# finalreport

**Project code:** RMT 008

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**Date published:** December 2006

**ISBN:** 9781741914726

**PUBLISHED BY**
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

# TESTING SIMULATION PROGRAMS AT FARM AND REGIONAL LEVEL IN TASMANIA

# Abstract

This project was designed to explore the possibility of using available modelling programs to examine typical enterprises in three areas of Tasmania. Following the modelling of existing enterprises, and with input from producers, processors and consultants alternative meat production systems were identified. An attempt made to develop production and economic data to examine the feasibility of these systems compared with existing systems. The final step was to extend these data from a farm to a regional basis.

A number of impediments to the process, both in modelling and availability of data were identified.

# Executive Summary

The objectives defined for this project were:-

1. Use the available models, GrassGro, Sustainable Grazing Systems (SGS) and Stockpol to model 2 –3 scenarios for typical Tasmanian sheep/beef areas (lower midlands, North East coast, Cressy area)
2. Use technical and industry reference groups to develop the inputs and evaluate the outputs.
3. With input from the model owners test the response of different animal genotypes.
4. Extend the modelling to express the benefits and constraints of potential new meat production systems at both the farm and regional scale;
5. Identify strengths and shortcomings of the methodology.
6. Build Tasmania's farm system modelling capacity and promote the value of modelling to a core group of industry representatives.

A Technical Reference Group consisting of Department of Primary Industry and Water and Tasmanian Institute of Agricultural Research extension and research specialists was established to assist in developing data inputs for the models and to review the outputs. An Industry Reference Group consisting of producers, processors and consultants was also established to provide input into the areas to model and review the model outputs.

The two major areas suggested as needing research by the project Industry Reference Group were the use of irrigation and nitrogen fertiliser to increase pasture growth. This has arisen as a result of the increase in the area under centre pivot irrigation in the State and the need to include a pasture rotation in these cropped areas

A number of alternative production systems were modelled to investigate the potential return from use of irrigation water in the systems, and an attempt was made to estimate the costs and returns of some of the enterprises using the program Red Sky.

Each of the models used had limitations in the process attempted and there were a range of issues which arose when using an output from one model as input for another. These were primarily because of the different model backgrounds. GrassGro is a dryland model with no facilities for irrigation, unless rainfall files are modified manually, but good animal growth predictions. SGS has the ability to apply nitrogen and irrigation in a range of different ways but has limited animal growth facilities. In order to use these models to examine the effects of nitrogen and irrigation on animal growth and production, animal growth was predicted from GrassGro and plant production from SGS and these data were used in Stockpol, a model which has user defined animal and plant production rates to predict production from a property. The major problems were

- Difficulties in defining actual fertiliser application rates except for nitrogen in SGS, and comparing fertiliser practices in the two models.
- Problems in predicting animal growth rates for pastures with varying nitrogen and irrigation additions because of the differences in plant production predictions between the models.
- Determining the area used for irrigation, and therefore the cost of irrigation when it was used to grow animals.

The State wide areas of each of the soil types used in the simulations was calculated from land capability data to give an indication of the area which could be influenced by any potential changes. Unfortunately there is no current method of determining what proportion of those soils could be irrigated, so it is not possible to put a regional financial value on any potential changes to production systems.

Given the constraints of the project it was not possible to develop any different animal genotypes which could be modelled. It is would involve some model rewriting.

Members of the Industry Reference Group indicated that their prime interest was in predicting the pasture which could be produced under irrigation and differential nitrogen addition. Because of their varying property enterprises they felt that they were individually able to determine the value of that production in their systems. This project was able to generate the information needed.

# Contents

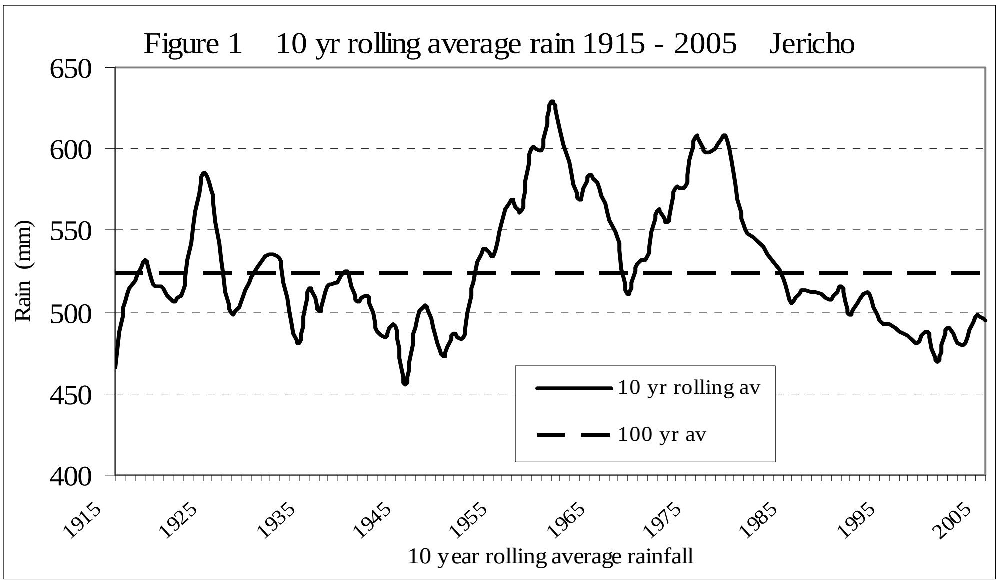
# 1 Background

The models used were GrassGro (ver 2.5.1), SGS (ver 3.5.6 build 6), Stockpol (ver 6.3.6.11) and the farm performance analysis program Red Sky (ver 4.2.40). GrassGro was used to calculate animal growth rates and SGS pasture growth. Data from GrassGro and SGS were used in Stockpol as this has the ability for multiple stock sales from a group of animals. To allow a comparison, excess pasture production in spring was assumed to be made into hay and sold.

Hypothetical properties typical of three areas, Jericho (500 mm rainfall, alluvial soil), Longford (650 mm rainfall and Brumby sandy loam soil and an irrigation scheme) and Scottsdale (1000 mm rainfall more fertile basalt soils) were modelled. Typical stocking rates and recommended pasture species (cocksfoot / sub clover Jericho and Longford, rye grass / white clover Scottsdale) used on higher producing farms were assumed.

Data Drill weather files (Queensland Department of Natural resources and Mines) were used for SGS models. The Data Drill accesses grids of data derived by interpolating the Bureau of Meteorology's station records, and although they are derived data they have the advantage of being available for any set of coordinates in Australia. In contrast, GrassGro weather data were those of nearby sites supplied with the program. It is possible to use Data Drill files in GrassGro, but they produce slightly different plant growth patterns from the inbuilt weather files (see Figures 13 and 14).

An initial analysis of long term (100 year) weather data was used to define the modelling period. Rainfall was of course the most variable component of the weather and Figure 1 shows the 100 year rainfall as 10 year rolling averages to show the short term trends for Jericho. The other sites had similar patterns. A 10 year rolling average takes the average of the current year plus the previous 9 years, so 1915 is the average of 1906 - 1915. In addition the 100 year rainfall average is shown.




Because recent years have had below average rainfall, simulations have been based on the last 15 years, rather than a longer time.

# 2 Project Objectives

[The objectives defined for this project were:-

- Use the available models, GrassGro, Sustainable Grazing Systems (SGS) and Stockpol to model 2 –3 scenarios for typical Tasmanian sheep/beef areas (lower midlands, North East coast, Cressy area)
- Use technical and industry reference groups to develop the inputs and evaluate the outputs.
- With input from the model owners test the response of different animal genotypes.
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- Identify strengths and shortcomings of the methodology.
- Build Tasmania's farm system modelling capacity and promote the value of modelling to a core group of industry representatives.

# 3 Methodology

## 3.1 Modelling

The relation between the models used is shown in Figure 2

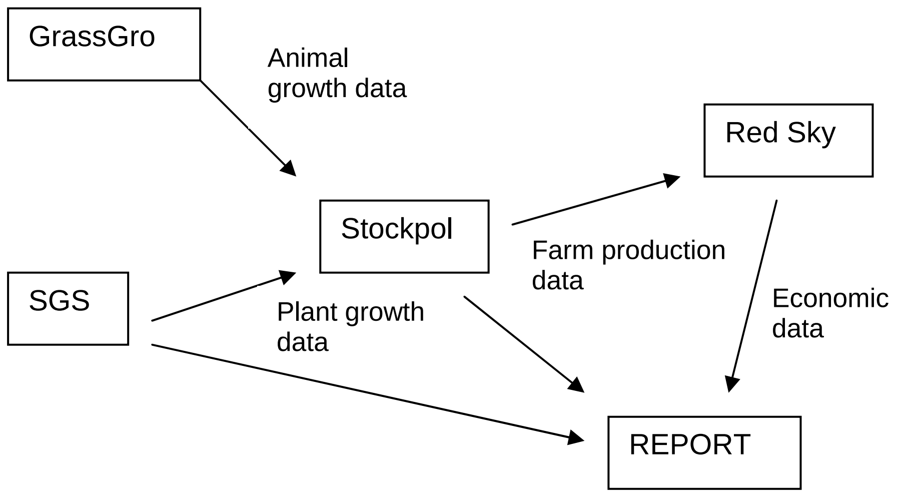
### 3.1.1 Pasture growth

Irrigation use was a major part of the project and plant growth rates for inclusion in Stockpol were generated in SGS with varying nitrogen fertiliser and irrigation inputs. The system adopted was to use the net positive pasture growth rate values from SGS with a 28 day cutting regime to a 1 tonne residual and the nitrogen which would have been in the cut material being returned.

Irrigation was applied at a nominated Growth Limiting Factor (GLF) calculated from the difference between potential and actual evaporation, with water being applied at a soil deficit of 20 mm to try and achieve the most effective use of water. For example, with a GLF of 0.8 the program would add water when the potential daily plant growth rate was reduced by 20%. Irrigation water use was recorded as the amount applied during the year.

Nitrogen was added in 4 equal amounts, in spring and autumn as these were the times of maximum nitrogen stress in the model. At each site nitrogen additions were continued until the maximum pasture response was achieved and further additions resulted in no or minimal pasture response. The higher levels were included to examine the response to nitrogen. In practice they could be environmentally unacceptable.

Figure 2 Model interactions used in the project




For comparative animal production simulations an intermediate nitrogen application and irrigation rate was selected and applied to the property.

### 3.1.2 Modelling animal growth

Animal growth rates from GrassGro were used as the basis for Stockpol animal inputs. Current input situations were modelled by using maintenance feeding and moderate soil fertility (Scalar 0.8) Animal growth rates for irrigated simulations were generated by ad lib supplementary feeding of young animals. Oats were used for sheep, and a 20 % barley / 80% hay mix for growing cattle. Mature animals were supplemented in winter to maintain condition only. In Stockpol it was assumed that mature animals were run in a dryland situation and young weaned animals were on irrigated pasture in the relevant simulations. Because the breeding animals have growth rates relevant to a lower productivity pasture, they should have been prevented from utilising the more abundant feed in the irrigated simulation.

In each Stockpol simulation an attempt was made to calculate the approximate area needed to maintain breeding animals and calves or lambs from birth to weaning for the year. The remainder of the property was then assumed to be irrigated. In simulations where weaners were sold from their mothers, the whole property was assumed to have been irrigated. This approach probably resulted in unrealistically high irrigation costs.

Sheep were assumed to be merino mothers crossed with either merino or Dorset sires and cattle were Angus.

In the Stockpol models supplementary feed was limited to approximately 0.5 kg of oats/ewe/day or one 350 kg round bale of hay per breeding cow in winter, roughly in line with current average practices. Increasing supplementary feeding would allow more stock to be carried, for example doubling the supplement resulted in a 12% increase in breeding cows carried at Scottsdale.

### 3.1.3 Excess pasture production

For comparison between simulations, it was assumed that excess pasture was made into hay and the production above farm needs sold. Pasture was locked up in early October and made into hay in the first week of January or earlier.

### 3.1.4 Modelling new plant species

The growth of a newly released annual legume, Arrotas clover, was simulated in SGS by modifying growth parameters from subterranean clover. Input was provided by the 4 people most involved with development of this cultivar, Bob Reid – Tas Global Seeds, Stewart Smith – DPIW, Sarah Campbell – DPIW and Eric Hall – TIAR.

A cutting trial was planned for 2006 to collect plant growth data to validate this model, but the low spring rainfall resulted in low initial growth and irrigation was needed for plant survival. It is now planned to collect growth data in the 2007 season. The predicted yield did however match actual yields at Elliott in the north west of Tasmania. (R Rawnsley TIAR pers. comm.).

The predicted average yield is shown in Table 1.

Table 1 Predicted Arrotas production (kg dm/ha/day) Longford, 15 year average

| | Non Irrigated | Irrigated* |
|---|---|---|
| | | |
| May | 0.00 | 0.00 |
| Jun | 0.00 | 0.00 |
| Jul | 0.57 | 0.54 |
| Aug | 7.85 | 7.69 |
| Sep | 31.35 | 31.17 |
| Oct | 63.84 | 63.78 |
| Nov | 56.00 | 66.94 |
| Dec | 39.08 | 64.91 |
| Jan | 55.75 | 68.53 |
| Feb | 0.00 | 0.00 |
| | | |
| TOTAL (t/ha) | 7.89 | 9.41 |
| | * 1.6 ML /ha/ year average | |

The data reflect the high growth rates into summer which differentiate Arrotas from other clovers, including other arrow leaf varieties.

### 3.2 Economic Analysis

Output data from Stockpol were used to develop an economic analysis in Red Sky. This proved to be difficult at more than the enterprise level as the simulations were not based on actual properties and so there were no specific land values, equity or other property data available.

### 3.3 Extension from farm to regional areas

To extend the data from the 3 selected sites to a regional basis, the areas of soil representative of those used in the models were mapped. This was done from a land system classification where similar polygons are developed based on geology, soil type, rainfall, altitude and vegetation. For this exercise all polygons which had the selected soil as a dominant or sub dominant component were included.

This method gives an underestimation of the total areas of each soil type, as there are areas where the nominated soil has a minor contribution to the calculated polygon. Including any occurrence of the specific soil type however would have overestimated the areas of each soil. These data were mapped by Mr Darren Kidd, Land Conservation Branch, DPIW.

## 4 Results and Discussion

### 4.1 Individual property modelling results

Annual pasture productivity at a range of irrigation rates and fertiliser additions was calculated over the 15 year period 1991 – 2005 from the SGS model (Longford Table 2, Figures 3 and 4, Scottsdale Table 3, Figures 5 and 6; Jericho Table 4 Figures 7 and 8). Figures 4,6 and 8 show the predicted daily pasture growth response to added nitrogen under full irrigation i.e. a Growth Limiting Factor of 0.95 (only 5% growth limitation due to water stress). As can be seen from the tables, there would have been a different amount of water applied at each nitrogen level, as the highest irrigation input represents full irrigation in the SGS model (GLF 0.95) Figures 3, 5 and 7 represent the annual response of pasture production over a range of nitrogen and irrigation applications. The data represent the average annual irrigation in the period 1991 – 2005.

Table 2

| Pasture dry matter production at Longford under varying urea and irrigation regimes | | | | | | |
|---|---|---|---|---|---|---|
| No added fertiliser | | | | | | |
| ML irrigation /ha | 0.00 | 0.90 | 1.60 | 2.20 | 2.30 | 2.60 |
| Annual dm prod (t/ha) | 3.32 | 5.28 | 5.62 | 5.89 | 6.02 | 6.08 |
| | | | | | | |
| 85 kg urea / ha | | | | | | |
| ML irrigation /ha | 0.00 | 1.40 | 1.80 | 2.40 | 2.70 | 2.50 |
| Annual dm prod (t/ha) | 6.10 | 6.60 | 6.94 | 7.25 | 7.45 | 7.60 |
| | | | | | | |
| 130 kg urea / ha | | | | | | |
| ML irrigation /ha | 0.00 | 1.50 | 2.20 | 2.40 | 2.70 | 2.80 |
| Annual pasture prod (t/ha) | 6.62 | 7.29 | 7.65 | 7.98 | 8.13 | 8.31 |
| | | | | | | |
| 220 kg urea / ha | | | | | | |
| ML irrigation /ha | 0.00 | 1.60 | 2.50 | 2.70 | 2.90 | 3.10 |
| Annual dm prod (t/ha) | 7.59 | 8.56 | 9.11 | 9.44 | 9.64 | 9.79 |
| | | | | | | |
| 390 kg urea / ha | | | | | | |
| ML irrigation /ha | 0.00 | 1.80 | 2.60 | 2.90 | 3.30 | 3.50 |
| Annual dm prod (t/ha) | 9.57 | 11.20 | 11.82 | 12.30 | 12.58 | 12.74 |
| | | | | | | |
| 560 kg urea / ha | | | | | | |
| ML irrigation /ha | 0.00 | 1.9 | 2.8 | 3.30 | 3.60 | 3.90 |
| Annual dm prod (t/ha) | 10.82 | 13.58 | 14.38 | 14.92 | 15.22 | 15.58 |
| | | | | | | |
| 740 kg urea / ha | | | | | | |
| ML irrigation /ha | 0 | 2.1 | 2.9 | 3.4 | 3.80 | 4.10 |
| Annual dm prod (t/ha)) | 11.31 | 15.46 | 16.54 | 17.26 | 17.69 | 17.91 |

Table 3

| Pasture dry matter production at Scottsdale under varying urea and irrigation regimes | | | | | |
|---|---|---|---|---|---|
| No added fertiliser | | | | | |
| ML irrigation /ha | 0.0 | 1.7 | 2.7 | 3.4 | 3.7 |
| Annual dm prod (t/ha) | 8.2 | 10.4 | 12.2 | 13.5 | 14.1 |
| | | | | | |
| 130 kg urea / ha | | | | | |
| ML irrigation /ha | 0.0 | 1.8 | 2.7 | 3.4 | 3.5 |
| Annual dm prod (t/ha) | 9.2 | 11.4 | 12.8 | 14.0 | 14.4 |
| | | | | | |
| 220 kg urea / ha | | | | | |
| ML irrigation /ha | 0.0 | 1.9 | 2.8 | 3.0 | 3.6 |
| Annual dm prod (t/ha) | 10.0 | 12.0 | 13.6 | 14.4 | 14.9 |
| | | | | | |
| 440 kg urea / ha | | | | | |
| ML irrigation /ha | 0.0 | 1.9 | 2.7 | 3.0 | 3.2 |
| Annual dm prod (t/ha) | 11.6 | 14.8 | 16.0 | 16.4 | 16.6 |
| | | | | | |
| 650 kg urea / ha | | | | | |
| ML irrigation /ha | 0.0 | 1.9 | 2.8 | 3.2 | 3.4 |
| Annual dm prod (t/ha) | 11.6 | 17.2 | 18.6 | 19.2 | 19.5 |
| | | | | | |
| 860 kg urea / ha | | | | | |
| ML irrigation /ha | 0.0 | 1.9 | 2.9 | 3.3 | 3.5 |
| Annual dm prod (t/ha) | 11.5 | 17.6 | 20.4 | 21.7 | 22.0 |

Table 4

| Pasture dry matter production at Jericho under varying urea and irrigation regimes | | | | | |
|---|---|---|---|---|---|
| No added fertiliser | | | | | |
| ML Irrigation /ha | 0.0 | 1.1 | 1.6 | 2.1 | 2.3 |
| Annual dm prod (t/ha) | 4.0 | 4.0 | 4.3 | 4.4 | 4.5 |
| | | | | | |
| 130 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 1.4 | 2.2 | 2.3 | 2.6 |
| Annual dm prod (t/ha) | 5.5 | 6.0 | 6.4 | 6.6 | 6.9 |
| | | | | | |
| 220 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 1.6 | 2.4 | 2.9 | 2.8 |
| Annual dm prod (t/ha) | 6.6 | 7.4 | 7.9 | 8.1 | 8.5 |
| | | | | | |
| 440 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 1.9 | 2.7 | 3.2 | 3.40 |
| Annual dm prod (t/ha) | 9.0 | 10.7 | 11.4 | 11.8 | 12.3 |
| | | | | | |
| 560 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 2.3 | 3.0 | 3.5 | 3.6 |
| Annual dm prod (t/ha) | 9.8 | 12.5 | 13.4 | 13.8 | 14.5 |
| | | | | | |
| 825 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 2.4 | 3.2 | 3.6 | 3.8 |
| Annual dm prod (t/ha) | 10.3 | 14.4 | 16.5 | 17.3 | 18.1 |
| | | | | | |
| 960 kg urea / ha | | | | | |
| ML Irrigation /ha | 0.0 | 2.4 | 3.3 | 3.6 | 3.8 |
| Annual dm prod (t/ha) | 10.1 | 14.8 | 17.0 | 18.0 | 18.4 |

Figure 3 Pasture yield Longford under varying irrigation and N treatments

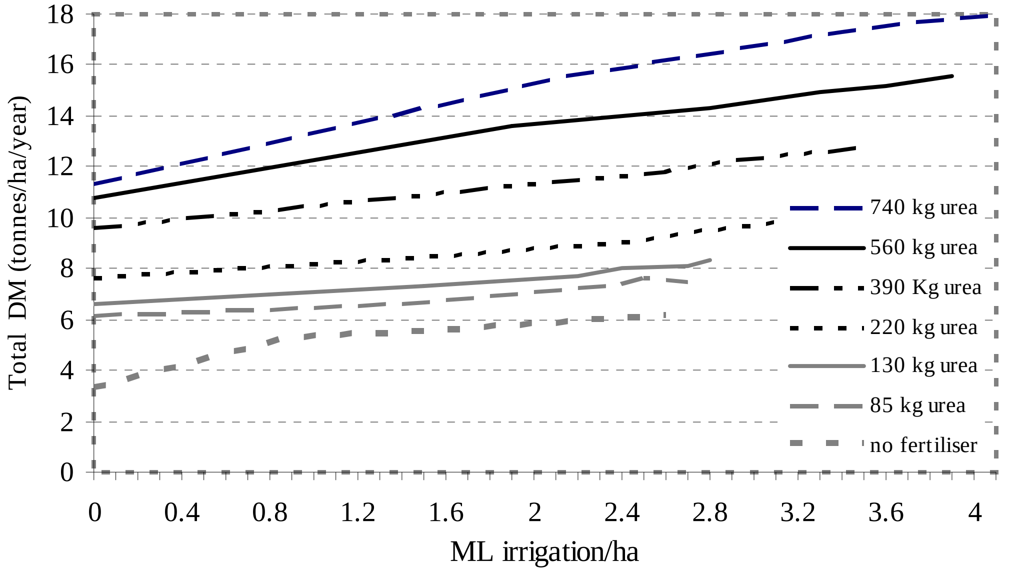



Figure 4 Nitrogen response under full irrigation Longford

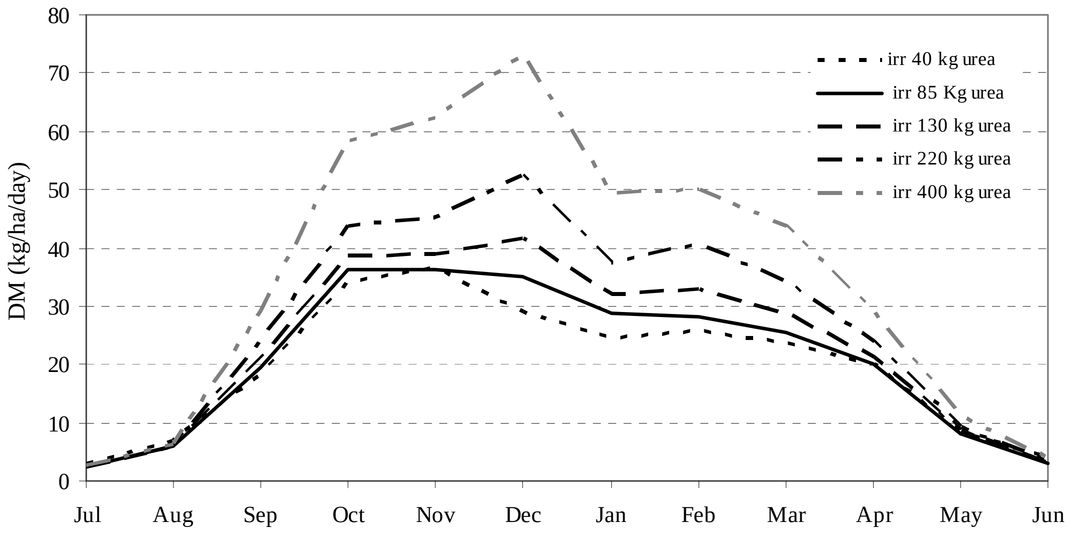


Figure 5 Pasture yield Scottsdale under varying irrigation and N treatments

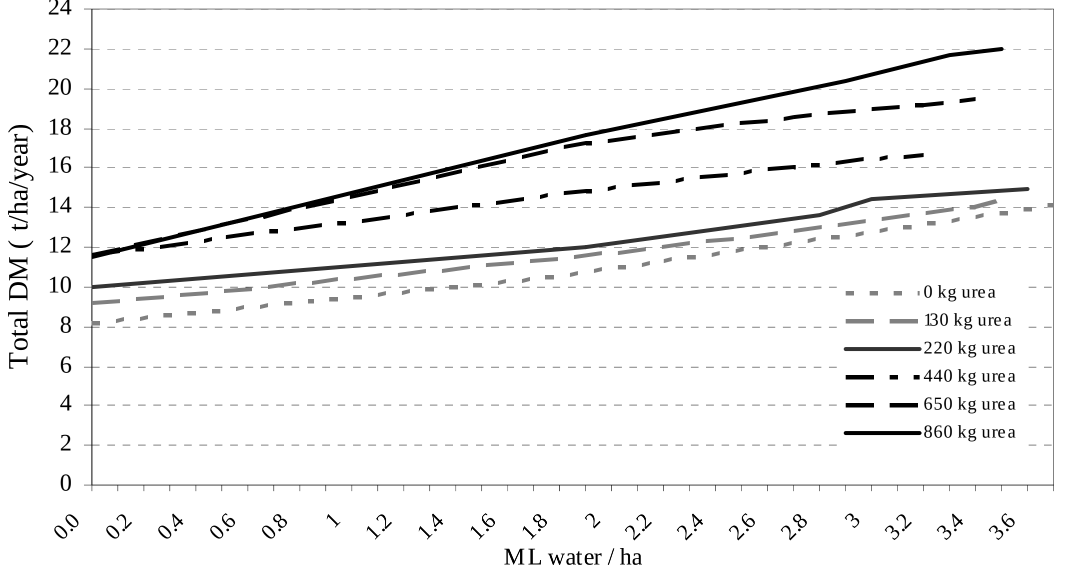



Figure 6 Nitrogen response under full irrigation Scottsdale

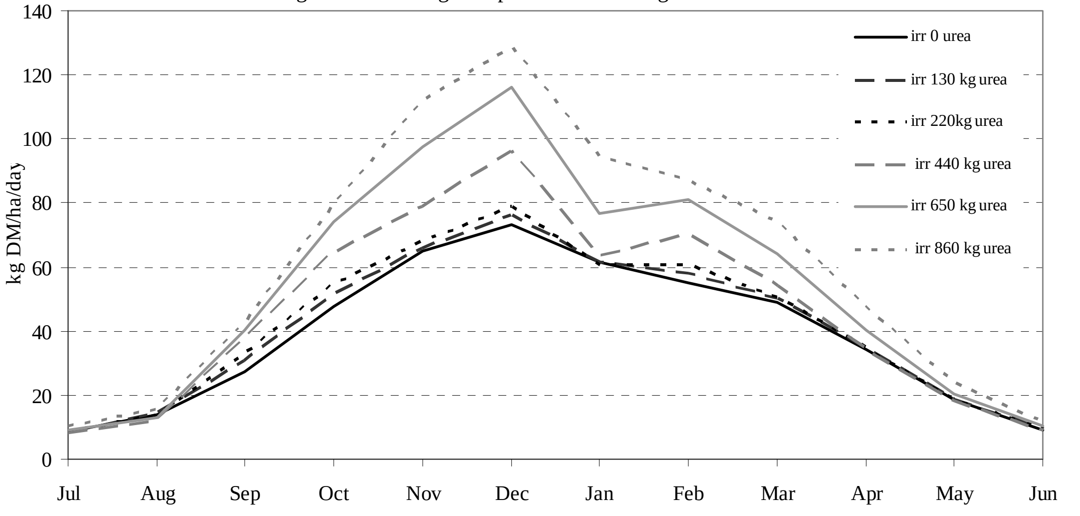


Figure 7 Pasture yield Jericho under varying irrigation and N conditions

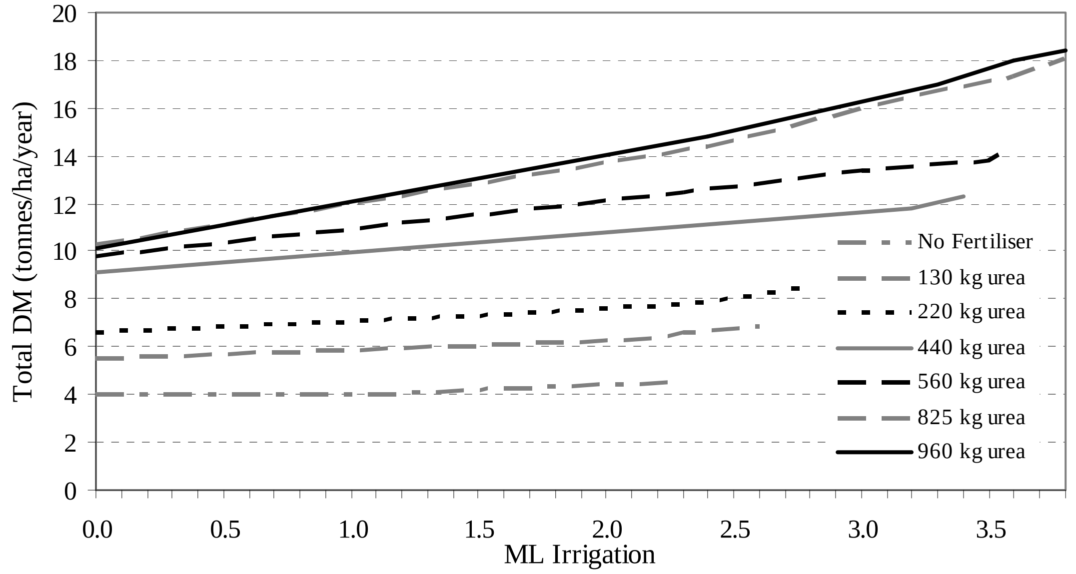
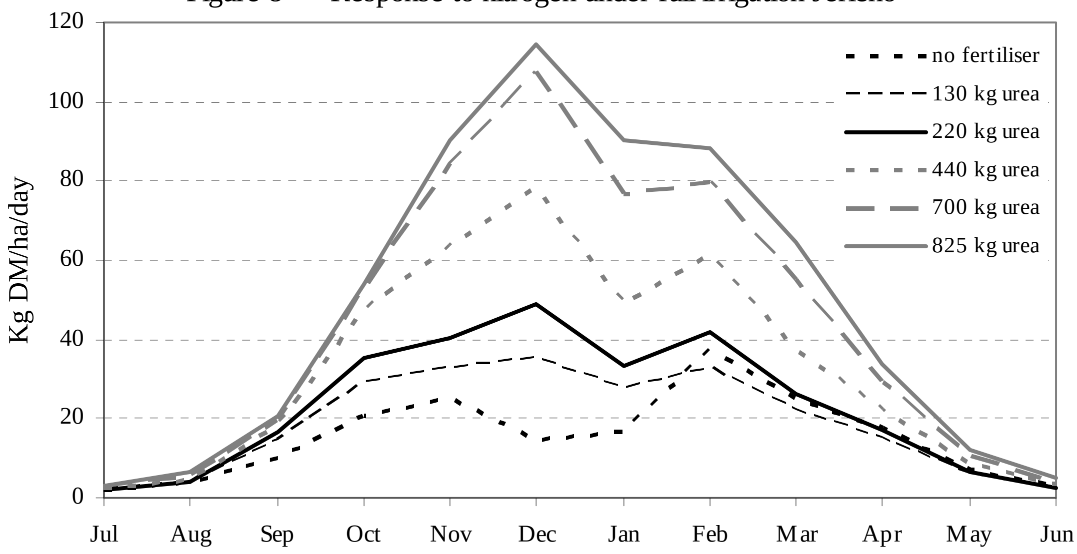



Figure 8 Response to nitrogen under full irrigation Jericho




The greater response to nitrogen at Jericho compared to Longford (Figures 4 and 8) is possibly a response to the Jericho soil having a greater water holding capacity.

If the SGS model accurately reflects actual nitrogen soil dynamics, and experience from other areas suggests that it does, then there are obvious differences in response between the soil types and climates in the simulation. In general however the response to irrigation is to ensure that there is a reliable autumn break each year. The irrigation applied obviously varies between years and Table 5 gives an example of the water applied at Longford in the 15 years of the simulation. The range was between 1.65 and 4.57 ML/ha/year with an average of 3.1. The response to nitrogen is greater under irrigation partly because the soil dryness as a result of low rainfall is removed.

Table 5 Variation in water applied for full irrigation from the SGS model at Longford 1991 - 2005

| | | | | | |
|---|---|---|---|---|---|
| Year | 1991 | 1992 | 1993 | 1994 | 1995 |
| Irrigation (ML/ha) | **4.57** | **3.04** | **2.54** | **3.45** | **2.62** |
| | | | | | |
| Year | 1996 | 1997 | 1998 | 1999 | 2000 |
| Irrigation (ML/ha) | **1.72** | **3.68** | **3.17** | **2.55** | **3.01** |
| | | | | | |
| Year | 2001 | 2002 | 2003 | 2004 | 2005 |
| Irrigation (ML/ha) | **2.63** | **3.48** | **3.51** | **4.28** | **1.65** |

## 4.2 Issues with models

### 4.2.1 Soil Fertility

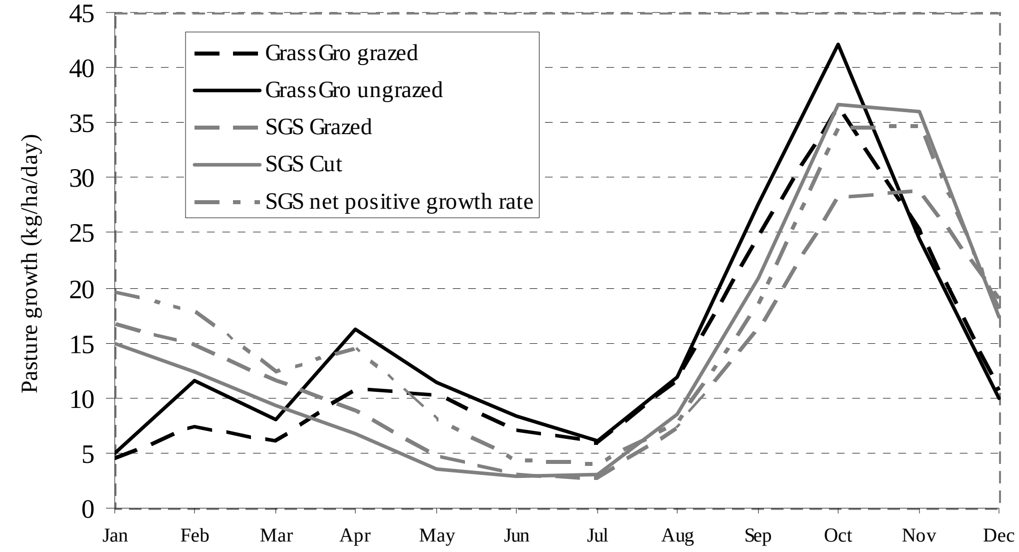
The models used in this project all have some limitations when applied to a specifically fertilised situation. GrassGro is a dryland model which has a fertility scalar between 0.5 and 1.0. This allows only a general soil fertility with no specific fertiliser additions. SGS currently allows nitrogen inputs but assumes all other soil nutrients are non limiting. There is, for example, no ability to examine the effects of nitrogen addition to an area which has had phosphate or potassium added. These are typically applied routinely in Tasmania. A no fertiliser regime in SGS results in low pasture growth rates.

### 4.2.2 Pasture growth rates

A comparison of pasture production from GrassGro and SGS can't be made directly as they measure pasture growth by different methods. In GrassGro it is possible to calculate daily pasture growth rates from an ungrazed or grazed simulation. These will differ due to the effect of defoliation by grazing on the plants. In SGS it is possible to either cut a pasture to simulate a cutting trial and measure the amount of dry matter removed, or measure the intakes of wethers with the numbers varied each day to maximise consumption. These different methods of pasture removal can be made to varying residual heights. It is also possible in SGS to calculate the net positive pasture growth rate under any of these treatments

As an example, Figure 9 shows pasture growth rates from Longford using no added fertiliser in SGS and a scalar of 0.5 for fertility in GrassGro.

Figure 9 Longford Pasture Growth Cocksfoot /Sub Clover




### 4.2.3 Weather files

The recent version of GrassGro (ver 2.5.1) allows a user to input Data Drill weather files downloaded from the Queensland Department of Natural Resources and Mines for any point in Australia. These data give different plant growth patterns (Figures 10 and 11 and Table 6) because of the underlying assumptions in relation to the predicted potential evaporation rates (Andrew Moore CSIRO pers. comm.). This could be a problem when the two weather data sets are being used to compare different simulations.

Figure 10 Scottsdale pasture growth from GrassGro weather file and Data Drill set

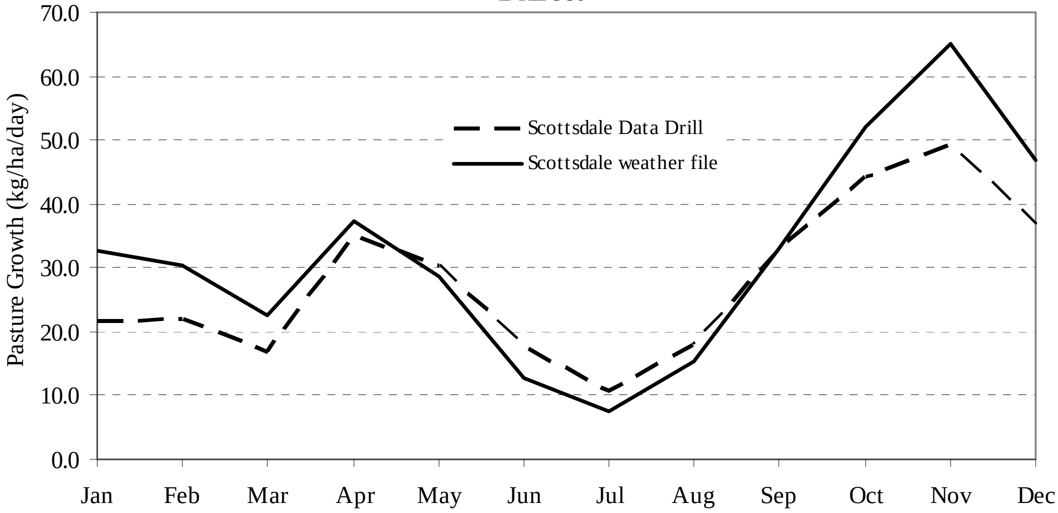


Figure 11 Oatlands pasture growth from GrassGro weather file and Data Drill set

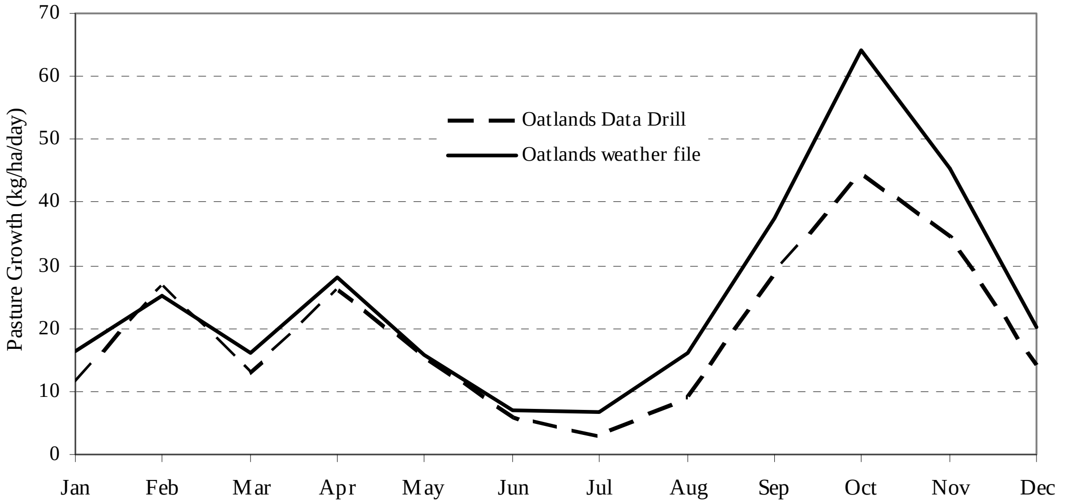



Table 6 Annual production from GrassGro using different weather data sets

| | Oatlands Data Drill | Oatlands Weather file | Scottsdale Data Drill | Scottsdale Weather file |
|---|---|---|---|---|
| Total annual production T/ha | 7.0 | 9.1 | 10.2 | 11.7 |
| % difference | | 29% | | 15% |

### 4.2.4 Transfer of data between models

It was necessary to generate animal growth data in GrassGro because the SGS animal model assumes that except for lambs, mature animals are present. Plant growth data was developed in SGS because of the lack of irrigation and specific fertiliser addition ability in GrassGro. This resulted in problems and inaccuracies in predicting the level of animal supplementation needed in a GrassGro model to match the additional feed produced with nitrogen and irrigation inputs in SGS.

GrassGro and Stockpol calculate different birth dates for animals, e.g. with a 20 November mating, cattle birth dates are 29 August for GrassGro and 16 September for Stockpol. GrassGro uses the average pregnancy and Stockpol uses an 18 day longer mid calving date. This needs to be taken into account when transferring growth rates from GrassGro to Stockpol.

## 4.3 Economic Analysis

Enterprise data for the economic modelling returns were calculated from information provided by the Technical and Industry Reference Groups, DPIW Livestock Enterprise Reports and sale data. These are shown in Appendix 1.

As commented earlier, there were also difficulties in defining the area irrigated in each simulation. For the simulations it was assumed that the proportion of the property not used for breeding animals would have been irrigated to feed growing stock. Where young animals were sold at weaning the whole property was assumed to have been irrigated, as it was not possible to separate the breeding animals from the young. In reality of course there is a set irrigated area which is available and enterprises are developed around this.

The economic output data are shown in Tables 7 and 8 for sheep and cattle respectively.

Within the restrictions of the irrigation modelling, the data indicate that there can be an increased financial return by producing red meat under irrigation. The most suitable enterprise however could only be decided on an individual property basis.

Table 7 Sheep economic data from Red Sky (1000 ha overall property area)

| Area | Jericho | Jericho | Longford | Longford |
|---|---|---|---|---|
| | | | | |
| Animals Sold | Finished lambs | Weaned lambs | Finished lambs | Finished lambs |
| Urea Kg/ha irrigated | 217 | 0 | 217 | 0 |
| Superphosphate fertiliser kg/ha | 250 | 125 | 250 | 125 |
| 30% potash/kg ha | 30 | 30 | 30 | 30 |
| ML water/ha | 2.9 | | 2.7 | |
| ha irrigated | 600 | | 400 | |
| Water cost/ML | $120.25 | | $45.00 | |
| Total DSE | 17,312 | 11,310 | 21,112 | 10,686 |
| Stocking rate (DSE per hectare) | 17.3 | 11.3 | 21.1 | 10.7 |
| Average carcass weight of lamb sold (kg) | 19.05 | 16.10 | 17.20 | 21.41 |
| Weight of wool produced per hectare (kg) | 25.3 | 16.5 | 30.9 | 15.9 |
| Operating profit per hectare | $349 | $305 | $304 | $227 |
| Operating profit per DSE | $20.14 | $26.99 | $14.41 | $21.20 |
| Gross revenue | $883,080 | $435,513 | $654,697 | $408,593 |
| Gross operating expenses | $534,420 | $130,279 | $350,502 | $182,061 |
| Operating profit | $348,660 | $305,234 | $304,194 | $226,532 |
| Irrigation (total cost) | $209,235 | $0 | $48,600 | $0 |

Table 8 Cattle economic data from Red Sky (1000 ha overall property area)

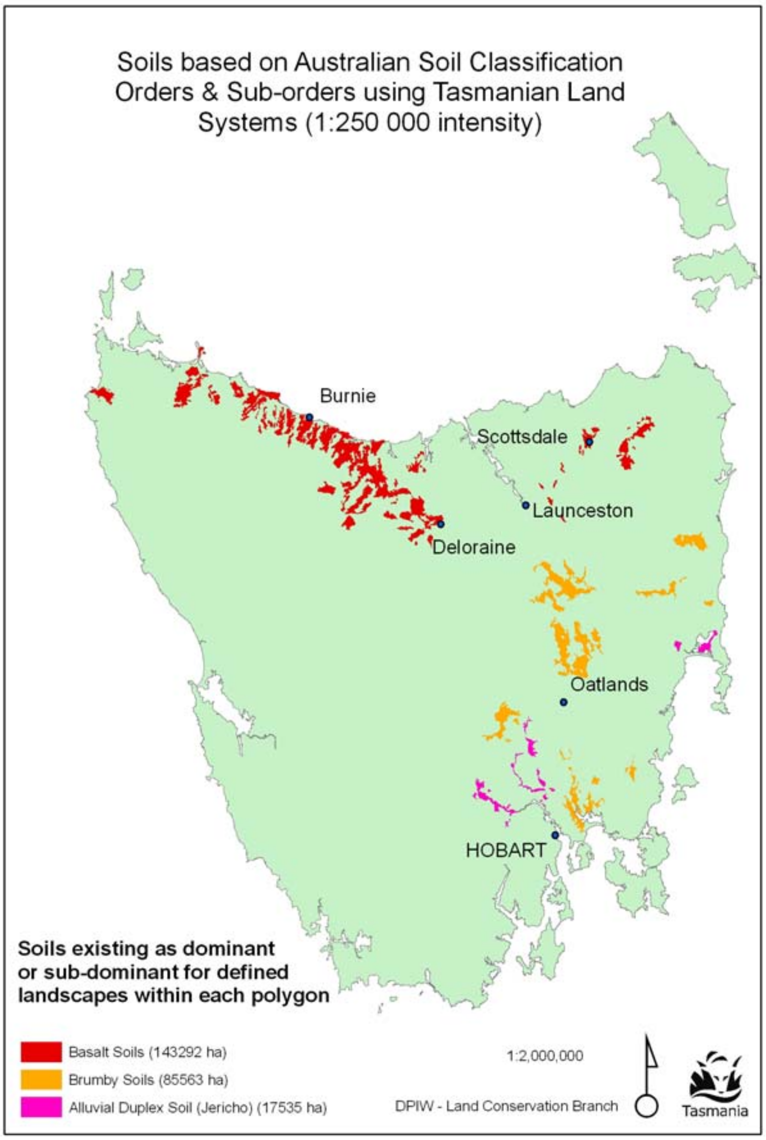
| Area | Longford | Longford | Scottsdale | Scottsdale | Scottsdale |
|---|---|---|---|---|---|
| Animals sold | 500kg + | Weaners | 500kg+ | 500kg+ | 500kg+ |
| Purchased | 0 | 0 | 0 | 0 | weaners |
| Urea Kg/ha irrigated | 217 | 217 | 0 | 435 | 435 |
| Superphosphate fertiliser kg/ha | 250 | 250 | 125 | 125 | 125 |
| 30% potash kg/ha | 30 | 30 | 30 | 30 | 30 |
| ML water/ha | 2.7 | 2.7 | 0 | 2.4 | 2.4 |
| ha irrigated | 450 | 1000 | 0 | 470 | 1000 |
| Water cost/ML | 45 | 45 | 0 | 120.25 | 120.25 |
| Total DSE | 11,269 | 14,782 | 14,664 | 19,886 | 12,978 |
| Stocking rate (DSE per hectare) | 11.3 | 14.8 | 14.7 | 19.9 | 13.0 |
| Average carcass weight of beef sold | 239.5 | 209.9 | 240.8 | 258.4 | 252.9 |
| Total weight of beef sold per hectare | 89.1 | 162.3 | 108.1 | 143.2 | 460.8 |
| Operating profit per hectare | $54 | $18 | $243 | $113 | $82 |
| Operating profit per DSE | $4.80 | $1.22 | $16.60 | $5.67 | $6.30 |
| Gross revenue | $333,514 | $440,007 | $362,733 | $510,515 | $872,812 |
| Gross operating expenses | $279,377 | $422,005 | $119,255 | $397,794 | $791,102 |
| OPERATING PROFIT | $54,137 | $18,002 | $243,478 | $112,721 | $81,710 |
| Irrigation (total cost) | $54,675 | $121,500 | $0 | $135,642 | $288,600 |

## 4.4 Extension from farm to regional basis

The areas of each soil type used in the models were extended to their State wide occurrence and are shown in Figure 12 . As stated earlier there would have been other small areas which are not represented in this map. The mapped areas of each soil are-:

| | | |
|---|---|---|
| Scottsdale | Basalt soil | 143,000 ha |
| Longford | Brumby soil | 86,000 ha |
| Jericho | Alluvial soil | 18,000 ha |

Figure 12 Areas of selected soils in Tasmania



We would expect any trial results from a site to be replicated over the whole area of that soil with some variation due to small differences in rainfall and temperature. For a comparison, SGS pasture production was calculated for two comparable areas with the same soil types. Net positive pasture growth rates were calculated for Longford (south of Launceston) and Avoca (south east of Launceston on the Brumby soil type. The same pasture composition, cocksfoot – sub clover, was used and the relevant Data Drill climate files applied (Figure 13). Similar calculations were made for Scottsdale and Penguin (east of Burnie) on basalt soil with a rye grass and clover pasture (Figure 14). Penguin has a higher autumn growth rate in response to greater rainfall and temperature, but the productivity was reasonably comparable.

Figure 13 Brumby soil pasture growth comparison at two sites

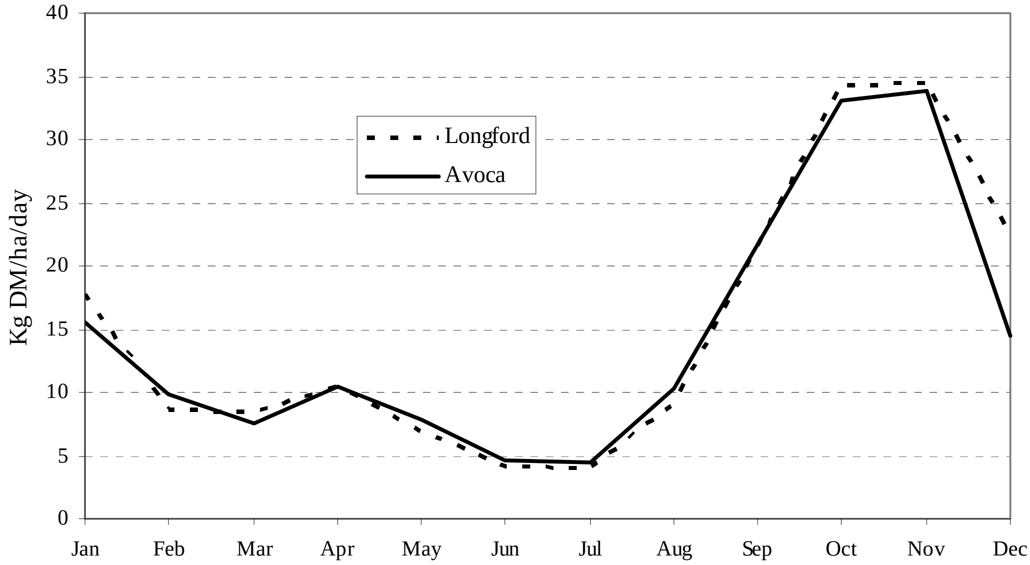
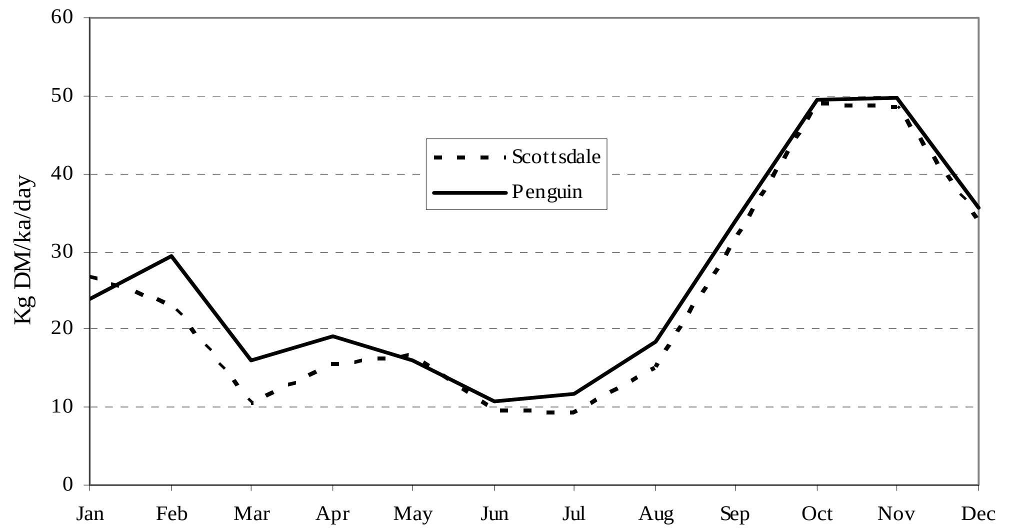


Figure 14 Basalt soil pasture growth comparison at two sites




## 4.5 Irrigation

Irrigation water is supplied in Tasmania from rivers, irrigation schemes and farm or community dams. With the modelling used in this project there is no way of estimating the area of irrigation currently used or the potential available.

In order to estimate the potential for irrigation there is a need for a spatial data base to allow the prediction of suitable areas, both for irrigation application and dam siting. Current landscape information is restricted to soil types and land capability classes both of which are quite large scale and general. Spatial mapping would provide both regional and property scale information in relation to land management and could be utilised to optimise enterprise planning such as allocation of land types to production systems, while minimising, or at least understanding the risk of, environmental impacts like salinisation potential.

# 5 Success in Achieving Objectives

The project highlighted some of the problems in attempting to merge data from several models due to the differing assumptions and types of outputs. This limited the value of both overall farm production data and extension of data to a regional basis. The main interest of the producers and consultants involved was however the effect on pasture productivity from irrigation and nitrogen addition. In this regard the project results satisfied their requirements as they considered that they could use the data in their own production system decisions.

The profile of modelling was also raised and during this project modelling was used to assist in the formulation of two proposals to funding bodies, examine the outputs of a research project predictions and make recommendations to changes in a farm production system. It is unlikely any of these would have been considered in the absence of an active modelling group.

# 6 Impact on Meat and Livestock Industry – now & in five years time

Currently, the GrassGro model can be and is being used to make recommendations in relation to south eastern Australian dryland farming systems. The SGS model is being used in research and is under active development. Neither model is currently suitable for the type of work this project attempted, but both can be used to provide valuable data for planning change or development. Although data from a single property or trial could be expanded to determine the effect on a region, this is limited to general soil classification, a coarse measure which will miss smaller areas. A significant problem is the lack of a technique to allow modelling of areas which could be irrigated. This limits the effectiveness of any predictions on a regional basis.

In 5 years time, it should be possible to examine the whole range of farming options on a single property. This could be done either by being able to draw data from different models into a compatible format, or by one model being developed to cover the whole range of farming options.
A good special mapping system would be valuable in predictive work to assess the effect of research results on a regional or State basis.

# 7 Conclusions and Recommendations

The project had limited outcomes due to difficulties in producing the data from one model necessary for input in another. It did however highlight some of the inconsistencies between the models which need to be resolved to allow data interchange. For the Technical reference group the pasture growth data developed in SGS were valuable as they see the use of irrigation and nitrogen fertiliser as a logical farm development. This is a result of the adoption of centre pivot irrigation for cropping and the potential for a pasture phase in the rotation.

Whole farm economic data were difficult to develop. The economics were extended only to an enterprise level as every property has different equity structures and enterprise mixes.

The results could be extended to a regional basis, but only really on a dryland basis. There is not enough data available to predict irrigation potential for any area

To progress this modelling approach to a whole farm basis, there is a need for further model development for example the ability to use specified levels of individual fertiliser and irrigation in GrassGro or the use of fertilisers other than nitrogen and an improved sheep and beef cattle module in SGS. An alternative would be to develop interchange of modules between models, including cropping as an enterprise.

# 8 Appendices

## 8.1 Assumed costs

| | | |
|---|---|---|
| **Sheep** | | |
| **Management** | | |
| Female Breed | | Merino |
| Male Breed | | Dorset & Merino |
| Mortality | % year | 2 |
| No. of ewes per Ram | | 50 |
| Av greasy fleece wt | kg | 4.5 (e) 3.9 (l) 5 (r ) |
| Av clean fleece wt | kg | 3.1 (e) 2.9 (l) 3.5 (r) |
| Fleece yield | % | 70 (e), 78(w), 75(l) |
| **Key Dates** | | |
| Mating | | 16-Apr |
| Lambing | | 21-Sep |
| Weaning | | 10-Dec |
| **Prices** | | |
| Wool $/kg (clean) | ewe | 7.50 |
| | lamb/hogget | 8.50 |
| Wool $/kg (greasy) | ewe | 5.25 |
| Av price range depending on carcass wt | | |
| Lambs | $/kg/carcass wt | 3.10-3.80 |
| Mutton | $/kg/ carcass wt | 1.5 |
| **Costs** | | |
| *Supplements* | | |
| ~Hay | $ tonne | 165 |
| | $/big bale | 57.75 |
| ~Silage | $ tonne | 200 |
| ~Oats | $/tonne 30t load | 215 |
| ~Barley | $/tonne 30t load | 225 |
| ~Wheat | $/tonne 30t load | 237 |
| Shearing | $/head | 3 |
| *Animal Health* | | |
| lamb | $/head | 4.3 |
| Hogget | $/head | 4.3 |
| Ewe | $/head | 6.2 |

| | | |
|---|---|---|
| Ram | $/head | 6.2 |
| Wether | $/head | 5.7 |
| *Replacement stock* | | |
| ~Ram | $/head | 800 |
| ~Ewe | $/head | 100 |
| *Fertiliers & Pastures* | | |
| Pasture management | $/Year | 130 |
| Reestablishment | $/ha/20yrs | 400 |
| Urea | $/t | 630 |
| Superphosphate | $/t | 261 |
| 0:06:17 | $/t | 357 |
| Irrigation $/ML | Scottsdale/Jericho | 120.25 |
| | Longford | 45 |
| Hay making | $/bale (350kg) | 10 |
| Silage making | $/tonne | 20 |

| **Cattle** | | |
|---|---|---|
| **Management** | | |
| Breed | | Angus |
| Mortality | % year | 2 |
| No. of cows / bull | | 50 |
| **Key Dates** | | |
| Mating | | 2-Nov |
| Calving | | 29-Aug |
| Weaning | | 2-Mar |
| **Prices** | | |
| Av price range depending on carcass wt | | |
| Steer & heifer | $/kg/Cwt | 3.0-3.50 |
| Cow | $/kg/Cwt | 2.30 |
| **Costs** | | |
| *Supplements* | | |
| ~Hay | $ tonne | 165 |
| | $/big bale | 57.75 |
| ~Silage | $ tonne | 200 |
| ~Oats | $/tonne 30t load | 215 |
| ~Barley | $/tonne 30t load | 225 |
| ~Wheat | $/tonne 30t load | 237 |
| *Animal Health* | | |

| | | |
|---|---|---|
| Cows & Bulls | $/head | 20 |
| Steers & heifers | $/head | 18 |
| *Replacement stock* | | |
| Bulls | $/head | 2500 |
| cows | $/head | 1000 |
| weaner steers | $/head | 490 |
| *Fertiliers & Pastures* | | |
| Pasture management | $/ha/year | 130 |
| Reestablishment | $/ha | 400 |
| Urea | $/t | 630 |
| Superphosphate | $/t | 261 |
| 0:06:17 | $/t | 357 |
| Irrigation $/ML | Scottsdale/Jericho | 120.25 |
| | Longford | 45 |
| Hay making | $/bale (350kg) | 10 |
| Silage making | $/tonne | 20 |