NSW DEPARTMENT OF
PRIMARY INDUSTRIES

StockPlan®: a Decision Aid for Management of Livestock During Drought and Other Times.

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Abstract

This report presents a detailed description of the software program *StockPlan*® including a description of the calculations used within the program. *StockPlan*® has been developed as a decision aid for farmers and their advisors during drought and during the drought recovery stage. *StockPlan*® consists of three different packages. *DroughtPack* calculates feed requirements and feed costs, *FSA* compares the feed, selling and agistment options and *Impack* examines the financial projections from various drought recovery strategies. Calculations used by the programs are discussed using numerical examples.

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Acronyms, Abbreviations, Software Names Used in the Report

AWI	Australian Wool Innovation
Beef-N-Omics	Software to help evaluate management options in a beef enterprise.
CFA	Cast for age.
CMA	Catchment Management Authority
DSE	Dry Sheep Equivalent. See footnote 11 for definition.
DPI	NSW Department of Primary Industries
DroughtPack	One of the suite of programs in *StockPlan*®
FSA	Feed, sell agist. One of the suite of software programs in *StockPlan*®.
Impack	One of the suite of programs in *StockPlan*®
MAFF	Ministry of Agriculture, Fisheries and Forestry.
Prograze®	A farmer training package aimed at improving pasture assessment and management.
StockPlan®	The package of software programs including *DroughtPack, FSA, Impack*

Acknowledgments

Financial support for the development of this software came from Australian Wool Innovation who funded and developed conversion of sections from spreadsheet type programs to stand alone programs running in the Delphi programming language. Thanks go to the original developers for an earlier DOS based version of *DroughtPack* and to Malcolm McPhee of the NSW DPI for his earlier work. Thanks also to the present contracted programmer, Michael Whelan of Southern Cross University, Lismore for his programming skills and his ability to suggest enhancements and better ways of presenting the information. Lastly thanks need to go to farmers and advisory officers both from NSW and from interstate for their comments in developing this package from concept to where it is at present.

Executive Summary

StockPlan® is a suite of programs aimed at addressing particular problems in drought management of livestock. The initial program, *DroughtPack* was developed to help graziers estimate feed requirements and feed costs during a drought. Feed, sell agist (*FSA*) helps users compare feeding, selling or agisting as options when faced with a drought. *Impack* examines drought recovery options to get the farm up back to full carrying capacity.

Most people would generally use *StockPlan*® to help in tactical decision making, however, once the programs are thoroughly understood, it can also be very useful for strategic planning to prepare for future droughts.

StockPlan® is generally sold as a package that includes a comprehensive training component to ensure that users have a good understanding of the appropriate uses and limitations of the three software programs, however, individual packages can be purchased. Detailed workshop notes and case studies have been developed to explain how to use the programs and how to interpret results.

This report has two purposes. Firstly, it details most of the calculations used to generate the financial results in each of the software programs. Secondly, in the process, it uses examples to show the capability of *StockPlan*® and what it can be used for. In the case of *Impack*, because of the huge volume of formulae involved, many of the obvious equations that are simply a summation of values or a multiplication of two variables (for example income = number for sale x price) are not provided.

As with all models that are designed for ease of use with a relatively small data input requirement, shortcomings are inevitable. These shortcomings are highlighted, but no apology is made because such programs can be justified if their simplicity encourages use but at the same time they are sufficiently dynamic with a good underpinning of science, to take the user to a new level of understanding of the interactions and consequences of a decision. In time, there will be an increasing number of farmers who have a sound knowledge of the consequences of their decisions and will be seeking decision aids which are more sophisticated.

With the assistance of Australian Wool Innovation (AWI) this program is now offered nationally. AWI helped fund the conversion of *FSA* and *Impack* from Excel ® spreadsheets to stand alone programs written in the Delphi language. *DroughtPack* was also revamped to a Windows format with the help of AWI funding.

1. Introduction

Farmers facing or recovering from drought confront many difficult decisions. There are subjective elements to all decisions but many elements of livestock management decisions can be quantified. However often farmers do not apply quantitative techniques either because they are not confident they can identify and estimate all the benefits and costs in a consistent manner or because data are not readily available. Both steps require inputs of farmers' valuable time. As a consequence crucial decisions are not made in a timely fashion and farmers place their businesses at greater financial and environmental risk than is necessary. *StockPlan*® is an attempt to assess the benefits and costs of livestock management decision in a consistent framework and to take some of the labour out of the tedious calculations that are necessary. It provides accurate summary information to help managers make decisions. Questions like if a drought is expected to last for say five months, how much feed will be required and what will it cost me? Is feeding, selling or agisting a better option for a certain class of livestock and how long does it take in weeks for selling to become a better option than feeding? What is the best re-stocking strategy? Should I buy in replacements to obtain full stocking capacity as quickly as possible, or are replacement cattle so expensive that a breed replacement strategy looks better? And what are the cash flow implications any restocking strategy? All these questions can be answered by using various components of *StockPlan*®.

The NSW Department of Primary Industries (DPI) saw the need to help farmers for a number of reasons. Firstly, the development of this software was seen as a means for farmers to make better decisions under very difficult circumstances. Secondly, if decisions are difficult to make, many farmers tend delay making a decision to sell stock even when selling is the best option financially. Holding on to stock can have a number of consequences that are undesirable from a government perspective. Land can over-grazed and cause damage to the environment. Sometimes stock welfare issues are a problem because of malnutrition. Thirdly, drought is a very debilitating time for farmers. Depression, family relationship break-downs and many other social factors cause health and welfare concerns for our farming community. The use of *StockPlan*® helps provides farmers with better information on the consequences of certain decisions. Farmers can develop better plans as a consequence and be more in control of their future.

StockPlan® began in the 1980's as one DOS based software program called *DroughtPack*. A decision to convert *DroughtPack* to a Windows based software program was initiated in 2001. At this stage the need for complementary software was also recognised. As a result, two Excel programs were developed. One program called Feed, Sell, Agist (*FSA*) looked at feeding, selling and agistment options for particular classes of animals and the other program called *Impack* shows the financial consequences of re-stocking strategies following drought. Australian Wool Innovation (AWI) has since shown interest in the software and have funded the conversion and improvement of *DroughtPack*, *FSA* and *Impack* to stand alone programs with improved capabilities. AWI has also funded the development of the Workshop material to be used for farmer training. Development of the software involved regular consultation with farmer groups and contact with a farmer steering committee which resulted in a number of significant enhancements. Details of financial components of three software programs follow in the next three sections.

2. DroughtPack

DroughtPack is used to calculate the likely supplementary feed requirements of different animal classes during a period where it is envisaged that pasture production will be insufficient to meet animal requirements. For each class of animal[1], the user can specify, stock numbers, their weight, the monthly weight gain or loss they wish, the percentage of the feed that the producer thinks will come from supplementation,[2] the supplementary feeds to be used (up to two per animal class) and the cost and the energy (MJ/Kg DM) they supply. From this information the program calculates the monthly feed requirements using the MAFF (1984) standards. Due to the complexity, details of these calculations are not provided here.

2.1 Data Requirements for *DroughtPack*

Users need to enter the following information:

- Starting month of the drought and expected drought length in months. The program can handle up to 12 months of drought.
- The beef numbers for each month categorised into dry cows, pregnant cows, early lactating cows, late lactating cows, weaned calf, young cattle, steers and bulls.
- The sheep numbers for each month categorised into dry ewes, pregnant ewes, early lactating ewes, late lactating ewes, weaned lambs, hoggets, wethers and rams.
- Supplementary feed available, dry matter %, energy rating of supplementary feed MJ/Kg DM, and cost landed per tonne (fresh basis) on farm. Up to 10 feeds can be specified. A supplementary option called the *Feed Cost Calculator* can be accessed within the program to compare the costs of various feeds or mixes of feeds on a protein and energy basis.
- The projected/desired weight of each class of animals for the first month and weight gain or loss required. The software will calculate the weight at the start of the next month, however the user will have to either copy the previous weight gains or re-enter the desired weight gain if it is to vary from month to month.
- The amount of supplementation required for each month of the projected drought. This assumes that farmers can assess how much feed value remains in the paddock and how quickly the feed will diminish. Some farmers are not trained in pasture assessment and others that are will have little experience in predicting availability in the coming months. However, the amount of feed remaining in a paddock is not a problem when full drought feeding is necessary and in drought situations this is mostly the case.
- The percentage of up to two supplementary feeds that have been specified that will be fed to meet energy requirements each month. If more than two feeds are anticipated to be used, then the producer can insert the energy and dry matter of the appropriate mix as one of the feeds available.

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[1] Animal classes include: Cattle: Dry cow, pregnant cow, early lactating cow, late lactating cow, weaned calf, young cattle, steer ,bull; Sheep: Dry ewe, pregnant ewe, early lactating ewe, late lactating ewe, weaned lamb, hogget, wether, ram.

[2] If for example, the producer thinks in a certain month that pastures will provide 20% of the feed, the remaining 80% will come from supplementation.

2.2 Results and calculations

2.2.1 Feed Costs

From these entries, the following information is generated for each class of animal as shown in Table 1

Table 1. Calculations completed to generate supplementary feed requirements

Name of item calculated	Actual calculation
Monthly supplementary MJ's required	Total feed requirement[3] x supplementation %.
Monthly total amount of each feed mix[4] required in tonnes dry matter (tDM)	MJ supplementary requirements ÷ Average MJ of supplement mix x % of this supplementary feed ÷ 1,000.
Monthly tDM of each feed required (if more than one feed is specified)	Sum of monthly tDM from each feed used in the month.
Total tonnes of each feed for cattle or sheep	Sum of tonnes of each feed required for each class of animal.
Total feed cost	Total tonnes of each feed x (cost of this feed + feed out cost).
Feed required (fresh weight)	Total tonnes of each feed ÷ % dry matter of each feed.

An example of the output produced showing feed requirements in a situation where hay is the selected feed and sheep and cattle are fed for the first four months of the year is shown in Figure 1.

Figure 1. The Feed Summary Table

Feed Summary for WA

	Feb	Mar	Apr	May	Total
Sheep Numbers	1000	1000	1000	1000	
Sheep Feed (t-dm)	2.7	10.9	27.2	13.6	54.5
Sheep Feed cost $	330	1320	3300	1650	6600
Cattle Numbers	100	100	100	100	
Cattle Feed (t-dm)	6.3	18.3	23.7	15.7	64.1
Cattle Feed cost $	763	2219	2873	1906	7760
Total feed (t-dm)	9.0	29.2	51.0	29.4	118.6
Total feed cost $	1093	3539	6173	3556	14361
Hay (t-fresh)	10.0	32.5	56.6	32.6	131.7

[3] Total feed requirement is not reported here. For details of these calculations see MAFF (1984)

[4] Mix will be determined by the percentages of up to two feeds that are specified for use.

2.2.2 Cash Flow options

If required, the user can provide additional information to generate a cash flow for the sheep and cattle enterprise and with the provision of more information again, can provide a cash flow analysis for the whole farm. The additional data required for the sheep and cattle enterprise cash flow are:

- A projection of monthly cattle and sheep costs for the period under review.
- A projection of monthly cattle and sheep income.

A whole farm cash flow can be generated with the following additional information,

- Monthly projections of other income (non- sheep or cattle income)
- Monthly variable costs for enterprises other than sheep or cattle.
- Overhead costs for the farm.

From these figures a whole farm budget can be prepared as depicted in Figure 2, continuing the example from Figure 1.

For farmers who already use software to generate cash flow budgets, it is most likely that the farmer will use *DroughtPack* to generate the feed cost information to transfer into their other package.

Figure 2. Cash Flow example output from DroughtPack

	Feb	Mar	Apr	May
Sheep Feed Cost	330	1320	3300	1650
Sheep Cost	0	2500	0	0
Sheep Income	0	0	0	15000
Sheep Income-Costs	-330	-3820	-3300	13350
Cattle Feed Cost	763	2219	2873	1906
Cattle Cost	300	0	210	0
Cattle Income	0	0	3200	0
Cattle Income-Costs	-1063	-2219	117	-1906
Other Income	0	4000	0	0
Other Costs	3200	2200	6518	680
Running Balance	-4593	-8858	-18611	-7956

The running balance for the first month under review is the starting bank balance at the beginning of the month + (sheep income – costs) + (cattle income – costs) + other income – other costs + starting balance x interest rate ÷ 12. In the example above, with a starting bank balance of zero, the running balance at the end of Feb = 0–330-1063+0-3200 + 0 x .07[5]/12 = -4593. The running balance at the end of March = -4593–3820-2219+4000-2200-(4593 x .07 ÷ 12) = -8858. In calculating other costs, remember not to include interest on any overdraft because it will be estimated in the calculations here provided the correct starting balance is given and all costs and

[5] .07 is the user nominated interest rate of 7%.

income are included. One implication of this example is that the farmer will need to be able to finance a cumulative deficit of almost $19,000 in April if he chooses to feed.

2.2.3 Capital valuations for livestock on hand and summary financial position

Cash costs do not always give the complete picture because there can sometimes be significant changes in the value of stock on hand which should influence a decision of whether to feed or to sell in the first place. For example, the greater the price you would expect to pay for similar animals when restocking, the more you can justify spending on feeding. The capital valuation of the livestock at the beginning and end of the period need to be also examined to get a complete picture. Stock values at the end of the review period can increase simply because there is more wool on sheep or lambs and calves are heavier or they can vary because of anticipated changes in price. Users are therefore asked to nominate the starting and finishing values of their stock for the period under investigation. To make a decision both the cash flow implications and the capital valuations should be taken into account. This can be done by looking at the summary report (Figure 3)

Figure 3. Summary financial position

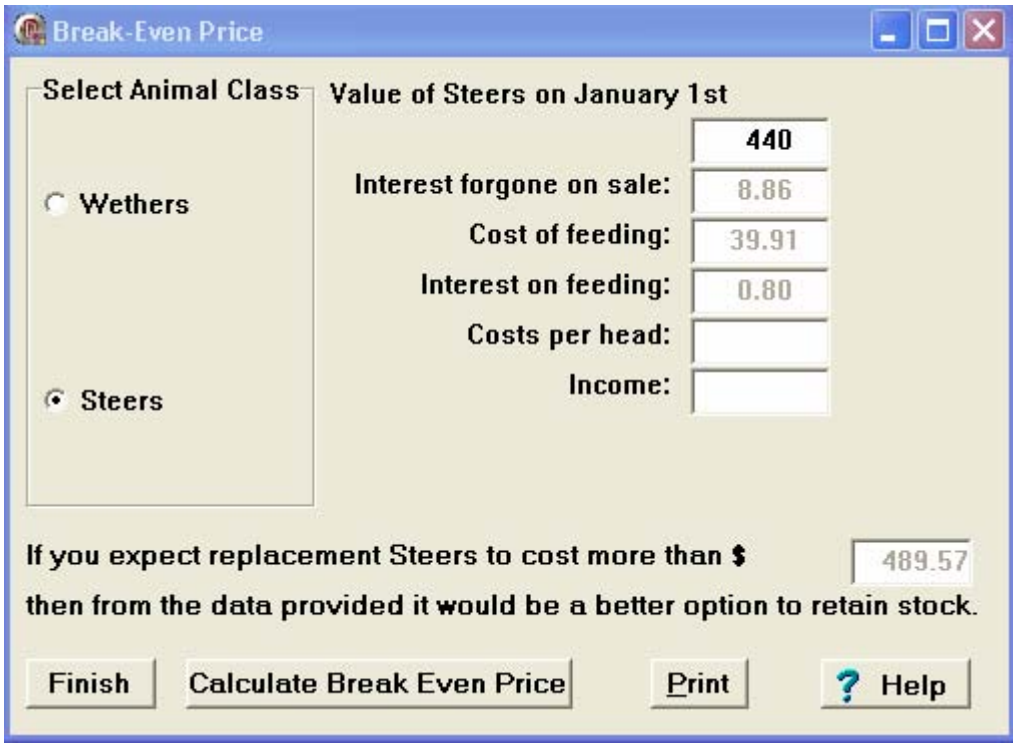
FINANCIAL SUMMARY	
Closing cash balance $	-7956
Opening cash balance $	0
Change in cash balance $	-7956
Closing stock value $	105000
Opening stock value $	100000
Change in stock value $	5000
Change in net value $	-2956

In this situation the increase in stock value of $5000, partially cancels the costs of feeding stock which results in a running balance of -$7,956. This implies that if you are confident of being able to buy back animals for $5,000 more than they are currently worth, then selling and restocking can still be justified because the expected feed costs over the same period are $7,956.

2.2.4 Break-even analysis

Break-even analysis is a very useful tool to help in deciding between selling and feeding because it estimates the price of replacement stock which once exceeded means that feeding is a cost effective option. The user has already specified the starting (or sale) value of each class of animal. To this is added the interest foregone had the animals been sold as illustrated in figure 4.

Figure 4. Example break-even analysis



In a situation where you are comparing the feeding option to a selling option, a decision to feed incurs two lots of interest costs to make a comparison. Firstly, the cost of buying feed attracts interest on the outlays. Secondly, the alternative to sell means that cash is made available because of the sale and can be used to earn interest or retire debt. This interest is termed interest forgone by not selling and is calculated on a cumulative basis.

Interest forgone on sale = sale value * $(1 + i)^n$ - sale value

Where i = annual interest rate ÷ 12 and n = number of months

For breeding animals:

The cost of feeding = sum of the weighted average cost of feeding cows or ewes for each month

The weighted average cost of feeding in month 1 using breeding cows as an example = ((per day cost of feeding dry cows in month 1 x number of animals that are dry in month 1) + (per day cost of feeding pregnant cows in month 1 x number of pregnant costs in month 1) + (per day cost of feeding early lactating cows in month 1 x number of early lactating cattle in month 1) + (per day cost of feeding late lactating cows in month 1 x number of late lactating cattle in month 1))x 30 days ÷ Total number of breeding cows.

For example where there are 20 dry cows and 80 pregnant cows in a particular month, the cost of feeding dry cows is 50 cents per day and the cost of feeding pregnant cows is 70 cents per day the weighted average feeding cost for this month would be= ((20 x 0.50) + (80 x 0.70)) x 30 days ÷ 100 = 66 x 30 ÷ 100 = $19.80 per head.

Interest on feed costs = $\sum_{n}^{n=1}$ ((weighted feed cost per month) x $(1+i)^n$)

Where i = annual interest rate[6] ÷ 12 and n = number of months

If farm grown feed is on hand, this program values the feed on an opportunity cost basis which is what the feed could have been sold for.

The final figures to calculate a break-even are the inclusion of any management costs that would be incurred for the cattle and any income that may be received. The break-even price is then calculated as:

The nominated starting price of the animal in the first month of the drought period + the interest forgone on the sale of the animal + the cost of feeding + the interest on feeding + management costs per head – any income received from sale of progeny + the value of the calf.

In figure 4 the break-even is $440.00 + $8.86 + $39.91 + $0.80 - $0 + $0 = $489.57

Based on these estimates, breakeven analysis suggests that it would be better to sell in the first place if you expect to be able to buy in replacement animals of the same quality for less than $489.57.

2.3 Feed Cost Calculator

This is an optional routine used to calculate the costs per megajoule (MJ) of energy supplied and the cost per kilogram (kg) of protein in a single feed or in a mix of up to four feeds.

The user can enter their own feed type information or select a generic feed from 56 available feeds. Default estimates for dry matter %, energy MJ/kg dry matter and crude protein percent dry matter (DM) are provided for each feed but the defaults can be overtyped. The user must enter a price per tonne (fresh basis) to complete the data entry. The following formulae are then used by the program to calculate:

Cost $/tDM	=	Cost $/t (fresh) ÷ dry matter as a decimal
MJ/tDM	=	MJ/kg dry matter * 1,000
Costs ¢/MJ	=	Cost ¢/tDM ÷ MJ/tDM
MJ/$100	=	MJ/tDM÷cost$/tDM*100
$/kg protein	=	Cost $/tDM ÷ (crude protein %DM * 10)

Up to four feeds can be listed side by side and combined into a mix in any proportion. The resultant mix calculations are then weighted by the proportions of the feeds the user specifies for the mix. For example the Crude Protein % of the mix in figure 5 is = 11 * 0.4 + 32 * 0.05 + 6.5 * 0.3 + 3.8 * 0.25 = 8.9%

[6] Two interest rates are entered by the user. A borrowing interest rate is selected by the computer when the cash balance calculation is negative. A lending interest rate is used when cash balances are positive.

Figure 5. Example output and inputs from the *Feed Cost Calculator*

	Barley	Lupins	Mature grass	Brewer`s grain-	Mix
	Grains	Grains	Hay	Grain Byprodu	
	Barley	Lupins	Mature grass	Brewer`s grain	
Cost $ per t	180	210	100	35	121.25
Dry Matter %	90	90	88	26	73.40
Energy MJ/kg	13.0	13.0	7.0	9.5	10.33
Crude Protein %	11.0	32.0	6.5	3.8	8.90
% in Mix	40	5	30	25	100.00
Cost $/t DM	200.00	233.33	113.64	134.62	165.19
MJ/t DM	13000	13000	7000	9500	10325
Cost c/MJ	1.54	1.79	1.62	1.42	1.60
MJ/$100	6500	5571	6160	7057	6250
Cost $/kg protein	1.82	0.73	1.75	3.54	1.86

2.4 Limitations of *Droughtpack*

As with any model, there are two broad sources of error. First any model is an abstraction from reality and hence while every effort is made to capture the main factors which influence decisions about feeding or de-stocking, some factors relevant to a decision maker are not captured by the model. These factors or interactions with the farm family or the farm business as a whole might include lack of available labour to consider the feeding option, an aversion to sell "years of breeding" and family health issues. Farmers using *StockPlan*® will need to consider these 'outside' factors unique to their family and business situation when evaluating the recommendations from *Stockplan*® This is especially the case because *DroughtPack* is designed to be a user friendly model that aims to minimise data requirements.

The second key area where errors are likely to arise is because of uncertainty about some of the key parameters used in the model. In particular, farmers are likely to be inaccurate in their projection of the percentage of feed supplementation that is required, but as discussed earlier, it is not a problem when 100% supplementation is required. Recently a significant number of farmers have developed pasture assessment skills through courses such as *Prograze*®. Users of software such as *DroughtPack* are highly likely to have done a *Prograze*® course. Incorrect estimation of the percentage of supplementation required will significantly alter the feed costs projections and decisions are likely to be poor.

Other problems that could occur are:

- the actual feed shortage period is either much shorter or longer than projected and supplementary feed cost projections could be inaccurate. *DroughtPack* allows additional months to be added when it becomes obvious that the drought will be longer than first anticipated.
- in periods of escalating drought, grain and hay prices can rise more rapidly than most people anticipate. The workshop encourages producers to fully discuss the feed prices that should be used.

Nevertheless, a decision aid such as *DroughtPack* enables the user to quickly do a few 'what ifs' to see the impact of changing some of the key assumptions. This provides the decision maker with a

sense of the riskiness of choosing the feeding option, especially if a worst case scenario is examined.

2.5 Conclusion on *DroughtPack*

DroughtPack is a decision aid developed to give farmers and their advisors a means of more accurately assessing possible feeding costs and quantities required when facing feed shortages. The power of the program is the ability to calculate supplementary feed requirements given specification of the number, weight and status (eg. pregnant, lactating) of livestock to be fed. The program is able to generate, from the information provided, monthly feed costs, quantities, cash flows, break-evens and a financial summary that provides the user with information on changes in cash balance and also changes in the capital value of the livestock inventory.

Some users of *DroughtPack* are using the information on feed requirements to order future deliveries of feed to match requirements and in quantities that can be handled by their storage capacity. Likewise mixed farmers have been able to more accurately determine their own feed needs and predict how much feed they have available for sale.

There are more sophisticated programs available that provide more detailed analyses of particular segments of the decision problem than *DroughtPack* but the ability to provide a moderately robust answer in a quick and easy-to-use format positions *DroughtPack* as a tool that will be used by farmers and their advisors.

3. Feed Sell Agist (*FSA*)

FSA varies from *DroughtPack* in a number of key areas. Firstly, as the name implies, agistment options can be examined as well as feeding or selling options. Secondly, *FSA* uses data on feeding costs generated from *DroughtPack* in a second stage comparison with agistment. Thirdly, it looks at individual classes of animals rather than a whole property analysis that is generally (but not necessarily) used by *DroughtPack*. Lastly, *FSA* has the ability to look at four possible drought lengths at once, enabling the user to get a much clearer picture of the risks involved and the time that it takes, for example, for selling to become a cheaper option than feeding.

From the input information requested, the model estimates the expected cost of each strategy. The model calculates both the direct costs of each strategy but also allows for the calculation of a "bottom line" which includes several items that do not impact immediately on the cash situation including:

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- the costs of any pasture re-establishment that may be necessary following the drought;
- the value of any remaining feed in the paddocks in a situation where agistment or selling are chosen. This feed has value to other stock which should be recognised;
- Any change in the capital value of animals throughout a drought. For example, stock may be cheaper during a drought but escalate in value at the end of the drought. The bottom line method takes changes in livestock values into account.

Formulae to calculate the “bottom line” are discussed further in section 3.2

3.1 Data requirements

The user firstly specifies the specific type of stock and the number involved in either feeding, selling or agisting[7].

Data input screens are shown in Figures 6 to 11.

[7] If there are no agistment opportunities available the agistment section can be ignored.

Figure 6. Time periods and Stock input screen

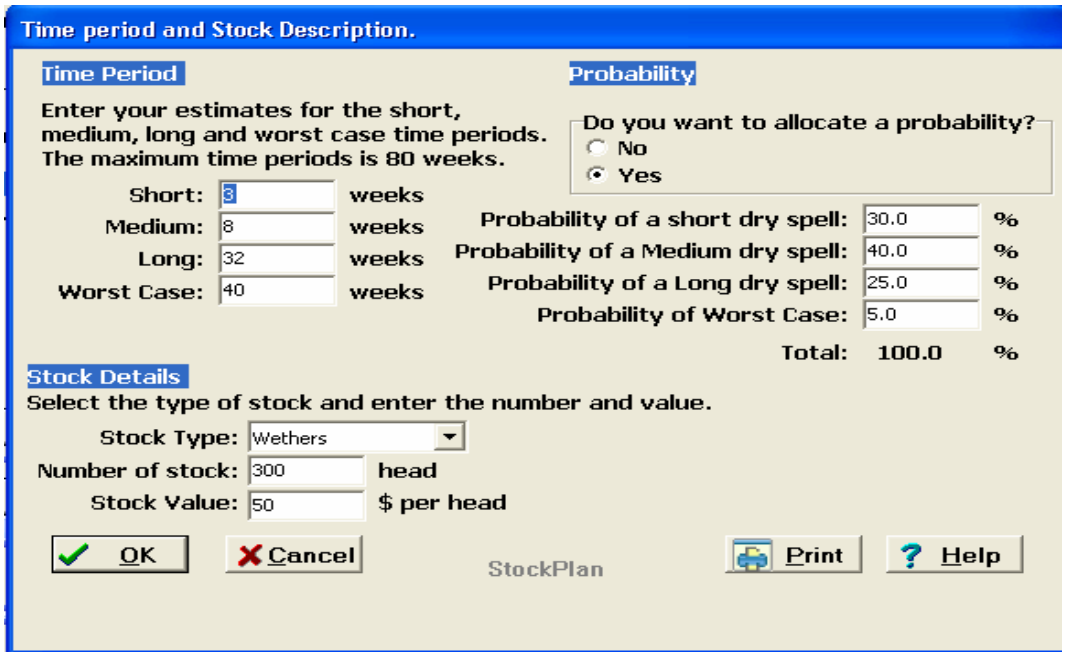
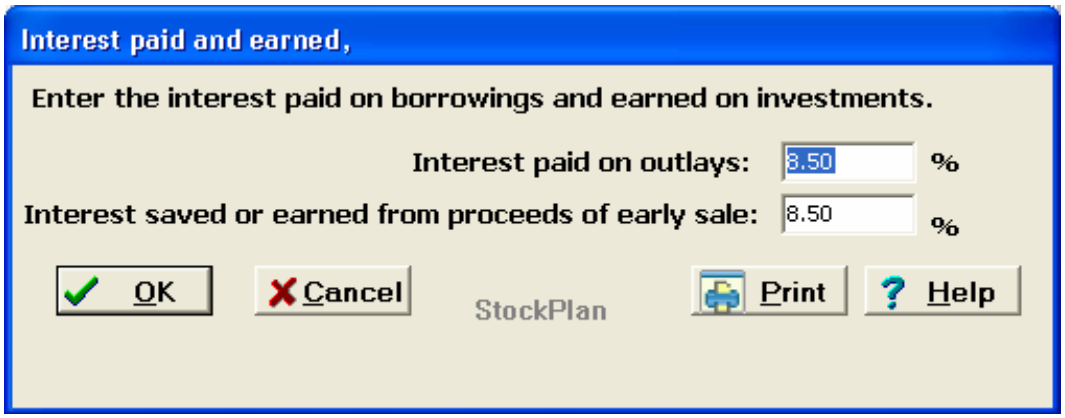
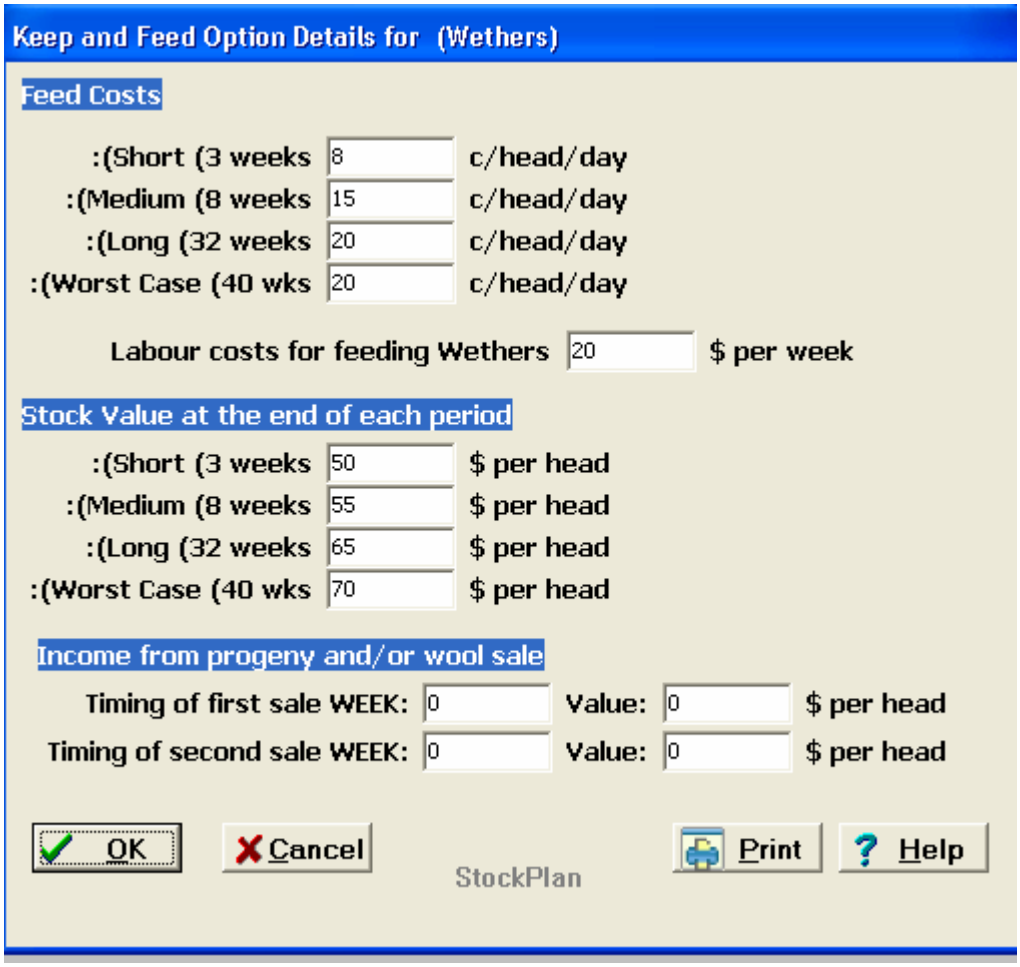


Figure 7. Interest rates input screen



In the above case the same interest rate is used for borrowing as lending based on the assumption that an overdraft is current and any proceeds from an early sale will simply be used to reduce the overdraft.

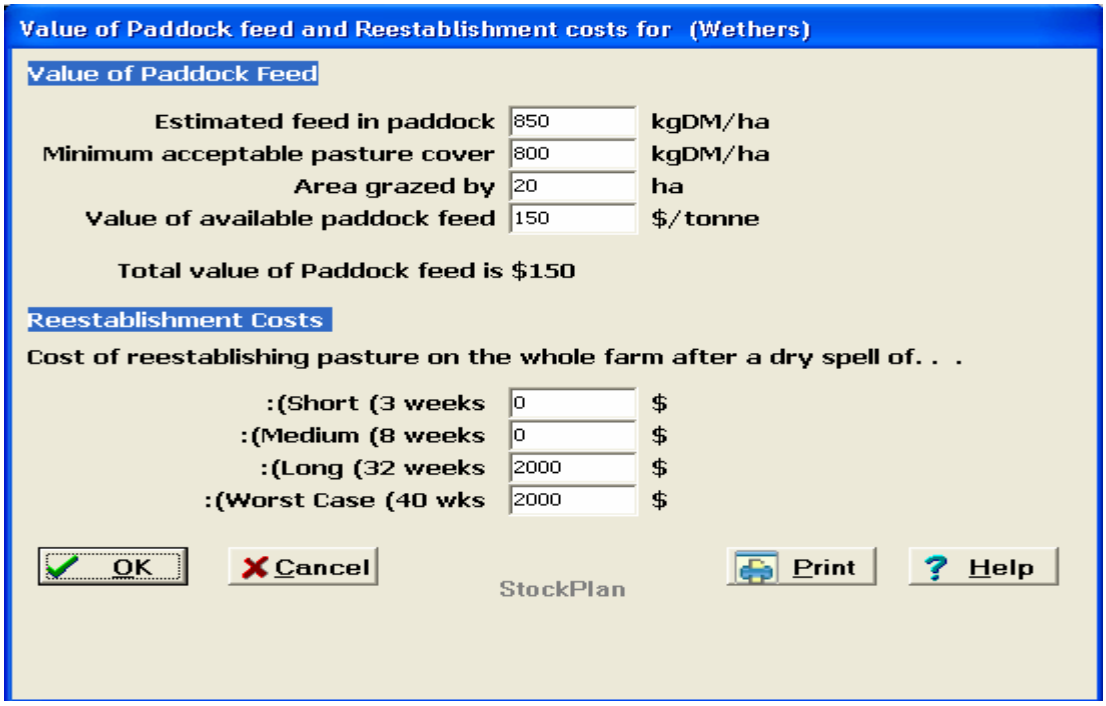
Figure 8. Feeding input screen



For this screen (figure 8), the user is likely to use *DroughtPack* to estimate daily feed costs. The labour cost estimate is optional but farmers are encouraged to enter a cost here because the opportunity cost of their labour is generally grossly undervalued. Stock values at the end of each period are quite difficult to estimate accurately but do influence the bottom line estimates considerably.

In most situations there will be no income but in situations involving sheep, sale of wool needs to be considered, as does sale of progeny from breeding enterprises.

Figure 9. Paddock Feed and Pasture Re-establishment Costs Screen



This screen (9) only needs to be used if there remains paddock feed that can be used by other enterprises should selling or agistment be chosen. If there is no remaining feed, enter the same number for the estimated feed in the paddock as the minimum acceptable pasture cover. Pasture re-establishment costs can be very high especially for highly improved pastures and need to be considered in calculating the "bottom line" costs of feeding options.

Figure 10. Selling Input Screen

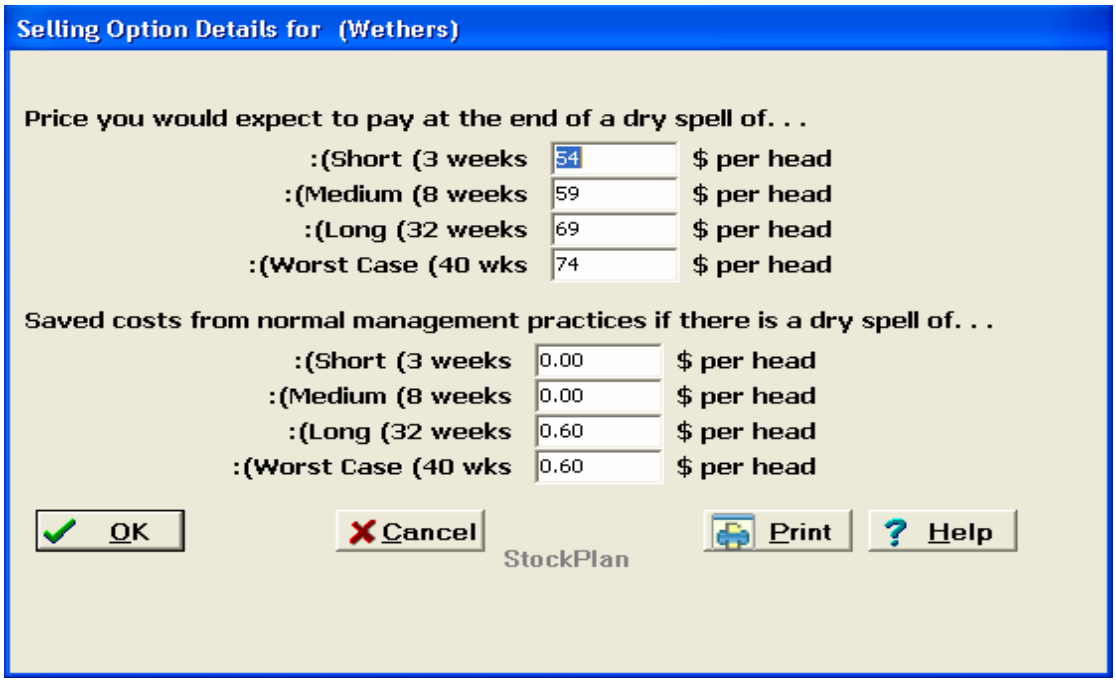
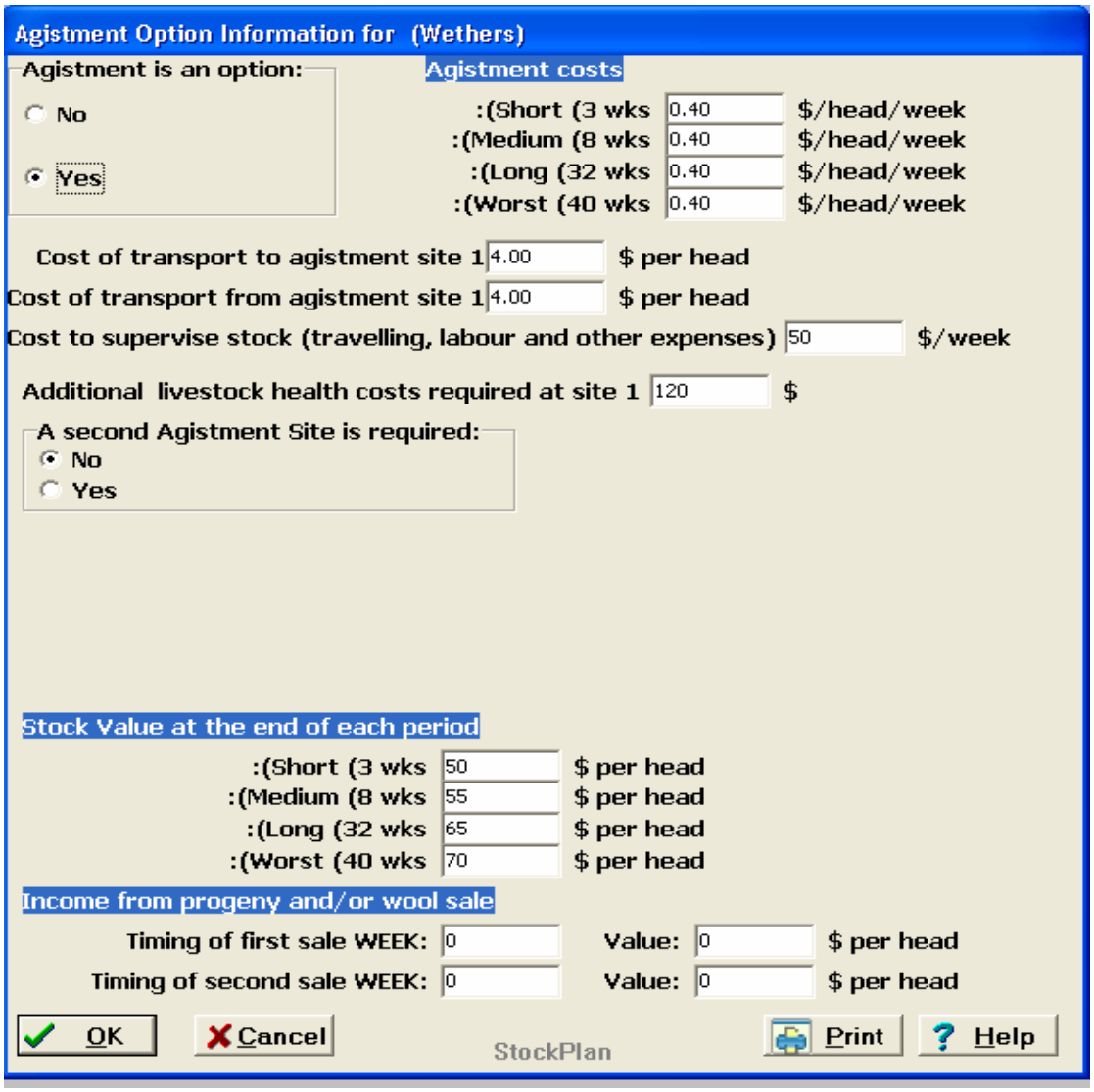


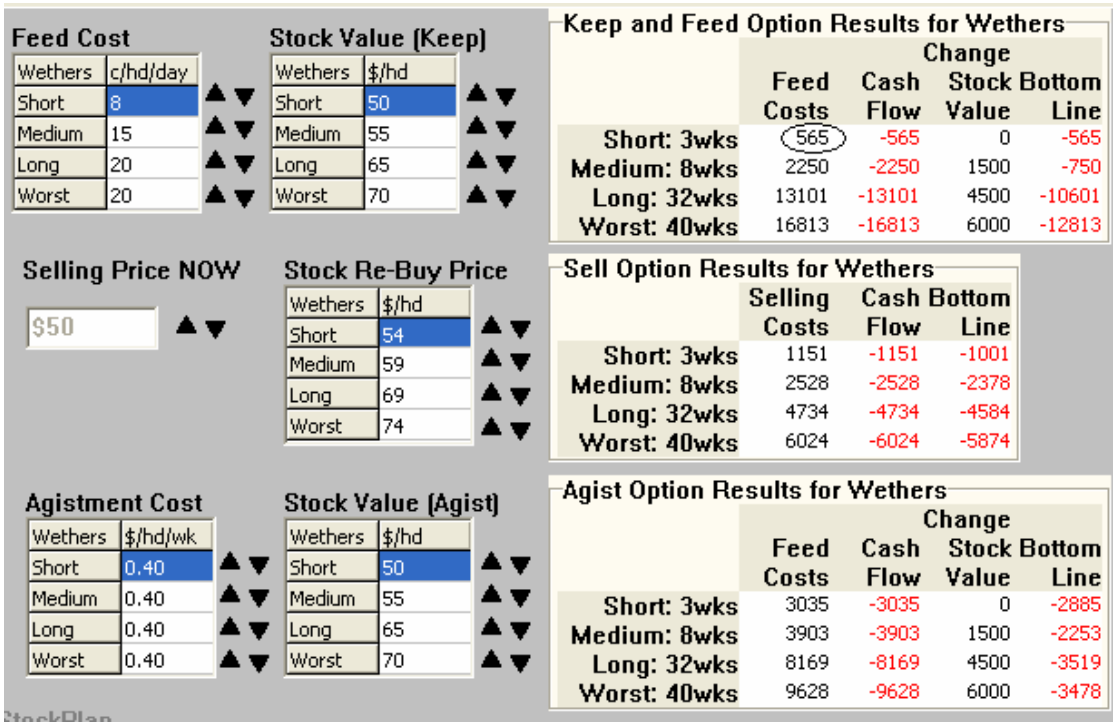
Figure 11. Agistment Input Screen



Agistment may not be an option in a wide spread drought but it is often a viable consideration if transport costs are not excessive and there is feed available for a considerable period. If agistment is not available, the screen can be eliminated by clicking the No button to the statement "Agistment is an option".

From these inputs the program produces the results as shown in Figure 12.

Figure 12. Results Screen



The left hand side of this calculator allows for adjustment of prices and values to test the sensitivity of the results by clicking on the up or down arrows. In the example shown in Fig. 12 feeding is the cheapest option for a short and medium period of 3 and 8 weeks. For all other drought lengths, selling is the best option on a cash flow basis and agistment the cheapest option on a "bottom line" basis. The reason for this difference is because stock were assumed to increase in value over the period under examination which made the "bottom line" result favour agistment where retaining ownership of the stock to realise this capital gain made this the better option.

3.2 The Calculations

The formulae for each of the results in the right hand side of the table are as follows.

3.2.1 Feed costs

For a short period (3 weeks) = Feed cost per week + labour cost in feeding out + accumulated interest.

From figure 8
Feed cost per week = 8¢/hd/day x 300 wethers x 7 days = $168.00/week.
Labour cost/wk = $20/wk
Total cost = $188 per week.
Interest week 2 = $188 x .085/52 = $0.31
Cumulative balance at end of week 2 = $188 + $0.31 + $188 = $376.31
Interest week 3 = $376.31 x .085/52 = $0.62
Cumulative balance at the end of week 3 = $376.31 + $0.62 + $188 = $564.92

This can also be calculated using a table format (Table 2)

Table 2. Derivation of cumulative balance

The cash flow results in all cases largely reflect feed costs because there is no income received during the planning period. Possible income in the case of wethers is from sale of wool. In the case of ewes, lambs could also be sold and in the case of breeding cows, calves can be sold.

The estimated 'bottom line' for feeding is the cash flow result + change in stock value – pasture re-establishment costs. In weeks 4 to 8 there is an increase in the value of the stock by $5 per head (see figs. 6 and 8) or $1500 for the 300 wethers. If period of limited feed only lasts for 8 weeks, there is no pasture re-establishment costs expected so the "bottom line" at week 8 = -$2250 + $1500 = -$750.

From figure 9, for a long period of feed shortage of 32 weeks, pasture re-establishment costs of $2000 are expected. Using the cash flow result and change in stock value from figure 12, the "bottom line" for feeding at week 32 is -$13,101 + $4,500 - $2,000 = -$10,601.

3.2.2 Selling costs

Selling costs are depicted in table 3. The selling value is obtained by multiplying the number of animals (300) by the value of the stock ($50) from figure 6. Saved management costs from figure 10 were zero (unless going beyond 32 weeks). Interest from proceeds of an early sale was 8.5% (figure 7).

Table 3. Method of calculation of selling option

Week	Selling Value	Saved management costs	Interest[8]	Cumulative Balance	Buy back price	Buy back cost	Cost
1	15000	0		15000			
2		0	$24.52	$15,025	54	16200	$1,175
3		0	$24.56	$15,049	54	16200	**$1,151**
4		0	$24.60	$15,074	59	17700	$2,626
5		0	$24.64	$15,098	59	17700	$2,602
6		0	$24.68	$15,123	59	17700	$2,577
7		0	$24.72	$15,148	59	17700	$2,552
8		0	$24.76	$15,172	59	17700	**$2,528**
9		0	$24.80	$15,197	64	19200	$4,003
10		0	$24.84	$15,222	64	19200	$3,978
11		0	$24.88	$15,247	64	19200	$3,953
12		0	$24.92	$15,272	64	19200	$3,928
13		0	$24.96	$15,297	64	19200	$3,903
14		0	$25.00	$15,322	64	19200	$3,878
15		0	$25.05	$15,347	64	19200	$3,853

The cash flow result is always the inverse of the selling costs in the case of selling.

The “bottom line” is the cash flow result + the value of paddock feed saved for other enterprises (from figure 9). The value of paddock feed saved is obtained by the calculation (estimated amount of feed in the paddock kgDM – minimum acceptable amount of feed in the paddock) x number of hectares grazed ÷ 1,000 x value of feed per tonne. From figure 9 the value of saved feed = (850-800) x 20 ÷ 1,000 x $150 = $150.

In week 3 the “bottom line” for selling is -$1,151 + $150 = -$1,001 (figure 12).

3.2.3 Agistment costs

Agistment costs for 300 wethers are calculated by adding from figure 11 the cost of transport to and from agistment, the agistment cost, the supervision costs, the additional management costs and the accrued interest together (Table 4). If a second agistment site is required this cost is also added.

[8] Weekly interest is calculated on the cumulative balance in the previous week. For example for week 2 interest = $15,000 x .085/52 = $24.52.

Table 4. Agistment costs calculations for the 300 wethers

As with feeding, cash flow in this case is the inverse of the agistment costs because there is no income received.

The "bottom line" in this case is the cash flow result + the change in stock value + the value of paddock feed saved.

In the case of a medium dry spell of 8 weeks, the "bottom line" for agisting is -$3,903 + $1,500 + $150 = -$2,253 (figure 12).

3.2.4 Expected values

An option on the time periods and stock data input sheet (See Fig. 6) was for the user to assign probabilities to feed shortages of increasing lengths. By choosing the "Yes" option, and assigning probabilities for each event occurring, an expected value for each option is calculated.

In our example, the probability of a short feed shortage is 30%; medium 40%, long 25% and worst case 5%.

The expected value on a "bottom line" basis for feeding is:

The sum of the "bottom line" cost for each period x the probability for that period.

In our example (see figure 12), the expected "bottom line" cost of feeding = -$565 x 30% - $750 x 40% - $10,601 x 25% - $12,813 x 5% = -$3,760

The complete set of expected values appears on the extreme right hand side of the results screen if the probability option is chosen. Expected value results are shown in Figure 13.

[9] See previous footnote

Figure 13. Expected value results

Expected Values

	Feed
Costs Only	5185
Cash Flow Bal.	-5185
Bottom Line	-3760

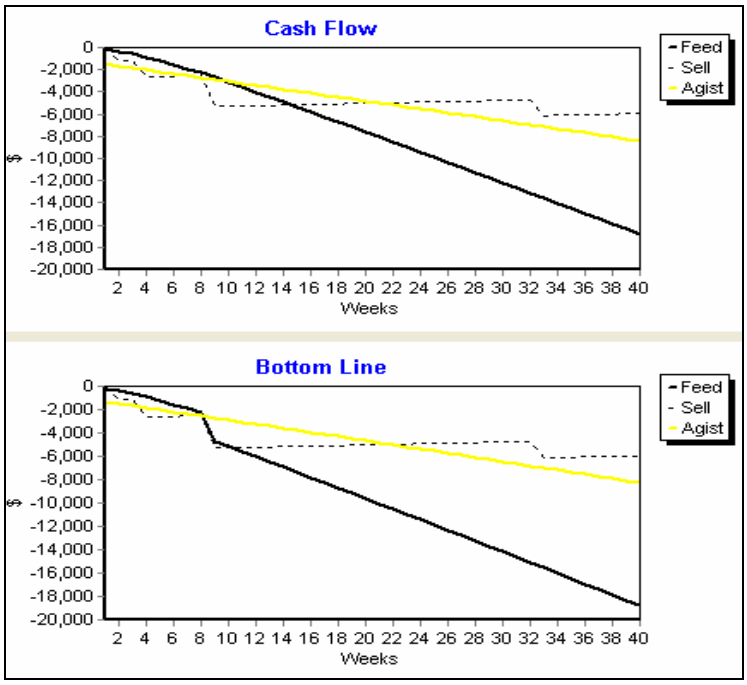
	Sell
Costs Only	2841
Cash Flow Bal.	-2841
Bottom Line	-2691

	Agist
Costs Only	4995
Cash Flow Bal.	-4995
Bottom Line	-2820

3.3 Interpreting the results from *FSA*

There are two main ways to examine the results. Using the expected value approach is one sound option. The results from Figure 13 indicate that by any of the criteria (costs only, cash flow balance or "bottom line"), the selling option is the most favourable option because it has the cheapest expected value. The other option is to look at the graphs (Fig. 14) and determine the number of weeks for the selling option or the agistment option to become cheaper than feeding. In normal situations, the "bottom line" figure is more important because it includes all things that change, but if finance is limiting, cash flow results can also be very important and may carry the most weight where minimising cash outlays is necessary for survival of the farm business.

Figure 14. Graphical results



The graphs in Figure 14 are very useful in quickly seeing when one option becomes cheaper than another. In this example, the bottom line graph shows that feeding is the cheapest option for around 8 weeks, agisting is then the cheapest option until around 22 weeks where selling takes over as the cheapest option. This is a quite usual scenario and the risk of a high bill if the feeding option is chosen and a long drought eventuates is clearly demonstrated.

The reason for the saw tooth shape of the selling line in the graphs in Figure 14 is because the increase in buy back price specified in Figure 8 is not smooth. In reality we expect prices to rise gradually, except for a situation where there is a sudden and unexpected breaking of the drought. However, this program only allows for specification of buy back prices at the beginning of each of the four periods. Agistment and feeding can also have a stepped appearance if these prices change during the period under examination.

3.4 Conclusion on FSA

'Feed sell agist' enables farmers and their advisors to quickly explore the financial consequences of these options and the sensitivity of results to changes in key variables. Up to four different drought lengths can be examined at once and results are provided for cash results as well as the longer term considerations such as the possibility of having to re-establish pastures and changes in the value of stock.

Like *DroughtPack* this decision aid is aimed for use by farmers and their advisors. The ability of *FSA* and the others programs in the *StockPlan*® suite to quickly evaluate the sensitivity of various tactics and get a better feel for the risks involved make it a useful tool to help with management decisions.

4. *Impack*

Impack is a series of interconnected models which calculates the numbers of animals of various categories[10] that are on hand, the sales numbers and the cash flow consequences for specified breeding, selling and buying policies of a beef breeding herd or sheep flock. It can be a very useful tool in evaluating various re-stocking options following drought or when a farm business is expanding. Many farmers and their advisors have tried to work out likely cash flows from a herd when they are expanding numbers. Questions such as if replacement stock are currently expensive, am I better breeding up my herd numbers by retaining more replacement female heifers or ewe hoggets or do I increase the age that I cull my breeding females by one year? As a consequence of these decisions, the number of animals available for sale and the number available for breeding varies, as do cash flows. Working out the numbers for sales without the aid of software such as *Impack* is an extremely laborious task that many managers and their advisors have tried, often with limited success and with errors. *Impack* once mastered provides a very convenient way of making these calculations and can provide results on both a cumulative gross margin basis as well as on a discounted cash flow basis.

4.1 Information Requirements and Calculations of the Herd Structure

Inputs required include;

- The maximum age at which breeders are mated
- Total number mated in the first year of the period
- Percent of progeny weaned
- Death rate of adults (over 18 months old)
- Death rate of weaners (weaning to 18 months)
- Rate of culling for reasons other than age
- Rate of selling of breeders which fail to rear to weaning
- For cattle, do the maidens calve at 2 years old or 3 years?
- For cattle, age at which male progeny are sold (18 or 30 months)
- For cattle, age at which surplus female progeny are sold (18 or 30 months)
- For sheep, is it a self replacing flock or are all replacement breeders purchased?

From this information the program can calculate the animal numbers within a flock or herd which would result if this breeding operation continued on indefinitely, with these controlling variables remaining the same.

The program allows for a year of reducing numbers due to a major disruption such as drought or disease and for a recovery over the following ten years. It was developed to explore the consequences of a forced reduction but caters for a wide range of management changes in the recovery phase and accurately reflects the consequences of these.

4.2 The herd structure model

A herd structure model is crucial to *Impack* to keep track of animal ages, and reproduction rates, which in turn determine the number of animals that are sold each year, hence the annual income

[10] For cattle, the categories include maiden heifers, 2 year old up to 20 year old cows in yearly age categories, total cows joined, calves and yearling steers. For sheep, categories include maiden ewes, 2,3,4,5,6 and 7 year old ewes, total ewes joined, lambs and weaners. It is unlikely the user will wish to retain animals for the maximum time allowable.

that can be expected from the herd. Calculation of age structures can get particularly challenging when the starting herd has varying numbers in different age groups. It is particularly important to know how many breeding animals in the herd have reached their age limit. This number culled for age together with an allowance for deaths, and culling for other reasons, determines the number of replacement females that are required. The formulae used for these calculations are closely related to those used in the *BEEF-N-OMICS* herd model (Dobos et. al. (1997). In a self replacing herd, a certain number of replacements are required to replace breeding animals that have left the herd. Departure from the herd can be for several reasons namely:

- Some breeding animals are sold because they are now past breeding age.
- Some non-pregnant animals are sold (termed the % fail to rear sold)
- Some are culled for other reasons.
- Deaths

Calculations to derive the number of cattle within each age group from the total herd size are based on the estimates of disappearance from an age group[11] for these various reasons and are carried out over the following three stages.

Stage one sets 1 as the index for the first age group.

The calculation to obtain the index for the second age group is;

Age 1 index (1)*(1-adult death % - Other cull %-((1- Pregnancy rate)* % fail to rear sold).

The details for Pregnancy rate calculation will come later. For example let's assume the Age 2 index is 0.8982.

The third age group index is:

Age 2 index (0.8982) *(1-adult death % - Other cull %-((1- Pregnancy rate)*% fail to rear sold).

Let's assume this index is 0.8068.

This formula is repeated for each age group until the year where the user specified that the breeders are culled for age.

Stage two uses the sum of the parts of stage one. For age group 1 it is 1, for age group 2 it is 1 + the result of the stage one calculation for group 2. From the above example this would be 1.8982. Age group 3 would be 1 + 0.8982 + 0.8068 = 2.7050. For a herd in 10 age groups this might end at 6.4659 at group 10.

In stage three, the index for each age group estimated in stage 1 is divided by the sum of these indices over all age groups (estimated in stage 2, 6.4559 in this example). These stage three factors are the proportions of particular age groups in the total herd at that point. Multiplying these factors by the herd total gives the number of animals present in each group.

If we have 200 cows then for age group 1, the number of animals is 1 / 6.4659 x 200 = 30.93 or 31.For age group 2 it is 0.8982/6.4659x200=27.78 or 28. Age group 3 is 0.8068/6.4659x200=24.96 or 25. This continues to the final group. Done this way, the total will

[11] The software allows for up to 20 age groups for cattle and 15 age groups for sheep but older age groups are not likely to be used because the user will specify a younger CFA for age year than the maximum allowed.

always be similar to that nominated as the total number of animals in the herd. Any differences in total numbers will be due to rounding each age group separately before summing them.

As noted above to estimate the stage one indices, an estimate of the pregnancy rate is required as this allows an estimate to be made of the number of cows culled because they fail to rear calves. The number culled depends on the pregnancy rate (which indicates how many cows did not give birth) and also on the rate at which the manager culls cows who fail to rear calves according to the following formula:

Proportion culled who failed to rear = (1- Pregnancy rate)* % fail to rear sold.

Because animals die and get culled during pregnancy, pregnancy rate calculates what proportion of the total must have been pregnant at the start to be able to provide the nominated weaning rate 15 months later.

This again is a three step calculation. Step one is to calculate the calving rate required to achieve the weaning rate. This is:

weaning rate + (weaning rate * weaner death rate*6/12) + other cull rate.

The 6/12 is because weaning is set at 6 months of age. At a weaning rate of 88% and a weaner death rate of 2%, and other culls at 1%, this would be:
Calving rate = 0.88 + (0.88*0.02*0.5) + 0.01 = 0.8988

Step two is to calculate the proportion of pregnant cows which would have died during pregnancy and before calving. This is given by:

Calving rate * adult death rate * 282/365. (282 days being gestation).

At an adult death rate of 2.5% this would be 0.8988 * 0.025 * 282/365 = 0.0174.

Step three is to add steps one and two and back calculate how many of the additional cows required to become pregnant to achieve the calving rate would have died during pregnancy, as they too would have been there at the start. This is step one + step two + (step two * adult death rate * 282/365). In our example 0.8988 + 0.0174 + (0.0174 *.025 *282/365) = 0.9165. This is a proportion which says that 91.7% cows need to be pregnant to achieve an 88% weaning rate, given the death and culling rates used here.

The program goes on to calculate the surplus animals emerging from this structure as cast for age (CFA), culled as fail to rear, culled for other reasons and surplus progeny as male or culled female groups and this allows an estimate to be made of the number of animals in each age group within the herd.

The number of CFA cows is another round of the age group calculations. Adult deaths, other culls and fail to rear proportions are deducted from the number in the final age group nominated.

The total sold that fail to rear number is the total herd number *(1-Pregnancy rate * proportion fail to rear sold) from the formula above.

Other culls are the total herd number * other cull %.

Surplus males are half the calculated weaning numbers less deaths to the nominated time of sale at either 18 or 30 months.

Surplus female numbers are the male calculation less the number required to go into age group one in the herd as replacements, plus a little back calculation to account for deaths between weaning and the age at which replacements enter the herd, as again these would need to be kept from the sale group at the start so sufficient remain available when the time comes for them to join the herd.

Applying prices to the number of cattle sold of each type and inserting running costs for the herd produces an annual gross margin.

An important step is to relate feed demand for a flock or herd estimated in terms of dry sheep equivalents to feed availability. The estimated dry sheep equivalent (DSE[12]) requirements for feed of the herd or flock are calculated to allow a $/DSE gross margin. It is also used when testing recovery strategies after a de-stocking to ensure the recovering herd or flock fits within the carrying capacity of the base herd or flock and to decide how many trade animals can be used if this is part of a chosen recovery strategy (see the example for details of how trading can be used).

Having calculated the number of animals in the breeding herd and the followers to sale, a standard DSE is applied on the basis of breeding cow + calf to weaning = 14 DSEs, young cattle weaning to 18months = 7 DSEs, and young cattle 18m to 30m = 10.5 DSEs. Trade steers DSE default is 10.5 but is selectable. Ewes + lambs to weaning in a self replacing sheep flock = 1.5 DSEs, in a non self replacing = 2 DSE per ewe. Lambs from weaning to sale and wethers = 1 DSE.

4.2.1 Using an existing but non standard herd structure

The section above describes the process *Impack* uses to calculate a static herd structure to which the herd would converge over time, without a sudden sale or purchase of certain age groups. However, should the enterprise being modelled have an age structure where all age groups are not uniformly represented, the structure can be entered manually but it will mean that over time there will different numbers of animals available for sale which will alter cash flows over time. Entering the existing base structure does however produce a more accurate annual enterprise gross margin for the base year and subsequent years and this provides the necessary background information in assessing the financial consequences of future management.

This “base herd” section can also be used independently of the remainder of the program to compare cross breed and straight bred herds, the consequences of reducing death rates, the consequences of different culling strategies or sales policies or changes to maximum age in the herd.

Once a base structure that best represents the current age structure of the herd is determined, the program uses the user inputs such as death rates and weaning percentages to calculate the flock or herd size, the age structure and surplus animal sales from it in each of the following 11 years. It does this by using the outputs of one year as inputs for the next and applying the controlling factors listed above to generate the new output, which flows into the next year and so on.

In a stable operation, these will be close to the original base structure in each of the following years. An unstable operation may produce declining or growing numbers in the years following.

[12] DSE is a Dry Sheep equivalent which is the amount of energy (feed) required to maintain a 50kg dry sheep at a constant weight.

4.2.2 Making changes to management

At this point dramatic changes can be made to the "Drought" year selling policies or any of the controlling factors listed above, to represent management for drought survival, for disease control or for herd or flock restructure for any reason. The program calculates the numbers and cash flow consequences of these changes over the next 10 years, allowing the full impact of this management decision to be expressed.

There is the facility to make further changes to the controlling factors nominated above, to sales policy and to include breeder purchases and stock trading, in the each of the next ten years separately. This facility enables users to see the herd numbers, the sales numbers and hence the financial consequences of each management decision option in recovering or restructuring the operation.

4.3 Data entry – an example

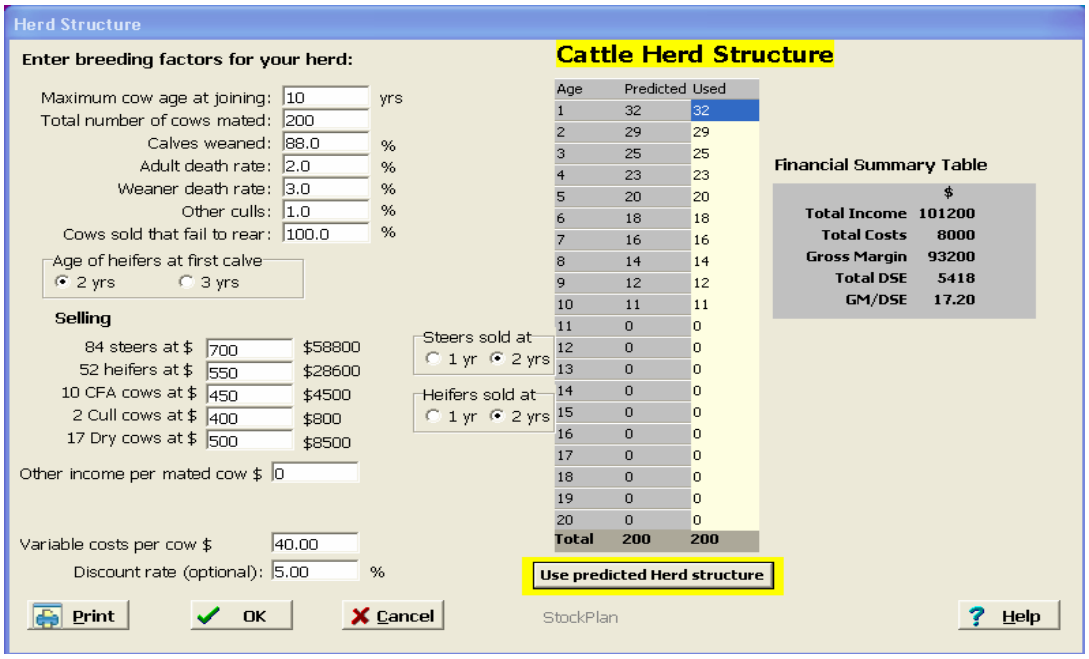
4.3.1 Establishing the base herd or flock

The capabilities of *Impack* are best demonstrated by using a cattle herd example because the cattle model contains most of the options provided in the two sheep models[13] and some additional options applicable only to a cattle breeding herd.

Step 1 – Breeding factors
You need to provide all the factor inputs listed above which control the flow of animals in the herd. There is a help facility, providing details of the data expected. Some data inputs are required in percentage terms and users may need to do some external calculations to get inputs into the required format.

Figure 15 shows the age structure of a stable or base herd where cows are retained for a maximum of 10 years and with death rates and culling rates as shown. The program will accept inputs of up to 20 years for cattle and 15 years for sheep. It displays the number of cows in each age group.

Figure 15. Establishing the base herd



[13] One model is used for breeding ewes and the other is used for wethers.

Step 2 - Herd structure

The model calculates from the breeding factors, what would be a stable herd as near as possible to the size specified. You can elect to 'use *predicted herd structure*' or if the herd you are working with is not the same as the one calculated you may overwrite this with your actual herd age structure numbers. If you use an actual herd, the numbers must add up to the nominated total.

Step 3 - Input costs and prices
Costs and prices in *Impack* are expected to be 'net on farm' figures, which may require some external calculations. The model calculates the surplus animals that result from the breeding factors acting on the age structure numbers and you need to provide the net price you would receive for these. You may choose to sell steers and surplus heifers at 1 year old or 2 years old. (18m, 30m). This affects the time over which nominated death rates apply.

The analyst also needs to input a total variable cost per cow for running this herd. You can provide an additional bulk income per cow if there is income from some source linked to the herd but not shown on the sheet (such as milk sales in a dairy). You may also nominate a discount factor which will apply in calculations of net present values. This establishes the base herd which is used to explore future management on the Options sheets.

4.4 Exploring options and viewing Summary Results

In this section we examine an example option of culling in the drought year 20% of the cows less than 6 years old, 50% of the 6 year old cows, 80% of the 7 and 8 year old cows and 100% of the 9 and 10 year old cows. In addition all heifer calves are sold. Following the drought a breed own replacements strategy is explored with 80% of heifers retained until the original herd size of 200 breeding cows is attained. After the results of this option are discussed, two further options are explored and discussed.

Results of this strategy are shown on the option 1 sheet (figure 16) can be slightly overwhelming at first but does provide a compact area for making changes and viewing consequences. The layout does quickly become familiar and convenient. The user can adjust any of the figures in the unshaded boxes in figure 16. The percentage of each age group of cows sold in the drought year is shown in the middle section of figure 16. 80% of the total heifers available were manually entered until the herd reached the original number of 200. From figure 16 it can be seen that the original herd size is not attained until year 5. .

Figure 16. Option sheet showing example described above

Beef Option 1

Breeding | Buy In | Prices and Trading Profit | On Hand | Sales & Income

Approx. Herd DSE	4246	2156	3087	3468	4082	4725	5239	5429	5440	5429	5429
Year	Drought	1	2	3	4	5	6	7	8	9	10
No. Cows mated	117	105	132	152	177	200	200	200	200	200	200
Max age at joining	10	10	10	10	10	10	10	10	10	10	10
% Calves weaned	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0
Adult death %	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Weaner death %	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
% Cull cows	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
% Fail to rear sold	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Own Heifers selected	32	0	39	36	45	47	30	30	29	30	30
Heifers available	85	0	49	45	56	65	76	85	85	85	85

Original DSE 5418

Cull age groups: Drought	Culls	Culls	Culls	Culls	Culls	Culls	Culls	Culls	Culls	Culls

Breeder selling: DROUGHT YEAR at (net price per head) $ 450

Age	1	2	3	4	5	6	7	8	9	10
%	20.0	20.0	20.0	20.0	20.0	50.0	80.0	80.0	100.0	100.0
Number	6	6	5	5	4	9	13	11	12	11

Reset table to match pre-drought structure.

Calf Selling: DROUGHT YEAR

	% Sold
Heifers	100
Steers	100
Net price per head $	300

Comparison TABLE	Original	Option 1	Difference
Stock value Yr 11	181200	180700	-500
Trading Loss/Gain	1025200	792630	-232570
Total Loss/Gain	1025200	792130	-233070
Loss/Gain per cow	5126	3961	-1165

Print | OK | Cancel | Help

A summary table appears at the bottom right hand corner of figure 16 showing that based on cattle prices assumed and feed costs of $23,000, both shown in Figure 17, stock values on hand at the end of the 10 year period are almost identical to the pre-drought situation and that in comparison to a no drought situation (original), the trading difference using a strategy of herd build up after drought based on breeding your own replacements (option 1), resulted in a loss in nominal terms from the drought over ten years of -$233,070.

Figure 17. Sale age, prices, feed cost and steer trading option input area

Beef Option 1

Breeding | Buy In | Prices and Trading Profit | On Hand | Sales & Income

Stock prices, feeding cost _steer trading option
Net sale price

Year	Drought	1	2	3	4	5	6	7	8	9	10
Steer Price	700	700	700	700	700	700	700	700	700	700	700
Steer Age	2	2	2	2	2	2	2	2	2	2	2
Heifer Price	550	550	550	550	550	550	550	550	550	550	550
Heifer Age	2	2	2	2	2	2	2	2	2	2	2
CFA Price	450	450	450	450	450	450	450	450	450	450	450
Cull Price	400	400	400	400	400	400	400	400	400	400	400
Dry Price	500	500	500	500	500	500	500	500	500	500	500
Cost of feeding if used	23000										
Profit on Trade Stock											
DSE of Trade Stock	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
No. Trade Steers Req.											

Reset prices to match pre-drought values.

If prices for sale animals were anticipated to vary over time, the altered prices would be entered in the unshaded cells in Figure 17.

4.5 Calculated 0utput

Once a drought management strategy is specified, as in Figure 16, the model calculates how the herd evolves in subsequent years. It estimates the numbers which would be in each age group of the breeding herd and the numbers of surplus animals which would be sold by applying the breeding factors nominated each year to the herd size. The resultant income and costs are calculated using the input prices and costs from Table 17.

The numbers of animals which would be present on the farm is shown in the On Hand sheet (figure 18), the numbers sold each year and values are displayed in the Sales sheet (figure 19).

Figure 18. Example numbers on hand, from section 4.4

Beef Option 1

Breeding | Buy In | Prices and Trading Profit | On Hand | Sales & Income

Stock on hand

Year	Drought	1	2	3	4	5	6	7	8	9	10	Original
Maiden Heifers	26		39	36	45	47	30	30	29	30	30	32
2yr	22	23		35	32	40	42	27	27	26	27	29
3yr	21	20	20		31	28	35	37	24	24	23	25
4yr	17	19	18	18		28	25	31	33	21	21	23
5yr	16	15	17	16	16		25	22	28	29	19	20
6yr	9	14	13	15	14	14		22	20	25	26	18
7yr	3	8	12	12	13	12	12		20	18	22	16
8yr	3	3	7	11	11	12	11	11		18	16	14
9yr		3	3	6	10	10	11	10	10		16	12
10yr			3	3	5	9	9	10	9	9		11
11yr												
12yr												
13yr												
14yr												
15yr												
16yr												
17yr												
18yr												
19yr												
20yr												
Cows Joined	117	105	132	152	177	200	200	200	200	200	200	200
Bobby Calves		100	91	114	132	154	173	173	173	173	173	173
Yearling Steers	85		49	45	56	65	76	85	85	85	85	85

An example of the Sales sheet, showing animal numbers sold each year, the income from them, the herd costs and the net cash balance is shown in Figure 19.

Figure 19. Example sales, returns & annual cash balance sheet from section 4.4

Results for beef 3 options 26-9-06.imp

Results for: beef 3 options 26-9-06.imp

Details of option results

Beef cattle breeding herd: OPTION 1

Print

Select Display: Summary; Cattle 1; Cattle 2; Cattle 3

Number of cattle sold

Year>>	Drought	1	2	3	4	5	6	7	8	9	10	Original
Steers	83	83	0	48	44	55	64	74	83	83	83	84
Heifers	52	52	0	10	9	11	18	45	54	55	54	52
CFA Cows	10	0	0	3	3	4	8	8	9	8	8	10
Cull Cows	2	1	1	1	2	2	2	2	2	2	2	2
Dry Cows	17	10	9	11	13	15	17	17	17	17	17	17
From age groups sold	82	0	0	0	0	0	0	0	0	0	0	
Calves	170											

Income from cattle sales

Income $	Drought	1	2	3	4	5	6	7	8	9	10	Original
Steers	58100	58100	0	33600	30800	38500	44800	51800	58100	58100	58100	58800
Heifers	28600	28600	0	5500	4950	6050	9900	24750	29700	30250	29700	28600
CFA Cows	4500	0	0	1350	1350	1800	3600	3600	4050	3600	3600	4500
Cull Cows	800	400	400	400	800	800	800	800	800	800	800	800
Dry Cows	8500	5000	4500	5500	6500	7500	8500	8500	8500	8500	8500	8500
Other Income	0	0	0	0	0	0	0	0	0	0	0	0
Age group sale	36900	0	0	0	0	0	0	0	0	0	0	
Trade steers	0	0	0	0	0	0	0	0	0	0	0	
Calves sold	51000											

Financial Summary

	Drought	1	2	3	4	5	6	7	8	9	10	Original
Total income	188400	92100	4900	46350	44400	54650	67600	89450	101150	101250	100700	101200
Purchase costs	0	0	0	0	0	0	0	0	0	0	0	0
Variable costs	4680	4200	5280	6080	7080	8000	8000	8000	8000	8000	8000	8000
Annual gross margin	160720	87900	-380	40270	37320	46650	59600	81450	93150	93250	92700	93200

Variance from normal (GMx11 $1025200 Stock Value $181200) = $-233070
Cash balance using the discount rate of 5.0% $598626. Variance from normal: $-175531

Note that the present financial summary does not categorise feed costs as a variable cost and whilst included in the gross margin, any feeding costs are not shown in Figure 19. As a result if feeding costs are incurred in a particular year, the annual gross margin cannot be calculated from the information provided in the financial summary but must be done externally as follows:

Annual gross margin = Total income less purchase costs less variable costs less feeding costs. The latter cost is not shown in figure 19.

In the above example the annual gross margin for the drought year is $188,400 less $0 less $4680 less $23,000 (from figure 17) = Annual gross margin of $160,720.

It is anticipated this source of confusion will be rectified in the next version of *Impack.*

4.6 Comparison with two alternative strategies

The example above showed that a considerable loss of income was likely to be experienced by following a sell and breed back strategy. To further demonstrate the use of *Impack*, two alternative strategies can be compared:

- Sell then buy in replacements as soon as the drought has finished or
- feed to retain all the cattle numbers.

This gives three options to consider:

- Option 1, the heavy cull and breed replacements strategy is discussed above.
- Option 2 looks at a heavy cull followed by re-buying breeding cattle aged from 1 year to 6 years old in year 1, immediately after the drought has finished.
- Option 3 looks at retaining all cattle an incurring a feed cost of $90,000 compared to the $23,000 projected for options 1 and 2.

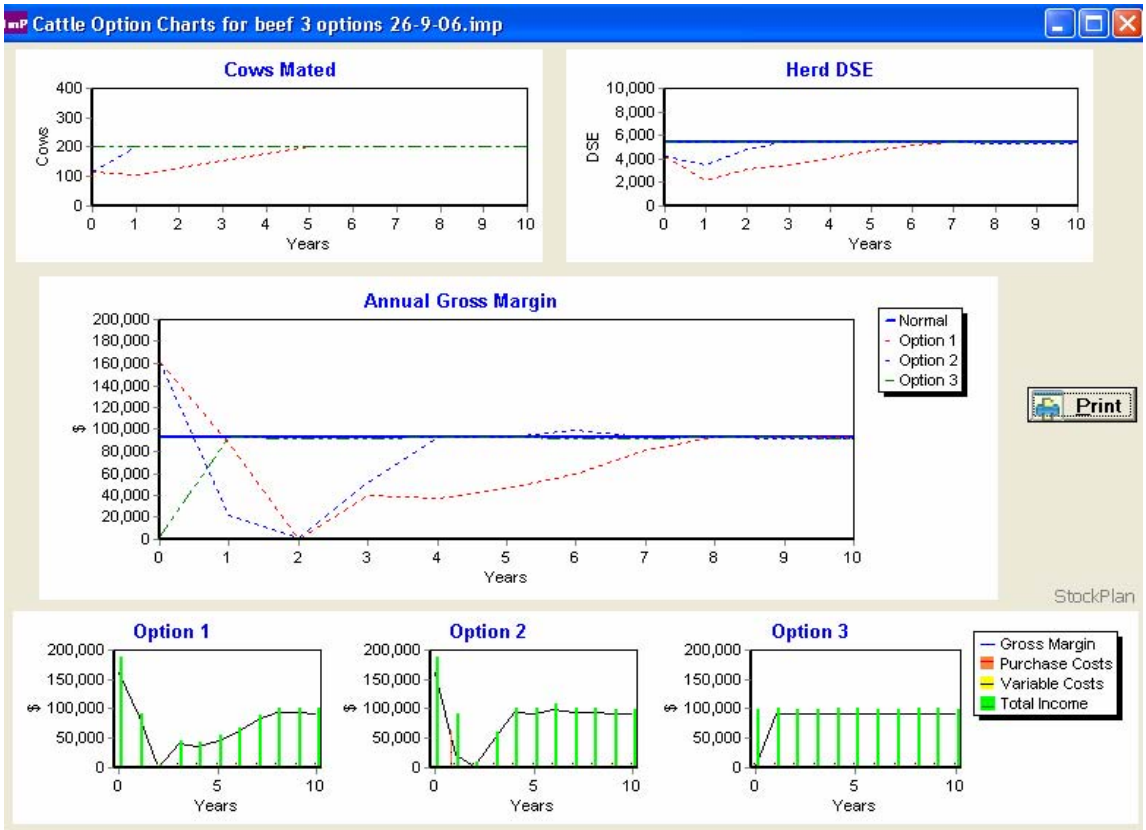
A full summary of option differences are shown in Table 5. At the point of making the decision about which strategy to use, there is very little feed available and *DroughtPack* has been used to calculate feeding costs.

Table 5. An example of three options to use during and after a drought

	Option 1. Heavy cull, breed replacements	Option 2 Heavy cull, buy in replacements	Option 3 Feed only strategy, remain in full production
	Action in drought year		
Selling Cows @ $450/hd			
10yo	100%	100%	0%
9yo	100%	100%	0%
8yo	80%	80%	0%
7yo	80%	80%	0%
6yo	50%	50%	0%
1-5yo	20%	20%	0%
Sell steer & heifer calves @ $300	100%	100%	0%
Feeding cost in drought year	$23,000	$23,000	$90,000
Action in year 1 (after drought has ceased)			
Heifer replacement strategy	Retain 80% until back to 200 breeders then enough to maintain herd at 200	Retain 80% in year 1 then enough to maintain herd at 200	Retain 30 or 31 each year to maintain 200 breeders
Buy back option	No buy back breed replacements.	Buy back 1 to 6 year old cows to get back to 200 breeders @ $650	No buy back necessary.

The most significant driver of the financial results from the three options outlined in table 5 is the number of breeding cattle carried in the years immediately after the drought and hence the income generated from them over the next five years. With option 1, breeding cow numbers fall to 117 in the drought, falling further to 105 in year 1 as there are no heifers available to bring in but then rising in subsequent years to 132, 152, 177 and 200. For option 2, breeding cow numbers also fall to 117 but the buy back policy results in full stocking rates attained again in the next year (year 1). Option 3 does not have any reduction in breeding numbers. As a result the cows mated, the herd DSE, the annual gross margins from these three strategies are markedly different (Fig 20).

Figure 20. Total cows mated, herd DSE, gross margin for a 10 year period following drought using strategies as described in Table 5



The trading results over 11 years (the sum of the all the gross margins including for the drought year) adjusted for changes in stock values at the end of the 10 year analysis period is provided for each of the 3 options in summary form in Figure 21.

Figure 21. Summary output showing key trading results for each option

Option 1

Comparison TABLE	Original	Option 1	Difference
Stock value Yr 11	181200	180700	-500
Trading Loss/Gain	1025200	792630	-232570
Total Loss/Gain	1025200	792130	-233070
Loss/Gain per cow	5126	3961	-1165

Option 2

Comparison TABLE	Original	Option 2	Difference
Stock value Yr 11	181200	179550	-1650
Trading Loss/Gain	1025200	889440	-135760
Total Loss/Gain	1025200	887790	-137410
Loss/Gain per cow	5126	4439	-687

Option 3

Comparison TABLE	Original	Option 3	Difference
Stock value Yr 11	181200	179950	-1250
Trading Loss/Gain	1025200	924080	-101120
Total Loss/Gain	1025200	922830	-102370
Loss/Gain per cow	5126	4614	-512

Results produced in Figure 21 show that options 2 and 3 were clearly better than option 1. Option 3 was the best on the basis of its smallest trading loss and total loss but because it is quite sensitive to just how long the drought lasts and as a result how much feeding costs are, some sensitivity analyses could be warranted to get a better idea of how much things would have to change before option 2 became the better option. For example, prices for buying in cows in option 2 would need to fall from $650 to $440 before this option became the best option on a discounted cash flow basis. Alternatively if buy-in prices are expected to be $650, the feeding costs in option 3 would only need to increase from $90,000 to $109,000 for option 2 to become superior. In an Australian environment, one of the greatest risks is likely to be underestimating the drought length and a 21% increase in feed costs is highly likely. Depending on attitudes to risk and that fact that option 3 could result in substantially greater losses in a worst case scenario, many decision makers would choose option 2 even though the analysis marginally favours option 3.

The program also incorporates the option to view results on a discounted cash flow basis. At the bottom of result sheet detailing the sales numbers, the income and the financial summary (figure 19), a summary discounted cash flow analysis is provided. In the case of our example (figure 19) the user has specified a discount rate of 5% entered on the input screen shown in figure 15. Applying a 5% discount rate to the annual gross margin results in a discounted gross margin total of $598,626 which is $175,531 less than the discounted sum of the gross margins in the “normal” or non-drought situation.

The discounted (5%) 11 year trading results for the three options were:

Option 1: $598,626
Option 2: $661,700
Option 3: $679,989

Under the assumptions used, option 1 is a poor one because of the delay in the herd build up and consequent loss of sales income. Differences between options 2 and 3 are smaller and could warrant some sensitivity testing to see how robust the results are.

4.7 Sheep models

Impak can also be used to analyse sheep flocks although the models are slightly different. Unlike the cattle model, the breeding flock model does not provide the option to have two sale ages for young stock because once weaning is past, the wether model can be used to explore the option of retaining your own surplus sheep as wool cutters. Nor does it provide a trading option to utilise vacant DSE capacity. The wether model can also explore ways of achieving a full stocking rate following a flock reduction.

The breeding flock model does allow for a flock where all replacements are purchased, as in most prime lamb producing flocks. In this form, the sheep model assumes all lambs are sold before 12 months of age. For a self replacing flock it assumes sales at 15 months. The program does display the DSE requirements of the type of flock selected and how it is structured.

For sheep, the program will permit weaning rates above 100% but always assumes there are 2% of ewes which fail to become pregnant. For self replacing flocks it assumes there are 5% of lambs reared as twins and for non self replacing flocks, 15% of lambs reared as twins. These assumptions can affect the numbers culled as 'fail to rear' but are representative of most Australian flocks.

The wether flock model assumes all replacements are purchased. Even if wethers come from the breeding flock, an opportunity cost approach is used.[14] All wethers have a DSE rating of 1, so the total numbers reflect the DSE requirements.

4.8 Limitations of *Impack*

As we have seen many parameters influence herd structure. It is easy to inadvertently select a set of parameters that do not lead to the herd structure anticipated. In fact the model may not be able to arrive at a sensible solution. So, pay full attention to error messages. For example, there may not be the number of replacement heifers available to supply the nominated number. The model still calculates but produces an error message to warn people of the problem. The 'Numbers On Hand or Sold' results can be useful in finding the cause and scale of the error. They may show up as negative numbers, which would indicate a production or controlling factor input that could not be achieved in practice.

ImPack assumes all deaths and culling are evenly distributed among available age groups. This may not always be true in practice. However errors will be small and as totals will remain accurate, the production and consequent economic outcomes are correct.

[14] Wethers transferred from the breeding flock to the wether flock are valued in both models at the price at which they could have been sold – their opportunity cost.

Take care to avoid having the total herd DSE estimate after a management change exceed the original DSE estimate before the change (or drought) as this reflects an increased carrying capacity invalidating a comparison to the returns from the original herd.

When using *ImPack* to recover from an imposed herd reduction it is necessary to end up by year 10 or earlier with the original stock numbers, and preferably, to have a similar age structure as the starting herd. This is because the future sales (hence income) beyond year 10 will be different.

4.9 Conclusion on *Impack*

The *Impack* software has a highly developed capacity to model herd or flock numbers within any breeding operation and show the cash flow consequences of changing management.

It has already been used extensively in NSW to examine the possible options to manage breeding programs through the 2002/03 drought. Individual producers, NSW Department of Primary Industries advisers and policy development personnel have used the program to select best bet options for individual herds and flocks and to explore the potential impact of drought on NSW farmers.

The program not only has the capacity to be used for drought planning. It can also be used for other situations that require a herd build up, such as after pasture improvement, property purchase or after a de-stocking period to eradicate a disease or parasite.

5. Accessing the program

StockPlan® is currently being made available to participants of workshops held in NSW. More detail of the workshops and contacts can be found by accessing the site: http://www.agric.nsw.gov.au/reader/drtplanning/stockplan.htm. *StockPlan*® is also being made available in other states and producers should contact their local advisory officers for details of accessing the workshop series. Further information can also be found about *StockPlan*® on the AWI site at
http://www.wool.com.au/mediaLibrary/attachments/Publications/insight_stockplan_211106.pdf

6. Overall Conclusion on *StockPlan*®

This paper has been written to ensure the methodologies and economic thinking used is on record. All three programs that make up the *StockPlan*® suite of programs were primarily designed to be able to be used by farmers and their advisors in planning for droughts. In designing decision aid software like this there is always a tradeoff between ease of use and the detail with which the decision environment is represented. At the extreme the model could be so detailed as to allow the decision maker to account for all dimension of his on- and off-farm decision environment to ensure that all interactions between decisions about drought feeding and herd management and with other farm enterprises and with other financial considerations such as indebtedness and taxation are fully accounted for. However such a model would require great skill and time to apply.

Partly to encourage more widespread adoption the *StockPlan*® suite of programs focuses almost exclusively on the application of sound budgeting principles to a realistic representation of the feeding and herd structure decisions farmers face in drought. Farmers using these programs then

need to consider whether their unique farm and family situations would be likely to make the livestock decisions suggested by the model incompatible with these broader goals.

Evaluations by farmer and advisor users of the software have been extremely positive to date and there has been widespread support both in NSW and interstate. As farmers become more attuned with the software, it is likely that it will be used more and more for strategic planning as well as the tactical use to which it has been mainly used in the current drought.

References

Dobos, R.C., Carberry, P.M., Vleeskens, S., Sangsari, E., Johnston, B.D. and Oddy, V.H. (1997), ‘An age and herd structure model for beef breeding enterprises’ in 'Proceedings of the International Congress on Modelling and Simulation', edited by A.D. McDonald and M. McAleer for Modelling and Simulation Society of Australia Inc., pp. 1080-1085.

Ministry of Agriculture, Fisheries and Food (1984) "Energy allowances and feeding systems for ruminants", Technical Bulletin 33, England.

Dobos, R., Davies, L. and Carberry, P. (2006) BEEF-N-OMICS Users manual (accessed through the Help option in the Main Menu of BEEF-N-OMICS software.) NSW Department of Primary Industries.

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(All available at http://www.agric.nsw.gov.au/reader/10550)

Number

1 Brennan, J.P. and Bantilan, M.C.S. 1999, *Impact of ICRISAT Research on Australian Agriculture*, Report prepared for Australian Centre for International Agricultural Research, Economic Research Report No. 1, NSW Agriculture, Wagga Wagga.

2 Davies, B.L., Alford, A. and Hollis, G. 1999, *Analysis of ABARE Dairy Data for Six Regions in NSW 1991-92 to 1996-97*, Economic Research Report No 2, NSW Agriculture, C.B. Alexander College, Paterson.

3 Brennan, J.P. and Singh, R.P. 2000, *Economic Assessment of Improving Nutritional Characteristics of Feed Grains*, Report prepared for Grains Research and Development Corporation, Economic Research Report No. 3, Wagga Wagga.

4 Zhao. X., Mullen, J.D., Griffith, G.R., Griffiths, W.E. and Piggott, R.R. 2000, *An Equilibrium Displacement Model of the Australian Beef Industry*, Economic Research Report No 4, NSW Agriculture, Armidale.

5 Griffith, G., I'Anson, K., Hill, D., Lubett, R. and Vere, D. 2001. *Previous Demand Elasticity Estimates for Australian Meat Products*, Economic Research Report No 5, NSW Agriculture, Armidale.

6 Griffith, G., I'Anson, K., Hill, D. and Vere, D. 2001. *Previous Supply Elasticity Estimates for Australian Broadacre Agriculture*, Economic Research Report No 6, NSW Agriculture, Armidale.

7 Patton, D.A. and Mullen, J.D. 2001, *Farming Systems in the Central West of NSW: An Economic Analysis*, Economic Research Report No. 7, NSW Agriculture, Trangie.

8 Brennan, J.P. and Bialowas, A. 2001, *Changes in Characteristics of NSW Wheat Varieties, 1965-1997*, Economic Research Report No. 8, NSW Agriculture, Wagga Wagga.

9 Mullen, J.D. 2001, *An Economic Perspective on Land Degradation Issues*, Economic Research Report No. 9, NSW Agriculture, Orange.

10 Singh, R.P., Mullen, J.D., and Jayasuriya, R. 2005, *Farming Systems in the Murrumbidgee Irrigation Area in NSW: An Economic Analysis*, Economic Research Report No. 10, NSW Department of Primary Industries, Yanco.

11 Brennan, J.P., Aw-Hassan, A., Quade, K.J. and Nordblom, T.L. 2002, *Impact of ICARDA Research on Australian Agriculture*, Economic Research Report No. 11, NSW Agriculture, Wagga Wagga.

12 Alford, A., Griffith, G. and Davies, L. 2003, *Livestock Farming Systems in the Northern Tablelands of NSW: An Economic Analysis*, Economic Research Report No. 12, NSW Agriculture, Armidale.

13 Alford, A., Griffith, G. and Cacho, O. 2003, *A Northern Tablelands Whole-Farm Linear Program for Economic Evaluation of New Technologies at the Farm Level*, Economic Research Report No. 13, NSW Agriculture, Armidale.

14 Mullen, J.D. and Vere, D.T. 2003, *Research and Extension Capabilities - Program Economists in New South Wales Agriculture*, Economic Research Report No. 14, NSW Agriculture, Orange.

15 Farquharson, R.J., Griffith, G.R., Barwick, S.A., Banks, R.G. and Holmes, W.E. 2003, *Estimating the Returns from Past Investment into Beef Cattle Genetic Technologies in Australia*, Economic Research Report No. 15, NSW Agriculture, Armidale.

16 O'Donnell, C.J., Griffith, G.R., Nightingale, J.J. and Piggott, R.R. 2004, *Testing for Market Power in Multiple-Input, Multiple-Output Industries: The Australian Grains and Oilseeds Industries*, Technical Report for the Rural Industries Research and Development Corporation, Economic Research Report No. 16, NSW Agriculture, Armidale.

17 Brennan, J.P., Martin, P.J. and Mullen, J.D. 2004, *An Assessment of the Economic, Environmental and Social Impacts of NSW Agriculture's Wheat Breeding Program*, Economic Research Report No. 17, NSW Agriculture, Wagga Wagga.

18 Griffith, G.R., Davies, B.L., Alford, A.R., Herd, R.M., Parnell, P.F. and Hegarty, R.S. 2004, *An Assessment of the Economic, Environmental and Social Impacts of NSW Agriculture's Investment in the Net Feed Efficiency R,D&E Cluster*, Economic Research Report No. 18, NSW Department of Primary Industries, Armidale.

19 Scott, J.F. and Farquharson, R.J. 2004, *An Assessment of the Economic Impacts of NSW Agriculture's Research and Extension: Conservation Farming and Reduced Tillage in Northern NSW*, Economic Research Report No. 19, NSW Department of Primary Industries, Tamworth.

20 Scott, J.F., Farquharson, R.J. and Mullen, J.D. 2004, *Farming Systems in the Northern Cropping Region of NSW: An Economic Analysis*, Economic Research Report No. 20, NSW Department of Primary Industries, Tamworth.

21 Crean, J., Shaw, A., Singh. R. and Mullen, J.D. 2004, *An Assessment of the Economic, Environmental and Social Impacts of NSW Agriculture's Advisory Programs in Water Use Efficiency*, Economic Research Report No. 21, NSW Department of Primary Industries, Orange.

22 Mullen, J.D. 2004, *Evaluations in 2003 of Five Areas of Investment by NSW Agriculture: Summary*, Economic Research Report No. 22, NSW Department of Primary Industries, Orange.

23 Vere, D.T., Jones, R.E. and Dowling, P.M. 2004, *An Economic Evaluation of Research into the Improved Management of the Annual Grass Weed Vulpia in Temperate Pastures in South-Eastern Australia*, Economic Research Report No. 23, NSW Department of Primary Industries, Orange.

24 Jones, R.E. and Dowling, P.M. 2004, *Sustainability, Externalities and Economics: The Case of Temperate Perennial Grazing Systems in NSW*, Economic Research Report No. 24, NSW Department of Primary Industries, Orange.

25 Brennan, J.P. and Quade, K.J. 2004, *Analysis of the Impact of CIMMYT Research on the Australian Wheat Industry*, Economic Research Report No. 25, NSW Department of Primary Industries, Wagga Wagga.

26 Brennan, J.P., Sykes, J.D. and Scott, J.F. 2005, *Trends in Pulse and Oilseed Crops in Winter Cereal Rotations in NSW*, Economic Research Report No. 26, NSW Department of Primary Industries, Wagga Wagga.

27 Vere, D.T., Griffith, G.R. and Silvester, L. 2005, *Australian Sheep Industry CRC: Economic Evaluations of Scientific Research Programs*, Economic Research Report No. 27, NSW Department of Primary Industries, Orange.

28 Singh, R.P., Brennan, J.P. Lacy, J. and Steel, F. 2005, *An Assessment of the Economic, Environmental and Social Impacts of the Ricecheck Program*, Economic Research Report No. 28, NSW Department of Primary Industries, Yanco.

29 Jones, R., Saunders, G. and Balogh, S. 2005, *An Economic Evaluation of a Pest Management Control Program: "Outfox the Fox"*, Economic Research Report No. 29, NSW Department of Primary Industries, Orange.

30 Griffith, G.R., Parnell, P.F. and McKiernan, W. 2005, *The Economic, Environmental and Social Benefits to NSW from Investment in the CRC for Beef Genetics Technologies*, Economic Research Report No. 30, NSW Department of Primary Industries, Orange.

31 Khairo, S.A., Mullen, J.D., Hacker, R.B. & Patton, D.P 2006, *Farming Systems in the Western Division of NSW: An economic Analysis*, Economic Research Report No.31, NSW Department of Primary Industries, Trangie.

32 Griffith, G.R., Vere, D.T. and Jones, R.E. 2006, *Sheep CRC Renewal Proposal: Economic Evaluation of the Proposed Scientific Themes*, Economic Research Report No. 32, NSW Department of Primary Industries, Armidale, September.

33 Alford, A.R., Cafe, L.M., Greenwood, P.L. and Griffith, G.R. (2007), *The Economic Effects of Early-Life Nutritional Constraints in Crossbred Cattle Bred on the NSW North Coast*, Economic Research Report No. 33, NSW Department of Primary Industries, Armidale, February.

34 Jones, R. and Aluwihare, P. 2007, *A bioeconomic model for measuring the opportunity costs of water sharing plans in unregulated river systems: the Mooki river catchment*, Economic Research Report No. 34, NSW Department of Primary Industries, Orange

35 Davies, B.L., Carberry, P.M., Graham, R.P., Mullen, J.D. and Meaker, G.P., (2007) *StockPlan®: A Decision Aid for Management of Livestock During Drought and Other Times*, Economic Research Report No. 35, NSW Department of Primary Industries, Paterson, May.

36 Gibson, T.S., Allan, G.L., File, G., Mullen, J.D., Scott-Orr, H., 2005, 'Priorities and Principles for Investment in Aquaculture Research by NSW Department of Primary Industries', *Economic Research Report* No. 36, NSW Department of Primary Industries, Orange. Available at: http://www.agric.nsw.gov.au/reader/10550