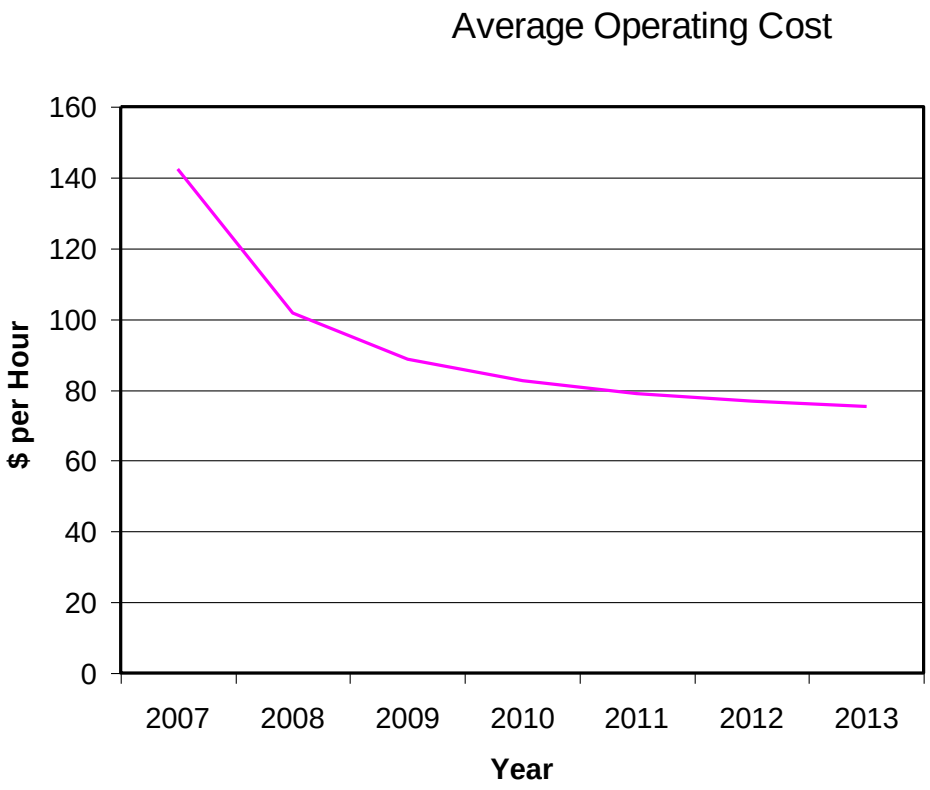
Putting it all together

Hourly cost of ploughing

- 100 kW Tractor *(cost $120,000 and used for 1,000 hours per year)*
- 5 furrow plough *($35,000 used for 300 hours a year. Interest rate 8%)*



Slightly different, this is the average cost throughout the machines life.
In 2010 this machinery has cost us an average of $82.50 per hour over the 4 years.

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From cost per hour to cost per hectare.

- Need to calculate work rate.

  5 furrow plough, 16” furrows (0.4m), plough width 2m.
  Field Efficiency 80%. Ploughing speed 7.5kmh^{-1}
  Farm situation
  Output = speed x width x efficiency

  = 7500 x 2 x 0.8

  = 12,000m^2 = 1.2 ha per hour.

- Contractor who has to travel. Field efficiency 60%

  Output = 7500 x 2 x 0.6 = 0.9 ha per hour.

- Assume an hourly charge rate of $100 per hour.

  Achieving 80% field efficiency, actual cost = $125 per hectare.
  60% field efficiency, actual cost = $167 per hectare.

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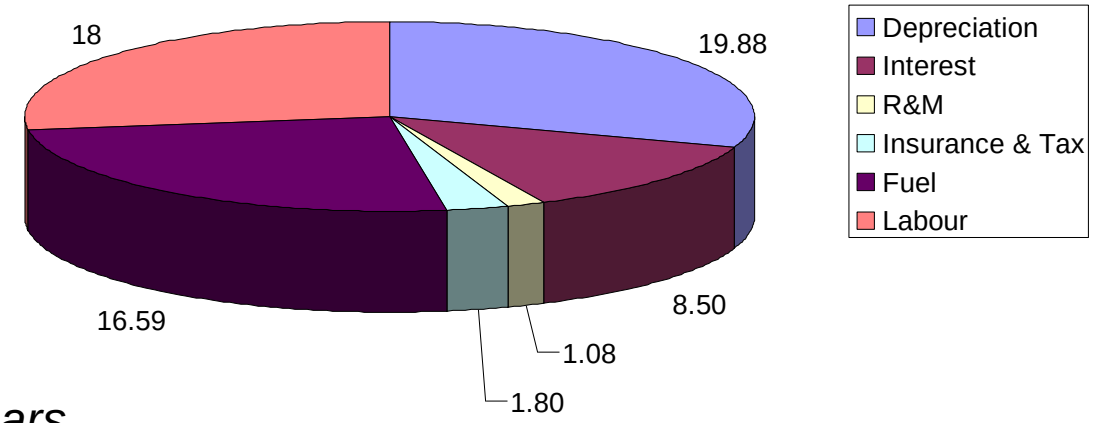
Tractor Operating costs. (Including Labour)

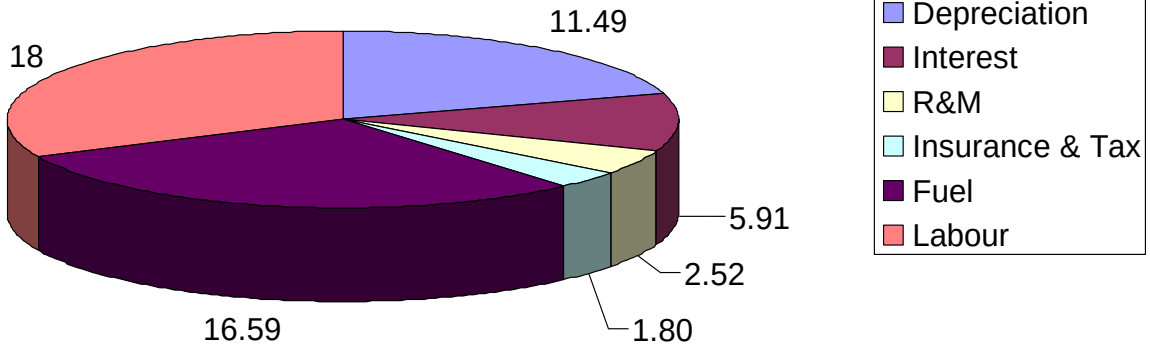
Keeping a tractor for 3 years.

1000 hours per year.
Average hourly operating cost = $65.85
Highest Dep. $19.88
Labour $18
Fuel $16.59



Keeping tractor for 7 years.

Average hourly operating cost = $56.30
Highest Labour $18.00
Fuel $16.59
Dep. $11.49



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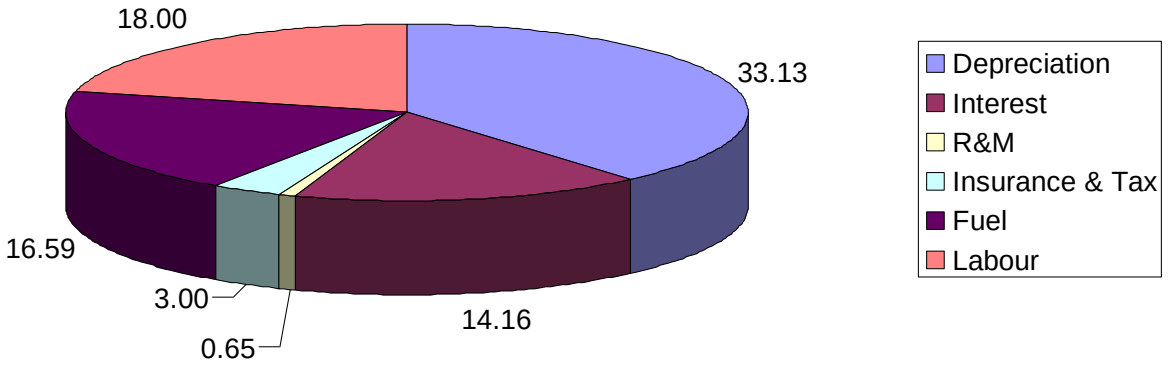
Tractor Operating costs. (Including Labour) 600 hours

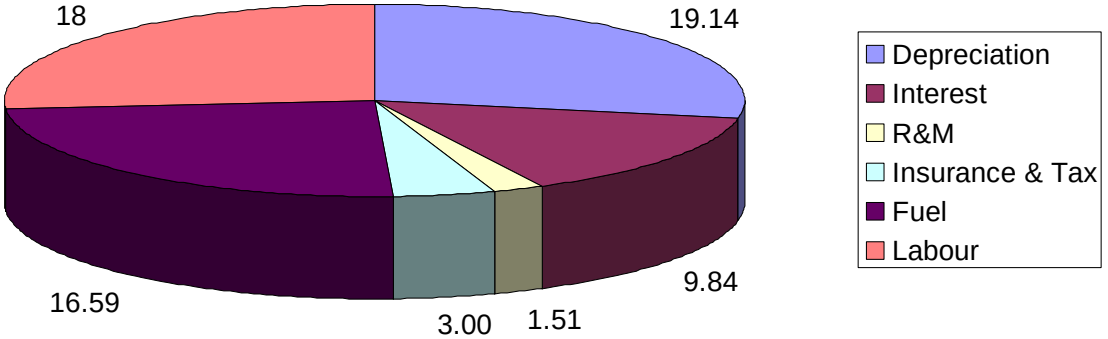
Keeping a tractor for 3 years.

600 hours per year.
Average hourly operating cost = $85.53
Highest Dep. $33.13
Labour $18
Fuel $16.59



Keeping tractor for 7 years.

Average hourly operating cost = $68.09
Highest Dep. $19.14
Labour $18.00
Fuel $16.59



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Conclusions

- Planning is essential.
  - Number of machines and capacity.
  - Replacement period.
  - Planning finance. Flexibility and cash flow

These methods estimate cost rather than give a definitive answer. For example depreciation on big ticket items can be difficult to predict.

- Fuel and Labour are important costs.
  - Training and driver education.
  - Properly matching machine to tractor.
  - Ballast and tyres.

- Clearly the shorter the ownership period and the fewer hours worked fixed cost can very quickly get out of control.

Sources of Information

Most of the work you have seen is based on the ASABE Standards. These contain standard figures to use for R&M, Depreciation etc.

Some information will be provided on NZCPA Website.
http://www.nzcpa.com

Bailey FAR CD

ASABE
American Society of Agricultural and Biological Engineers

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