Assessing the value of changing beef breeder herd management strategy in northern Australia

Fred Chudleigh[1], Trisha Cowley[2],
Tim Moravek[1], Tim McGrath[1], Mick Sullivan[1]
[1]Department of Agriculture and Fisheries Queensland,
[2]Department of Primary Industry and Fisheries
Northern Territory

Contributed paper prepared for presentation at the 61st AARES Annual Conference, Brisbane, 8-10 February 2017

Assessing the value of changing beef breeder herd management strategy in northern Australia

Fred Chudleigh[1], Trisha Cowley[2],

Tim Moravek[1], Tim McGrath[1], Mick Sullivan[1]

[1]*Department of Agriculture and Fisheries Queensland,*

[2]*Department of Primary Industry and Fisheries*

Northern Territory

Abstract

The scope for improving the economic and financial performance of beef businesses by changing breeder herd management practices and reproduction efficiency was investigated across a range of regions in northern Australia from early 2013 to late 2015.

Case studies and desktop analyses were applied to identify the relative and absolute value of altering management strategies such as: weaning, pregnancy testing, herd segregation, supplementation, genetic improvement, mating, culling, infrastructure investment, enterprise selection, herd bull use and age of turnoff. In more extensive herds with uncontrolled mating, emphasis was placed on answering the question: what are the costs of out-of-season calving?

The project provided insight into:

- the value of changing management strategies,
- the capacity of industry participants to appropriately assess the value of strategies,
- the nature and value of indicators applied by industry to assess strategies.

Analysis identified that a relatively large proportion (>50%) of the changes in management strategy selected by project co-operators were unlikely to improve profit, with about one-third likely to significantly reduce profit. The inability of beef business managers to nominate profitable changes in management strategy was due, in large part, to a lack of appropriate skills in identifying the most profitable option for change and to the use of spurious indicators unlikely to assist in the identification of profitable change. The provision of decision support frameworks that incorporate an appropriate disciplinary balance and focus on developing skills and knowledge are identified as important in helping beef enterprise managers make better choices.

Keywords

Farm management economics, management strategies in northern Australia, case study analysis, beef options analysis, decision making frameworks

Contents

Introduction

The project B.NBP.0763[1] (Chudleigh *et al*. 2016) investigated the scope for improving the profitability of beef businesses across northern Australia by changing breeder herd management practices and reproduction efficiency.

The project was undertaken during a period of difficult seasonal and market conditions for beef producers; these conditions focussed the attention of people throughout the northern beef industry on strategies to maintain and lift profit.

Case studies were a key component of the project and considered the property level performance of various management practices (or strategies) aimed at improving breeder herd economic performance. In total, 17 case studies were undertaken with property managers across northern Australia, with up to five scenarios considered in each case study.

The main strategies considered in case studies were:

- weaning management
- heifer management
- pregnancy testing with or without herd segregation
- supplementation strategies
- genetic improvement
- mating strategy
- culling strategies
- infrastructure investment
- age of turnoff
- optimal enterprise
- herd bull management

The case study process identified the absolute and relative economic impact of changing a herd management strategy and also provided insight into:

- what managers currently saw as the best options to improve the profitability of the business under management
- some of the financial and technical constraints that limited their capacity to implement change
- the capacity of managers to assess the value of change
- the tools applied when assessing change

This paper focusses on the insights provided by the case study process into the capacity of managers to assess the value of change, the tools applied by managers to assess expected outcomes and some of the constraints that limit north Australian beef producers improving their economic performance.

[1] The project was jointly funded by the Queensland and Northern Territory Governments with assistance from Meat and Livestock Australia (MLA)

Methods

Case studies offer "a systematic means of compiling information in complicated areas of human endeavour and providing useful observations that go beyond the range of controlled experiments" (Murray *et al.*1994). They have been widely used in both economic and farming systems research to identify linkages and relationships that occur in complex and dynamic systems.

The project (B.NBP.0763) used case studies to examine the biological, social, and economic factors of north Australian beef breeding systems. The process examined interactions between production practices, business management and business returns. The goal was to identify the economic value of applying different approaches to solving similar problems. The overall 'problem' in this case was the profitability of beef production systems in northern Australia and the role of investments in increasing profit.

A range of beef producers from the region described as the Northern Forest country type in the CashCow project (McGowan *et al*. 2014) were mainly targeted for the case studies. This was due to the relatively poor reproduction performance identified by the CashCow project for that region. Discrete groups of producers were targeted around the Sturt Plateau/VRD regions in the Northern Territory and Charters Towers/Georgetown regions in Queensland. Additional co-operators with generally better levels of reproduction efficiency from the Brigalow regions of central Queensland provided a counterpoint to the majority of case studies undertaken in the Northern Forest.

Case study process

Information was collected from case study co-operators about their production system, enterprise size and current management strategy. Management strategies or development options of interest to co-operators were also identified with at least one looking at the improvement of reproduction efficiency in the breeding herd.

The persons attending the meeting included a specialist beef production officer with detailed knowledge of local beef production systems, an agricultural economist who conducted the interview and at least one representative of the beef business — usually the owner or manager of the property. It was common for more than one representative of the beef business to be present, and this often assisted the discussion when it came to identifying alternative ways of operating the beef enterprise.

The production and financial data collected was collated into a herd model and budget for the operation of the beef business over the current and subsequent years. The budget was used to estimate production, financial and economic performance for the current production system. Follow-up discussions were undertaken where necessary to clarify strategies or the parameters used in the budget.

The role of the case study process was not to introduce new ideas or technologies to the co-operator; the focus was the expected outcomes for the current management strategy and what the co-operator saw as worthwhile alternatives.

Case study budgeting process

The use of dynamic herd budgeting spreadsheet tools allowed the detail of the production system to be identified and linked to the budget. Estimates of factors such as mortality rates, pregnancy rates, growth rates, sale weights, prices, treatment costs and grazing pressure could be applied to all major classes of livestock within the beef herd at various points in the production cycle and varied for each year of the analysis. The effect of any variation in individual factors could be traced through to impacts on herd output, cash flow, profit and equity. Breeding females could be allocated to four different calving periods across a production year with impacts on the subsequent rates of conception, weaning, growth and mortality able to be accounted for.

In all cases, the current debt and financing strategy of the business was ignored, as the focus was the economic improvement of the beef enterprise, not how the business was financed. The economic analyses replaced the living costs (or drawings) of the owners with an estimate of the opportunity cost of the labour used in generating profit — this was made by the beef business manager(s).

The budgeting process developed scenarios based on the knowledge of the manager(s). The level of the response to changed inputs and the cost of gaining the response were estimated by the manager(s).

The current herd and financial records for the property were used as the basis of the budgeting process. Budgets were extended for a decade to help capture the time taken to implement change and potential productivity response arising from the change.

The volatile nature of the northern beef industry, together with the generally low levels of profitability being experienced at the time, encouraged the view that if a strategy did not pay within ten years, it was probably not going to help that much.

Some strategies that relied upon capital investments with an effective life longer than a decade were assessed over the life of the capital, but their impact at the level of the beef business was generally compared over the first decade of the implementation phase of the strategy for the reason above.

Economic and financial analysis and the case studies

The economic and financial[2] analyses undertaken in the case studies consisted of a comparison of the current management system continued into the future, with an alternative system starting at the same point and also continued into the future.

Ferris and Malcolm (1999) identified that "the key to making good decisions about how the farm business might operate is to have sound and thorough knowledge about how the business currently works". They also identified that "budgets are no more reliable than the data and

[2] Financial analyses consisted of a constructing a ten year cash flow estimate for the beef enterprise. Economic analyses concentrated on identifying the annual profit produced by the enterprise and the investment returns likely to be generated by the business or on any additional capital invested over the following decade. Although the initial debt of the enterprise was not identified, any deterioration in the performance of the enterprise over time was identified through an accumulation of new debt and the change in equity over time.

judgements that go into them" but that "scenarios and breakeven budgets are very valuable techniques to provide information in the decision process".

The case study analyses relied upon the co-operator 'knowing how the business worked' to construct a scenario budget which identified the 'base case' for the operation of the business or the 'without change' scenario. Starting with what was known before moving on to estimating the impact of change was seen as the best way of us building knowledge of how the business currently works.

Change was then modelled by altering the herd performance and inputs of the base case budget so that a new budget was constructed for each scenario. The comparison of the two budgets, one of which reflected the implementation and results of the proposed change from a common starting point, was the focus of the analysis. It was hoped that this process would help identify any gaps in the logic applied when estimating the impacts of change.

The application of a 10-year model that included the implementation phase of an alternative strategy and starts at the same point as the base model is different to the way that improvements in beef production systems have often been modelled. That is, they are often modelled as two steady states; with one state representing the average output of the 'without change' scenario and the other state representing the average output of the 'with change' scenario once it is fully implemented.

The steady state method can be a valid way of quickly comparing the eventual economic benefit of a change but does not easily account for the time taken to implement the change and the timing of costs or benefits incurred in making the change. The method applied in the case studies accounts for the time taken to implement different strategies, any changes in the timing of the receipt of benefits or expenditure on costs between the alternative strategies, the value of the various resources required to undertake the base case scenario or an alternative strategy and the residual value of any additional or existing resources applied.

A herd budgeting method that compares outcomes by commencing at a common point and builds difference over time will likely show less difference over the first decade than may be indicated by the comparison of two steady-state profit budgets, one of which that has been pitched after the alternative strategy has been fully implemented.

As well as herd and cash flow budgets, discounted cash flow (DCF) techniques were applied to look at both the returns to the discrete (whole) farm investment and at the marginal returns associated with any additional capital or resources invested within farm operations. The economic criterions of choice were Net Present Value (NPV) at the required rate of return and the Internal Rate of Return (IRR).

A discrete investment of additional capital was not always identifiable when implementing some strategies, as they relied only upon a change in herd operation and/or a variation in treatment and labour costs. This limited the capacity to calculate an IRR for the marginal returns, and made the NPV the criterion of choice when reporting the economic impact of change.

The ongoing need for plant and equipment was captured by including an inventory of plant and equipment and a plant replacement strategy in the data collected. This allowed the inclusion of plant and equipment replacement in the DCF analysis as it was expected to occur. The plant

replacement strategies followed by the manager over time and the expected salvage value of plant and machinery at the end of the planning period were both included.

The DCF analysis was compiled in real (constant value) terms, with all variables expressed in terms of the price level of the present year. It was also assumed that future inflation would affect all costs and benefits evenly.

In summary, the spreadsheet tools applied had the capacity to undertake a detailed assessment of economic and financial feasibility; including the estimation of cash flow over time, cash balance at the end of the planning period and expected change in net worth, as well as report measures of economic and production efficiency. Both the financial and economic outputs of the model were underpinned and directly linked to year-by-year estimates of the productivity of the modelled breeding herd.

The focus of all case studies was the need to improve profitability. Therefore marginal analyses using partial discounted net cash flow budgets were the main focus. Such partial budgeting provides an estimate of the extra return on extra capital invested in developing the existing operation.

Results

Estimating a profitable change to management strategy

Figure 1 shows the NPV calculated for 56 alternative management strategies nominated by project co-operators. The NPV was calculated by constructing partial discounted net cash flow budgets that compared a 'without change' management strategy to the alternative under consideration.

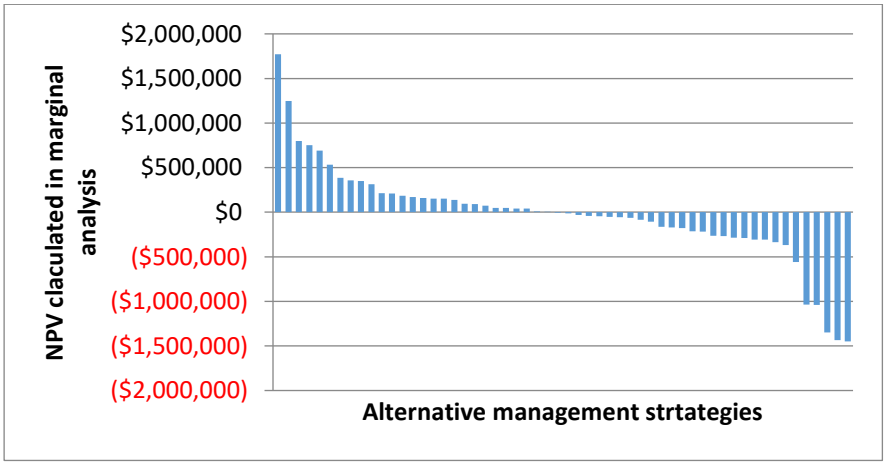

Figure 1 NPV range for alternative management strategies

Although the IRR for the change was often calculable, the NPV is seen as a more reliable indicator of the impact on profit of implementing a change in management strategy.

The values shown in Figure 1 do not provide insight into the relative value of strategies or the relative size of benefits achievable by individual beef businesses when changing management strategy as the estimates of NPV include impacts achieved by beef enterprises with between $1

million and $25 million invested in assets. Of more interest are the outcomes for changes in management strategy chosen by case study co-operators on the basis that the change was likely to improve business returns.

If it was proposed that a positive NPV will improve profit and a negative NPV will reduce profit, then about 48% of the proposed management changes would have reduced profit and about 52% would have improved profit.

Given that there is some uncertainty about the eventual outcomes of modelling exercises, selecting a range of NPV values for the subjective assessment of impact to an NPV greater than $50,000 being likely to improve profit or an NPV less than -$50,000 being likely to reduce profit identifies that of 38% of selected alternative management strategies may have improved profit while 62% were poor choices or likely to have little impact.

A further widening of the range to account for the variation in property size so an NPV exceeding $100,000 is (subjectively) chosen as likely to noticeably improve business profit and an NPV of less than -$100,000 is chosen as likely to noticeably reduce business profit, about 32% of the chosen strategies would have significantly improved business profit, about 32% would have made no real impact and 36% would have significantly reduced business profit.

The relationship between change in NPV and change in production indicators

Although the NPV is the criterion of choice for assessing the economic value of changing the management of a beef business, a number of co-operators supported the use of production-based indices when estimating the benefits of change. The two indicators most commonly supported were the change in the Cost of Production (CoP) and the change in the kilograms of beef produced per adult equivalent (AE) or Livestock Unit (LSU). The second indicator is generally shortened to kg beef /AE or kg beef /LSU.

Each production indicator has been a feature of recent analyses of the northern Australian beef industry (McCosker *et al* (2009), McLean *et al.* (2014)) and the use of the CoP is promoted by Meat and Livestock Australia (MLA). A tool to calculate CoP is featured on the MLA website, and is accompanied by the quote "The cost of production calculator is a tool kit to help you determine your CoP and compare performance annually".

CoP is generally defined as the cost of producing a (liveweight) kilogram of beef, and is usually based on the ratio of total fixed and variable costs for a beef enterprise to the total liveweight kilograms of beef produced. The kg beef /AE indicator is generally calculated to take into account the kilograms of beef associated with purchases, sales and changes in livestock inventory. AEs are defined in the appendix attached.

The identified production indicators are generally calculated as a component of a comparative analysis or benchmarking exercise wherein the aim is to highlight differences between the performance parameters of the 'top' versus 'average' producers – usually the top 10%, 20% or 25% versus the average. The CashCow project (McGowan *et al*. 2014) identified the distribution of performance of mobs of cattle as variation around the median (50th percentile), mostly to the 25th to 75th percentile levels with outliers represented as separate data points on box plots. The 75th percentile value was defined as the achievable level for some performance measures while the 25th percentile value was defined as the achievable level for others.

The widespread discussion and application of production and other indicators in comparative analysis and benchmarking exercises funded by MLA and other agencies across the northern beef industry has led many to identify them as indicators useful to the decision making process – hence the desire by some co-operators to calculate them in the analysis of options.

Figures 2 and 3 are extracted from McLean *et al.* (2014) and the correlations and relationships shown are often used within industry to underpin the assumption that a predicted change in the CoP or change in the kg beef /AE are useful in assessing the value of a change in a management strategy. The data points shown in Figures 2 and 3 are calculated for different beef enterprises and show how the values change across enterprises, not how they respectively change for alternative management scenarios within beef enterprises.

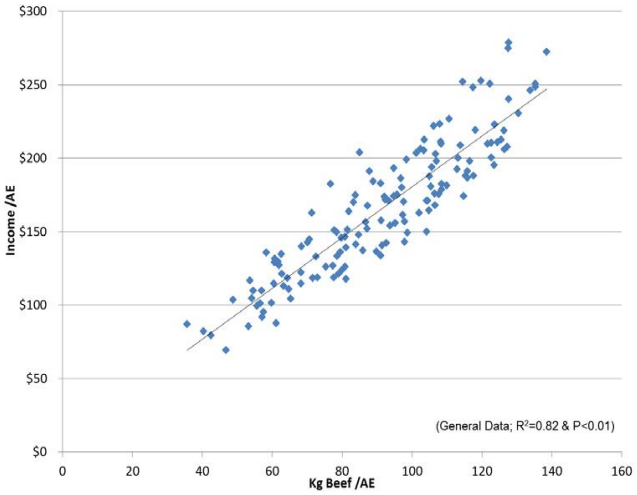

Figure 2 Relationship between kg beef/AE and income/AE (McLean et al. (2014))

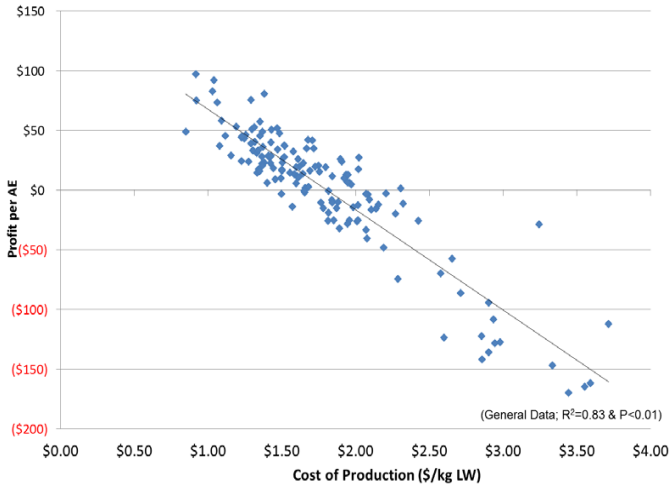

Figure 3 Relationship between CoP and profit (McLean et al. (2014))

McLean *et al.* (2014) provide the following equation: *kg Beef/AE = −70.2 + 0.181 x Sale Weight + 150.338 x Reproductive Rate − 227.858 x Mortality* and state "this equation is robust and can be applied at an industry level, a regional level or an individual business level if the appropriate data are used".

They also indicate "the owner of this business can use this information to make an investment decision to achieve these targets" and "Profit-driven producers should set a minimum productivity (kg beef/AE) target for their herd, of the greater of either 100 kg or the Top 25% figure for their region".

McLean *et al.* (2014) state: "Cost of production is a measure which encompasses both expenses and productivity and it explains more than 80% of the difference in profit between herds" and "Given this relationship between cost of production and profit, the major cause of lower profits in the northern beef industry is higher cost of production".

To identify whether the correlations and findings of McLean *et al* (2014) applied at the level of change in strategy *within a beef enterprise*, the relative change in NPV (measured as the ratio of the NPV calculated for the partial budget to the NPV of the 'without-change' business), the relative change in the CoP and the relative change in kg beef /AE were calculated for each alternative strategy identified in Figure 1. These data points were then organised to produce scatter graphs.

If the high correlations across properties identified in Figures 2 and 3 are relevant to decision making within beef enterprises, this relevance should be shown as a tight distribution of values aligned from the top left-hand corner to the bottom-right hand corner of a scatter graph for percentage change in NPV and percentage change in CoP and from the top right-hand corner to the bottom left-hand corner for percentage change in NPV and percentage change in kg beef /AE.

Figure 4 identifies the relationship between the relative change in NPV and the relative change in CoP for the same strategy within each beef enterprise.

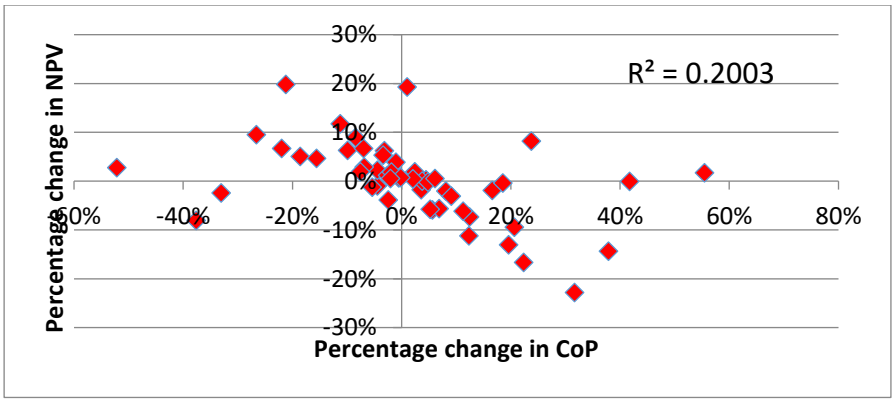

Figure 4 Percentage change in NPV vs percentage change in COP

Figure 5 identifies the relationship between the relative change in NPV and the relative change in kg beef /AE for the same strategy within each beef enterprise.

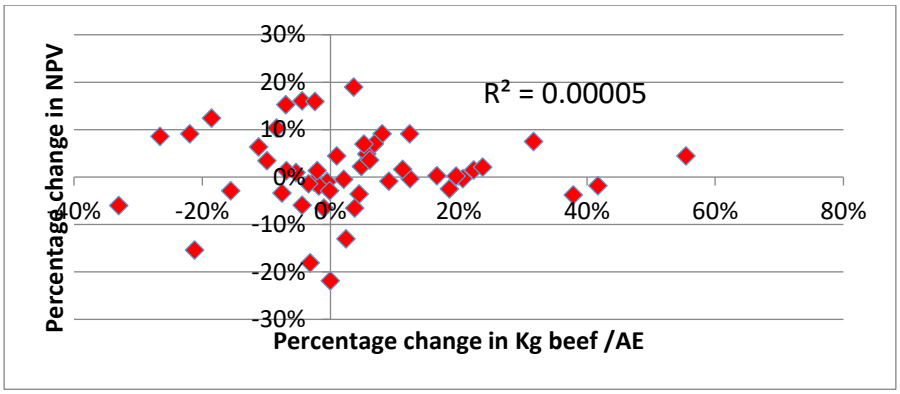

Figure 5 Percentage change in NPV vs percentage change in kg beef /AE

Figures 4 and 5 indicate there is no real correlation between change in profit and change in CoP or between change in profit and change in kg beef /AE when measured as a response to a change in strategy within beef enterprises.

That is, neither the amount of change nor the direction of change in the CoP or in the kg beef /AE (or other indicators based on measures of production or performance in a beef herd) will be useful predictors of the amount or direction of change in business profit when individual strategies seeking to improve the economic performance of a beef business are being tested.

Conversely, by definition, the correlation between the change in NPV caused by a change in management strategy and the change in enterprise profit is 1.

Discussion

Management characteristics and decision making

A number of insights were revealed by consideration of the results and the case study discussions.

One insight is that a significant number of participants in the northern beef industry are unable to appropriately assess the value of change to their business. This problem is caused, in part, by the use of inappropriate decision making frameworks and indicators when assessing the value or impact of change.

Another insight is that the highest likelihood of significantly damaging enterprise performance coincided with management teams that were both inexperienced in the operation of the beef business and lacking the appropriate skills to assess the value of change. They did not have the experience, skills and knowledge to take advantage of sound opportunities for improvement or to know what was likely to be a risky or damaging proposition.

The limiting factor of inexperience of the management team in a particular beef business or inexperience in beef business management were greatly offset if the right decision support structures and mentoring processes were in place. One particular case study provided an excellent example of the capacity of a young and inexperienced management team to turn the prospects of a failing beef business around when they were provided with, and engaged in, the right learning and mentoring framework.

A mentoring and learning framework that appropriately develops the knowledge and skills of inexperienced management teams and their decision-making processes can significantly improve decision making and business outcomes.

Where the beef enterprise was owned or managed by the one management team for a decade or more, the capacity of the management team to learn from its experience was important in decision making. Long-term experience in the particular beef enterprise seemed to prevent poor strategies being put forward for consideration. Where an inappropriate decision-making framework was applied by experienced management, there was also a lower capacity to identify alternative management strategies that were profitable.

Experienced managers that had a long-term relationship with production scientists and an emphasis on production indicators were also likely to exhibit a strong focus on technical efficiency and a desire to "push the production envelope". Where an effective management team was in place this did not seem to overly damage the performance of the underlying business or limit the choice of strategies put forward. For these effective teams, the potentially negative impact of the component of the team focussed on technical efficiency appeared to be effectively offset when it came to decision making and strategy choice by another member of the team focussed on the financial and economic efficiency (cash flow and profit aspects) of the strategies being considered.

Where property management relied on a single person and that person was focussed on technical efficiency (i.e. focussed on maximising herd parameters like weaning rate, total beef produced per hectare or per head), the choices made significantly damaged the economic performance of the underlying business. It did not seem to matter whether this single manager was male or female in this group of case study co-operators.

The most effective decision making and selection of profitable options seemed to occur where more than one member of the management team was fully engaged in the operation of the business, where the team was experienced in the operation of the particular property under management and applied an appropriate decision making framework. Appropriate mentoring and skills development were critical where management was inexperienced.

Appropriate and inappropriate decision making frameworks

The economic analysis component of the case studies focussed on profit and how much it may change with a change in management strategy. Profit is an economic criterion and is the true measure of economic performance. Financial analyses focussed on cash flow aspects of management strategy change and, while consideration of net cash flow is of greater importance to farm managers, net cash flow is not the same as profit and consideration of profit and changes in profit are also key components of an appropriate decision making framework.

Appropriate decision making frameworks also identify that decision making is about the future not the past and that improving the economic and financial performance of a beef herd is about changing to new production frontiers, and re-organising resource use at the margin.

We have identified some performance indicators and decision making frameworks as spurious (– where spurious is defined as something of illegitimate birth; outwardly similar or corresponding to something without having its genuine qualities: false, of falsified or erroneously attributed origin; forged). Identifying the lack of usefulness of indicators like CoP

and kg beef /AE plus techniques like benchmarking and comparative analysis for decision making is nothing new. For example:

- Campbell (1944) clearly identified the shortcomings of CoP studies – "investigations having as their objective the determination of unit production costs … represent misdirected effort, since the results derived therefrom are well-nigh meaningless".

- Campbell (1944) also points to conclusions reached in the 1920s (Bennett 1928) that "Statistics of money cost per unit of product are of negligible value in a program intended to increase farm efficiency; they contribute next to nothing to the theory of cost and price relationships in agriculture; and they do not provide a sound basis for price fixing… Such data as are of value for farm management purposes are not statistics of money costs per unit of product".

- Forster (1944) identifies "of all the methods devised to analyse and present farm management data, this method (direct comparison) is the most defective. From most any point it can and has been repeatedly demolished". The term direct comparison is interchangeable with benchmarking which has also become interchangeable with comparative analysis.

- Mauldon and Schapper (1970) identified "that the purposes served by those who want statistical comparisons of key or efficiency ratios between different farms and between activities within a farm, could be met costlessly and punctually by sets of (almost) random numbers. This is because such comparisons and margins are of slight use in planning, budgeting and diagnosing strengths and weaknesses in farm management, and are untimely, expensive, and inaccurate".

- Malcom (2004) identified that "economic illiteracy is abundant in farm management analysis". He was concerned with one area of activity – "economic illiteracy and irrationality in…. the analysis of significant farm management questions by publicly-funded and farmer-funded agencies and agents".

Although this critique was begun almost 90 years ago and continues to this day, it is apparent that many publicly-funded agencies and agents still support analyses and studies that by not incorporating sound economic processes can generate perverse outcomes for the northern beef industry.

Recent examples of the application of such processes in the north Australian beef industry include:

- McGowan *et al* (2014) identifying "that liveweight production from breeding mobs/herds can be calculated from readily collected data, and used as a key performance indicator for achievable performance in northern beef herds" and that "the economically achievable performance level was selected as the 75 percentile point in distributions within country type"; and
- A synopsis document of the CashCow project (MLA 2015) assumed "that, for each broad country type, the 75th percentile for pregnant within four months and annual pregnancy rate, and the 25th percentile for calf loss and cow loss, were the commercially achievable rates"; and

- Relatively large amounts of funding of benchmarking exercises and associated workshops by the Reef Trust Phase 3 across the Great Barrier Reef catchments. The outcomes will apparently be an improvement in the profitability and sustainability of primary producers, an improvement in water quality and "happy management teams" achieved by benchmarking workshops enabling landholders to change practices. (Australian Government 2016)

As identified by Bennett (1928), Campbell (1944), Forster (1944), Mauldon and Schapper (1970), Ferris and Malcolm (1999) and Malcolm (2004), there is no appropriate form of economic analysis capable of supporting these assumptions. The ongoing stream of public funds for benchmarking and comparative analysis activities shows well founded criticism of such methods has little impact.

The decision to develop and use inappropriate decision making frameworks and indicators seems to derive from a number of factors:

- There appears to be a common belief amongst many associated with the northern beef industry that extra production of beef equals extra profit and that maximising production will maximise profit. That is, although the law of diminishing returns seems well understood in a production sense, there appears little capacity to extend the concept to include the idea that profit is maximised when marginal costs almost equals marginal revenue. The erroneous belief that extra production equals extra profit seems to underpin the use of many production indicators.
- Where some form of cash or profit analysis is incorporated in a study of beef business performance, it nearly always looks at historical profit or historical net cash flow. There appears to be little understanding that, while such figures may indicate the capacity of the business to consider change and alternative management strategies, they provide no indication of which change may improve future financial and economic performance for any beef business. Although an estimate of last year's profit or the average of the last x number of years' profit is relatively easily extracted from a set of tax returns, the values generated don't indicate a suitable future direction for that beef business. Time poor analysts appear to prefer to quickly calculate performance indicators based on the past to the more time consuming process of building a picture of the current beef business and then looking forward to identify strategies that will improve business performance.
- It also appears common practice that, once an historical estimate of profit or net cash flow or associated performance ratio of some form has been generated for each farm in a multi-farm analysis, there is a tendency to rank the performance estimates for the group of farms. Underlying this process is the mistaken belief that lower ranked farms can replicate the technical efficiency of the higher ranked farms and achieve the same level of economic and financial performance. The ranking of a beef enterprise within any group gives no indication whether that business is above, below or at a level of performance that is relevant for that business. Within any group, higher ranked businesses may have more opportunities for improvement than lower ranked businesses and vice versa. Even though these mistaken beliefs have been effectively demolished (Candler and Sargent (1962), Mauldon and Schapper (1970)), it appears more and more complex indicators of technical efficiency are being produced over time and then used in the development of performance league tables.

- Supporters of various spurious indicators often claim that the outputs of economic and financial analyses are too difficult to understand and that their methods are "more acceptable" or that they are only using them to indicate "production" or "productivity". Although it is difficult to understand why competent analysts who bring high levels of rigour to their own field can accept or perpetrate nonsense outside of their field, it seems that this is not going to change and some analysts will continue to have considerable difficulty in understanding the concepts of agricultural and farm management economics and want to create or use techniques they find more tractable.
- Supporters of various spurious indicators usually also indicate that improving productivity is synonymous with improving profitability. The analysis undertaken for this paper clearly pinpoints the inability of productivity indicators to identify the relative or absolute value of alternative changes in management strategy to a beef business.
- The processes of comparative analysis and benchmarking produce data sets that are attractive to many science managers and funders. The data sets describe the costs and incomes for their farmer clients adequately for the needs of the funding agent. Although the poor value of the data to their farmer clients is often identified by farm management economists and others, the data has value to the funding agency which is prepared to overlook the theoretical shortcomings of the process (when they are recognised).
- Many scientists and industry development officers are strongly committed to achieving research outcomes of high quality with statistical rigour. Pressure on research funding and the use of tools like Cost Benefit Analysis to allocate research resources or justify funding cuts has led many scientists and others to want to identify their work as economically valuable. Although the limitations and challenges of using economics to evaluate Research Development and Extension (RD&E) activities are known (McClintock et al 2013), many researchers still look for positive feedback from economists. They often find it difficult to accept that the outcomes of high quality research or development activities may have low economic impact. This can lead to the search for "some other sort of economics" (Malcolm 2000) which makes their work outputs or findings "economically" positive.

Building appropriate decision support structures

Makeham (1971) identifies "the two major challenges to today's farm manager are:

- How to incorporate new technology profitably into his existing business organisation;
- How to be sufficiently flexible, mentally and financially, to adjust his resource management to meet both changed economic circumstances and widely varying climatic conditions."

Although we now find that farm managers can be both male and female, the challenges facing farm managers are still the same almost fifty years later. Even so, the hope of Makeham (1971) that the principles of farm business management would be incorporated into the decision making processes of farm managers to allow them to "meet these two challenges with some success" has only partly been realised.

There is a long history of interaction between farm management economists and north Australian beef industry participants. For example Harrison and Campbell (1970) provided a

detailed explanation of how to apply discounted cash flow analysis techniques to beef development projects and Holmes (1990) applied case studies and herd budgeting software to analyse the economic value of phosphorus supplementation and how phosphorus supplementation integrated with other practices to improve profitability. The Breedcow and Dynama herd budgeting software (Holmes 2013) has provided an excellent framework for identifying the economic and financial impact of a change in management strategy in the northern beef industry for almost 30 years.

Even though there is a long history of interaction between farm management economists and the northern beef industry, the fact that experienced beef business managers across northern Australia often put forward poor choices for alternative management strategies suggests that there is a need to revisit the topic of training in farm business management and consideration given to the development of appropriate structures that will facilitate better decision making among current beef enterprise managers.

The separate provision of training in farm business management has a very patchy history of variable results and poor outcomes and is unlikely to be (re)funded. We believe the provision of a decision support framework that incorporates farm management economics and works with beef managers on topics of interest to them is likely to be more efficient.

One recent beef industry project that incorporated farm management economics into its structure and delivered an appropriate decision making framework was the High Output Forages project (Bowen *et al* 2014).

This project investigated the relative profitability of forage options for backgrounding or finishing cattle in the Fitzroy River catchment of Queensland. Data was collected at 24 forage sites on commercial properties over 2011-2014. Whole-farm case studies were developed with co-operators and the factors affecting profitability were further investigated through constructed forage scenarios. The project provided a better understanding of the expected forage, animal and economic performance from key forage options under commercial management conditions. Project activities (field days, workshops, a producer guide to forage use, gross margin spreadsheets) generated very positive feedback from participating industry managers.

During the life of the project a total of 1927 people received direct information about the project at 108 events/contacts, including 25 field days or workshops. The overall acceptance and rating of project messages was high with an average approval rating of 85% across all events and of 88% across the seven dedicated extension events held after the finalisation of the project results. The intended level of practice change as a result of project messages and recommendations was 65% across all surveyed events and 87% for the six full-day workshops held after finalisation of project results.

Bowen and Hopkins (2016) identified "that the effectiveness of the communication and extension activities conducted as part of this project has in large part been due to the multidisciplinary, systems approach achieved through a project team drawn from a range of key disciplines, i.e. agronomy, animal nutrition, economics, and extension specialists. The high level of industry acceptance and intended adoption of project messages demonstrates the significant synergies and positive outcomes for industry from accessing multidisciplinary, regional teams with a strong focus on applied research. Another key aspect which contributed

to industry engagement was the involvement of beef producer co-operators in the project, enabling commercially relevant data to be collected that producers could relate to and have confidence in. The economics component of the project was essential in giving producers the 'bottom-line', profitability, answers they were looking for".

Another similar, but more focussed, decision support framework is currently being developed by beef industry development officers in the Northern Territory.

The Profitable Grazing Systems (NT) project hopes to assist participants investigate and share their experience when assessing and implementing options to improve profit. It will have a focus on improving animal nutrition and will work with beef managers in groups and individually to identify key topics of interest to the managers. They will then be assisted to evaluate and prioritise strategies, identify implementation pathways and record what the results and key learnings have been.

The framework will include detailed consideration of the technical aspects of local production systems - specifically developing an understanding of what is required as base line production data and how it is measured.

Participating managers will develop a cost benefit for their own situation in order to prioritise which strategy will be most profitable in relation to their understanding of their current performance, aspirations and opportunities for improvement. The project will also include a group workshop where participants will build representative scenario's together using a range of economic decision tools. Another key component of the Profitable Grazing Systems project is that it will be led by skilled technical officers and scientists whose function will be, in part, to come up with options beyond current experience.

Makeham (1971) identified farm management economics "is but one part of a broad spectrum of disciplines, each of which have an important bearing on any successful farm business operation". The decision support frameworks applied in the High Output Forages project and being developed in the Northern Territory Profitable Grazing Systems project strike an appropriate balance of disciplines and include farm management economics as a core discipline.

Conclusions

After reviewing the relationship between science and economics, Malcolm (2000) identified that economics is not part of research organisational policy or culture and that it is unlikely to become part soon. We, like Malcolm (2000), find there appears little chance of reducing the publicly funded support for inappropriate decision making frameworks or changing the anti-economic, fundamentalist organisational cultures that exist within some agencies.

Even so, there is some hope. Along what is described as the RD&E (Research, Development and Extension) continuum, there often exists an excellent relationship between researchers and industry development officers tasked with identifying and developing innovations for use by industry and farm management economists.

The value in the relationship appears to derive from the synergies achieved when relevant but different sets of skills and knowledge are applied to the problem of assessing the value of an innovation to beef producers. The third skill set required to make the relationship highly

effective are the skills of the experienced property manager who can describe the context within which the innovation will be applied.

In the short term, progress in improving management skills and knowledge and reducing the impact of inappropriate decision frameworks is most likely to be achieved by industry development officers, farm management economists and experienced farm managers working together to solve farm management problems and highlighting the benefits of maintaining their relationship.

Although Malcolm (2004) identifies that poor business decision making should be a self-correcting problem, we argue that public funds are currently being misspent on promoting inappropriate decision making frameworks and that reallocation of those funds would provide the northern Australian beef industry with better outcomes.

There is still a clear role for publicly funded industry development officers to extend the vision of the beef enterprise manager and for farm management economists to assist the incorporation of new technology profitably into northern Australian beef businesses.

References

Australian Government (2016) Reef Trust Phase Three Investment Programme, available at https://www.environment.gov.au/marine/gbr/reef-trust/investments/phase-three

Bennett MK (1928) Farm Cost Studies in the United States: Their development, applications and limitations, Stanford University Press.

Bowen MK, Chudleigh F, Buck S, Hopkins K, Brider J (2014) High-output forage systems for meeting beef markets – Phase 2. Project B.NBP.0636 Final Report, Meat and Livestock Australia, Sydney

Bowen MK and Hopkins K (2016) Report on extension activities for project 'High-output forage systems for meeting beef markets – Phase 2, Meat and Livestock Australia, Sydney

Campbell KO (1944) Production cost studies as a field of research in agricultural economics, Journal of the Australian Institute of Agricultural Science, vol. 10, pp. 31–37.

Candler W and Sargent D (1961) 'Farm Standards and the Theory of Production', Journal of Agricultural Economics, 15 (2):282-290.

Chudleigh F, Oxley T, Cowley T, McGrath T, Moravek T, Sullivan M (2016) The impact of changing breeder herd management and reproduction efficiency on beef business performance, Project B.NBP.0763, Meat & Livestock Australia Ltd. North Sydney

Forster GW (1944) Discussion (Theory of the firm and farm management research) Journal Farm Economics 22: 123-126

Ferris A and Malcolm B (1999) Sense and Nonsense in Dairy Farm Management Economic Analysis available at http://ageconsearch.umn.edu/bitstream/123803/2/FerrisMalcolm.pdf

Harrison SR and Campbell CB (1970) Discounted Cash Flow Analysis of Beef Development Projects, Technical Bulletin No 8, Economic Services Branch, Queensland Department of Primary Industries.

Holmes WE (1990) Phosphorus and beef production in northern Australia, 11. A case study approach to the economic assessment of phosphorus supplementation, Tropical Grasslands, Volume 24, 250-255

Holmes WE (2013) Breedcow and Dynama Herd Budgeting Software Package, Version 6 for Windows, Queensland Department of Employment, Economic Development and Innovation, Townsville available at https://www.daf.qld.gov.au/animal-industries/beef/breedcow-and-dynama-software

Malcolm LR (2000) Farm Management Economic Analysis: A Few Disciplines, a Few Perspectives, a Few Figurings, a Few Futures. Invited Paper Presented to Annual Conference of Australian Agricultural and Resource Economics Society, Sydney

Malcolm LR (2004) Where's the economics? The core discipline of farm management has gone missing! Australian Journal of Agricultural and Resource Economics, 48(3):395-417.

Malcolm LR (2005) In memory of Jack Makeham: the pioneer of farm management in Australia, Memorial Lecture, Australian Farm Business Management Journal Volume 3 No 1

Makeham JP (1971) Farm Management Economics, Gill Publications, Armidale, NSW.

Mauldon R, Schapper H (1970), Random numbers for farmers, The Journal of the Australian Institute of Agricultural Science, 35(4), 274-284

McClintock A, Malcolm LR, Crean J, Jackson T and Heath J (2013) Pragmatic Selection of RD&E Investments in Primary Industries, Contributed paper prepared for presentation at the 57th AARES annual conference, Sydney

McCosker T, McLean D, Holmes P (2009) Northern Beef Situation Analysis (2009), Project B.NBP.0518, Meat & Livestock Australia Ltd. North Sydney

McGowan MR (2014) Northern Australian beef fertility project: CashCow, Project code: B.NBP.0382, Meat & Livestock Australia Ltd.

McLean I, Holmes P, Counsell D (2014) The northern beef report. 2013 northern beef situation analysis. Final Report of Project B.COM.0348 to Meat and Livestock Australia, Sydney

MLA (2015b) Technical synopsis: CashCow findings – Insights into the productivity and performance of northern breeding herds, Meat & Livestock Australia Ltd. North Sydney

Murray H, Green-McGrath D, Lev LS, Morrow AM (1994) Whole Farm Case Studies: A How-To Guide, Oregon State University Agricultural Communications

Appendix - Glossary and definitions

Discounting and investment analysis

In undertaking investment analysis, it is necessary to make predictions of cash inflows and outflows for a future time period. A key feature of investment analysis is the process of discounting these future cash flows to present values. Discounting is used to evaluate the profitability of an investment whose life extends over a number of years. Discounting is also used when selecting among investments with differing cash flow patterns.

Investors generally prefer to receive a given amount of money now rather than receiving the same amount in the future. This is because money has an opportunity cost. For example, if asked an amount of money they would just prefer to receive in 12 months' time in preference to $100 now, most people would nominate a figure around the $110 mark (certainly more than $100!). In other words, money has an opportunity cost of around 10 per cent to them.
At an opportunity cost of 10 per cent, an amount of $100 now has a future value of $110 in 12 months' time ($100 x 1.1). It would have a future value of $121 in two years' time (i.e. $100 x 1.1 x 1.1).

For similar reasons, society puts an opportunity cost on funds employed in public sector development projects making discounting equally important in the allocation of public funds. Because of the time preference for money (opportunity cost), it is difficult to compare money values received at different points of time. To compare and aggregate money values over time, it is first necessary to discount them to their Present Value equivalents. Thus, $121 in two years' time has a Present Value of $100 at an opportunity cost (discount rate) of 10 per cent.

The general formula for discounting a future amount to its Present Value is:

$$\text{Present Value} = A / (1+i)n$$

Where:
A = future amount
i = Discount rate
n = Number of periods in the future

The stream of funds occurring at different time periods in the future is then reduced to a single figure by summing their present value equivalents.

Note that discounting is not carried out to account for inflation; discounting would still be applicable in periods of nil inflation. It is common, however, to remove the inflation component from discount rates when undertaking investment analyses.

Nominal interest rates are those quoted on cash investments. Real discount rates have the inflation component removed from this nominal rate. It is also necessary that future cash inflows and outflows are expressed in real (constant) terms i.e. they should not include an allowance for inflation.

Alternatively, cash inflows and outflows may be expressed in current (nominal) dollar terms. In this situation, a nominal (inflation included) discount rate would be used.

Profitability measures

Three profitability criteria can be calculated. They are:

- Net Present Value (NPV) – the stream of future cash flows is reduced to a single figure. The NPV is the difference between the Present Value (PV) of the investment inflows and the PV of the investment outflows. An investment is acceptable if the NPV is positive.
- Benefit-Cost Ratio (B/C Ratio) – the PV of the investment inflows divided by the PV of the investment outflows. An investment B/C ratio greater than one is required.
- The Internal Rate of Return (IRR) – the discount rate at which the PV of inflows equals the PV of outflows. It is internal because it is calculated independently of the cost of borrowed funds. It represents the maximum rate of interest that could be paid if all funds for the investment were borrowed and the investment was to break even.

The three decision criteria are interrelated. For example, at a discount rate of eight per cent:

NPV	Negative	Zero	Positive
IRR	< 8%	8%	>8%
BC RATIO	Less than 1	1	Greater than 1

'With' and 'without' scenarios

There are two critical questions that must be considered in any investment analysis.

1. What is likely to happen with the change?

2. What is likely to happen without the change? This is also known as the 'counterfactual' or 'baseline scenario', and often is represented by a business or investment structure that is currently in place.

Since the 'with' change scenario is hypothetical by definition, specifying it is necessarily subjective, and consequently more problematic than the 'without' change scenario. It should be inferred from the best available information, and the necessarily subjective underlying assumptions made explicit.

The specification of a counterfactual or baseline scenario is a key part of any impact analysis. Use of the 'with' and 'without' principle forces formal consideration the net impact of the investment.

Compounding and discounting

Future costs and benefits can be valued in real (constant) or nominal (current) prices. In the real terms approach, all variables are expressed in terms of the price level of a single given year. While any year may be used, the present year will usually carry most meaning as a base.
Note that if an entire analysis is conducted in the prices of the year in which the analysis takes place, it is being carried out in real terms. The method generally assumes that future inflation will affect all costs and benefits even-handedly.

If there are good reasons for thinking that particular cost or benefit streams will not follow general price movements, those changes in relative prices should be built into the analysis. If land rents, for example, in the context of a property evaluation, are expected to exceed the rate of inflation by two per cent a year for the next three years, the analysis should include this parameter. Assumptions regarding expected relative price changes should be made explicit.

In the nominal price approach, the impact of expected inflation is explicitly reflected in the cash flow projections. As in the real price case, different inflation rates can be applied, if necessary, to different cost and benefit streams. Because of the demanding nature of the data requirements under this approach (inflation rates need to be estimated for the entire project period), the approach is not generally used.

As noted, when using constant values, it is usual to accept the prices of the first year of the project. However, when the cost-benefit analysis is undertaken as part of an ex post evaluation, the convention is to use the prices of the final year of the project.

The Australian Bureau of Statistics publishes numerous implicit price deflators (IPDs) which may be used to convert nominal net benefits to real net benefits (see Australian National Accounts – National Income and Expenditure, annual, ABS Catalogue No. 5204.0). However, unless a specific IPD seems applicable, a general deflator such as the Gross Non-Farm Product IPD may appropriately be used.

It is important that real prices and nominal prices are not confused in the analysis. In particular, when the analysis is presented in nominal prices, the discount rate should be adjusted for inflation. This captures the point that investors require compensation for anticipated inflation as part of the price of making funds available. With annual compounding, the formula for converting a real discount (r) into a nominal one (n) is:
$n = (1 + r)\ (1 + \text{inflation rate}) - 1$

Thus with a real discount rate of say 6 per cent, and an expected annual rate of price inflation of 3 per cent, the correct nominal discount rate is 9.2 per cent. Note: the ‘intuitive’ alternative of summing the real discount rate and the inflation rate (to give 9 per cent), slightly underestimates the correct value.

Conversely, to convert nominal discount rates into real discount rates, the equation is:
$r = (1 + n) / (1 + \text{inflation rate}) - 1$

Thus, if the nominal discount rate is 9 per cent and the expected inflation rate is 3 per cent, the corresponding real discount rate is 5.8 per cent. Note here that an intuitive ‘subtraction’ approach overestimates the correct value.

For most investment analyses, all benefits and costs should be expressed in constant dollar terms and discounted or compounded by the discount rate to the current year.

The criterion of choice in investment analysis is the Net Present Value (NPV) or the Internal Rate of Return (IRR). The NPV for individual investments can be converted to an annuity and presented as the ‘net annual economic benefit generated during the next x years.’ The Internal Rates of Return (IRR) is useful in comparing the likely returns of alternative investments but can be problematic when used inappropriately.

The Benefit Cost Ratio (B/C ratio) i.e. benefits in relation to costs is generally less used in investment analysis but is widely used in processes like Benefit Costs Analysis (BCA). A calculated B/C ratio of greater than one indicates a profitable investment.

It is desirable to analyse all investments over a common time period e.g. 30 years. However, this will not always be possible because of different starting dates between investments and because of the different time frames over which benefits are likely to apply.

Glossary of key terms used in economic and financial analysis

Activity – Activity specifies a particular method of producing a crop or operating a livestock enterprise. For example, spring and winter wheat crops are considered as different activities but as the same enterprise. Cows fed three different rations and giving three levels of milk output can be treated as three separate activities.

Adult Equivalent (AE): Cattle of different ages and body weight have different requirements for feed. In determining the composition and grazing pressure of a herd, it is necessary to work on a common animal unit. In this analysis an AE is defined as a 450 kg dry animal.

Note: Adult Equivalents for dry cattle are based on relativity to a standard weight of beast carried for 12 months. AEs for breeders are based on weight, plus a loading for breeders that have (or wean) a calf. This loading represents the extra nutritional requirement of a cow that rears a calf, relative to a dry cow. The loading for rearing a calf can be between 20% and 35% of the loading given to the breeder depending upon the modelling process used and the age to which the cow calf unit is being assessed. The loading usually covers the extra load of pregnancy and lactation. In some models it will also cover the pasture consumed by the calf itself up to age five months, at which point the weaner can be rated in its own right.

Adult Equivalents are calculated for a PERIOD of time, not for a point in time. Except for weaners and sale cattle, this will be 12 months, e.g. from age 12 months to 24 months. The weaner group will usually be rated up until weaning for keepers and (more or) less for those sold.

One adult equivalent (AE) can be thought of as the amount of feed consumed in 12 months by a non-lactating animal of average weight 450 kg. Therefore, if average feed consumption is 2.2% of bodyweight, this would be equivalent to approximately 3,650 kg dry matter per year for one AE. Cattle supplemented with phosphorus or urea will eat more than un-supplemented cattle of the same bodyweight. For full-year supplementation, feed intake could be 20% higher than for un-supplemented cattle. When comparing herds with and without supplementation, reduce the total AE of the supplemented herd to ensure a fair comparison (17% reduction will equate to 20% extra feed consumption), applying pro-rata reduction for part-year supplementation.

Annuity – an equal sum spent or received; an amount paid or received annually or at other regular intervals for a stated period of time.

Annual equivalent – A stream of equal amounts paid or received annually for a period such that discounting at an appropriate discount rate it will have a specified present worth. It is determined by multiplying an initial value by the capital recovery factor for the appropriate interest rate and period. To annualise is to find the annual equivalent of a value.

Benefit-cost analysis (BCA) – A conceptual framework that can be applied to the economic evaluation of projects and programs in the public sector. It differs from a private financial appraisal (sometimes termed investment analysis) in that it considers all gains (benefits) and all losses (costs), regardless of to whom they accrue.

Benefit-cost ratio (B/C Ratio) – The ratio of the present value of investment benefits to the present value of investment costs. A value greater than 1 suggests a profitable investment.

Constant (real) dollar terms – all variables are expressed in terms of the price level of a single given year.

Current (nominal) dollar terms – the impact of expected inflation is explicitly reflected in the cash flow projections.

Depreciation – (as applied in estimating operating profit). It is a form of overhead cost that allows for the use / fall in value of assets that have a life of more than one production period. It is an allowance that is deducted from gross revenue each year so that all of the costs of producing an output in that year are set against all of the revenues produced in that year. Depreciation of assets is estimated by valuing them at either current market value or expected replacement value, identifying their salvage value in constant dollar terms and then dividing by the number of years until replacement.

Discounting – The process of adjusting expected future costs and benefits to values at a common point in time (typically the present) to account for the time preference of money. With discounting, a stream of funds occurring at different time periods in the future is reduced to a single figure by summing their present value equivalents to arrive at a Net Present Value. Note that discounting is not carried out to account for inflation. Discounting would still be applicable in periods of nil inflation.

Discount rate – The interest rate used to determine the present rate of a future value by discounting.

Dry sheep equivalent (DSE) – Often defined as a two year old merino sheep (wether or non-lactating non-pregnant ewe). There are roughly eight DSE's to one AE. A DSE is often defined as the amount of feed required to maintain a 48 kilogram wether for a period of time, usually a year.

Economics – The science which studies human behaviour as a relationship between ends and scarce means which have alternative uses.

Economically sustainable – The use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term. Within a business context, economic sustainability involves using the capital of the company efficiently to allow it to continue functioning over time.

Enterprise – Enterprise denotes the production of a particular commodity or group of related commodities for direct sale, thus by 'wheat enterprise' we imply the production and sale of a wheat crop but do not specify the method of production.

Enterprise (or Activity) gross margin – The gross margin of an enterprise (or activity) is its gross income minus its variable costs.

Enterprise (or Activity) variable costs – Costs directly attributable to an enterprise or activity and which vary in direct proportion to the scale of the enterprise or activity.

Equity capital – The value of the owner's capital. This is equal to total capital minus total liabilities.

Equity Ratio (or per cent) – The proportion of equity capital to total capital, usually expressed as a percentage.

Farm budget – Accounts for the gross margins of each of the enterprises considered as well as the fixed or overhead costs of the farm (also called a profit and loss statement). Usually includes a statement of farm assets and liabilities (or a balance sheet) and a cash flow budget.

Fixed (or overhead) costs – Defined as costs which are not affected by the scale of the activities in the farm business. They must be met in the operation of the farm. Examples include: wages and employee on-costs, repairs, insurance, shire rates and land taxes, depreciation of plant and improvements, consultants fees and the operators allowance for labour and management. Some fixed costs (such as depreciation or operator's allowance) are not cash costs. It is usual to count the smaller amounts of interest on a typical overdraft or short term working capital as an operating expense (fixed cost) and deducted in the calculation of operating profit. Non-operating expenses such as the returns to lenders of fixed capital (interest, rent, lease payments) are deducted in the calculation of net profit.

Gross margin – A gross margin is the gross income from an enterprise less the variable costs incurred in achieving it. It excludes fixed or overhead costs.

Internal Rate of Return (IRR) – The discount rate at which the present value of income from a project equals the present value of total expenditure (capital and annual costs) on the project; the breakeven discount rate = the maximum interest that a project can pay for the resources used if the project is to recover its investment and expenses and still just breakeven.

Investment appraisal – An evaluation of the profitability of an investment.

Investment criteria – These are measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio and Internal Rate of Return.

Key Performance Indicators (KPIs) – Key performance indicators (KPIs) are tracking indicators used to measure the achievement of outputs against targets.

Live Stock Unit (LSU) – see Adult Equivalent

Marginal return: extra or added return – Principle of marginality emphasises the importance of evaluating the changes for extra effects, not the average level of performance.

Net Profit – this is the reward to the farmers own capital. Net Profit equals Operating profit less non-operating expenses. Non-operating expenses such as returns to lenders of fixed capital (interest, rent, leases) are deducted from Operating Profit in the calculation of Net Profit. It is available to the owner of the business to pay taxes or to provide living expenses (consumption) or it can be used to reduce debt. Net profit minus income tax minus personal consumption (above operators allowance if it has already been deducted from operating profit) = change in equity. Net non-operating incomes can be added to net profit.

Nominal (current) terms – the impact of expected inflation is explicitly reflected in the cash flow projections.

Operators allowance – An allowance for the owners labour and management; it can be estimated by reference to what professional farm managers / overseers are paid. Although it is often not paid in the farm accounts, it is an input required to generate the operating profit and must be deducted if a true estimate of operating profit and the return to the total capital in the business is to be calculated. It is generally not equal to the irregular wages paid to or drawings made by the owners. If some wages have been paid to the owners in the farm accounts and they are already included in the calculation of fixed costs, then the only difference between the wages paid and the true opportunity cost of their labour and management will need to be allowed for when calculating operating profit.

Opportunity cost – The benefit foregone by using a scarce resource for one purpose instead of its next best alternative use.

Other farm income – Income earned by the farm business but not attributable to a particular enterprise, such as income from contract work.

Overhead (or Fixed) costs – see Fixed costs.

Present Value of Benefits (PVB) – The discounted value of a stream of future benefits.

Present Value of Costs (PVC) – The discounted value of a stream of future costs.

Operating Profit – This is the return to total capital invested after the variable and overhead (fixed) costs involved in earning the revenue have been deducted. Operating profit represents the reward to all of the owners of the capital tied up in the business. Operating profit equals (total receipts minus variable costs equals' total gross margin) minus overheads. When operating profit is expressed as a percentage return to total capital it indicates the efficiency of the use of all of the capital invested in the farm business.

Stochastic – A process with an indeterminate or random element as opposed to a deterministic process that has no random element.

Rate of return on equity – Net Profit expressed as a percentage of the average of the owner's equity capital used in the business for the period under review (usually a year).

Rate of return on total capital – Operating Profit expressed as a percentage of the average of the total capital employed for the period under review (usually a year).

Real (constant) dollar terms – all variables are expressed in terms of the price level of a single given year.

Reproduction efficiency is defined as the number of weaners produced divided by the total number of breeders mated expressed as an annual percentage.

Risk analysis – An analysis or an assessment of factors that affect or are likely to affect the successful achievement of an intervention's objectives. A detailed examination of the potential unwanted and negative consequences to human life, health, property, or the environment posed by interventions; a systematic process to provide information regarding such undesirable consequences; the process of quantification of the probabilities and expected impacts for identified risks.

Sensitivity analysis – An analytical technique to test systematically what happens to earning capacity if events differ from the estimates made about them in planning.

Total Capital – The total value of the capital of the farm business, such as land, improvements, livestock, plant and materials.

Total gross margin – The sum of the gross margins of all the enterprises or activities in the farm plan.

Total liabilities – The total value of the liabilities of the farm business, such as bank debt, unpaid accounts, tax due etc.

Variable costs – costs which change according to the size of an activity. The essential characteristic of a variable cost is that it changes proportionately to changes in enterprise size (or to change in components of the enterprise).