# BULL BEEF SYSTEMS FOR WAIRARAPA HILL COUNTRY

A Thesis Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Agricultural Science at
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## ABSTRACT

The purpose of this study was to investigate the viability of a number of bull beef production systems integrated with sheep, within summer dry and summer wet Wairarapa hill country environments.

This was achieved by construction of a spreadsheet feed budget simulation model, based on representative Wairarapa pasture growth and animal production data. The model balanced feed requirements over fortnightly periods, with unconsumed feed transferred between periods subject to allowances for senescence and decay. Gross margin analysis was used to investigate the financial profitability of the systems examined, including the base sheep policies used.

A survey of commercial sheep/bull beef hill country farmers within the Wairarapa was carried out to verify the assumptions made in model construction and to identify practical problems/opportunities. Several off-farm factors were then considered (eg supply of bulls, availability of killing capacity, United States beef market) in terms of their on-farm impact and the outlook for bull beef, over the next 2-3 years. Following analysis of the survey and off-farm data, several farmers were re-visited individually, and then a follow-up group meeting was held, to discuss the results of the model and survey analysis.

The study showed that there are a number of bull beef systems which are viable and profitable on Wairarapa hill country, and that the number of bulls farmed on hill country is likely to increase in the future. While some farmers were achieving levels of production indicated feasible by the model, many were producing below these levels. There is therefore considerable opportunity to increase meat production and profitability on these farms. There is also considerable opportunity, in terms of the supply of bulls, for the bull beef industry to expand within New Zealand, although there are some market uncertainties which could hinder this.

The overall conclusion from this study is that the production of bull beef offers considerable scope to increase the profitability of North Island hill country farming, and that this industry will continue to expand.

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Any deficiencies or errors in this report are the sole responsibility of the author.

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# CHAPTER ONE: INTRODUCTION TO STUDY

## 1.0 INTRODUCTION AND CHAPTER OUTLINE

Traditionally, hill country has been an important and integral part of the New Zealand farming industry; running breeding ewes and cows, it provided a supply of store stock to be finished on lowland fattening farms. The recent downturn in the New Zealand sheepmeat industry, coupled with rapidly escalating input costs, has placed pressure on hill country farmers to increase profitability by either producing a higher value finished product or diversifying into more profitable farming systems. Bull beef fits both these categories, and farmer interest in bull beef has increased markedly in recent years.

This study investigates the viability of different bull beef systems, integrated with sheep, on Wairarapa hill country.

The first sections of this chapter backgrounds the motivation for this study, and the choice of the Wairarapa as the study region. The objectives and methodology of the study are then discussed, followed by an outline of the thesis.

## 1.1 MOTIVATION FOR STUDY

Betwen 1977 and 1984 the author worked as a Farm Advisory Officer with the Ministry of Agriculture and Fisheries (MAF) in Warkworth, Northland. This involved close liaison with several farmers who operated bull beef units. During the same period widespread interest was shown by several hill country farmers in bull beef because of its potentially high returns relative to sheep. However, little was known of how different systems of bull beef production could be "fitted into" a hill country environment, and most farmers simply adopted the systems which had been developed on easier country. This information gap provided the stimulus for the study.

## 1.2 CHOICE OF THE WAIRARAPA AS THE STUDY REGION

The Wairarapa region was chosen as the area of study for a number of reasons:

1. Wairarapa Farm Advisory Officers indicated that there was considerable interest shown by farmers within the region for bull beef farming. Although some Wairarapa hill country farmers had already established bull beef units, little was known about how these systems were operated, or their profitability.

2. The Wairarapa provided examples of both summer dry and summer moist hill country environments, which were representative of other hill country areas in the North Island. This, coupled with the fact that the problems/opportunities faced by Wairarapa hill country farmers were likely to be similar to those faced by other North Island hill country farmers (Parker 1984, $MAF_1$ 1985), meant that findings from this study could be applied to a significant proportion of North Island hill country.

3. An important practical consideration was the region's close proximity to Massey University. The furtherest survey farms could be reached within a two hour drive. (In addition the University already had a presence in the Wairarapa through its Riverside property and this was likely to be of assistance in making farmer contacts.)

## 1.3 OBJECTIVE OF THE STUDY

The objective of this study was to determine the suitability of a range of bull beef farming systems, their potential levels of beef production and associated levels of profitability, under Wairarapa hill country conditions.

This required investigation of the effects of different management practices on productivity and financial returns and the means by which these management practices could be most effectively integrated into existing or new farming systems. This would provide the basis for developing a set of management recommendations for farming bull beef on hill country, and would indicate areas requiring further research and extension input.

It would also involve evaluation of some of the off-farm factors affecting bull beef farming in New Zealand, and the possible on-farm impact of these over the next 2-3 years.

## 1.4 RESEARCH METHODOLOGY

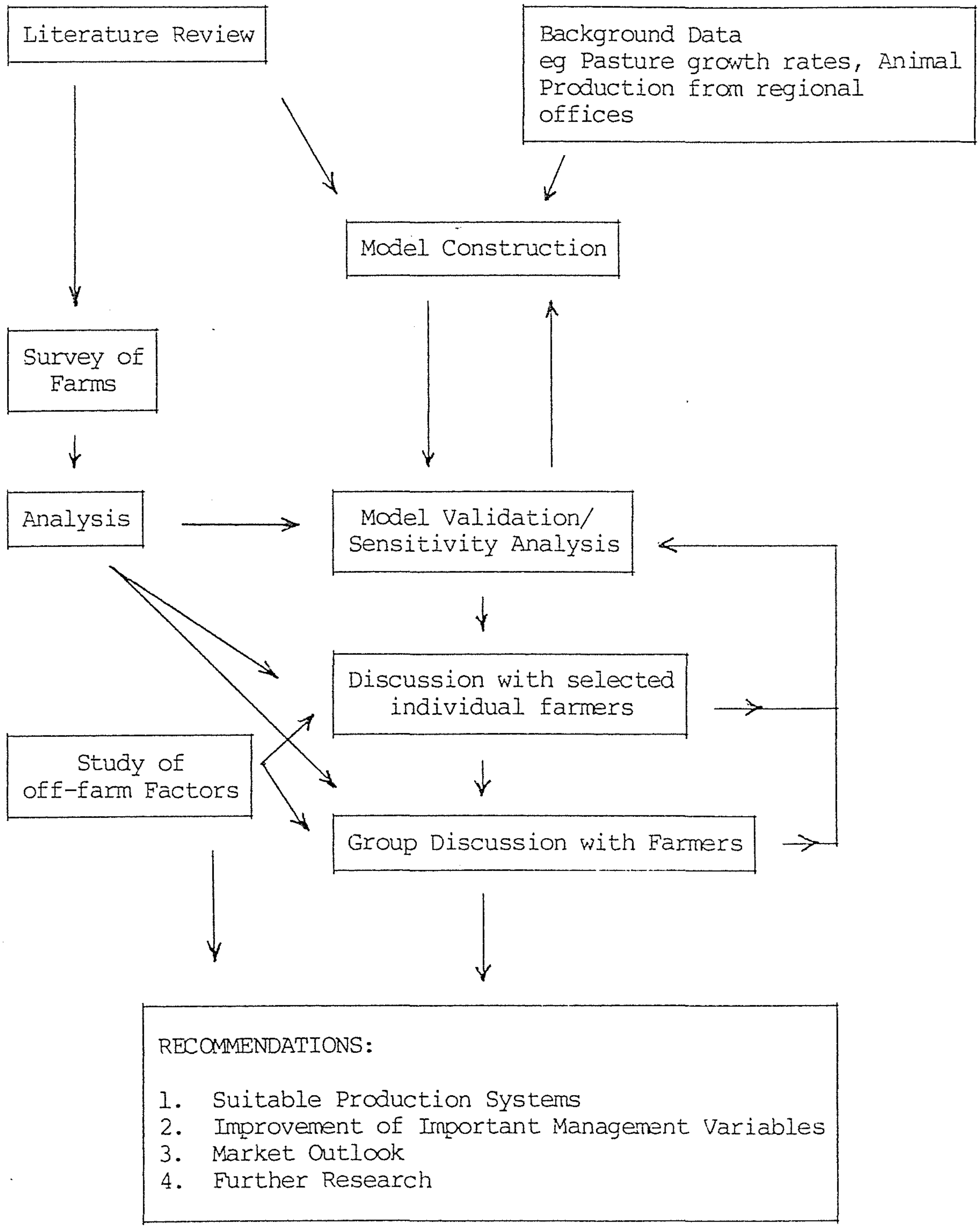
Agricultural research can be broadly classified as being involved with either analysis or synthesis (Wright 1973). Analysis is directed at gaining an understanding of the relationship between components of existing farming systems, while synthesis involves the formulation of new or improved farming systems. Models provide one framework for describing the inter-relationships between the components of a farming systems (eg McCall 1984), and enable different production/management policies to be explored to identify potentially superior farming systems for field testing (McRae 1975, Wright et al 1976). It is in the latter context that this study is set.

A summary of the research methodology used in this study is illustrated in Figure 1.1. The first step was to construct a mathematical feed-budget model which simulated the whole farm situation, and facilitated the investigation of the impact of different bull beef systems. A survey of Wairarapa sheep/bull beef farmers was then undertaken to collect data to verify the assumptions used in model construction and to identify management strategies currently in use.

While models can rapidly simulate a range of different management practices for a farming system, it is important that the "solutions" be compared with those obtained in reality (Dent and Anderson 1971). For this reason some of the original survey farmers were revisited to discuss, in an interactive situation similar to that described by Walker (1984), their reaction to the model solutions and the practicality of implementing these. Later, the results of the study were presented to the survey farmers as a group. This had two purposes; first to provide feedback to the farmers as a courtesy for taking part in the survey, and secondly to gather further farmer reaction to the model solutions and their practicability.

On-farm research also needs to consider the effects of external (ie off-farm) factors; both in terms of the impact changes on-farm may have off-farm (ie

FIGURE 1.1: Thesis Research Methodology



changes in the timing of availability of stock for slaughter), and the impact changes in processing and markets might have on the on-farm system. Some externalities (eg supply of bulls, availability of killing capacity, the bull beef schedule, the United States beef market) were therefore studied to determine their impact on bull beef farming both locally and nationally. The objective of this aspect of the research was to identify possible indicators/strategies which farmers could follow or adopt to improve profitability and reduce risk.

## 1.5 THESIS OUTLINE

In Chapter Two background information about bull beef production; its history in New Zealand, efficiency of meat production, breed comparisons, grazing management, the grading system, and principles of designing bull beef farming systems, is presented.

The construction of the feed budget model and the procedure used to integrate the pasture supply and animal requirement components of the model is described in Chapter Three. The common representative sheep policies and the different bull beef policies compared in the study are also outlined.

The results obtained from the model in relation to the two environments considered (summer dry and summer wet) are presented and discussed in Chapter Four. The effect of altering sheep:bull ratios is also described.

A financial analysis of the different bull systems, and the base sheep policies, is outlined in Chapter Five, as well as the financial viability of supplementary feeding.

In Chapter Six the selection of the survey farmers, the design of the questionnaire, and the results of the survey are presented. Differences between the assumptions made for model construction and the survey results are highlighted.

The reaction of the survey farmers, both individually and as a group are outlined in Chapter Seven, and aspects of bull grazing management on hill country are developed in more detail.

In Chapter Eight "off-farm" factors are discussed. This involved consideration of the supply of bulls (within the study region as well as New Zealand generally), the availability of killing capacity to farmers within the study area, the factors affecting the New Zealand bull beef schedule, the United States beef market and potential market "indicators", the existence of other markets, and lastly the possibility of hedging strategies (for New Zealand bull beef farmers) using the Futures market.

In the last chapter, Chapter Nine, the methodology used in this study is evaluated, and recommendations for bull beef farming on hill country, and areas of further research arising from this study are presented.

# CHAPTER TWO: BULL BEEF PRODUCTION

## 2.0 CHAPTER OUTLINE

In the first section of this chapter the history of bull beef farming in New Zealand, and its expansion over the last decade is looked at. Comparative trial results of beef production from steers and bulls, and from different breeds is discussed, followed by an outline of bull grazing management, the problems of bull behaviour, and the effect of sheep/cattle interaction on pastures and animal growth. The implications of the New Zealand grading system for bull meat are then considered. In the final sections factors relating to the design of bull beef production systems are reviewed.

## 2.1 HISTORY IN NEW ZEALAND

Bull beef first became an important pastoral farming activity in New Zealand in the late sixties. This was mainly due to the comparatively low returns from traditional sheep and beef farming, the rise in bull beef schedule prices, and the ready availability of bull calves from the dairy industry. These factors led to a rapid increase in the number of bulls slaughtered until the crash in the beef schedule during the 1974/75 season. The resultant lower retention of calves for bull beef is reflected in the number of bulls slaughtered in 1976/77 (Table 2.1) and the proportion of bulls killed in 1975/76 (Table 2.2). An improvement in manufacturing beef prices and the introduction of the dairy beef guarantee scheme (Muldoon 1977) reduced the bobby calf kill by 10% in 1976 (Table 2.1). With the exception of 1981/82, when bull beef schedule prices again dropped, the bobby calf kill has continued to decrease gradually. The annual bull kill closely reflects the national bobby calf kill, with about a two year time lag (Table 2.1).

Apart from some domestic usage, New Zealand exports all its bull beef, as manufacturing beef. The predominant market is the United States, which takes 80-90% of New Zealand's manufacturing beef (Table 2.3). Bull beef receives a premium over other manufacturing beef in this market because of its low fat content, dark colouring, and water absorbent nature. These qualities make it ideal for processing and mixing with fat trimmings from

TABLE 2.1

Bobby Calf Slaughterings, Dairy Beef Retention
Bull Slaughtering Patterns

1970-1985 (000 head)

| Year Ending September | Dairy Beef Calves Reared | Bull Kill | Bobby Calf Kill |
|---|---|---|---|
| 1970 | 388 | 130 | 1199 |
| 1971 | 382 | 169 | 984 |
| 1972 | 402 | 231 | 979 |
| 1973 | 422 | 250 | 972 |
| 1974 | 239 | 212 | 1152 |
| 1975 | 146 | 220 | 1332 |
| 1976 | 208 | 222 | 1201 |
| 1977 | 198 | 150 | 1176 |
| 1978 | 218 | 168 | 1149 |
| 1979 | 312 | 177 | 1016 |
| 1980 | 366 | 182 | 931 |
| 1981 | 300 | 203 | 964 |
| 1982 | 251 | 252 | 1013+ |
| 1983 | 400 | 239 | 867+ |
| 1984 | 529 | 206 | 807+ |
| 1985 | 550 | 267 | 792+ |

Sources: NZ Meat and Wool Board Economic Service "Beef Production 1971/72-1982/83" Paper No 1879

NZ Meat Producers Board Annual Reports

+Ministry of Agriculture and Fisheries Economics Division

TABLE 2.2

National Cattle Slaughter
by Stock type

(000) head

| | 1971-72 | 1975-76 | 1982-83 | 83/84+ |
|---|---|---|---|---|
| Cows | 618 | 849 | 710 | 568 |
| Heifers | 201 | 472 | 439 | 384 |
| Steers | 817 | 1030 | 764 | 611 |
| Others (Bulls) | 234 | 222 | 241 | 207 |
| TOTAL | 1771 | 2573 | 2154 | 1770 |

% of total

| | 1971-72 | 1975-76 | 1982-83 | 83/84+ |
|---|---|---|---|---|
| Cows and Heifers | 46.2 | 51.2 | 53.4 | 53.8 |
| Steers | 40.5 | 40.0 | 35.4 | 34.5 |
| Others (Bulls) | 13.3 | 8.8 | 11.2 | 11.7 |

Source: NZ Meat and Wool Board Economics Service "Beef Production 1971/72-1982/83" Paper No 1879

+MAF Economics Division "NZ Livestock Slaughtering Statistics" Statistical Report No 1

TABLE 2.3

Manufacturing Beef Export Production

Tonnes shipping weight. Year Ending September

| | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|
| Frozen Bull Carcass | 174 | 120 | 96 | 60 | 137 |
| Frozen Bull Manuf | 36252 | 26016 | 27547 | 28033 | 30545 |
| Frozen Steer and Heifer Manuf | 57492 | 45366 | 45153 | 48853 | 51118 |
| Frozen Cow Manuf | 105888 | 89343 | 100418 | 84169 | 77437 |
| Total Manuf | 199632 | 160725 | 173118 | 161055 | 159100 |
| % Bull Beef | 18 | 16 | 16 | 17 | 19 |

| | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|
| Frozen Bull Carcass | 198 | 197 | 92 | 157 | 559 |
| Frozen Bull Manuf | 34510 | 41533 | 41069 | 37056 | 47155 |
| Frozen Steer and Heifer Manuf | 25555 | 32877 | 27320 | 21376 | 22042 |
| Frozen Cow Manuf | 64672 | 66424 | 56913 | 47508 | 50030 |
| Total Manuf | 124737 | 140834 | 125302 | 105940 | 119227 |
| % Bull Beef | 27 | 29 | 33 | 35 | 39 |
| Total Manufacturing Beef Exports to US | | 115531 | 103253 | 81915 | 107299 |

Source: NZ Meat Producers Board, Annual Reports

TABLE 2.4

Relative Profitability of Pastoral Farming (Lower North Island)

1977/78-1985/86. Gross Margins ($/ha)

| | 1977/78 | 78/79 | 79/80 | 80/81 | 81/82 | 82/83 | 83/84 | 84/85 | 85/86 |
|---|---|---|---|---|---|---|---|---|---|
| Sheep Prime Lamb | 328 | 360 | 377 | 381 | 433 | 409 | 422 | 438 | 343 |
| Sheep Store Lamb | 281 | 300 | 314 | 334 | 363 | 348 | 343 | 356 | 269 |
| Prime Beef | 289 | 379 | 320 | 147 | 331 | 285 | 430 | 402 | 240 |
| Beef Breeding | 111 | 153 | 229 | 318 | 320 | 320 | 403 | 640 | 319 |
| Bull Beef | 270 | 379 | 480 | 438 | 675 | 637 | 684 | 1176 | 1044 |
| Dairying | 376 | 455 | 472 | 538 | 657 | 870 | 924 | 990 | 1287 |

Source: MAF Advisory Services
"Cropping and Livestock Gross Margins, Manawatu"

domestically produced US prime beef. These relatively higher returns has made bull beef one of the most profitable pastoral farming activities in New Zealand, particularly over the last 5 years (Table 2.4). This has been responsible for an increasing number of bulls being farmed, and more widespread farmer interest in bull beef.

## 2.2 EFFECT OF CASTRATION

Castration of male livestock has occurred since the earliest domestication of animals by man (Turton 1969). Its main advantages are that the animal is rendered more docile - reducing handling problems, preventing indiscriminant mating, and avoiding potential problems of "male odour" in the meat (Turton 1969).

Generally, the effect of castration is to modify the secondary sex characteristics of an animal. These have a major effect on body composition and hence carcass characteristics (Turton 1969). Thus, the entire animal has a relatively greater development of forequarter musculature and when slaughtered at the same liveweight or age as steers, increased lean meat content and decreased fat (Field 1971, Preston and Willis 1974, Everitt et al 1977, Seideman et al 1982). Steers have more intra-muscular fat (marbling), more subcutaneous fat, less longissmus area, and more kidney fat than bulls (Seideman et al 1982). A review of trials comparing bulls and steers by Field (1977) showed that the average fat thickness over the longissmus muscle was generally 50% more in steers, but that the average dressing out percent for bulls and steers was the same (59.7% vs 59.6%). Bulls also yield a significantly higher proportion of edible meat and consequently a greater quantity of higher priced cuts (rib, loin, rump and round), than steers (Preston and Willis 1974).

There is considerable evidence showing that entire males outgrow their castrated counterparts (Turton 1969, Harte 1969, Field 1971, Siedeman et al 1982, Smith, 1985). Most work indicates a 10-20% growth rate advantage to bulls over steers (Price and Yeates 1969), although (Preston and Willis 1974), note an advantage of up to 25% to bulls. This may be because bulls are more efficient coverters of feed. Field (1971) for example, found that bulls were 13% more efficient in converting energy to liveweight than steers, while Preston and Willis (1974) in a review of comparative feeding trials indicated a range of 8-16% greater efficiency of feed conversion in bulls.

## 2.3 BREED COMPARISONS

There have been a number of New Zealand trials comparing different breeds for beef production (eg Barton 1968, Barton and Armstrong 1974, Everitt et al 1970, Everitt and Langridge 1978). In general, these trials showed a liveweight gain advantage of Friesians over other breeds. Everitt et al (1980) found that growth rates in Friesian steers compared favourably with European breeds such as the Simmental and Charolais, although New Zealand grassland feeding conditions probably did not allow the high genetic growth potential of several European breeds to be fully realised. Other trials have shown that Friesian bulls were superior in weight gain to Angus, Friesian x Jersey, Jersey, and Sahiwal cross bulls (Dalton and Everitt 1972, Everitt and Ward 1974, Reardon et al 1983). The high potential for growth from Friesian bulls under pastoral conditions is illustrated by spring weight gains of up to 1.6 kg liveweight gain (LWG) per day in 15 month bulls and up to 2.0 kg LWG/day in 2 year old bulls (McRae pers com).

Although New Zealand trials have shown Friesians to have among the highest liveweight gains, Polish trials with different Friesian genotypes under intensive indoor greenfeed conditions (Reklewski 1982) and Irish trials under pastoral conditions (Flanagan 1982) have indicated New Zealand Friesians have among the slowest growth rates. From this it would appear that, in terms of bull beef production, New Zealand would benefit from the introduction of exotic Friesian genetic material.

Nevertheless, the New Zealand trials indicate that Friesians are the best available breed at present for bull beef production. This is perhaps fortuitous given that the predominant supply source of bulls for bull beef is the New Zealand Dairy Industry. At the start of the 1986/87 season 60% of the cows were Friesian or Friesian crosses while 64% of the semen used in artificial inseminations in 1985/86 was Friesian (Crabb pers com). Bulls of Friesian extraction are therefore likely to remain the main breed in the NZ bull beef industry in the forseeable future.

## 2.4 BULL GRAZING MANAGEMENT

Farmers have used rotational grazing (regular shifts to fresh pasture) and set stocking with bulls, or a combination of both grazing systems, with equal success (Gooding 1973, de Lacy 1977, Leech 1980, Grant 1981, Nichols 1981). Whether to rotationally graze or set stock is dependent upon three factors: likely pasture growth rates, pre grazing dry matter levels and the level of feed requirements (Milligan and Smith 1984). In general if pasture growth rates and existing feed levels are low, rotational grazing will be superior. However, if pasture growth exceeds feed requirements, continuous grazing is likely to be superior.

Bulls have been intensively breakgrazed successfully using electric fences on both easy country (de Lacy 1977), and hill country (Leech 1980).

### 2.4.1 BULL BEHAVIOUR

One of the main problems associated with bull beef farming is the increasingly "agressive" behaviour of bulls after reaching puberty. This may be manifested as restlessness, roaring, riding, hole digging, fence smashing, and uneven grazing (Everitt and Ward 1974). Groups of younger bulls ($2\frac{1}{2}$-3 years) were found by Kilgour and Campin (1973) to be far "more amicable" than older bull groups ($3\frac{1}{2}$-$4\frac{1}{2}$ years, $5\frac{1}{2}$-$6\frac{1}{2}$ years), where the degree of antagonistic behaviour and individualistic grazing increased with age. Jersey bulls were more agressive than Friesians. However, because the vast majority of bulls reared for bull beef are slaughtered by 2 years of age, the increasing aggressiveness of older bulls is usually not a major problem in New Zealand. Farmers have also developed management practices which alleviate bull behaviour problems. These include: frequent shifts onto fresh pasture, keeping bulls in small mobs (30-80 animals) of the same age and similar liveweight, removing bulls from the mob which are being ridden by other bulls, and electric fencing (Gooding 1973, Grant 1981, Nichol 1981, Leech 1980, Smith 1985).

Recently, interest in the use of hormone implants to control behaviour, as well as to increase liveweight gains has increased. Zeronal (Ralgro), is the only hormone implant currently registered in New Zealand. This stimulates growth by increasing growth hormone and/or insulin production (Bass et al 1984). In a New Zealand trial, McKenzie (1983) found that bulls implanted every 70 days over a 420 day period from weaning at 12 weeks had a 4.8% increase in mean liveweight over untreated animals. However, bulls implanted every 105 days showed no significant liveweight response. Treated animals exhibited 25% less riding than untreated animals and bulling activity (ie restlessness, fighting) was sharply reduced. A consistent growth response to zeronal was not recorded in Bass et al's (1984) trials, and aggressive behaviour in young bulls was only controlled from 8 to 11 months of age. The author's experience is in agreement with these latter results.

### 2.4.2 SHEEP/BULL INTERACTION

Various trials at Invermay have indicated that pasture DM production is higher under sheep than cattle only grazing (Scott 1976, Boswell 1976, Monteath et al 1977). This was mainly due to a "tighter" (ie less open) sward, less compaction of the soil, and more even nutrient return in dung and urine under sheep grazing. Trials involving simultaneous grazing of sheep and cattle indicated more of an advantage to sheep (in terms of liveweight gain) than to cattle (Boswell and Cranshaw 1977). These trials also resulted in higher DM production to simultaneously (sheep and cattle) grazed pastures than to either sheep or cattle only grazing.

Another important factor is that sheep and cattle tend to graze different horizons within a sward, with sheep tending to restrict their diet predominantly to the green herbage component, while cattle are less selective (Rattray and Clark 1984). The performance of both species suffers when grazing dry-rank pasture: sheep maintain the quality of their diet (ie green leaf), but reduce the total amount eaten, whereas cattle maintain intake, but reduce the quality of their diet (ie by eating more dead stem). The difference in grazing behaviour means that "sheep will graze out cattle, but not vice versa". Therefore any grazing management system integrating the two must take this into account. Thus, Boswell and Cranshaw (1977) found that cattle grazed as leaders ahead of sheep grew faster (up to 34% more) because they always grazed at a lower grazing pressure. If grazing simultaneously, cattle intakes will decrease before sheep intakes. This suggests that bulls should be grazed ahead of sheep, or simultaneously only if the same residual pasture cover is desired for both the species.

There would appear to be advantages therefore, in integrating the grazing of sheep and bulls, particularly because the highest levels of technical efficiency (DM consumed, meat produced) for bulls are achieved when bulls are grown as fast as practical (Section 2.6). In this situation sheep could be used to maintain pasture density/quality.

Another theoretical advantage of the integration of sheep and cattle grazing is the control of internal worm parasite burdens (Brundson et al 1975, Nicol and Thompson 1982, Vlassoff 1983). With little interchange of nematodes between the two species, mature animals of one specie can be used to "clean up" pastures behind immature animals of the other specie. However, recent trials (Familton et al 1986) have shown this to be not as effective in practice as the theory suggests, and few farmers practice it.

## 2.5 CARCASS GRADING

In New Zealand, steers and heifers are graded, or classified, on the basis of external fat cover into one of six classes. Two of these fat cover classes are further subdivided according to the degree of muscling or conformation of the hindquarter (NZ Meat Board 1979) (Figure 2.1).

FIGURE 2.1 NZ Beef Grading Classification for Steers and Heifers

| GRADE | M | L | P | G | T | E |
|---|---|---|---|---|---|---|
| Fat cover (mm) | to 1 | 1-3 | 4-12 | 13-18 | 19-24 | Over 24 |
| Conformation | | 1 / 2 | 1 | | | |

Compact Leggy Compact

TABLE 2.5

New Zealand Bull Schedule as at September 15, 1986, showing the Marginal Value of the last kilogram of Carcass Weight between weight ranges

| Carcass Weight Range (kg) | Price (¢/kg) | Value of extra kg to lift into that weight range ($) |
|---|---|---|
| < 195 | 188 | |
| 195.5 - 220 | 205 | 35.20 |
| 220.5 - 245 | 213 | 19.73 |
| 245.5 - 270 | 217 | 11.97 |
| 270.5 - 295 | 221 | 13.01 |
| 295.5 - 320 | 224 | 11.09 |
| 320.5 - 345 | 229 | 18.29 |
| > 345.5 | 235 | 23.05 |

Fat is measured on the cold carcass as the depth of subcutaneous fat over the fourth quarter of the eye muscle at the twelfth rib. However, other factors such as the degree of fat on other parts of the carcass may override this measurement. Dairy type steers (such as Friesian) are often disadvantaged under this system because of their more "leggy" hindquarter conformation (relative to other beef breeds) and are usually graded L2, which has a lower schedule value than either the L1 or P1 grades (Everitt et al 1970, Barton and Armstrong 1974).

Bulls, however, are graded solely on the basis of carcass weight and conformation is not important. The bull schedule is divided into eight weight ranges, with discrete lifts in the schedule between each weight range. This means that the marginal value of the extra kilogram of carcass weight needed to lift the animal into the next weight bracket is significant in terms of returns to the farmer (Table 2.5).

As can be seen from Table 2.5 there is a major incentive for farmers to grow their bulls through into at least the second or third weight ranges of the schedule. An important feature of the bull grading system is that because conformation is unimportant, bulls grown for bull beef can be selected solely for their rate of liveweight gain.

## 2.6 PRINCIPLES OF DESIGNING BULL BEEF FARMING SYSTEMS

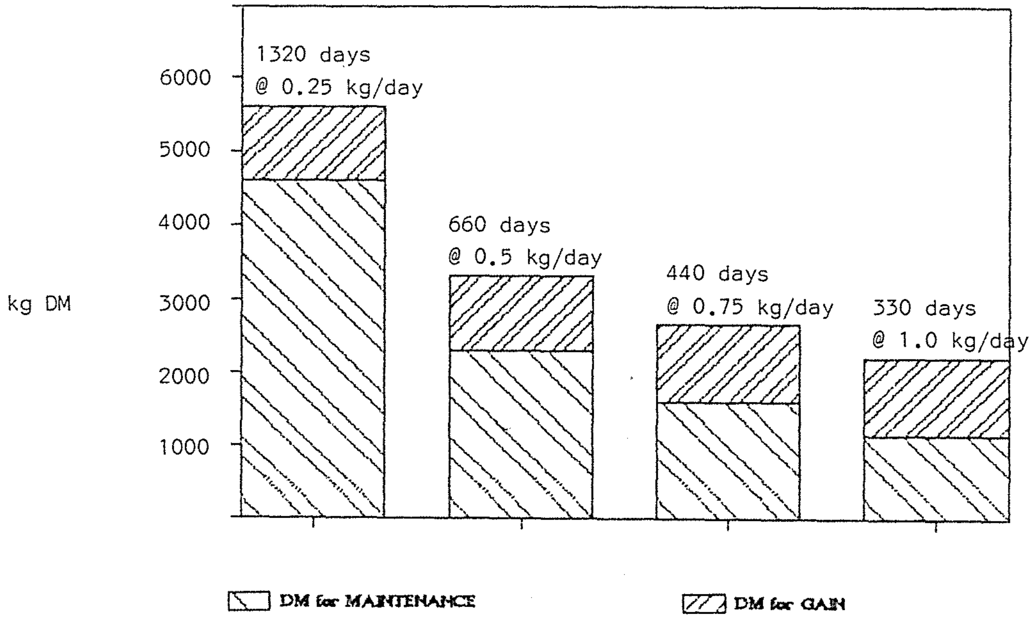
The main management requirements of pastoral beef production is to equate the seasonal pattern of pasture production with the increasing feed requirements of the growing animal (Joblin 1968, 1969, Reardon 1978).

McRae and Morris (1984) identified the principle factors in any bull beef system as being the timing of buying and selling, the age and liveweight of the animals being farmed, and stocking rate (feeding levels).

Two important aspects relating to these factors are:

1. Animals that are well fed and hence can grow quickly will produce more beef from a given quantity of feed than animals stocked so that they grow more slowly (McRae and Morris 1984). This is illustrated in Figure 2.2.

Figure 2.2 Dry Matter Required to Grow a Bull from 100 kg to 430 kg Liveweight




Thus, if bulls are highly stocked so that their intake is reduced, the efficiency of beef production is also reduced because a proportionally greater amount of feed is used for maintenance rather than LWG.

2. Heavier animals require more feed above maintenance requirements to grow at the same rate as lighter animals (refer to Table 3.3). Thus younger (lighter) animals use feed more efficiently than older (heavier) animals.

Incorporating these principles into a workable and profitable system is not always straightforward. An efficient bull beef production system would appear to require young bulls to be grown as fast as possible to reach a profitable killable weight as soon as possible. The main constraint to this is that pasture growth rates (and hence feed supply) vary throughout the year. This means that, in order to maintain a high level of technical efficiency, stocking rates/feeding levels would need to be manipulated to accommodate fluctuations in feed supply. If high stocking rates were maintained in order to maximise production from the spring flush, this would probably involve high winter stocking rates, with resultant nil or low liveweight gains over this period, and hence reduced beef production. A more profitable system may therefore involve sub optimal (in terms of spring) stocking rates, which allow for reasonable LWG over the winter. Additionally, older (heavier) bulls are able to eat more and grow physically faster than young (lighter) bulls. With the schedule value for meat increasing with weight, the technical inefficiency of heavy animals in terms of feed conversion to saleable meat may be compensated for by higher meat returns.

Apart from the work of McRae and Morris (1984), no simulation studies of alternative bull beef production systems appear to have been done in New Zealand. In this study seven different bull systems were modelled in terms of timing of buying and selling, age and liveweight of bulls, and liveweight gain profiles. The outline of these systems are given in Section 3.9.

## 2.7 CONCLUSION

Over the last ten years, bull beef farming in New Zealand has increased in popularity, due to its high profitability relative to other pastoral activities. With the predominance of the Friesian breed in the national dairy herd, from which bulls for the bull beef industry are supplied, Friesians dominate the bull beef industry within New Zealand. Trials within New Zealand have shown Friesian bulls to have the highest rate of liveweight gain, and hence this advantage to the breed is further increased by the fact that bull beef is graded solely on the basis of carcass weight, making liveweight gain the primary criteria for selecting bull replacements.

The main principle of bull beef production is to feed bulls as well as possible at all times of the year so as to maximise weight gain and hence the efficiency of DM usage. With pasture growth rates varying both within and between seasons, matching the pattern of pasture supply to bull feed requirements is the most difficult problem in designing a profitable pastoral bull beef system.

# CHAPTER THREE: MODEL CONSTRUCTION

## 3.0 CHAPTER OUTLINE

In this chapter, the construction of the feed budget model is discussed. First the pasture supply side is considered, looking at different methods of modelling pasture production, the measurement of pasture growth, possible sources of errors, and the pasture growth rate data used. The procedure used to incorporate senescence and decay of pasture is then outlined. Following this the sheep and bull components of the animal requirement side of the model are described. The final section summarises the model and the inputs required to operate it.

## 3.1 FEED BUDGETING APPROACH

Feed budgeting is a process of reconciling animal feed requirements with available pasture (Frengley 1974). This usually involves estimating quantitatively the feed supply available in any time period, and equating this with the feed requirements (demand) of stock. The effect of manipulating feed supply and/or feed demand can then be calculated (Frengely 1974), enabling rotation lengths to be planned, the size and timing of feed deficits to be estimated, supplement requirements to be determined and the impact of buying and selling decisions to be quantified (Milligan 1981). The use of feed budgets for these purposes has led to improved feeding and productivity of livestock and hence greater economic returns (Parker 1973).

One concept of feed budgeting involves the derivation of a feed supply profile through time (from pasture rate of growth data), and the design of management systems which generate matching feed demand profiles (Herlihy 1970). The compatibility of a particular animal production enterprise with the pasture production pattern is determined by comparing the feed supply and demand profiles. This technique is used in this study.

## 3.2 MODELLING PASTURE GROWTH

The potential production of pastures is set by climate, soil fertility, species composition, and green leaf cover (Bircham and Korte 1984). Herbage production in a grazed pasture is continuous. Thus, new tissue formed via photosynthesis, if not consumed by grazing animals, eventually, through the process of senescence, death, and decay, disappears from the sward (Bircham and Korte 1984). Modelling these processes for feed budgeting purposes poses problems. This is mainly due to the absence of experimental data which adequately describe these processes. However, some recent modellers have attempted to derive pasture production from basic principles by including climatic data (rainfall, radiation levels, mean soil temperatures), soil type, pasture type, and aspect to derive (monthly) pasture production (Baars 1980, Bircham 1981, McCall 1984). This approach was not used in this study because there was insufficient detailed Wairarapa climatic data (eg radiation, soil temperatures) available (- although they could have been estimated), and because it was unlikely that a more complicated model of this type would have resulted in "better" solutions (Gray pers comm).

A second method of modelling pasture growth is to construct a pasture growth profile using average measurements from a range of trial sites. Since such data from the study area was available, this simpler method of modelling pasture supply was adopted for this study.

## 3.3 MEASURING PASTURE GROWTH

The two main methods of measuring pasture growth rates are: the difference technique and the trim technique (Radcliffe et al 1968). The most commonly used field technique is a variation of the trim technique called the "rate of growth" method (Radcliffe 1974), where a site is pre-trimmed to a set height (ie 2.5 cm), and a animal proof cage placed over it. At a set time interval the regrowth is cut to the original height, and weighed. A sample is dried to estimate the dry matter content to enable the calculation of yield. Another site is then pre-trimmed and the cage shifted onto it.

Pasture growth rates collected in this manner over several years given an indication of the rate and pattern of pasture growth. All the pasture growth data used in this study were obtained via the above "rate of growth" technique.

### 3.3.1 SOURCES OF ERROR

To extrapolate from growth rate data to in-the-field grazing management is difficult because the dynamics of each situation are different. Errors can arise in three main areas:

1. Effect of Grazing Animals

There is an interaction between grazing pressure, defoliation height, grazing interval and dry matter production (Campbell 1969, Jagusch et al 1968, Joyce 1970, Tainton 1974, Bircham and Korte 1984). For example, by varying the intensity and frequency of grazing, Brougham (1959) obtained ±30% variations in measured DM production.

Grazing animals can adversely affect pasture production by mechanical damage via treading, particularly at heavy stocking rates (Edmonds 1963, 1974). Cattle tend to compact the soil more (relative to sheep), with adverse (up to -20%) effects on DM production (Monteath et al 1976).

Animals are the main means of nitrogen transfer from clovers to associated grasses and speed up the cycling of all plant nutrients (Smetham 1973). The very high concentration of nutrients in dung and urine can result in higher losses via luxury uptake by plants and greater leaching losses of the more mobile nutrients (ie N, S, K). These losses are greater with cattle than with sheep, especially in the case of nitrogen (Scott 1976, Gillingham, Syers and Gregg 1984).

2. Effect of Aspect and Topography

Under hill country conditions there are additional effects due to slope and aspect on pasture composition and soil moisture levels which affect pasture DM production (Radcliffe 1982). Steep land can also lead to a lower level of pasture utilization (Sheath 1983).

3. Sheep/Cattle Interaction

As detailed in Section 2.4.2, pasture production can vary depending on the predominant species of animal grazing the pasture.

While all these factors affect pasture production, they were not incorporated into the pasture supply side of the model, because of the lack of experimental data from which meaningful mathematical relationships could be derived.

## 3.4 PASTURE GROWTH RATE DATA USED FOR MODEL CONSTRUCTION

The Wairarapa region includes summer dry and summer wet districts, and a wide range of intermediate climatic conditions (Map 3.1). To model all districts would have been impractical so it was decided to construct two broadly representative pasture growth profiles; one for a summer dry region corresponding to an area receiving around 900 mm of rain annually, and the other for a summer wet region corresponding to an area receiving 1200 mm annually.

Data for the pasture growth profiles was based on: 5 years of records from a site close to Masterton (Radcliffe 1975), 4 years of records from two sites at the Department of Scientific and Industrial Research (DSIR) station at Rawhiti (Barker pers com), 20 months data from a MAF monitoring site at Bideford ($MAF_1$, 1986), estimates of growth rates at Riverside (Parker 1984), 3 years of records from a site on the (ex) Merck Sharp Dohme farm at Gladstone ($MAF_1$, 1986), and 4 years and 2 years data from MAF monitoring sites at Marima and Ruawhata respectively ($MAF_2$ 1986).[1]

The pasture growth rate profiles derived for the summer dry and summer wet regions are shown in Figure 3.1. The 26 fortnightly growth rates used in the model and the proportion of DM grown in each season is shown in Table 3.1 Relative to the summer dry region, the summer wet region grows 106% more DM over the summer, 2% more DM over the autumn, 4% more over the spring, but 18% less over the winter (Figure 3.1, Table 3.1).

## 3.5 NUTRITIVE VALUE OF PASTURE

The nutritive value of pasture is a function of feed intake and digestibility (Ulyatt 1974) and is defined as the nutrient concentration per unit of feed

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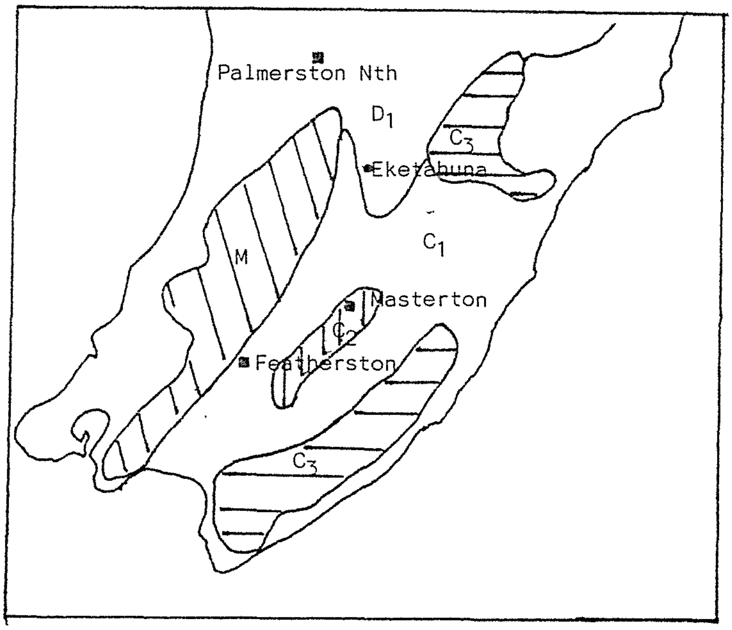
[1] The full set of data for each site is included in Appendix I.

MAP 3:1

Climatic Regions of Southern North Island of New Zealand

Source: NZ Meterological Service
Miscellaneous Publication 175
Part 2: Climatic Regions




$C_1$ Very warm summers, day temps occasionally rise above 30°C with dry foehn northwesterlies. Annual rainfall 1000 to 1500 mm; marked decrease in amount and reliability of rain in spring and summer. Moderate winter temps with maximum rainfall in this season.

$C_2$ Drier than $C_1$. Rainfall 600 to 1000 mm. Summer droughts common.

$C_3$ Cooler and wetter than $C_1$. Very heavy rain at times from south and southeast. Annual rainfall 1500 to 2500 mm.

$D_1$ West to northwest winds prevail with relatively frequent gales. Annual rainfall 900 to 1300 mm. Rainfall reliable and evenly distributed throughout the year. Warm summers and mild winters.

M High rainfall mountain climates.

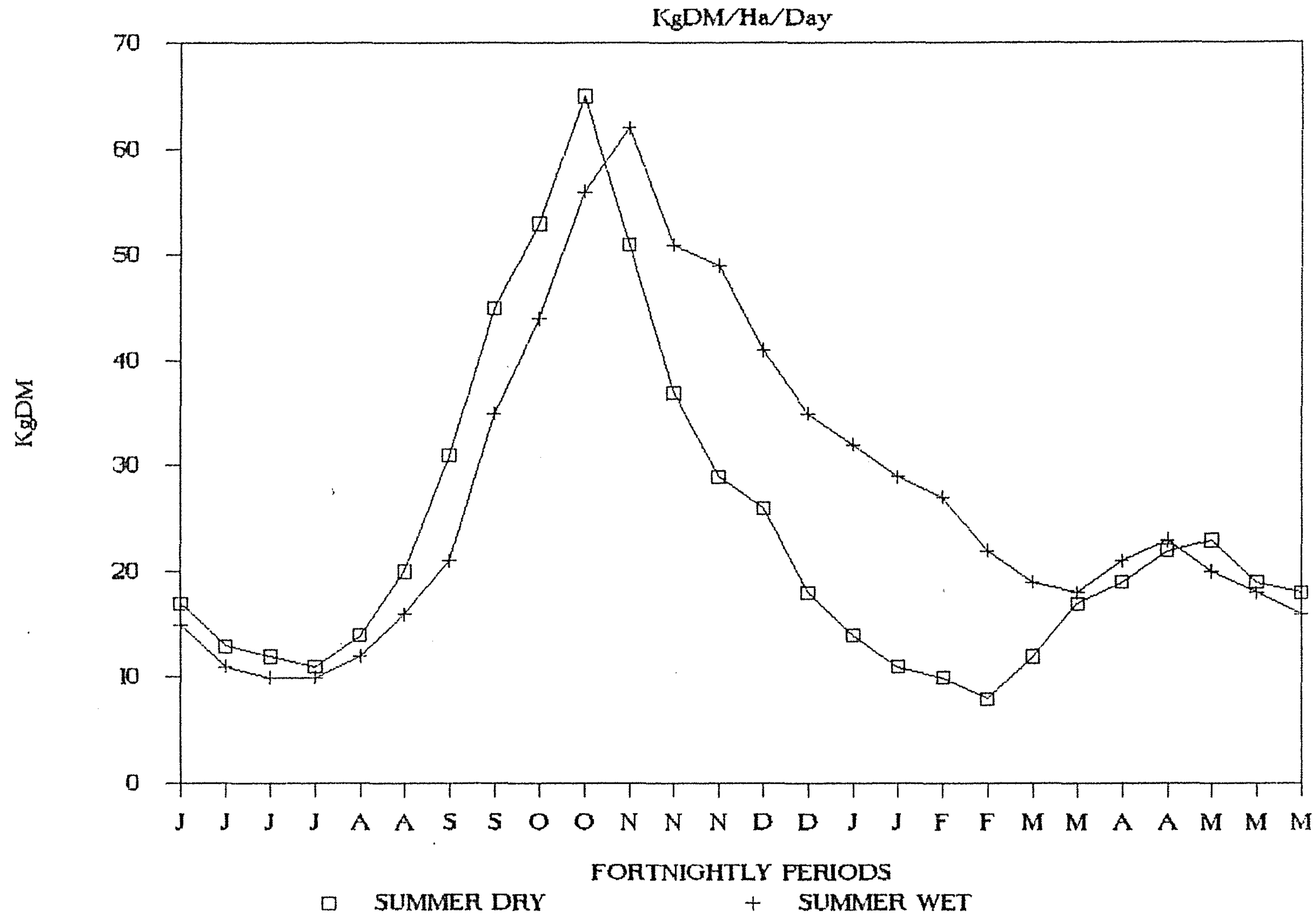
TABLE 3.1

Fortnightly Pasture Rates of Growth (kg DM/ha/day)
and Seasonal Proportions of Growth for
Representative Summer Dry and Summer Wet Regions

| | Period | Summer Dry RoG | Season | Summer Wet RoG | Season |
|---|---|---|---|---|---|
| Jun 1-14 | 1 | 17 | | 15 | |
| 15-28 | 2 | 13 | | 11 | |
| Jul -12 | 3 | 12 | Winter | 10 | Winter |
| -26 | 4 | 11 | | 10 | |
| Aug - 9 | 5 | 14 | 1428kg | 12 | 1176kg |
| -23 | 6 | 20 | = 17% | 16 | = 12% |
| Sep - 6 | 7 | 31 | | 21 | |
| -20 | 8 | 45 | | 35 | |
| Oct - 4 | 9 | 53 | Spring | 44 | Spring |
| -18 | 10 | 65 | | 56 | |
| Nov - 1 | 11 | 51 | 4130kg | 62 | 4312kg |
| -15 | 12 | 37 | = 48% | 51 | = 43% |
| -30 | 13 | 29 | | 49 | |
| Dec -14 | 14 | 26 | | 41 | |
| -28 | 15 | 18 | Summer | 35 | Summer |
| Jan -11 | 16 | 14 | | 32 | |
| -25 | 17 | 11 | 1320kg | 29 | 2720kg |
| | | | = 15% | | = 27% |
| Feb - 8 | 18 | 10 | | 27 | |
| -22 | 19 | 8 | | 22 | |
| Mar - 8 | 20 | 12 | | 19 | |
| -22 | 21 | 17 | | 18 | |
| Apr - 5 | 22 | 19 | Autumn | 21 | Autumn |
| -19 | 23 | 22 | | 23 | |
| May - 3 | 24 | 23 | 1730kg | 20 | 1764kg |
| -17 | 25 | 19 | = 20% | 18 | = 18% |
| -31 | 26 | 18 | | 16 | |
| | TOTAL | 8639 | | 10031 | |

Figure 3.1

# MODEL PASTURE RATE OF GROWTH



(Ulyatt et al 1980). This is most commonly measured in terms of mega joules of metabolizable energy per kilogram of dry matter (MJME/kg DM).

The energy content of pasture is a function of fibre and protein levels (Jagusch 1973). The season of the year and stage of growth within a season affects protein and fibre (and hence energy) content of the pasture; high quality (energy) pastures have low amounts of fibre and high quantities of protein (Jagusch 1973). Normally, animal production depends on the ability of the herbage to supply energy, provided that protein, minerals, vitamins, and water are not limiting (Ulyatt 1974). Most New Zealand pastures have a surfeit of protein and minerals in relation to the requirements of grazing ruminants (Jagusch 1973), and for the purposes of this study it is assumed that only the energy content of the pasture is limiting for animal growth.

Since the energy value of pasture varies throughout the year, and because animal requirements are commonly given in terms of ME, it was decided to include changes in energy value of pasture within the pasture supply side of the model. The ME content of pasture at various stages of growth have been reported by Jagusch (1973), Milligan and McConnell (1976), Scott et al (1979), and Ulyatt et al (1980). From these reports, fortnightly energy values, representative of hill country pasture for both summer dry and summer wet regions, were estimated to reflect changes in pasture quality throughout the year (Table 3.2).

Hence, the model calculated "feed" grown in each period in terms of MJME by multiplying the kg DM/ha/day growth by the energy content of pasture in that period.

## 3.6 TRANSFER OF PASTURE BETWEEN PERIODS

In a grazing situation, pasture not consumed in the period in which it grows is "carried over" into future periods. The length of the carry over period is a function of senescence and decay rates (Bircham and Korte 1984). Senescence rates are usually increased by shading, high temperatures and moisture deficits. Higher rates of senescence can also be expected in swards which have been laxly grazed, particularly during the early summer (Bircham 1981).

TABLE 3.2

Fortnightly Nutritive Value of Pasture Production
(MJME/kg DM) for Representative Regions

| | | Period | Summer Dry kg DM/ha/day | Quality MJME | Summer Wet kg DM/ha/day | Quality MJME |
|---|---|---|---|---|---|---|
| Jun | 1-14 | 1 | 17 | 10.8 | 15 | 11.0 |
| | 15-28 | 2 | 13 | 11.0 | 11 | 11.0 |
| Jul | -12 | 3 | 12 | 11.0 | 10 | 11.0 |
| | -26 | 4 | 11 | 11.2 | 10 | 11.2 |
| Aug | - 9 | 5 | 14 | 11.3 | 12 | 11.3 |
| | -23 | 6 | 20 | 11.5 | 16 | 11.3 |
| Sep | - 6 | 7 | 31 | 11.7 | 21 | 11.5 |
| | -20 | 8 | 45 | 11.7 | 35 | 11.7 |
| Oct | - 4 | 9 | 53 | 11.5 | 44 | 11.7 |
| | -18 | 10 | 65 | 11.3 | 56 | 11.5 |
| Nov | - 1 | 11 | 51 | 11.1 | 62 | 11.3 |
| | -15 | 12 | 37 | 11.0 | 51 | 11.1 |
| | -30 | 13 | 29 | 10.8 | 49 | 11.0 |
| Dec | -14 | 14 | 26 | 10.5 | 41 | 11.0 |
| | -28 | 15 | 18 | 9.8 | 35 | 10.8 |
| Jan | -11 | 16 | 14 | 9.6 | 32 | 10.5 |
| | -25 | 17 | 11 | 9.2 | 29 | 10.3 |
| Feb | - 8 | 18 | 10 | 8.8 | 27 | 10.3 |
| | -22 | 19 | 8 | 8.5 | 22 | 10.0 |
| Mar | - 8 | 20 | 12 | 9.0 | 19 | 9.6 |
| | -22 | 21 | 17 | 9.6 | 18 | 9.8 |
| Apr | - 5 | 22 | 19 | 10.2 | 21 | 10.2 |
| | -19 | 23 | 22 | 10.5 | 23 | 10.5 |
| May | - 3 | 24 | 23 | 10.5 | 20 | 10.5 |
| | -17 | 25 | 19 | 10.8 | 18 | 10.8 |
| | -31 | 26 | 18 | 10.8 | 16 | 10.8 |

McCall (1984) assumed senescence rates to be a constant proportion of total live herbage and used a rate of 0.8% per day in the spring, increasingly linearly up to 2.4% per day during drought conditions. Hunt (1970) calculated a senescence rate of 0.79% per day for green herbage in spring reproductive pastures and 0.88% for autumn vegetative growth. The above senescence rates were initially used in the model for this study. Several runs of the model were then made using the described pasture growth rates (Section 3.5) and feed requirements (Section 3.7), to gauge the effects of different senescence rates on pasture cover. As a result of this iterative process, senescence rates (Table 3.3) which yielded an annual pattern of change in pasture cover similar to those recorded in the Wairarapa (Parker pers com) were adopted for the summer dry and summer wet environments.

Decay and eventual disappearance of dead herbage is regulated largely by temperature and moisture levels (Bircham and Korte 1984). Bowman et al (1982) found decay rates were closely associated with rainfall levels in the previous 2 weeks. In warm-moist conditions the breakdown and disappearance of dead tissue is more rapid because conditions suit bacterial and fungal growth, and removal of detritus by earthworms. In cold and/or dry conditions, rates of decay and disappearance are much reduced (Bircham and Korte 1984). Dead material therefore accumulates during dry summers due to high senescence rates, but low decay/disappearance rates. In autumn, when soil temperatures are still relatively high and soil moisture levels have increased, this situation is reversed. This effect was recorded by Campbell (1964) who found that the nett gain of available DM during the autumn was negligible and that the real advantage of the autumn flush was because of increased pasture quality.

Because of wide variations in micro climatic conditions, McCall (1984) found that it was not possible to derive a simple relationship between decay rate and dead herbage. Both McCall's (1984) and Hunt's (1977) models used climatic data to determine decay rates. This was not possible in this model due to insufficient soil temperature data. It was therefore assumed that decay rates were a constant proportion of total dead herbage throughout the relative season. Decay rates were finalized as for senescence rates, by an iterative process using the model. They were related to the senescence rates used and took into account differences in seasonal climatic conditions.

TABLE 3.3

Senescence Rates Used in the Model
(as a percent of green herbage per day)

| | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| Summer Dry | 0.5 | 1.0 | 1.8 | 0.7 |
| Summer Wet | 0.4 | 0.9 | 1.4 | 0.9 |

TABLE 3.4

Decay Rates Used in the Model
(as a percent of dead herbage per day)

| | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| Summer Dry | 0.3 | 0.8 | 0.4 | 2.0 |
| Summer Wet | 0.2 | 0.8 | 1.0 | 2.4 |

Thus, decay rates were low in winter/dry summer and high in autumn/wet summer (Table 3.4).

The initial proportions of "green" and "dead" herbage were set at 85% and 15% respectively at the start of winter (June 1). These figures were based on studies of Manawatu hill country pastures by Gray (pers com).

The dynamic nature of pasture growth and feed transfer between periods in the model was therefore described in three ways:

1. Changes in pasture quality during the year were accounted for by adjusting the ME value of pasture, as outlined in section 3.5.

2. Where the energy value of pasture grown in any one period exceeded animal consumption, the balance was transferred into the next period. The amount of energy carried forward from each period was reduced by the appropriate seasonal senescence rate. Energy could be carried forward for a maximum of 3 periods before it was assumed to disappear. Available energy at the start of each period therefore comprised energy "grown" in that period plus any energy carried over from the previous periods. If stock requirements exceeded available energy, the total energy pool was reduced by the difference between pasture growth and animal requirements.

   An example of the method used to transfer pasture energy between periods in the model is shown below:

   $X_{t-i}$ is the amount of energy carried forward to period t from period t-i (i = 0,1,2,3)

   (Thus $X_t$ is energy grown in period t, and $X_{t-4} = 0$)

   $A_t$ = amount of energy available in period t

   $$= \sum_{i=0}^{3} X_{t-i}$$

$R_t$ = energy required in period t

$B_t$ = Balance of energy not consumed in period t
= $A_t - R_t$

It is assumed that the proportion of each component in $A_t$ carried over to period (t+1) is constant, and given by $K_t = k_t(1-S_t)$, except that $X_{t-4} = 0$

and where

$$k_t = \frac{B_t}{A_t}$$

$S_t$ = senescence rate in period t

Thus
$$X_{(t+1)-1} = K_t X_t$$
$$X_{(t+1)-2} = K_t X_{t-1}$$
$$X_{(t+1)-3} = K_t X_{t-2}$$
$$X_{(t+1)-4} = 0$$

3. Average pasture cover (X), described in terms of kg DM/ha, was adjusted at the end of each period by the net change in energy during that period. Average pasture cover therefore reflected the energy balance (B) at the end of each period. An average pasture cover of 1200 kg DM/ha was assumed for June 1. This was then altered according to two factors:

(i) If the energy balance (B) at the end of the period was positive, the average pasture cover increased by that amount of energy less the carried over energy (C) divided by the pasture quality/energy level for that period.

eg $$X_t = X_{t-1} + (B_t - \frac{C_t)}{E_t}$$

where $X_t$ = pasture cover at the end of period t
$X_{t-1}$ = pasture cover at the end of period t-1
$B_t$ = balance of energy not consumed in period t

$C_t$ = total energy carried over from period t-1 into period t

$E_t$ = energy value of pasture in period t

Conversely, if the energy balance was negative, average pasture cover would decrease.

$$\text{eg} \quad X_t = X_{t-1} - \frac{B_t}{E_t}$$

(ii) The starting average pasture cover was split into "green and "dead" material (85% and 15% respectively) as previously mentioned. Green material was senesced at the prescribed senescence rate into dead material, which in turn disappeared at the specified decay rate.

$$\text{eg} \quad APC_{t+1} = [APC_t - (D_{t+1} \times DR_{t+1})] + B_{t+1}$$

where $APC_{t+1}$ = average pasture cover at the end of period t+1

$APC_t$ = average pasture cover at the end of period t

$D_{t+1}$ = amount of dead material at the end of period t+1

$DR_{t+1}$ = decay rate (% per day x number of days in period t+1)

$B_{t+1}$ = nett feed surplus at the end of period t+1

and where $D_{t+1} = [(APC_t - D_t) \times S_{t+1}] + [D_t \times (1 - DR_t)]$

$D_t$ = dead material at end of period t

$S_{t+1}$ = senescence rate (% per day x number of days in period t+1)

The average pasture covers derived were used to indicate possible changes in animal requirement patterns, in several ways. First, if animal requirements exceeded energy supply, the extent to which the shortfall could be buffered (relative to acceptable pasture cover levels at various times of the year) by decreasing pasture cover was indicated. Secondly, in periods of surplus, pasture cover indicated the amount of surplus feed which could be conserved. Thirdly, differences between the commencing (June 1) and closing (May 31) pasture cover indicated whether the system could operate at higher or lower stocking rates and/or animal performance levels.

Although some aspects of the pasture component of the model were estimated due to lack of suitable research data, pasture covers generated by the model are similar to those experienced in the field by farmers who took part in the survey and pasture covers monitored at monthly intervals over a period of 6 years at Riverside (Parker 1985(a)).

## 3.7 ANIMAL FEED REQUIREMENTS

The standard method of reporting animal requirement data is in terms of MJME per day (Scott et al 1979, ARC 1980, MAFF 1977). This is compatible with the pasture supply side of the model.

### 3.7.1 SHEEP ENERGY REQUIREMENTS

The energy requirements used in this study for sheep are based on the energy requirement tables of Rattray (1979) and Sykes and Geenty (1983). These authors specify daily MJME requirements for ewes in different physiological states at a range of liveweights, and for lambs and hoggets of different liveweights growing at varying rates.

In this study a single sheep production system was modelled (section 3.9), because it was impractical to to investigate several sheep options as well as a range of different bull farming systems. The above mentioned estimates of sheep feed were therefore considered to be acceptable for this purpose.

### 3.7.2 BULL ENERGY REQUIREMENTS

There are a number of publications citing energy allowances for growing and fattening beef cattle (NRC 1976), ARC (1980), MAFF (1977), Joyce et al (1975)). However, most of the data is based on overseas research and is usually for growing steers and heifers. Joyce et al (1975) compared National Research Council (NRC (United States)) and Agricultural Research Council (ARC (Britain)) estimates of feed requirements for growing cattle with data collected under New Zealand pastoral conditions. They derived several equations from the data, of which one;

$$MEI = LW^{0.75} (0.594 + 0.564 \ LWG)$$

has been widely adopted in New Zealand for feed budgeting purposes (Rattray 1979). In their feed budgeting booklet, Milligan and McConnell (1976) give requirements for growing steers and heifers based on NRC data. This feed requirement table was used by McRae and Morris (1984) in their comparative study of bull beef systems.

There are some problems in converting steer requirements to those suitable for bulls. ARC (1980) suggest that bulls have up to 15% higher maintenance requirements than steers at bodyweights up to 200 kg. This gradually decreases to about 5% at bodyweights of 500-600 kg. Field observations on Manawatu bull beef farms suggest that young (lighter) bull requirements were similar to the figures cited by Milligan and McConnell (1976) while older (heavier) bulls required less (McRae pers com).

ARC (1980) published several tables of energy requirements for bulls. These are split into bulls of "large", "medium", and "small" mature size, and are further subdivided according to the relative efficiency of utilization of energy for maintenance compared with growth. These factors make it difficult to incorporate the figures directly into a feed budgeting model.

Bull energy requirements, based on NRC data, were published by Minish and Fox (1982). These correspond closely to the observed feed requirements of bulls on Manawatu bull beef farms (McRae and Morris pers com), and were used as the basis of the bull energy requirements in this study. The NRC tables specify liveweights and liveweight gains, in pounds (lbs). These were converted to kilograms using the conversion factor 1 kg = 2.205 lbs. Megacalories of nett energy (NE) were re-expressed as megajoules using the conversion 1 Mcal = 4.184 MJ. To convert NE to ME, the following formula was used:

$$ME = \frac{NEm}{km} + \frac{NEf}{kf}$$

where km and kf are the efficiencies of utilization of ME for maintenance and fattening respectively.

In their study Joyce et al (1975) found that km and kf factors of 0.63 and 0.40 respectively gave the most accurate indication of ME requirements for New Zealand conditions. These values were used in this study.

Feed requirement tables however, only give a single or "point in time" estimate of requirements relative to a given liveweight and liveweight gain. To model continuous liveweight changes, which the analysis of bull systems would involve, a formula that expressed bull requirements for any liveweight and liveweight gain through time was required. Regression analysis of the feed requirements published by Minish and Fox (1982) showed a strong positive linear ($R^2$ = 0.99) relationship between energy requirements, liveweight and liveweight gain. However, this analysis also indicated a "gap" in the data between the liveweights 325 kg and 435 kg. A positive linear relationship between components above and below this gap respectively was found, but extrapolation across the gap indicated that the gap was not quite linear between the two weight ranges. To overcome this, a "best fit" formula was derived by Townsleys (pers com) (Equation 3.1, Equation 3.2) summarising the bull energy requirements published by Minish and Fox (1982).

$$\text{ME maintenance} = 1.7\ 9W^{0.55058}$$
$$= 1.789(Wo+gt)^{0.55058}$$

where Wo = initial liveweight (kg)
g = average daily gain (kg)
t = time period (days)

intergrating with respect to time:

$$TME_m = \int 1.789(Wo+gt)^{0.55058}dt$$

$$= 1.789[1.55058g]^{-1}[(Wo+gT)^{1.55058} - Wo^{1.55058}] \text{ for } g > 0$$

$$\text{and} \quad = 1.789Wo^{0.55058}T \text{ for } g = 0 \qquad (3.1)$$

where $TME_m$ = Maintenance requirements in ME with respect to time

$$\begin{aligned} \text{ME gain} &= ag + bg^2 \\ &= (\alpha o + \alpha_1 W)g + (\beta o + \beta_1 W)g^2 \\ &= [\alpha o + \alpha_1(Wo + gt)]g + [\beta o + \beta_1(Wo + gt)]g^2 \\ &= \alpha og + \alpha_1 Wog + \alpha_1 g^2 t + \beta og^2 + \beta_1 Wog^2 + \beta_1 g^3 t \end{aligned}$$

$$\begin{aligned} TME_g &= \int MEg\ dt \\ &= \alpha ogT + \alpha_1 WogT + \tfrac{1}{2}\alpha_1 g^2 T^2 + \beta og^2 T \\ &\quad + \beta_1 Wog^2 T + \tfrac{1}{2}\beta_1 g^3 T^2 \end{aligned} \qquad (3.2)$$

where TMEg = Energy requirements in ME for liveweight gain with respect to time

and where

| $\alpha 0$ | $\alpha 1$ | |
|---|---|---|
| 7.128 | 0.09169 | $W < 325$ kg |
| 23.305 | 0.04192 | $325 < W < 435$ kg |
| 7.547 | 0.07814 | $W > 435$ kg |

| $\beta 0$ | $\beta 1$ | |
|---|---|---|
| 1.671 | 0.009173 | $W < 325$ kg |
| 2.717 | 0.005953 | $325 < W < 435$ kg |
| 1.088 | 0.009699 | $W > 435$ kg |

These equations were easily accommodated on the microcomputer spreadsheet and were used to calculate bull energy requirements for the different bull systems modelled. They were also used to generate the bull energy requirement Table 3.5.

It is important to note that most of the data (including that used as the basis in this study) relating to bull energy requirements is from stall fed animals. As Minish and Fox (1982) note, maintenance requirements for animals outside in cold (ie winter) conditions, can increase by up to 30%.

## 3.8 PASTURE ALLOWANCE AND FEED INTAKE

Animal feed intake is constrained by the speed with which food passes through the rumen, digestibility of material, rumen size, and animal liveweight (Bines 1970). While Marsh (1977a) found a linear relationship

TABLE 3.5

BULL ENERGY REQUIREMENTS (MJME)

Live Weight (kg)

| kg/day wt gain | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 22.6 | 28.3 | 33.1 | 37.4 | 41.4 | 45.0 | 48.5 | 51.7 | 54.8 | 57.7 | 60.6 |
| 0.1 | 24.2 | 30.4 | 35.7 | 40.5 | 44.9 | 48.9 | 52.5 | 56.0 | 59.5 | 62.9 | 66.0 |
| 0.2 | 26.0 | 32.5 | 38.3 | 43.6 | 48.5 | 52.8 | 56.7 | 60.5 | 64.4 | 68.1 | 71.7 |
| 0.3 | 27.7 | 34.8 | 41.0 | 46.8 | 52.1 | 56.9 | 60.9 | 65.0 | 69.3 | 73.5 | 77.5 |
| 0.4 | 29.6 | 37.1 | 43.9 | 50.1 | 55.9 | 61.0 | 65.3 | 69.7 | 74.4 | 79.0 | 83.5 |
| 0.5 | 31.4 | 39.5 | 46.7 | 53.5 | 59.8 | 65.2 | 69.8 | 74.4 | 79.6 | 84.6 | 89.5 |
| 0.6 | 33.3 | 41.9 | 49.7 | 56.9 | 63.8 | 69.6 | 74.4 | 79.3 | 84.9 | 90.4 | 95.7 |
| 0.7 | 35.3 | 44.4 | 52.7 | 60.4 | 67.8 | 74.0 | 79.0 | 84.3 | 90.4 | 96.3 | 102.1 |
| 0.8 | 37.4 | 47.0 | 55.8 | 64.0 | 72.0 | 78.5 | 83.8 | 89.4 | 95.9 | 102.3 | 108.6 |
| 0.9 | 39.4 | 49.6 | 58.9 | 67.7 | 76.2 | 83.1 | 88.7 | 94.6 | 101.6 | 108.5 | 115.2 |
| 1.0 | 41.6 | 52.3 | 62.1 | 71.5 | 80.5 | 87.9 | 93.7 | 99.9 | 107.4 | 114.7 | 122.0 |
| 1.1 | 43.8 | 55.0 | 65.4 | 75.4 | 84.9 | 92.7 | 98.8 | 105.3 | 113.3 | 121.1 | 128.9 |
| 1.2 | 46.0 | 57.8 | 68.8 | 79.3 | 89.4 | 97.6 | 104.0 | 110.9 | 119.3 | 127.7 | 135.9 |
| 1.3 | 48.3 | 60.7 | 72.3 | 83.3 | 94.0 | 102.6 | 109.2 | 116.5 | 125.5 | 134.4 | 143.1 |
| 1.4 | 50.7 | 63.6 | 75.8 | 97.4 | 98.7 | 107.7 | 114.6 | 122.3 | 131.8 | 141.2 | 150.4 |
| 1.5 | 53.1 | 66.6 | 79.4 | 91.6 | 103.4 | 112.9 | 120.1 | 128.1 | 138.2 | 148.1 | 157.9 |

between herbage allowance and liveweight gain in steers growing up to 0.63 kg per day grazing pasture, Reardon (1977) also found that DM intake increased non-linearly with increasing allowance (over the range 2-12 kg DM/100 kg LW), with no difference between young and old cattle. Trials with Friesian bulls indicated that liveweight gain was linearly related to pasture allowance in winter and spring, and quadratically related in summer and autumn (Clark and Brougham 1979). This aspect of allowance versus intake is a daily management problem which is separate to that of actual physical intake of DM. No account was made for the relationship between pasture allowance and animal intake in the model. The figure of 3% of bodyweight as a maximum DM intake for fattening beef cattle has been accepted by several researchers (McRae 1975), although there appears to be some variation. Marsh (1977b) for example, suggests that the 3% figure is reasonable for cattle between 3-6 months, but that this reduces to around 2.25% of liveweight in older cattle.

Estimates of DM intake as a percentage of bodyweight for bulls, relative to liveweight gain, can be obtained by combining the data from Tables 3.2 and 3.5. These are summarised in Table 3.6.

TABLE 3.6

**DM Intake as a percentage of Bull Liveweight**

| Bodyweight of bull (kg) | Liveweight Gain (kg day) | kg DM required | DM as % of LW |
|---|---|---|---|
| 150 (summer) | 0.8 | 4.35 | 2.9 |
| 250 (winter) | 1.0 | 6.5 | 2.6 |
| 400 (spring) | 1.5 | 10.3 | 2.6 |
| 600 (spring) | 2.0 | 16.8 | 2.8 |

To calculate the energy requirements for each bull system, the required pattern of liveweight gain was entered manually. The energy requirements generated were then cross checked manually to ensure that DM intake did not exceed 3% of bodyweight. If this relationship was exceeded, the rate of liveweight gain was be reduced.

## 3.9 SHEEP POLICIES MODELLED

Representative sheep policies, one each for the summer dry and summer wet situations, were built to provide a basis for comparisons between the different bull policies. These sheep policies were based on the MAF farm monitoring models for the Wairarapa with additional regional data provided by local advisors. Subsequent changes could easily be made if large discrepancies between sheep policies on the farms surveyed and the sheep models constructed were found to occur, or if investigation of the impact of different sheep policies was required.

### Summer Dry Sheep Policy

The summer dry sheep policy was based on a 55 kg ewe at tupping, with a 95% survival to sale lambing. Ewes were flushed for two weeks from late March to early April. Tupping started on March 23 and continued for 3 cycles until May 20. A tightly spread lambing started on August 24, with 40% of the ewes assumed to have lambed on the first day of the first period (14 days) of lambing. At the commencement of the second and third lambing periods 70 and 100% of the ewes respectively were assumed to have lambed.

Lambs were weaned in early December at an average liveweight of 20 kg. Replacement ewe lambs - 25% of the breeding ewe flock - were selected at this stage. The remaining lambs were grown at an average of 100 grams LWG/day until they were sold at an average carcass weight of 11.0 kg. Half of the works lambs were sold at the end of December, 25% at the end of January, and the balance at the end of February. Twenty (20) percent of ewes were culled at the end of December. Replacement ewe lambs were grown at the following rates:

| | |
|---|---|
| 80 gms/day | December-April |
| 50 gms/day | May-August |
| 130 gms/day | September-October |
| 100 gms/day | November-December |
| 50 gms/day | January-March |

to achieve a 55 kg two tooth liveweight at tupping.

<u>Summer Wet Sheep Policy</u>

The summer wet sheep policy was based on a 55 kg ewe at tupping, giving a 100% (survival to sale) lambing. Ewes were flushed for 4 weeks from mid-March to mid-April. Tupping started on April 6, and continued for 3 cycles until the end of May. Lambing started on September 7 with the same lambing spread as the summer dry sheep policy.

The only other aspect of the summer wet sheep policy which varied from that of the summer dry was the lamb selling policy. Non replacement lambs were grown at an average of 150 grams/day, being sold in equal numbers (25%) at the end of December, January, February, and March at an average carcass weight of 12.5 kg.

Breeding ewes were assumed to equal 1.0 stock unit (su), and replacement hoggets 0.7 su. Stocking rate, entered manually, was assumed to be 10.5 su/ha and 12.5 su/ha for summer dry and summer wet areas respectively. The sheep:cattle ratio, which could be varied from 0 to 100%, was also entered manually. The Wairarapa average is around 80:20.

The model then calculated the number of ewes and hoggets carried per hectare using equations 3.3 and 3.4.

$$\text{Ewes/ha} = (\text{stocking rate x \% sheep})/1.175 \qquad (3.3)$$

$$\text{Hoggets/ha} = [(\text{stocking rate rate x \% sheep}) - \text{number of ewes}]/0.7 \qquad (3.4)$$

Thus, at a stocking rate of 10.5 su/ha and a 80:20 sheep:cattle ratio, 7.15 ewes and 1.8 hoggets/ha (a total of 8.4 su) would be required.

## 3.10 BULL POLICIES MODELLED

Seven different bull systems were considered. These differed in terms of purchasing and selling dates, rates of liveweight gain, and age of bull. It was assumed that a rising 1 year bull was equivalent to 4.5 su, and a rising 2 year bull to 5.5 su, on July 1. With the overall stocking rate and percentage of bulls set, the number of bulls per hectare was calculated as follows:

For policy 1, at a stocking rae of 10.5 su/ha and 20% cattle;

bulls/ha = (10.5 x 0.2)/4.5
= 0.47

Thus with the number of bulls per hectare set, plus the initial purchase and final sale weights (and the respective dates at which these occurred) a pattern of liveweight gain (LWG) was determined. Again the determination of the LWG profile was by an iterative process; an initial profile based on the pattern of pasture growth and quality was entered into the model, and the pasture covers generated considered. The LWG pattern was then manipulated until an acceptable pasture cover was derived.

The broad details of the policies are as follows: (see Table 3.7 also)

POLICY 1: Buy in spring weaner bull (3 months of age, 100 kg LW) at beginning of November. Aim to reach a 220 kg carcass weight at 16 months of age. at the end of the following November.

POLICY 2: Buy in spring weaner bull (as in Policy 1): aim to reach 220 carcass weight by 18 months of age.

POLICY 3: Buy in spring weaner bull (as in Policy 1): Bulls are kept over 2 winters to reach 330 kg carcass weight by 30 months of age.

POLICY 4: Buy in autumn weaner (6-7 months old, 140 kg LW) at the end of February. Aim to reach 220 kg carcass weight by 18 months of age.

POLICY 5: Buy in rising yearling bull (200 kg LW) at end of July. Aim to reach 220 kg carcass eight by 18 months of age.

POLICY 6: Buy in R 2 year bull (380 kg LW) at end of July. Aim to reach 300 kg carcass weight by 30 months of age.

POLICY 7: Buy in 18 month bull (365 kg LW) at end of February. Aim to reach 300 kg carcass weight by 30 months of age.

TABLE 3.7

Summary of Bull Systems Modelled

| Policy | Bull Purchase Age (months) | Bull Purchase Weight (kg) | Bull Sale Age (months) | Sale Weight (kg Carcass) |
|---|---|---|---|---|
| 1 | 3 (Nov) | 100 | 16 (Nov) | 220 |
| 2 | 3 (Nov) | 100 | 18 (Jan) | 220 |
| 3 | 3 (Nov) | 100 | 29 (Dec) | 330 |
| 4 | 7 (Feb) | 140 | 17 (Dec) | 220 |
| 5 | 12 (Jul) | 200 | 18 (Jan) | 220 |
| 6 | 14 (Jul) | 380 | 30 (Jan) | 300 |
| 7 | 19 (Feb) | 365 | 29 (Dec) | 300 |

With respect to the bull policies, the only information which needed to be entered into the model was the initial weight of the bull and the average LWG in kg/day per period. Bull liveweight at the end of each period was displayed along with the total bull energy requirements per period. A fold out summary of the bull policies modelled, to allow for constant reference, is located at the end of Chapter Nine.

### 3.10.1 RELATIONSHIP BETWEEN BULL LIVEWEIGHT AND CARCASS WEIGHT

It is axiomatic that carcass weight increases with liveweight. Preston and Willis (1974) indicate a linear relationship (r = 0.83 $\pm$ 0.03) for these two variables over the range 90-590 kg liveweight, with dressing out percentages of 51 to 60%. A very high linear relationship (r = 0.99) between carcass weight and liveweight over the range 453 to 480 kg LW, with dressing out percentages varying from 48.6% to 52.4% has been recorded in bulls slaughtered from Massey University's Tuapaka and Keeble farms (Morris pers com). In their comparative study McRae and Morris (1984) assumed a flat dressing out percentage of 50% at all bull liveweights, while Smith (1985) assumed a 55% dressing out for bulls at 400 kg LW.

For the purposes of this study, the following dressing out percentages were assumed:

| Dressing out % | Liveweight Range |
|---|---|
| 50 | less than 400 kg |
| 51 | 401-500 kg |
| 52 | greater than 500 kg |

Therefore, a liveweight of 433 kg equates with a 221 kg carcass weight (Policies 1, 2, 4, 5), 635 kg LW equates with 330 kg carcass weight (Policy 3), and a 577 kg LW equates with a 300 kg carcass weight (Policies 6 and 7).

## 3.11 SUMMARY OF MODEL OPERATIONS

A feed budgeting model which calculated animal requirements and pasture cover was developed to investigate the feasibility of different bull beef farming systems on Wairarapa hill country. A basic sheep policy which varied primarily in terms of lamb selling policy between summer wet and summer dry regions was initially assumed.

The model was divided into 26 fortnightly periods, starting on June 1. The information required to run the model was; bull policy number (1-7), stocking rate (su/ha), the ratio of sheep su to cattle su, lambing %, initial bull liveweight and its liveweight gain profile, initial pasture cover (kg DM/ha), and pasture senescence and disappearance rates for each season.

The model output showed, for each of the 26 fortnightly periods, animal requirements and pasture growth in both MJME and kg DM, the amount of pasture transferred between periods, the difference between animal requirements and pasture growth, and the average pasture cover in kg DM/ha. Examples of model output are shown in Chapter 4.

The model was originally built on a SUPERCALC 2 (Version 1.0 Sorcim Corp 1983) spreadsheet, for an APRICOT micro computer. The completed model required 125 kilobytes of disk space and took 20 minutes to run. Later, the model was re-constructed to run on an IBM micro computer using the LOTUS SYMPHONY (Version 1.1 Lotus Development Corporation 1985), spreadsheet. This required 110 kilobytes of disk space and calculation time was reduced to about 45 seconds. Sensitivity analysis, by varying input parameters could therefore be carried out simply and quickly.

# CHAPTER FOUR: MODEL RESULTS

## 4.0 CHAPTER OUTLINE

The seven different bull policies were examined using the model for their energy demand effects on energy supply, and the average pasture covers generated, for both the summer wet and summer dry environments. The first section of this chapter outlines the criteria used to evaluate the model output. A summary of the model outputs, completed prior to the farmer survey, for each of the seven bull policies is then discussed. This is followed by an investigation on the effects of altering sheep:bull ratios on energy supply/demand and pasture covers generated.

## 4.1 CRITERIA USED TO EVALUATE MODEL OUTPUT

As discussed in Section 3.1, one use of feed budgets is to derive animal production systems which "fit" the supply of available pasture. In this study, two criteria were used to judge the relationship between animal requirements and pasture supply. The first of these was the energy balance figures from the model output, which indicated whether the supply of energy (made up of energy grown plus energy carryover) was sufficient to meet animal requirements in each period. If the energy balance was negative, the extent to which the system "worked" then depended on the extent to which pasture covers could buffer the deficit. Thus pasture covers were the second criteria used - while they buffered negative energy balances, they also had to stay above arbitrarily predefined minimum levels. These minimum levels were: 1000 kg DM/ha at the start of lambing and through the summer period. A positive balance over the year as a whole (ie the pasture cover at the end of May had to be equal or greater than the starting pasture cover) was also required.

## 4.2 SUMMER DRY MODEL RESULTS

The summer dry region, as outlined in Section 3.4, is representative of an area receiving around 900 mm of annual rainfall, growing a total of around 8600 kg DM/ha per year, and supporting an average stocking rate of 10.5

su/ha. Its main feature is low (and variable) pasture production over the summer period. The pasture growth profile (Figure 3.1) indicates that livestock policies in this environment need to be able to take advantage of the large spring flush, but also be sufficiently flexible to enable stock numbers to be quickly reduced going into the summer as pasture production declines.

The model indicated (as could be expected) that animal production was limited by summer pasture production. The pattern of change in pasture cover, illustrated in Figure 4.1 for Policy 1, was similar for all the bull policies modelled. Thus pasture cover increased rapidly through the spring from 1200-1300 kg DM/ha at lambing to reach levels of up to 2500 kg DM/ha by mid November. This then declined rapidly through the summer before a slight autumn flush. Lowest pasture covers occurred from February to April.

Liveweight gain profiles for bulls were altered (see Section 3.9 for the method used) so as to match feed demand and pasture supply. The average liveweight gains for each season and each policy is shown in Table 4.1.

A summary of the model output for each of the bull policies are illustrated in Tables 4.2 to 4.8. These show, per fortnightly period, bull liveweights and average LWG per day, average pasture cover (with details of the carryover and balance of energy) and feed requirements for bulls and all livestock.(1) The main features of each of the bull beef policies, are:

Policy 1 (Table 4.2): This policy involved growing bulls at high average liveweight gains throughout the year. A negative energy balance from mid February to early March (periods 19-20), is buffered by reducing pasture cover. Pasture cover declines rapidly over the summer, but increases again slightly through the late autumn.

Policy 2 (Table 4.3): This policy is similar to 1, although with slower liveweight gains. This results in the bulls being carried for longer into a

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[1] The total output for Policy 1 is shown in Appendix II(a). This also shows the sheep component of the Summer Dry model.

Figure 4.1 Feed Demand and Supply and the Resultant Pasture Cover for Bull Policy 1 in a Summer Dry Environment (10.5 su/ha 80:20 Sheep : Bulls)

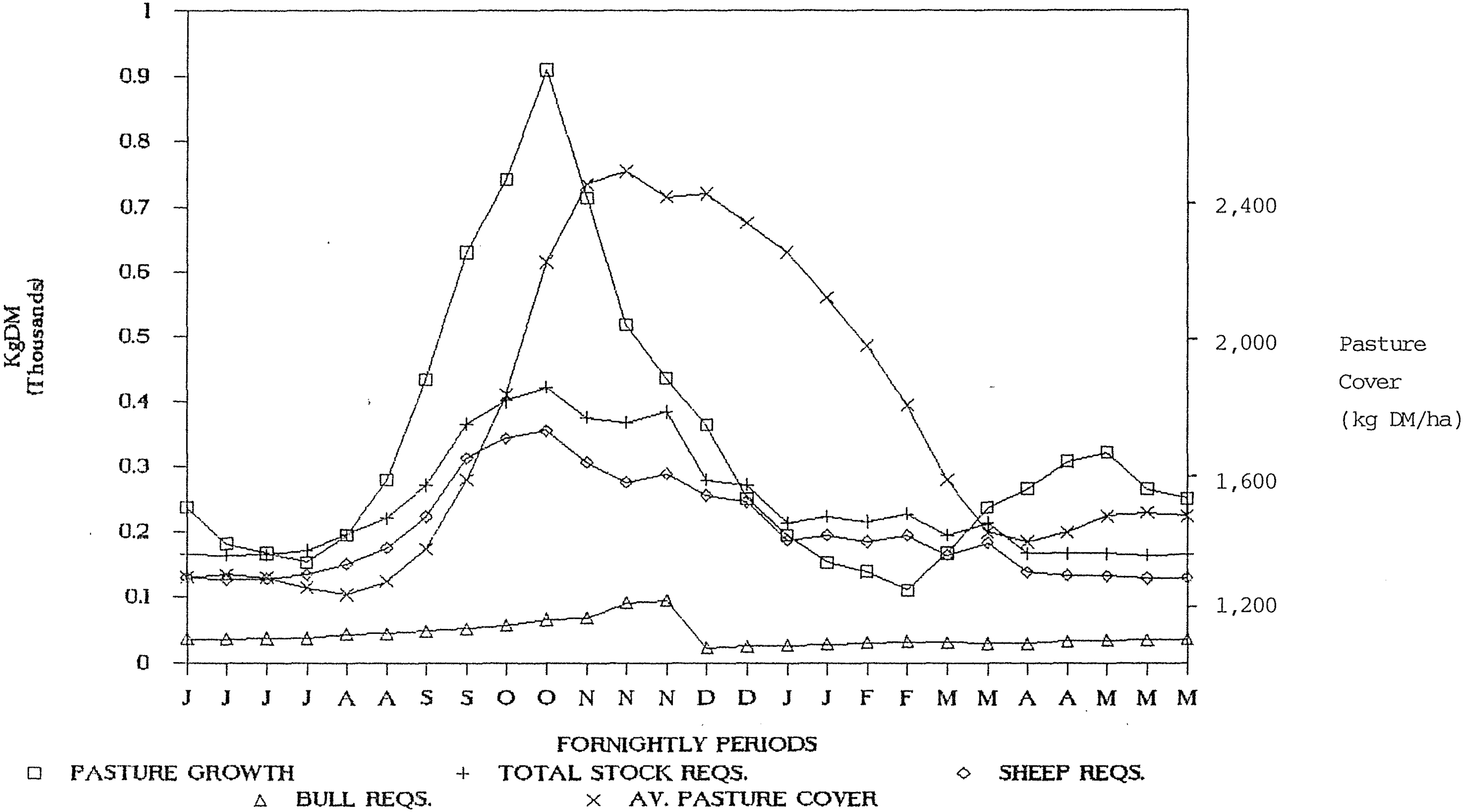


TABLE 4.1

Average Liveweight Gains (kg/day) on a Seasonal Basis for Summer Dry Bull Policies

| | | Summer Dec-Feb | Autumn Mar-May | Winter Jun-Aug | Spring Sep-Nov | Average LWG Purchase Sale |
|---|---|---|---|---|---|---|
| POLICY 1 | R1 yr | 0.57 | 0.68 | 0.83 | 1.34 | 0.85 |
| POLICY 2 | R1 yr | 0.43 | 0.57 | 0.60 | 1.21 | 0.72 |
| | R2 yr | 1.08 | | | | |
| POLICY 3 | R1 yr | 0.37 | 0.44 | 0.33 | 1.01 | 0.68 |
| | R2 yr | 0.58 | 0.54 | 0.69 | 1.33 | |
| | R3 yr | 1.10 | | | | |
| POLICY 4 | R1 yr | | 0.69 | 0.70 | 1.36 | 0.95 |
| | R2 yr | 1.20 | | | | |
| POLICY 5 | R1 yr | | | 1.15 | 1.41 | 1.31 |
| | R2 yr | 1.20 | | | | |
| POLICY 6 | R2 yr | | | 0.90 | 1.36 | 1.11 |
| | R3 yr | 1.13 | | | | |
| POLICY 7 | R2 yr | | 0.47 | 0.55 | 1.19 | 0.76 |
| | R3 yr | 1.00 | | | | |

TABLE 4.2 MODEL OUTPUT for BULL POLICY 1 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 1 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 100 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.47 | | |
| Ewes/Ha: | 7.15 | | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.75 | 242.00 | 0 | 774.17 | 1264 | 166.32 | 36.35 |
| 15-28 | 2 | | | 0.75 | 252.50 | 719.98 | 912.44 | 1272 | 164.50 | 36.67 |
| JULY -12 | 3 | | | 0.75 | 263.00 | 848.56 | 871.32 | 1261 | 165.93 | 37.64 |
| -26 | 4 | | | 0.75 | 273.50 | 810.33 | 601.71 | 1227 | 172.63 | 37.91 |
| AUG -9 | 5 | | | 1.00 | 287.50 | 544.70 | 542.89 | 1210 | 196.16 | 44.48 |
| -23 | 6 | | | 1.00 | 301.50 | 497.31 | 1171.64 | 1250 | 221.36 | 45.13 |
| SEPT -6 | 7 | | | 1.10 | 316.90 | 1083.05 | 2980.35 | 1356 | 271.84 | 48.31 |
| -20 | 8 | | | 1.20 | 333.70 | 2554.61 | 5648.52 | 1557 | 365.56 | 52.65 |
| OCT -4 | 9 | | | 1.30 | 351.90 | 4833.54 | 8749.94 | 1825 | 401.44 | 57.67 |
| -18 | 10 | | | 1.50 | 372.90 | 7416.76 | 12929.66 | 2230 | 422.13 | 66.25 |
| NOV -1 | 11 | | | 1.50 | 393.90 | 10753.85 | 14509.77 | 2472 | 375.63 | 69.24 |
| -15 | 12 | 0.60 | 108.40 | 1.50 | 414.90 | 11626.08 | 13276.75 | 2511 | 367.94 | 91.89 |
| -30 | 13 | 0.60 | 117.40 | 1.30 | 434.40 | 10089.25 | 10625.58 | 2429 | 385.34 | 95.91 |
| DEC -14 | 14 | 0.60 | 125.80 | | | 7294.49 | 8180.70 | 2445 | 279.60 | 23.10 |
| -28 | 15 | 0.60 | 134.20 | | | 4945.97 | 4747.66 | 2353 | 272.24 | 25.70 |
| JAN -11 | 16 | 0.55 | 141.90 | | | 2946.59 | 2774.56 | 2262 | 213.92 | 26.36 |
| -25 | 17 | 0.55 | 149.60 | | | 1750.23 | 1101.38 | 2119 | 224.53 | 28.38 |
| FEB -8 | 18 | 0.55 | 157.30 | | | 711.18 | 42.53 | 1974 | 215.98 | 30.57 |
| -22 | 19 | 0.55 | 165.00 | | | 29.64 | -960.82 | 1791 | 228.52 | 32.56 |
| MARCH -8 | 20 | 0.55 | 172.70 | | | 0.00 | -253.23 | 1544 | 196.14 | 31.61 |
| -22 | 21 | 0.55 | 180.40 | | | 0.00 | 227.76 | 1405 | 214.27 | 30.42 |
| APRIL -5 | 22 | 0.55 | 188.10 | | | 196.32 | 1198.81 | 1375 | 167.72 | 29.36 |
| -19 | 23 | 0.75 | 198.60 | | | 1077.08 | 2553.33 | 1407 | 167.41 | 33.01 |
| MAY -3 | 24 | 0.75 | 209.10 | | | 2307.18 | 3931.59 | 1456 | 167.29 | 34.09 |
| -17 | 25 | 0.80 | 220.30 | | | 3520.86 | 4614.91 | 1459 | 164.70 | 35.19 |
| -31 | 26 | 0.80 | 231.50 | | | 3943.99 | 4869.66 | 1451 | 166.29 | 36.32 |

TABLE 4.3 MODEL OUTPUT for BULL POLICY 2 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 2 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 100 |
| %Sheep: | 80 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| %Cattle(Bulls): | 20 | | |
| Bulls/Ha: | 0.47 | | |
| Ewes/Ha: | 7.15 | | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.50 | 211.10 | 0 | 854.82 | 1272 | 158.85 | 28.88 |
| 15-28 | 2 | | | 0.50 | 218.10 | 794.99 | 1072.64 | 1287 | 156.76 | 28.92 |
| JULY -12 | 3 | | | 0.50 | 225.10 | 997.56 | 1110.00 | 1284 | 157.78 | 29.49 |
| -26 | 4 | | | 0.60 | 233.50 | 1032.30 | 896.10 | 1257 | 166.16 | 31.45 |
| AUG -9 | 5 | | | 0.75 | 244.00 | 802.28 | 908.52 | 1249 | 186.60 | 34.92 |
| -23 | 6 | | | 0.75 | 254.50 | 823.00 | 1610.88 | 1299 | 211.49 | 35.25 |
| SEPT -6 | 7 | | | 0.80 | 265.70 | 1477.09 | 3511.07 | 1415 | 260.16 | 36.63 |
| -20 | 8 | | | 1.10 | 281.10 | 2994.60 | 6183.40 | 1622 | 357.45 | 44.54 |
| OCT -4 | 9 | | | 1.30 | 299.30 | 5263.41 | 9243.43 | 1893 | 395.91 | 52.14 |
| -18 | 10 | | | 1.50 | 320.30 | 7786.88 | 13358.94 | 2301 | 416.90 | 61.02 |
| NOV -1 | 11 | | | 1.30 | 338.50 | 11049.08 | 14920.31 | 2550 | 365.24 | 58.85 |
| -15 | 12 | 0.50 | 107.00 | 1.30 | 356.70 | 11894.67 | 13679.67 | 2597 | 355.73 | 79.67 |
| -30 | 13 | 0.50 | 114.50 | 1.20 | 374.70 | 10350.90 | 10993.99 | 2520 | 375.46 | 86.02 |
| DEC -14 | 14 | 0.50 | 121.50 | 1.20 | 391.50 | 7508.97 | 7748.24 | 2472 | 341.21 | 84.71 |
| -28 | 15 | 0.50 | 128.50 | 1.10 | 406.90 | 4657.33 | 3834.56 | 2315 | 335.96 | 89.42 |
| JAN -11 | 16 | 0.50 | 135.50 | 1.00 | 420.90 | 2381.19 | 1600.84 | 2160 | 277.29 | 89.73 |
| -25 | 17 | 0.30 | 139.70 | 1.00 | 434.90 | 1028.74 | -207.62 | 1955 | 288.39 | 92.24 |
| FEB -8 | 18 | 0.30 | 143.90 | | | 0.00 | -619.66 | 1818 | 210.42 | 25.00 |
| -22 | 19 | 0.30 | 148.10 | | | 0.00 | -937.36 | 1645 | 222.28 | 26.32 |
| MARCH -8 | 20 | 0.50 | 155.10 | | | 0.00 | -227.97 | 1415 | 193.33 | 28.80 |
| -22 | 21 | 0.50 | 162.10 | | | 0.00 | 253.72 | 1290 | 211.57 | 27.72 |
| APRIL -5 | 22 | 0.60 | 170.50 | | | 219.77 | 1231.33 | 1270 | 166.83 | 28.48 |
| -19 | 23 | 0.60 | 178.90 | | | 1106.30 | 2630.08 | 1315 | 162.88 | 28.48 |
| MAY -3 | 24 | 0.60 | 187.30 | | | 2376.60 | 4051.43 | 1376 | 162.49 | 29.28 |
| -17 | 25 | 0.60 | 195.70 | | | 3624.33 | 4782.62 | 1391 | 158.75 | 29.24 |
| -31 | 26 | 0.60 | 204.10 | | | 4077.26 | 5071.10 | 1395 | 159.98 | 30.01 |

TABLE 4.4 MODEL OUTPUT for BULL POLICY 3 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 3 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt | |
| %Sheep: | 80 | of Bull(kg): | 100 |
| %Cattle(Bulls): | 20 | Pasture cover | |
| Bulls/Ha: | 0.21 | at 1st June: | 1200 |
| Ewes/Ha: | 7.15 | (kgDM/Ha) | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | 3rd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.30 | 189.40 | 0.60 | 426.30 | 826.02 | 1269 | 161.52 | 31.55 |
| 15-28 | 2 | | | 0.30 | 193.60 | 0.60 | 434.70 | 1019.53 | 1282 | 159.15 | 31.32 |
| JULY -12 | 3 | | | 0.30 | 197.80 | 0.60 | 443.10 | 1036.75 | 1277 | 159.95 | 31.66 |
| -26 | 4 | | | 0.30 | 202.00 | 0.60 | 451.50 | 812.44 | 1249 | 167.55 | 32.83 |
| AUG -9 | 5 | | | 0.50 | 209.00 | 0.75 | 462.00 | 810.37 | 1239 | 188.90 | 37.22 |
| -23 | 6 | | | 0.50 | 216.00 | 1.00 | 476.00 | 1444.05 | 1281 | 218.49 | 42.25 |
| SEPT -6 | 7 | | | 0.75 | 226.50 | 1.10 | 491.40 | 3244.97 | 1387 | 270.11 | 46.58 |
| -20 | 8 | | | 0.75 | 237.00 | 1.20 | 508.20 | 5897.48 | 1590 | 362.89 | 49.98 |
| OCT -4 | 9 | | | 1.00 | 251.00 | 1.30 | 526.40 | 8954.81 | 1858 | 400.71 | 56.94 |
| -18 | 10 | | | 1.20 | 267.80 | 1.40 | 546.00 | 13100.48 | 2263 | 420.22 | 64.34 |
| NOV -1 | 11 | | | 1.20 | 284.60 | 1.50 | 567.00 | 14613.67 | 2502 | 376.73 | 70.34 |
| -15 | 12 | 0.50 | 107.00 | 1.20 | 301.40 | 1.50 | 588.00 | 13449.08 | 2550 | 357.58 | 81.53 |
| -30 | 13 | 0.50 | 114.50 | 1.00 | 316.40 | 1.30 | 607.50 | 10884.54 | 2479 | 372.13 | 82.69 |
| DEC -14 | 14 | 0.40 | 120.10 | 0.75 | 326.90 | 1.20 | 624.30 | 7811.47 | 2443 | 330.44 | 73.94 |
| -28 | 15 | 0.40 | 125.70 | 0.75 | 337.40 | 1.00 | 638.30 | 4033.88 | 2301 | 320.91 | 74.37 |
| JAN -11 | 16 | 0.40 | 131.30 | 0.60 | 345.80 | | 638.30 | 2284.25 | 2206 | 218.99 | 31.43 |
| -25 | 17 | 0.25 | 134.80 | 0.60 | 354.20 | | 638.30 | 776.74 | 2060 | 228.41 | 32.26 |
| FEB -8 | 18 | 0.25 | 138.30 | 0.40 | 359.80 | | 638.30 | -158.92 | 1915 | 216.65 | 31.23 |
| -22 | 19 | 0.25 | 141.80 | 0.40 | 365.40 | | 638.30 | -991.32 | 1734 | 228.63 | 32.66 |
| MARCH -8 | 20 | 0.30 | 146.00 | 0.40 | 371.00 | | 638.30 | -252.54 | 1493 | 196.06 | 31.53 |
| -22 | 21 | 0.30 | 150.20 | 0.40 | 376.60 | | 638.30 | 232.94 | 1359 | 213.74 | 29.88 |
| APRIL -5 | 22 | 0.50 | 157.20 | 0.50 | 383.60 | | 638.30 | 1186.15 | 1331 | 169.47 | 31.12 |
| -19 | 23 | 0.50 | 164.20 | 0.50 | 390.60 | | 638.30 | 2565.82 | 1369 | 165.10 | 30.70 |
| MAY -3 | 24 | 0.50 | 171.20 | 0.60 | 399.00 | | 638.30 | 3960.05 | 1422 | 165.66 | 32.45 |
| -17 | 25 | 0.50 | 178.20 | 0.60 | 407.40 | | 638.30 | 4673.97 | 1431 | 161.55 | 32.05 |
| -31 | 26 | 0.50 | 185.20 | 0.75 | 417.90 | | 638.30 | 4940.51 | 1427 | 164.47 | 34.50 |

TABLE 4.5 MODEL OUTPUT for BULL POLICY 4 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 4 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 140 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.47 | | |
| Ewes/Ha: | 7.15 | | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.50 | 214.20 | 0 | 852.04 | 1272 | 159.11 | 29.14 |
| 15-28 | 2 | | | 0.50 | 221.20 | 792.40 | 1067.30 | 1286 | 157.01 | 29.17 |
| JULY -12 | 3 | | | 0.55 | 228.90 | 992.59 | 1091.65 | 1283 | 158.99 | 30.70 |
| -26 | 4 | | | 0.55 | 236.60 | 1015.23 | 886.52 | 1256 | 165.49 | 30.78 |
| AUG -9 | 5 | | | 1.00 | 250.60 | 794.19 | 836.15 | 1243 | 192.29 | 40.61 |
| -23 | 6 | | | 1.10 | 266.00 | 757.86 | 1448.99 | 1284 | 219.90 | 43.66 |
| SEPT -6 | 7 | | | 1.20 | 282.80 | 1330.16 | 3243.01 | 1390 | 270.51 | 46.99 |
| -20 | 8 | | | 1.30 | 301.00 | 2769.21 | 5877.13 | 1590 | 364.37 | 51.45 |
| OCT -4 | 9 | | | 1.50 | 322.00 | 5012.27 | 8899.80 | 1855 | 403.95 | 60.18 |
| -18 | 10 | | | 1.50 | 343.00 | 7520.11 | 13057.79 | 2261 | 419.94 | 64.06 |
| NOV -1 | 11 | | | 1.50 | 364.00 | 10837.07 | 14621.41 | 2503 | 373.07 | 66.68 |
| -15 | 12 | | | 1.30 | 382.20 | 11696.80 | 13668.32 | 2570 | 338.77 | 62.72 |
| -30 | 13 | | | 1.20 | 400.20 | 10377.36 | 11230.13 | 2514 | 356.04 | 66.61 |
| DEC -14 | 14 | | | 1.20 | 417.00 | 7685.58 | 8128.61 | 2486 | 321.81 | 65.30 |
| -28 | 15 | | | 1.20 | 433.80 | 4879.37 | 4233.59 | 2347 | 317.90 | 71.36 |
| JAN -11 | 16 | | | | | 2611.63 | 2692.70 | 2281 | 187.56 | 0.00 |
| -25 | 17 | | | | | 1710.54 | 1322.80 | 2167 | 196.15 | 0.00 |
| FEB -8 | 18 | | | | | 866.04 | 466.41 | 2051 | 185.41 | 0.00 |
| -22 | 19 | | | | | 323.78 | -389.89 | 1899 | 195.96 | 0.00 |
| MARCH -8 | 20 | 0.60 | 148.40 | | | 0.00 | -236.04 | 1646 | 194.23 | 29.70 |
| -22 | 21 | 0.60 | 156.80 | | | 0.00 | 243.60 | 1502 | 212.63 | 28.77 |
| APRIL -5 | 22 | 0.60 | 165.20 | | | 202.80 | 1219.83 | 1467 | 166.29 | 27.94 |
| -19 | 23 | 0.75 | 175.70 | | | 1098.94 | 2600.47 | 1496 | 165.00 | 30.60 |
| MAY -3 | 24 | 0.75 | 186.20 | | | 2349.81 | 3999.15 | 1541 | 164.92 | 31.71 |
| -17 | 25 | 0.75 | 196.70 | | | 3578.98 | 4708.60 | 1542 | 161.41 | 31.90 |
| -31 | 26 | 0.75 | 207.20 | | | 4017.52 | 4979.57 | 1531 | 162.92 | 32.95 |

TABLE 4.6 MODEL OUTPUT for BULL POLICY 5 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 5 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 200 |
| %Sheep: | 100 | | |
| %Cattle(Bulls): | 10 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.23 | | |
| Ewes/Ha: | 8.94 | | |
| Hoggets/Ha: | 2.23 | | |

| PERIOD | | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | | | 0 | 815.78 | 1268 | 162.46 | 0.00 |
| | 15-28 | 2 | | | 758.68 | 1002.93 | 1280 | 159.79 | 0.00 |
| JULY | -12 | 3 | | | 932.73 | 1016.73 | 1275 | 160.36 | 0.00 |
| | -26 | 4 | | | 945.56 | 784.38 | 1246 | 168.39 | 0.00 |
| AUG | -9 | 5 | 1.10 | 215.40 | 705.66 | 559.52 | 1216 | 208.93 | 19.34 |
| | -23 | 6 | 1.20 | 232.20 | 509.16 | 954.92 | 1236 | 241.24 | 20.94 |
| SEPT | -6 | 7 | 1.30 | 250.40 | 880.79 | 2424.08 | 1311 | 302.09 | 22.69 |
| | -20 | 8 | 1.30 | 268.60 | 2077.72 | 4593.94 | 1463 | 414.94 | 23.79 |
| OCT | -4 | 9 | 1.30 | 286.80 | 3937.04 | 7237.21 | 1680 | 455.03 | 25.32 |
| | -18 | 10 | 1.50 | 307.80 | 6168.01 | 11089.02 | 2037 | 474.51 | 29.67 |
| NOV | -1 | 11 | 1.50 | 328.80 | 9321.63 | 12644.69 | 2245 | 414.62 | 31.64 |
| | -15 | 12 | 1.50 | 349.80 | 10312.19 | 11851.21 | 2282 | 378.09 | 33.02 |
| | -30 | 13 | 1.50 | 372.30 | 9201.07 | 9591.35 | 2196 | 398.86 | 37.07 |
| DEC | -14 | 14 | 1.30 | 390.50 | 6749.22 | 6856.05 | 2144 | 353.83 | 33.20 |
| | -28 | 15 | 1.30 | 408.70 | 4223.13 | 3316.26 | 1987 | 344.54 | 36.37 |
| JAN | -11 | 16 | 1.10 | 424.10 | 2098.01 | 1534.55 | 1865 | 268.69 | 34.25 |
| | -25 | 17 | 1.10 | 439.50 | 1009.60 | -35.22 | 1690 | 281.57 | 36.39 |
| FEB | -8 | 18 | | | 0.00 | -653.55 | 1560 | 226.62 | 0.00 |
| | -22 | 19 | | | 0.00 | -850.08 | 1409 | 236.60 | 0.00 |
| MARCH | -8 | 20 | | | 0.00 | -212.95 | 1209 | 205.66 | 0.00 |
| | -22 | 21 | | | 0.00 | 78.55 | 1087 | 229.82 | 0.00 |
| APRIL | -5 | 22 | | | 67.68 | 1016.88 | 1078 | 172.94 | 0.00 |
| | -19 | 23 | | | 916.31 | 2386.31 | 1133 | 168.00 | 0.00 |
| MAY | -3 | 24 | | | 2153.47 | 3786.11 | 1204 | 166.51 | 0.00 |
| | -17 | 25 | | | 3407.59 | 4532.03 | 1229 | 161.89 | 0.00 |
| | -31 | 26 | | | 3901.48 | 4868.46 | 1241 | 162.46 | 0.00 |

TABLE 4.7 MODEL OUTPUT for BULL POLICY 6 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 6 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 380 |
| %Sheep: | 100 | | |
| %Cattle(Bulls): | 10 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.19 | | |
| Ewes/Ha: | 8.94 | | |
| Hoggets/Ha: | 2.23 | | |

| PERIOD | | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | | | 0 | 815.78 | 1268 | 162.46 | 0.00 |
| | 15-28 | 2 | | | 758.68 | 1002.93 | 1280 | 159.79 | 0.00 |
| JULY | -12 | 3 | | | 932.73 | 1016.73 | 1275 | 160.36 | 0.00 |
| | -26 | 4 | | | 945.56 | 784.38 | 1246 | 168.39 | 0.00 |
| AUG | -9 | 5 | 0.80 | 391.20 | 705.66 | 558.16 | 1216 | 209.05 | 19.46 |
| | -23 | 6 | 1.00 | 405.20 | 507.92 | 944.85 | 1235 | 242.01 | 21.71 |
| SEPT | -6 | 7 | 1.20 | 422.00 | 871.52 | 2398.12 | 1309 | 303.52 | 24.12 |
| | -20 | 8 | 1.30 | 440.20 | 2055.54 | 4547.59 | 1459 | 417.00 | 25.86 |
| OCT | -4 | 9 | 1.40 | 459.80 | 3897.58 | 7088.26 | 1666 | 464.55 | 34.84 |
| | -18 | 10 | 1.40 | 479.40 | 6042.37 | 10887.96 | 2016 | 481.19 | 36.34 |
| NOV | -1 | 11 | 1.40 | 499.00 | 9158.23 | 12411.94 | 2219 | 420.87 | 37.89 |
| | -15 | 12 | 1.50 | 520.00 | 10136.81 | 11579.97 | 2248 | 386.80 | 41.74 |
| | -30 | 13 | 1.30 | 539.50 | 9015.62 | 9358.31 | 2159 | 403.27 | 41.48 |
| DEC | -14 | 14 | 1.20 | 556.30 | 6610.20 | 6671.02 | 2104 | 358.21 | 37.58 |
| | -28 | 15 | 1.20 | 573.10 | 4125.84 | 3447.79 | 1971 | 349.19 | 41.02 |
| JAN | -11 | 16 | 1.00 | 587.10 | 2205.70 | 1615.08 | 1847 | 271.52 | 37.08 |
| | -25 | 17 | | | 1068.06 | 357.99 | 1709 | 245.18 | 0.00 |
| FEB | -8 | 18 | | | 247.66 | -531.89 | 1565 | 226.62 | 0.00 |
| | -22 | 19 | | | 0.00 | -850.08 | 1415 | 236.60 | 0.00 |
| MARCH | -8 | 20 | | | 0.00 | -338.95 | 1200 | 205.66 | 0.00 |
| | -22 | 21 | | | 0.00 | 78.55 | 1078 | 229.82 | 0.00 |
| APRIL | -5 | 22 | | | 66.18 | 1015.38 | 1070 | 172.94 | 0.00 |
| | -19 | 23 | | | 914.29 | 2384.29 | 1125 | 168.00 | 0.00 |
| MAY | -3 | 24 | | | 2152.25 | 3784.88 | 1197 | 166.51 | 0.00 |
| | -17 | 25 | | | 3406.50 | 4530.94 | 1222 | 161.89 | 0.00 |
| | -31 | 26 | | | 3900.77 | 4867.75 | 1234 | 162.46 | 0.00 |

TABLE 4.8 MODEL OUTPUT for BULL POLICY 7 on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 7 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 365 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.38 | | |
| Ewes/Ha: | 7.15 | | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.40 | 416.80 | 0 | 811.42 | 1268 | 162.87 | 32.90 |
| 15-28 | 2 | | | 0.40 | 422.40 | 754.62 | 992.65 | 1279 | 160.36 | 32.52 |
| JULY -12 | 3 | | | 0.50 | 429.40 | 923.17 | 974.88 | 1271 | 163.30 | 35.01 |
| -26 | 4 | | | 0.50 | 436.40 | 906.64 | 734.31 | 1241 | 169.39 | 34.67 |
| AUG -9 | 5 | | | 0.75 | 446.90 | 661.45 | 661.52 | 1224 | 195.99 | 44.32 |
| -23 | 6 | | | 0.75 | 457.40 | 603.04 | 1288.39 | 1265 | 220.40 | 44.17 |
| SEPT -6 | 7 | | | 1.00 | 471.40 | 1187.69 | 3029.30 | 1365 | 276.60 | 53.07 |
| -20 | 8 | | | 1.10 | 486.80 | 2592.72 | 5623.52 | 1560 | 370.96 | 58.04 |
| OCT -4 | 9 | | | 1.20 | 503.60 | 4806.26 | 8643.80 | 1821 | 408.30 | 64.53 |
| -18 | 10 | | | 1.30 | 521.80 | 7320.16 | 12771.49 | 2221 | 427.58 | 71.70 |
| NOV -1 | 11 | | | 1.30 | 540.00 | 10627.14 | 14324.16 | 2457 | 380.93 | 74.55 |
| -15 | 12 | | | 1.20 | 556.80 | 11492.75 | 13364.60 | 2516 | 347.83 | 71.78 |
| -30 | 13 | | | 1.20 | 574.80 | 10176.37 | 10877.09 | 2449 | 370.12 | 80.69 |
| DEC -14 | 14 | | | 1.00 | 588.80 | 7475.07 | 7890.55 | 2420 | 324.43 | 67.93 |
| -28 | 15 | | | | | 4759.56 | 4813.11 | 2354 | 246.54 | 0.00 |
| JAN -11 | 16 | | | | | 2984.10 | 3065.17 | 2290 | 187.56 | 0.00 |
| -25 | 17 | | | | | 1934.73 | 1547.00 | 2175 | 196.15 | 0.00 |
| FEB -8 | 18 | | | | | 995.37 | 595.73 | 2059 | 185.41 | 0.00 |
| -22 | 19 | | | | | 405.58 | -308.09 | 1907 | 195.96 | 0.00 |
| MARCH -8 | 20 | 0.40 | 370.60 | | | 0.00 | -303.02 | 1647 | 201.67 | 37.14 |
| -22 | 21 | 0.40 | 376.20 | | | 0.00 | 182.94 | 1496 | 218.94 | 35.09 |
| APRIL -5 | 22 | 0.50 | 383.20 | | | 147.82 | 1086.69 | 1454 | 173.95 | 35.60 |
| -19 | 23 | 0.50 | 390.20 | | | 979.33 | 2435.62 | 1478 | 169.31 | 34.91 |
| MAY -3 | 24 | 0.50 | 397.20 | | | 2200.46 | 3812.90 | 1521 | 168.43 | 35.23 |
| -17 | 25 | 0.50 | 404.20 | | | 3421.07 | 4521.97 | 1519 | 164.06 | 34.56 |
| -31 | 26 | 0.50 | 411.20 | | | 3885.26 | 4826.63 | 1508 | 164.84 | 34.86 |

second summer to achieve the target slaughter weight, increasing the period of a negative energy balance (periods 17-20). Pasture cover therefore falls to slightly lower levels than for Policy 1. This illustrates the sensitivity of the summer dry environment to high stocking rates/animal performance levels over the summer.

Policy 3 (Table 4.4): This policy involves carrying bulls from weaners through to 2½ years of age. To "compensate" for carrying the bulls for this period of time, the policy aimed to grow them through to a very heavy weight (330 carcass weight). The pattern of pasture cover, and period of negative energy balance, generated by this system is very similar to that of Policy 1.

Policy 4 (Table 4.5): This policy generated the best "fit" between feed demand and supply, because no older bulls were grazed over the summer period. To achieve the target weight (221 kg carcass weight) by 17 months of age, a high overall average liveweight gain of 0.95 kg/day was required.

Policies 5 and 6 (Tables 4.6, 4.7 respectively): These two policies were similar, with bulls farmed solely over the spring period to take advantage of high spring pasture growth rates. Policy 5 involved running yearling bulls, while two year old bulls were run for Policy 6.

While policies 1-4 and 7, were operated at an 80:20 sheep:bull winter stock unit ratio, it was assumed for policies 5 and 6 that the farmer would operate a 100% sheep system (in terms of winter stock units) and buy in the equivalent of 10% more stock units - as bulls - during late winter (early August). Purchasing bulls in this manner would help to maintain pasture control during the spring flush. By controlling pastures over the spring-early summer period Korte (1982) and Hughes (1983) found a marked improvement (up to 100%) in summer-autumn pasture growth and quality. Policies 5 and 6 as run in the model, reduced spring-early summer pasture covers by 300 kg DM/ha (relative to the other policies), and increased the proportion of green material over the summer. In view of the response to controlling spring pastures outlined above, the model pasture growth rates and energy values were increased by 5% over January, February and March for these policies.

Lower average pasture cover during the spring had a flow on effect, and despite increased pasture growth and energy values due to improved spring pasture control, the summer pasture covers are also lower relative to the other policies (Tables 4.6, 4.7,.

Better spring pasture control would also result in lower pasture senescence/decay rates. However, they were not reduced for the model output shown in Tables 4.6, 4.7. If both of these were reduced by 0.2 units, average summer pasture covers would improve by 100-200 kg DM/ha.

Policy 7 (Table 4.8): This policy is essentially the same as policy 4, except one year older bulls are farmed. Again, as in policy 4, the average pasture cover generated showed a close agreement between feed supply and demand.

### 4.2.1 SUMMARY OF SUMMER DRY MODEL RESULTS

All the bull systems modelled were feasible in terms of the pasture covers generated. Policies 4 and 7 gave the best fit between feed demand/supply and generated the highest pasture covers over the whole year. However, high pasture covers are not necessarily "best", as high pasture covers, especially in the spring, could indicate a lack of pasture control. In this situation pasture quality (and future growth) will decrease, and it may not be possible to achieve the desired animal production. A summary of pasture covers and liveweight profiles generated by the model are shown in Figures 4.2 and 4.3 respectively.

Comparison of Policies 1-3 indicate that model output was very sensitive to the presence and rate of liveweight gain of large (R2 yr) bulls over the summer period. Although Policy 1 required a higher level of liveweight gain at all times relative to Policy 2, this system generated higher summer pasture covers with a higher level of green material (2.4%) making it less vulnerable to drought conditions. This advantage is negated to some extent by the requirement to grow replacement bulls at higher average growth rates (Table 4.1).

Apart from Policies 5 and 6, the pasture covers generated from the other bull systems, particularly Policies 4 and 7 indicate that a higher winter

Figure 4.2 A Summary of Average Pasture Covers for all Bull Policies in the Summer Dry Environment

(10.5 su/ha 80:20 Sheep:Bulls)

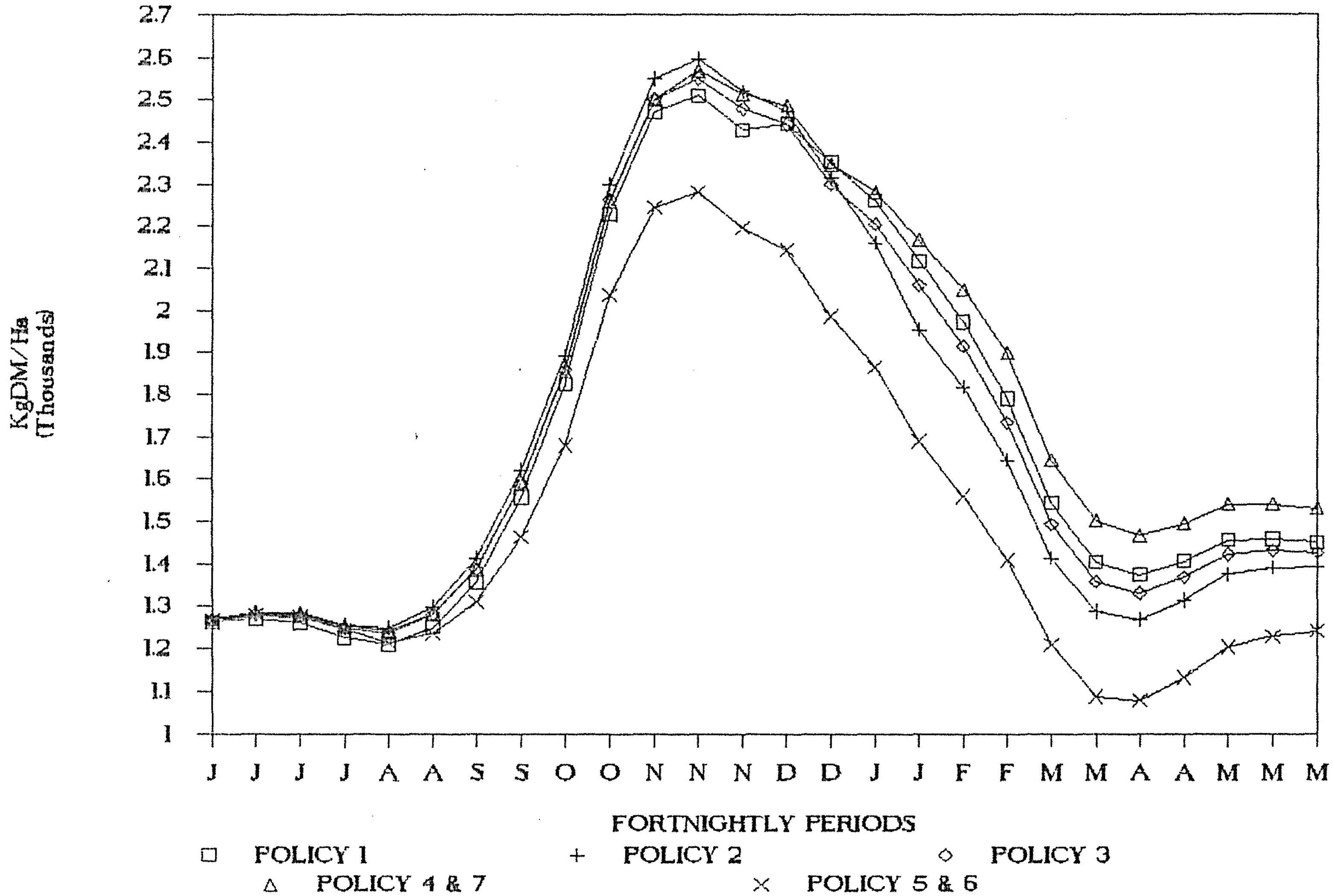


Figure 4.3 Summary of Bull Liveweight Profiles in the Summer Dry Environment

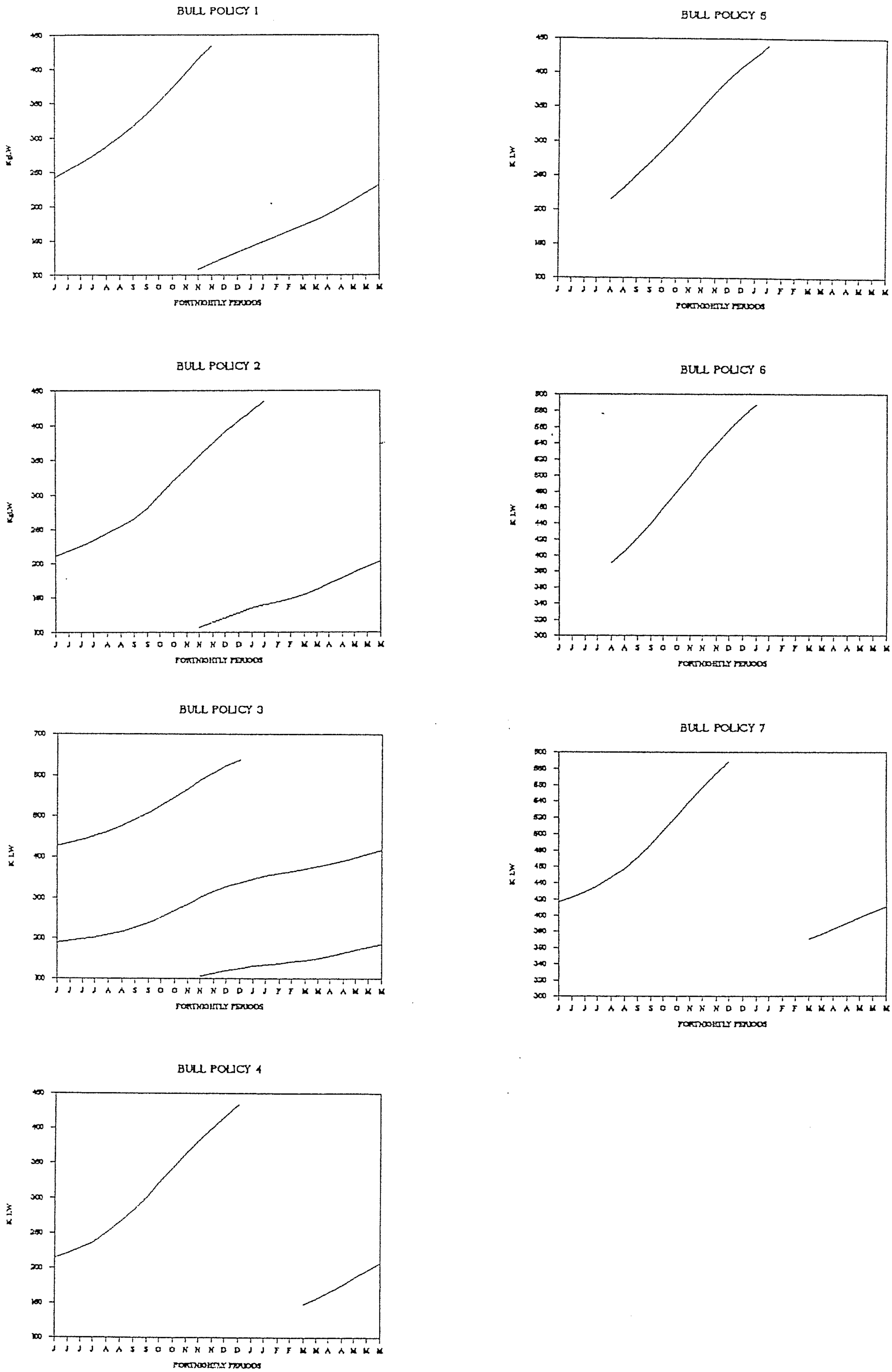
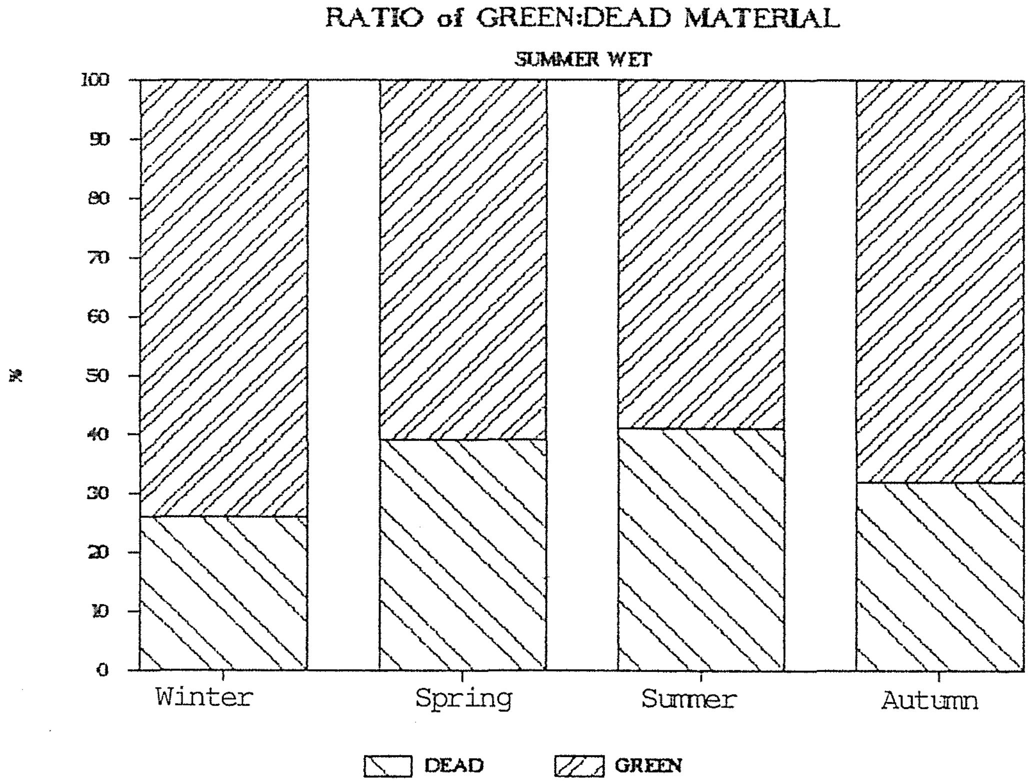
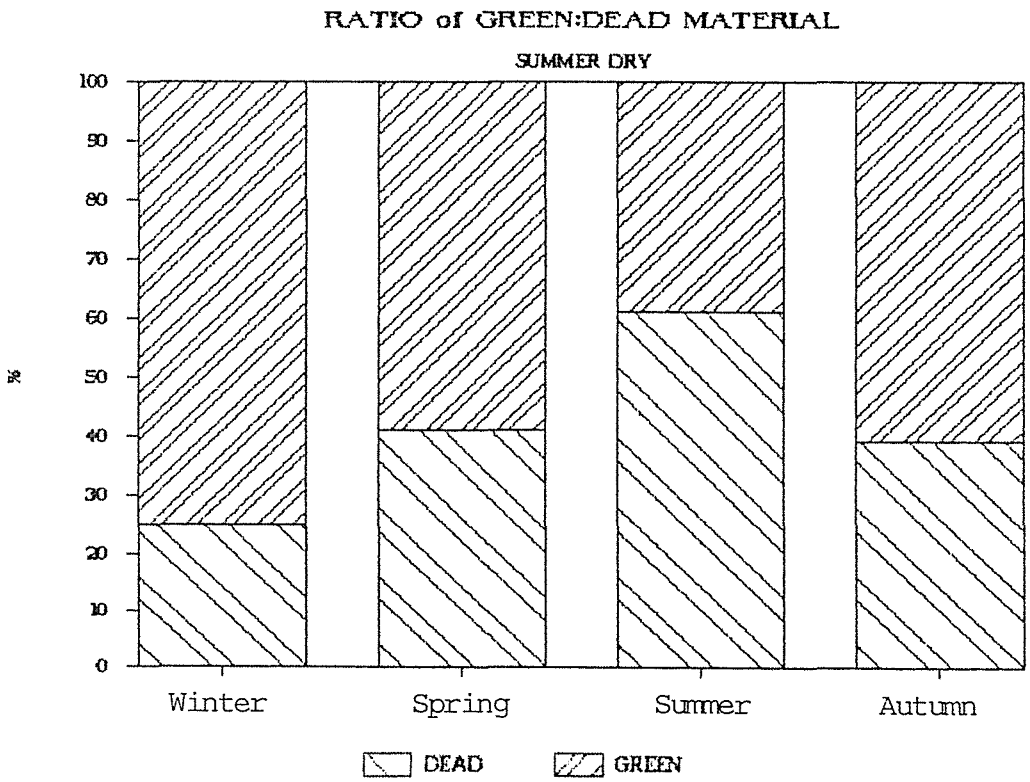


Figure 4.4 Summary of the Proportion of Green and Dead Material in Model Generated Pasture Covers



stocking rate could be carried. (This is discussed further in Sections 4.4 and 6.3).

Another important factor which the model shows is the accumulation of dead material during the summer. As Figure 4.4 indicates, up to 60% of the total cover during summer is dead material in the summer dry environment, compared with just over 40% in the summer wet environment. These figures varied only slightly between the different bull policies. This has practical significance because sheep restrict their diet predominantly to green herbage, while cattle are less selective (outlined in Section 2.4.2). Thus, although the summer dry model output indicates that the systems are sustainable in terms of energy supply, in practice reductions in animal intake/LWG may occur, particularly with sheep and young bulls (the summer dry survey farmers generally had lower lamb carcass weights/wool weights). In this situation cattle, especially older cattle, would be better suited.

## 4.3 SUMMER WET MODEL RESULTS

The summer wet region is representative of an area receiving 1200 mm of rain annually, producing 10000 kg DM per year, and supporting an average stocking rate of 12.5 su/ha. The main features of pasture production are the higher rates of growth (relative to the summer dry environment) during the late spring-summer period and low winter growth rates (Figure 3.1). Farming systems for this environment therefore essentially need to have low winter feed requirements but be able to take advantage of high pasture growth rates through the late spring-summer.

The bull systems modelled for this environment were the same as for the summer dry environment, but with different patterns of liveweight gain (Table 4.9).

A summary of the model output for each of the bull policies in the summer wet environment are illustrated in Tables 4.10 to 4.16[2]. The main features of each policy are:

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[2]The total model output for Policy 1 is shown in Appendix II(b). This also shows the sheep component of the Summer Wet model.

TABLE 4.9

Average Liveweight Gains (kg/day) on a
Seasonal Basis for Summer Wet Bull Policies

| | | Summer Dec-Feb | Autumn Mar-May | Winter Jun-Aug | Spring Sep-Nov | Average LWG Purchase Sale |
|---|---|---|---|---|---|---|
| POLICY 1 | R1 yr | 0.71 | 0.79 | 0.48 | 1.40 | 0.85 |
| POLICY 2 | R1 yr | 0.51 | 0.59 | 0.33 | 1.16 | 0.72 |
| | R2 yr | 1.08 | | | | |
| POLICY 3 | R1 yr | 0.43 | 0.49 | 0.30 | 0.97 | 0.68 |
| | R2 yr | 0.62 | 0.60 | 0.51 | 1.33 | |
| | R3 yr | 1.20 | | | | |
| POLICY 4 | R1 yr | | 0.69 | 0.40 | 1.24 | 0.87 |
| | R2 yr | 1.25 | | | | |
| POLICY 5 | R1 yr | | | 1.05 | 1.40 | 1.28 |
| | R2 yr | 1.18 | | | | |
| POLICY 6 | R2 yr | | | 0.88 | 1.33 | 1.21 |
| | R3 yr | 1.17 | | | | |
| POLICY 7 | R2 yr | | 0.43 | 0.28 | 1.05 | 0.68 |
| | R3 yr | 1.23 | | | | |

TABLE 4.10 MODEL OUTPUT for BULL POLICY 1 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 1 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 100 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.56 | | |
| Ewes/Ha: | 8.51 | | |
| Hoggets/Ha: | 2.13 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ kgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.50 | 263.70 | 0 | 213.19 | 1214 | 190.62 | 38.70 |
| 15-28 | 2 | | | 0.50 | 270.70 | 201.25 | -211.54 | 1171 | 191.53 | 39.34 |
| JULY -12 | 3 | | | 0.30 | 274.90 | 0.00 | -523.12 | 1115 | 187.56 | 34.83 |
| -26 | 4 | | | 0.30 | 279.10 | 0.00 | -507.56 | 1061 | 185.32 | 34.52 |
| AUG -9 | 5 | | | 0.50 | 286.10 | 0.00 | -351.70 | 1020 | 199.12 | 39.64 |
| -23 | 6 | | | 0.75 | 296.60 | 0.00 | -56.99 | 1005 | 229.04 | 47.16 |
| SEPT -6 | 7 | | | 1.00 | 310.60 | 0.00 | 159.19 | 972 | 280.16 | 54.81 |
| -20 | 8 | | | 1.30 | 328.80 | 137.21 | 1995.41 | 1082 | 331.18 | 65.13 |
| OCT -4 | 9 | | | 1.50 | 349.80 | 1743.91 | 3627.09 | 1191 | 455.04 | 73.92 |
| -18 | 10 | | | 1.50 | 370.80 | 3170.31 | 6462.94 | 1420 | 497.68 | 77.30 |
| NOV -1 | 11 | | | 1.50 | 391.80 | 5641.83 | 9843.13 | 1729 | 496.20 | 80.76 |
| -15 | 12 | 0.60 | 108.40 | 1.50 | 412.80 | 8447.21 | 11028.27 | 1889 | 481.47 | 108.19 |
| -30 | 13 | 0.60 | 117.40 | 1.50 | 435.30 | 9250.88 | 11973.27 | 2047 | 487.51 | 120.49 |
| DEC -14 | 14 | 0.60 | 125.80 | | | 9538.46 | 11938.66 | 2154 | 355.80 | 26.25 |
| -28 | 15 | 0.75 | 136.30 | | | 8435.61 | 10015.71 | 2182 | 343.69 | 30.38 |
| JAN -11 | 16 | 0.75 | 146.80 | | | 7062.57 | 8899.90 | 2233 | 273.02 | 32.66 |
| -25 | 17 | 0.75 | 157.30 | | | 6112.21 | 7466.98 | 2237 | 274.47 | 34.71 |
| FEB -8 | 18 | 0.80 | 168.50 | | | 5208.08 | 6457.52 | 2229 | 256.70 | 37.17 |
| -22 | 19 | 0.80 | 179.70 | | | 4563.82 | 4930.47 | 2136 | 271.33 | 39.83 |
| MARCH -8 | 20 | 0.80 | 190.90 | | | 3609.63 | 3685.32 | 1916 | 258.12 | 43.07 |
| -22 | 21 | 0.80 | 202.10 | | | 2843.92 | 2466.58 | 1689 | 290.50 | 43.73 |
| APRIL -5 | 22 | 0.80 | 213.30 | | | 1911.58 | 2322.39 | 1569 | 253.72 | 43.46 |
| -19 | 23 | 0.80 | 224.50 | | | 1877.58 | 3120.67 | 1545 | 203.61 | 43.61 |
| MAY -3 | 24 | 0.80 | 235.70 | | | 2611.38 | 3413.93 | 1480 | 203.57 | 44.99 |
| -17 | 25 | 0.75 | 246.20 | | | 2868.31 | 3452.33 | 1404 | 197.92 | 43.75 |
| -31 | 26 | 0.75 | 256.70 | | | 2830.81 | 3093.66 | 1308 | 199.66 | 44.93 |

TABLE 4.11 MODEL OUTPUT for BULL POLICY 2 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 2 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 100 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.56 | | |
| Ewes/Ha: | 8.51 | | |
| Hoggets/Ha: | 2.13 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQ.kgDM | TOTAL BULL REQ.kgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.25 | 218.10 | 0 | 316.10 | 1224 | 181.26 | 29.35 |
| 15-28 | 2 | | | 0.25 | 221.60 | 298.40 | -7.51 | 1190 | 181.81 | 29.62 |
| JULY -12 | 3 | | | 0.25 | 225.10 | 0.00 | -468.87 | 1139 | 182.62 | 29.90 |
| -26 | 4 | | | 0.25 | 228.60 | 0.00 | -452.80 | 1090 | 180.43 | 29.63 |
| AUG -9 | 5 | | | 0.50 | 235.60 | 0.00 | -300.82 | 1054 | 194.62 | 35.14 |
| -23 | 6 | | | 0.50 | 242.60 | 0.00 | 71.56 | 1049 | 217.67 | 35.78 |
| SEPT -6 | 7 | | | 0.75 | 253.10 | 61.68 | 370.29 | 1029 | 267.16 | 41.82 |
| -20 | 8 | | | 1.00 | 267.10 | 323.47 | 2373.93 | 1153 | 314.75 | 48.70 |
| OCT -4 | 9 | | | 1.30 | 285.30 | 2075.06 | 4132.43 | 1274 | 440.16 | 59.03 |
| -18 | 10 | | | 1.30 | 303.50 | 3610.90 | 7071.69 | 1516 | 483.06 | 62.67 |
| NOV -1 | 11 | | | 1.30 | 321.70 | 6159.92 | 10523.36 | 1835 | 481.86 | 66.42 |
| -15 | 12 | 0.50 | 107.00 | 1.30 | 339.90 | 8981.96 | 11735.27 | 2006 | 465.95 | 92.67 |
| -30 | 13 | 0.50 | 114.50 | 1.20 | 357.90 | 9777.00 | 12736.83 | 2181 | 465.93 | 98.90 |
| DEC -14 | 14 | 0.50 | 121.50 | 1.20 | 374.70 | 10066.24 | 11712.94 | 2213 | 424.30 | 94.74 |
| -28 | 15 | 0.50 | 128.50 | 1.20 | 391.50 | 8201.91 | 9042.40 | 2166 | 412.18 | 98.86 |
| JAN -11 | 16 | 0.50 | 135.50 | 1.00 | 405.50 | 6351.54 | 7520.00 | 2152 | 336.72 | 96.36 |
| -25 | 17 | 0.50 | 142.50 | 1.00 | 419.50 | 5201.33 | 5880.84 | 2091 | 340.03 | 100.27 |
| FEB -8 | 18 | 0.50 | 149.50 | 1.00 | 433.50 | 4189.25 | 4768.00 | 2023 | 321.81 | 102.28 |
| -22 | 19 | 0.55 | 157.20 | | | 3460.82 | 3905.62 | 1945 | 263.52 | 32.01 |
| MARCH -8 | 20 | 0.55 | 164.90 | | | 2973.70 | 3133.49 | 1750 | 249.35 | 34.31 |
| -22 | 21 | 0.55 | 172.60 | | | 2500.94 | 2213.58 | 1547 | 281.32 | 34.54 |
| APRIL -5 | 22 | 0.60 | 181.00 | | | 1763.70 | 2259.32 | 1448 | 245.41 | 35.15 |
| -19 | 23 | 0.60 | 189.40 | | | 1846.12 | 3178.58 | 1445 | 195.10 | 35.10 |
| MAY -3 | 24 | 0.60 | 197.80 | | | 2669.56 | 3566.01 | 1398 | 194.62 | 36.04 |
| -17 | 25 | 0.60 | 206.20 | | | 2999.01 | 3667.27 | 1339 | 190.12 | 35.95 |
| -31 | 26 | 0.60 | 214.60 | | | 2999.48 | 3349.71 | 1258 | 191.57 | 36.84 |

TABLE 4.12 MODEL OUTPUT for BULL POLICY 3 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 3 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt | |
| %Sheep: | 80 | of Bull(kg): | 100 |
| %Cattle(Bulls): | 20 | Pasture cover | |
| Bulls/Ha: | 0.25 | at 1st June: | 1200 |
| Ewes/Ha: | 8.51 | (kgDM/Ha) | |
| Hoggets/Ha: | 2.13 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | 3rd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | ENERGY BALANCE (MJME) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQS. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.20 | 198.50 | 0.30 | 431.90 | 284.52 | 1221 | 184.13 | 32.22 |
| 15-28 | 2 | | | 0.20 | 201.30 | 0.30 | 436.10 | -68.09 | 1184 | 184.61 | 32.42 |
| JULY -12 | 3 | | | 0.20 | 204.10 | 0.50 | 443.10 | -544.10 | 1127 | 189.46 | 36.74 |
| -26 | 4 | | | 0.20 | 206.90 | 0.60 | 451.50 | -551.35 | 1069 | 189.23 | 38.43 |
| AUG -9 | 5 | | | 0.50 | 213.90 | 0.60 | 459.90 | -369.72 | 1026 | 200.72 | 41.24 |
| -23 | 6 | | | 0.50 | 220.90 | 0.75 | 470.40 | -34.23 | 1013 | 227.03 | 45.14 |
| SEPT -6 | 7 | | | 0.60 | 229.30 | 1.00 | 484.40 | 189.54 | 983 | 277.52 | 52.17 |
| -20 | 8 | | | 0.60 | 237.70 | 1.20 | 501.20 | 2109.24 | 1100 | 323.77 | 57.72 |
| OCT -4 | 9 | | | 1.00 | 251.70 | 1.30 | 519.40 | 3815.89 | 1215 | 447.41 | 66.29 |
| -18 | 10 | | | 1.20 | 268.50 | 1.50 | 540.40 | 6617.10 | 1443 | 498.62 | 78.24 |
| NOV -1 | 11 | | | 1.20 | 285.30 | 1.50 | 561.40 | 9962.19 | 1749 | 497.40 | 81.96 |
| -15 | 12 | 0.50 | 107.00 | 1.20 | 302.10 | 1.50 | 582.40 | 11251.87 | 1920 | 469.16 | 95.88 |
| -30 | 13 | 0.50 | 114.50 | 1.00 | 317.10 | 1.30 | 601.90 | 12406.73 | 2102 | 463.39 | 96.37 |
| DEC -14 | 14 | 0.40 | 120.10 | 0.75 | 327.60 | 1.20 | 618.70 | 11635.24 | 2149 | 413.32 | 83.76 |
| -28 | 15 | 0.40 | 125.70 | 0.75 | 338.10 | 1.20 | 635.50 | 9164.05 | 2119 | 400.19 | 86.88 |
| JAN -11 | 16 | 0.40 | 131.30 | 0.60 | 346.50 | | | 8271.74 | 2170 | 274.59 | 34.24 |
| -25 | 17 | 0.40 | 136.90 | 0.60 | 354.90 | | | 7064.09 | 2176 | 275.22 | 35.47 |
| FEB -8 | 18 | 0.40 | 142.50 | 0.50 | 361.90 | | | 6274.13 | 2173 | 254.04 | 34.52 |
| -22 | 19 | 0.40 | 148.10 | 0.50 | 368.90 | | | 4887.62 | 2086 | 267.57 | 36.06 |
| MARCH -8 | 20 | 0.40 | 153.70 | 0.60 | 377.30 | | | 3702.45 | 1875 | 254.77 | 39.73 |
| -22 | 21 | 0.50 | 160.70 | 0.60 | 385.70 | | | 2519.03 | 1656 | 287.17 | 40.39 |
| APRIL -5 | 22 | 0.50 | 167.70 | 0.60 | 394.10 | | | 2404.13 | 1543 | 249.70 | 39.44 |
| -19 | 23 | 0.50 | 174.70 | 0.60 | 402.50 | | | 3233.18 | 1527 | 198.92 | 38.92 |
| MAY -3 | 24 | 0.50 | 181.70 | 0.60 | 410.90 | | | 3560.74 | 1469 | 198.10 | 39.52 |
| -17 | 25 | 0.50 | 188.70 | 0.60 | 419.30 | | | 3620.65 | 1400 | 193.17 | 39.00 |
| -31 | 26 | 0.50 | 195.70 | 0.60 | 427.70 | | | 3278.48 | 1310 | 194.30 | 39.57 |

TABLE 4.13 MODEL OUTPUT for BULL POLICY 4 on SUMMER WET WIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 4 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 140 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.56 | | |
| Ewes/Ha: | 8.51 | | |
| Hoggets/Ha: | 2.13 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE MJME | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.30 | 211.40 | 0 | 311.24 | 1223 | 181.71 | 29.79 |
| 15-28 | 2 | | | 0.30 | 215.60 | 293.81 | -17.76 | 1189 | 182.32 | 30.14 |
| JULY -12 | 3 | | | 0.30 | 219.80 | 0.00 | -475.33 | 1138 | 183.21 | 30.48 |
| -26 | 4 | | | 0.30 | 224.00 | 0.00 | -460.04 | 1088 | 181.07 | 30.28 |
| AUG -9 | 5 | | | 0.60 | 232.40 | 0.00 | -321.81 | 1049 | 196.48 | 37.00 |
| -23 | 6 | | | 0.60 | 240.80 | 0.00 | 48.43 | 1043 | 219.71 | 37.83 |
| SEPT -6 | 7 | | | 0.80 | 252.00 | 41.49 | 337.94 | 1022 | 268.22 | 42.87 |
| -20 | 8 | | | 1.00 | 266.00 | 295.25 | 2347.26 | 1147 | 314.61 | 48.57 |
| OCT -4 | 9 | | | 1.10 | 281.40 | 2051.67 | 4178.93 | 1274 | 434.18 | 53.06 |
| -18 | 10 | | | 1.30 | 299.60 | 3651.85 | 7119.06 | 1516 | 482.50 | 62.12 |
| NOV -1 | 11 | | | 1.50 | 320.60 | 6202.82 | 10495.35 | 1829 | 488.13 | 72.69 |
| -15 | 12 | | | 1.50 | 341.60 | 8956.36 | 11879.09 | 2016 | 450.69 | 77.41 |
| -30 | 13 | | | 1.50 | 364.10 | 9890.31 | 12994.78 | 2204 | 452.78 | 85.75 |
| DEC -14 | 14 | | | 1.50 | 385.10 | 10264.79 | 12048.60 | 2247 | 411.84 | 82.28 |
| -28 | 15 | | | 1.30 | 403.30 | 8424.35 | 9489.47 | 2220 | 391.38 | 78.06 |
| JAN -11 | 16 | | | 1.20 | 420.10 | 6638.92 | 7999.90 | 2222 | 318.38 | 78.03 |
| -25 | 17 | | | 1.00 | 434.10 | 5500.16 | 6460.39 | 2186 | 312.77 | 73.02 |
| FEB -8 | 18 | | | | | 4569.88 | 6202.13 | 2215 | 219.53 | 0.00 |
| -22 | 19 | | | | | 4458.92 | 5223.85 | 2162 | 231.51 | 0.00 |
| MARCH -8 | 20 | 0.60 | 148.40 | | | 3879.66 | 4050.66 | 1951 | 248.19 | 33.15 |
| -22 | 21 | 0.60 | 156.80 | | | 3135.03 | 2857.39 | 1733 | 280.33 | 33.55 |
| APRIL -5 | 22 | 0.60 | 165.20 | | | 2183.99 | 2698.85 | 1620 | 243.52 | 33.26 |
| -19 | 23 | 0.75 | 175.70 | | | 2150.63 | 3469.16 | 1600 | 196.43 | 36.43 |
| MAY -3 | 24 | 0.75 | 186.20 | | | 2875.84 | 3754.34 | 1538 | 196.33 | 37.75 |
| -17 | 25 | 0.75 | 196.70 | | | 3126.41 | 3772.80 | 1464 | 192.15 | 37.97 |
| -31 | 26 | 0.75 | 207.20 | | | 3059.44 | 3383.93 | 1369 | 193.95 | 39.23 |

TABLE 4.14 MODEL OUTPUT for BULL POLICY 5 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 5 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 200 |
| %Sheep: | 100 | | |
| %Cattle(Bulls): | 10 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.28 | | |
| Ewes/Ha: | 10.64 | | |
| Hoggets/Ha: | 2.66 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | FEED CARRYOVER (MJME's) | ENERGY BALANCE MJME | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ KgDM |
|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0 | 221.17 | 1215 | 189.89 | 0.00 |
| 15-28 | 2 | | | 208.78 | -189.77 | 1173 | 190.23 | 0.00 |
| JULY -12 | 3 | | | 0.00 | -560.00 | 1114 | 190.91 | 0.00 |
| -26 | 4 | | | 0.00 | -543.17 | 1057 | 188.50 | 0.00 |
| AUG -9 | 5 | 1.00 | 214.00 | 0.00 | -600.75 | 994 | 221.16 | 21.81 |
| -23 | 6 | 1.10 | 229.40 | 0.00 | -308.96 | 956 | 251.34 | 23.98 |
| SEPT -6 | 7 | 1.20 | 246.20 | 0.00 | -156.43 | 897 | 307.60 | 25.92 |
| -20 | 8 | 1.30 | 264.40 | 0.00 | 1514.17 | 979 | 360.58 | 28.02 |
| OCT -4 | 9 | 1.30 | 282.60 | 1294.54 | 2584.71 | 1040 | 505.73 | 29.32 |
| -18 | 10 | 1.50 | 303.60 | 2258.31 | 4835.99 | 1211 | 559.85 | 34.37 |
| NOV -1 | 11 | 1.50 | 324.60 | 4229.80 | 7755.79 | 1466 | 555.97 | 36.67 |
| -15 | 12 | 1.50 | 345.60 | 6714.90 | 9027.83 | 1610 | 505.63 | 39.03 |
| -30 | 13 | 1.50 | 368.10 | 7703.48 | 10267.85 | 1766 | 501.88 | 43.10 |
| DEC -14 | 14 | 1.30 | 386.30 | 8386.87 | 9756.71 | 1794 | 449.47 | 37.53 |
| -28 | 15 | 1.30 | 404.50 | 7078.20 | 7718.27 | 1752 | 430.73 | 39.09 |
| JAN -11 | 16 | 1.10 | 419.90 | 5562.30 | 6869.17 | 1774 | 337.54 | 37.09 |
| -25 | 17 | 1.00 | 433.90 | 4877.12 | 5740.29 | 1755 | 336.20 | 36.50 |
| FEB -8 | 18 | | | 4165.68 | 5232.64 | 1755 | 274.41 | 0.00 |
| -22 | 19 | | | 3838.46 | 4444.63 | 1712 | 289.38 | 0.00 |
| MARCH -8 | 20 | | | 3423.57 | 3587.07 | 1572 | 263.32 | 0.00 |
| -22 | 21 | | | 2900.51 | 2397.47 | 1388 | 302.30 | 0.00 |
| APRIL -5 | 22 | | | 1928.20 | 2246.15 | 1304 | 262.83 | 0.00 |
| -19 | 23 | | | 1840.00 | 3121.00 | 1323 | 200.00 | 0.00 |
| MAY -3 | 24 | | | 2651.84 | 3510.46 | 1301 | 198.23 | 0.00 |
| -17 | 25 | | | 2998.72 | 3638.93 | 1264 | 192.72 | 0.00 |
| -31 | 26 | | | 3028.44 | 3661.21 | 1231 | 193.41 | 0.00 |

TABLE 4.15 MODEL OUTPUT for BULL POLICY 6 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 6 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 380 |
| %Sheep: | 100 | | |
| %Cattle(Bulls): | 10 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.23 | | |
| Ewes/Ha: | 10.64 | | |
| Hoggets/Ha: | 2.66 | | |

| PERIOD | | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | FEED CARRYOVER (MJME's) | ENERGY BALANCE MJME | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ KgDM |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | | | 0 | 221.17 | 1215 | 189.89 | 0.00 |
| | 15-28 | 2 | | | 208.78 | -189.77 | 1173 | 190.23 | 0.00 |
| JULY | -12 | 3 | | | 0.00 | -560.00 | 1114 | 190.91 | 0.00 |
| | -26 | 4 | | | 0.00 | -543.17 | 1057 | 188.50 | 0.00 |
| AUG | -9 | 5 | 0.75 | 390.50 | 0.00 | -608.37 | 993 | 221.84 | 22.49 |
| | -23 | 6 | 1.00 | 404.50 | 0.00 | -334.91 | 953 | 253.64 | 26.28 |
| SEPT | -6 | 7 | 1.00 | 418.50 | 0.00 | -160.41 | 894 | 307.95 | 26.26 |
| | -20 | 8 | 1.20 | 435.30 | 0.00 | 1500.87 | 975 | 361.72 | 29.16 |
| OCT | -4 | 9 | 1.30 | 453.50 | 1282.68 | 2472.67 | 1027 | 514.29 | 37.89 |
| | -18 | 10 | 1.40 | 473.10 | 2160.35 | 4648.24 | 1191 | 567.66 | 42.18 |
| NOV | -1 | 11 | 1.50 | 494.10 | 4065.53 | 7475.72 | 1436 | 566.21 | 46.91 |
| | -15 | 12 | 1.50 | 515.10 | 6476.62 | 8679.30 | 1571 | 515.56 | 48.96 |
| | -30 | 13 | 1.40 | 536.10 | 7420.29 | 9891.66 | 1720 | 510.33 | 51.55 |
| DEC | -14 | 14 | 1.30 | 554.30 | 8107.69 | 9389.73 | 1741 | 457.45 | 45.51 |
| | -28 | 15 | 1.20 | 571.10 | 6846.54 | 7431.25 | 1697 | 435.86 | 44.21 |
| JAN | -11 | 16 | 1.00 | 585.10 | 5381.19 | 6654.69 | 1719 | 340.71 | 40.27 |
| | -25 | 17 | | | 4749.28 | 5988.39 | 1739 | 299.70 | 0.00 |
| FEB | -8 | 18 | | | 4363.36 | 5430.32 | 1741 | 274.41 | 0.00 |
| | -22 | 19 | | | 3983.89 | 4590.06 | 1700 | 289.38 | 0.00 |
| MARCH | -8 | 20 | | | 3519.84 | 3683.33 | 1561 | 263.32 | 0.00 |
| | -22 | 21 | | | 2958.31 | 2455.28 | 1379 | 302.30 | 0.00 |
| APRIL | -5 | 22 | | | 1969.32 | 2287.27 | 1296 | 262.83 | 0.00 |
| | -19 | 23 | | | 1869.14 | 3150.14 | 1316 | 200.00 | 0.00 |
| MAY | -3 | 24 | | | 2673.11 | 3531.73 | 1295 | 198.23 | 0.00 |
| | -17 | 25 | | | 3014.11 | 3654.33 | 1258 | 192.72 | 0.00 |
| | -31 | 26 | | | 3038.56 | 3671.33 | 1226 | 193.41 | 0.00 |

TABLE 4.16 MODEL OUTPUT for BULL POLICY 7 on SUMMER WET WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 7 | Lambing%: | 100 |
| Stocking rate(su/ha): | 12.5 | Initial wt of Bull(kg): | 365 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.45 | | |
| Ewes/Ha: | 8.51 | | |
| Hoggets/Ha: | 2.13 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE MJME | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.20 | 409.80 | 0 | 274.34 | 1220 | 185.06 | 33.15 |
| 15-28 | 2 | | | 0.20 | 412.60 | 258.98 | -86.99 | 1182 | 185.45 | 33.27 |
| JULY -12 | 3 | | | 0.20 | 415.40 | 0.00 | -507.25 | 1128 | 186.11 | 33.39 |
| -26 | 4 | | | 0.20 | 418.20 | 0.00 | -489.51 | 1076 | 183.71 | 32.91 |
| AUG -9 | 5 | | | 0.40 | 423.80 | 0.00 | -330.39 | 1037 | 197.24 | 37.76 |
| -23 | 6 | | | 0.50 | 430.80 | 0.00 | 16.66 | 1028 | 222.53 | 40.64 |
| SEPT -6 | 7 | | | 0.50 | 437.80 | 14.26 | 340.69 | 1009 | 265.62 | 40.27 |
| -20 | 8 | | | 0.75 | 448.30 | 297.72 | 2320.66 | 1132 | 317.10 | 51.05 |
| OCT -4 | 9 | | | 1.00 | 462.30 | 2028.31 | 4045.84 | 1251 | 443.56 | 62.44 |
| -18 | 10 | | | 1.10 | 477.70 | 3535.89 | 6918.21 | 1486 | 489.88 | 69.50 |
| NOV -1 | 11 | | | 1.20 | 494.50 | 6028.12 | 10268.36 | 1796 | 492.76 | 77.32 |
| -15 | 12 | | | 1.30 | 512.70 | 8773.02 | 11600.73 | 1975 | 459.25 | 85.97 |
| -30 | 13 | | | 1.50 | 535.20 | 9681.64 | 12521.95 | 2141 | 476.79 | 109.77 |
| DEC -14 | 14 | | | 1.50 | 556.20 | 9920.38 | 11470.55 | 2165 | 433.08 | 103.52 |
| -28 | 15 | | | 1.20 | 573.00 | 8053.47 | 9004.64 | 2132 | 401.93 | 88.61 |
| JAN -11 | 16 | | | 1.00 | 587.00 | 6335.63 | 7668.47 | 2135 | 321.06 | 80.71 |
| -25 | 17 | | | | | 5317.12 | 7029.41 | 2177 | 239.76 | 0.00 |
| FEB -8 | 18 | | | | | 5005.08 | 6637.34 | 2209 | 219.53 | 0.00 |
| -22 | 19 | | | | | 4764.34 | 5529.28 | 2157 | 231.51 | 0.00 |
| MARCH -8 | 20 | 0.50 | 372.00 | | | 4066.28 | 4129.69 | 1937 | 259.40 | 44.35 |
| -22 | 21 | 0.50 | 379.00 | | | 3148.30 | 2769.62 | 1710 | 290.64 | 43.86 |
| APRIL -5 | 22 | 0.50 | 386.00 | | | 2109.78 | 2530.00 | 1590 | 252.80 | 42.54 |
| -19 | 23 | 0.50 | 393.00 | | | 2018.27 | 3281.35 | 1567 | 201.71 | 41.71 |
| MAY -3 | 24 | 0.40 | 398.60 | | | 2729.97 | 3591.64 | 1505 | 197.94 | 39.35 |
| -17 | 25 | 0.30 | 402.80 | | | 3003.65 | 3672.08 | 1436 | 190.11 | 35.93 |
| -31 | 26 | 0.30 | 407.00 | | | 2995.42 | 3353.36 | 1346 | 190.86 | 36.13 |

Policy 1 (Table 4.10): This policy results in a negative energy balance from mid June to late August (periods 2-6), which is buffered by pasture cover, and generates an average cover of just under 1000 kg DM/ha at the start of lambing. Pasture cover then increases rapidly during the spring and early summer before declining in the autumn.

Policy 2 (Table 4.11): With slower bull growth rates than for Policy 1, the negative winter energy balance is less severe and of shorter duration. Consequently pasture cover at the start of lambing is slightly higher (1029 kg DM/ha).

Policy 3 (Table 4.12): As for the summer dry situation, this policy results in an energy balance and pasture covers very similar to Policy 1. Pasture cover at the start of lambing is just under 1000 kg DM/ha which then increases during spring.

Policy 4 (Table 4.13): To compensate for low winter growth rates, the bulls are carried for 1 month longer in the summer wet environment to reach their target weight of 433 kg LW at slaughter. Table 4.13 shows a negative energy balance from mid June to early August (periods 2-5), with a cover of just over 1000 kg DM/ha at the start of lambing.

Policies 5 and 6 (Tables 4.14 and 4.15 respectively): The same assumptions that were made with respect to these policies in the summer dry assumptions also applied in the summer wet environment; namely that the farm operated an all sheep policy other than buying in the equivalent of 10% of stock units as bulls in the late winter (early August), and that summer growth was boosted by 5% through controlling the spring flush. The energy balance was negative from mid June to early September (periods 2-7), with pasture covers just under 900 kg DM/ha at the start of lambing.

Delaying the purchase of the bulls in Policy 5 by a fortnight (late August-period 6) increased pasture cover at the start of lambing by only 30 kg DM/ha. However, subsequently pasture cover improved more rapidly through the spring (to November), and hence greater liveweight gain (in either sheep or bulls) could be expected with a later buying policy (However, the purchase price of bulls usually increases as spring pasture growth rate improve).

Policy 7 (Table 4.16): This policy is very similar to Policy 4 in terms of the pasture covers generated. However, the effect of older/heavier bulls (and hence greater feed requirements) results in slightly lower pasture covers compared with Policy 4. Pasture cover at the start of lambing is just over 1000 kg DM/ha.

### 4.3.1 SUMMARY OF SUMMER WET MODEL RESULTS

All the bull systems modelled appeared feasible in terms of pasture covers generated (Figures 4.5 and 4.6). Apart from Policies 5 and 6, there was little difference between the bull systems in terms of pasture cover. Policies 5 and 6 illustrate the sensitivity of pasture cover to feed demand over the winter-early spring period. By delaying the purchase of bulls by only a fortnight (given the pasture growth rates used in the model) pasture cover improved over lambing. In practice, this would be reflected by higher sheep performance. The model highlighted the importance of taking an adequate bank of feed into the winter. While the average cover of 1200 kg DM/ha at the start of June used in the model was sufficient to overcome the feed deficit in the late winter-early spring, a higher initial cover would allow for greater winter bull growth rates, and/or a higher pasture cover at the start of lambing. However, increasing the average pasture cover at the start of winter would involve a re-organization of autumn management. The reduction in income from selling lambs earlier at lighter weights, or reductions in animal LWG over the autumn, could well negate any gains to increased winter-early spring production. A higher cover at the start of winter would also mean a higher level of dead matter. Thus the higher level of pasture would not necessarily result in higher liveweight gains.

Lambing a fortnight earlier (August 24 vs September 7) had a major impact, reducing average pasture covers during September to between 800-900 kg DM/ha. Under these circumstances the assumed bull growth rates could not be achieved, and sheep performance would be adversely affected.

## 4.4 ALTERATION OF SHEEP:CATTLE RATIOS

The effect of altering the sheep:cattle ratio on the relationship between feed supply and demand (as reflected by changes in pasture cover) was

Figure 4.5 A Summary of Average Pasture Covers for all Bull Policies in the Summer Wet Environment

(12.5 su/ha 80:20 Sheep:Bulls)

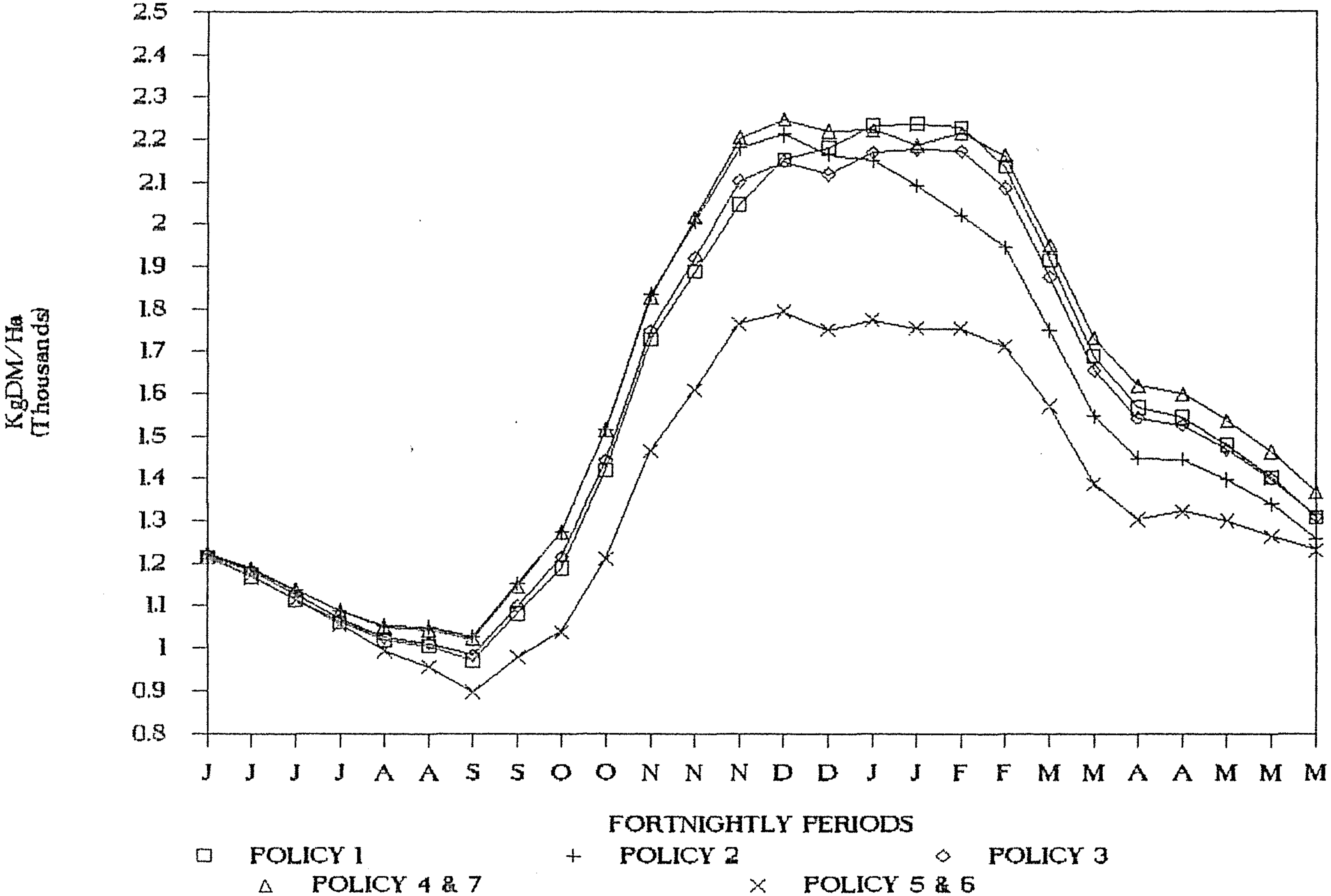


Figure 4.6 A Summary of Bull Liveweight Profiles in the Summer Wet Environment

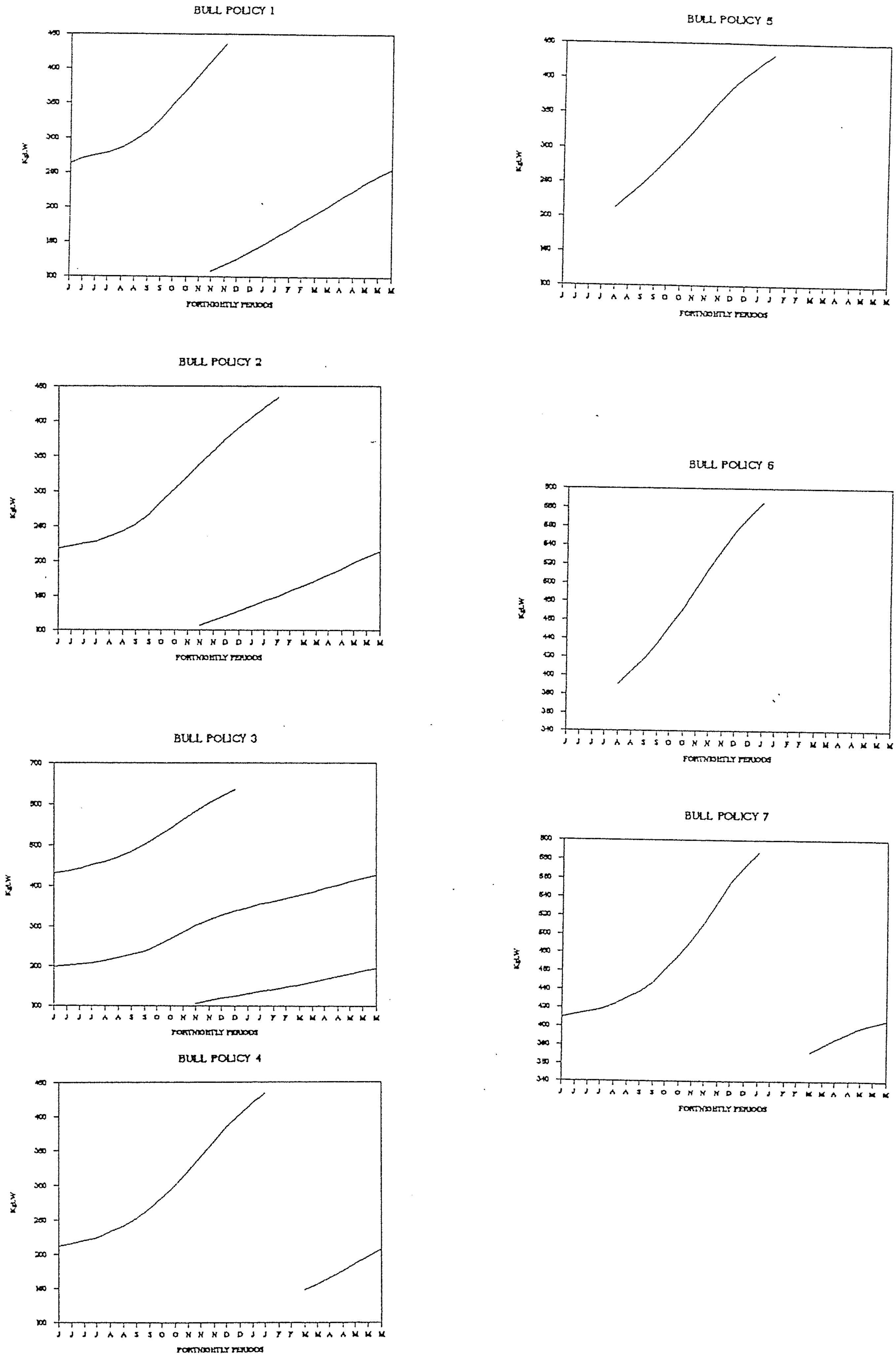


Figure 4.7 Average Pasture Covers Generated by Increasing the Proportion of Bulls in Policy 1. Summer Dry Environment. 10.5 su/ha

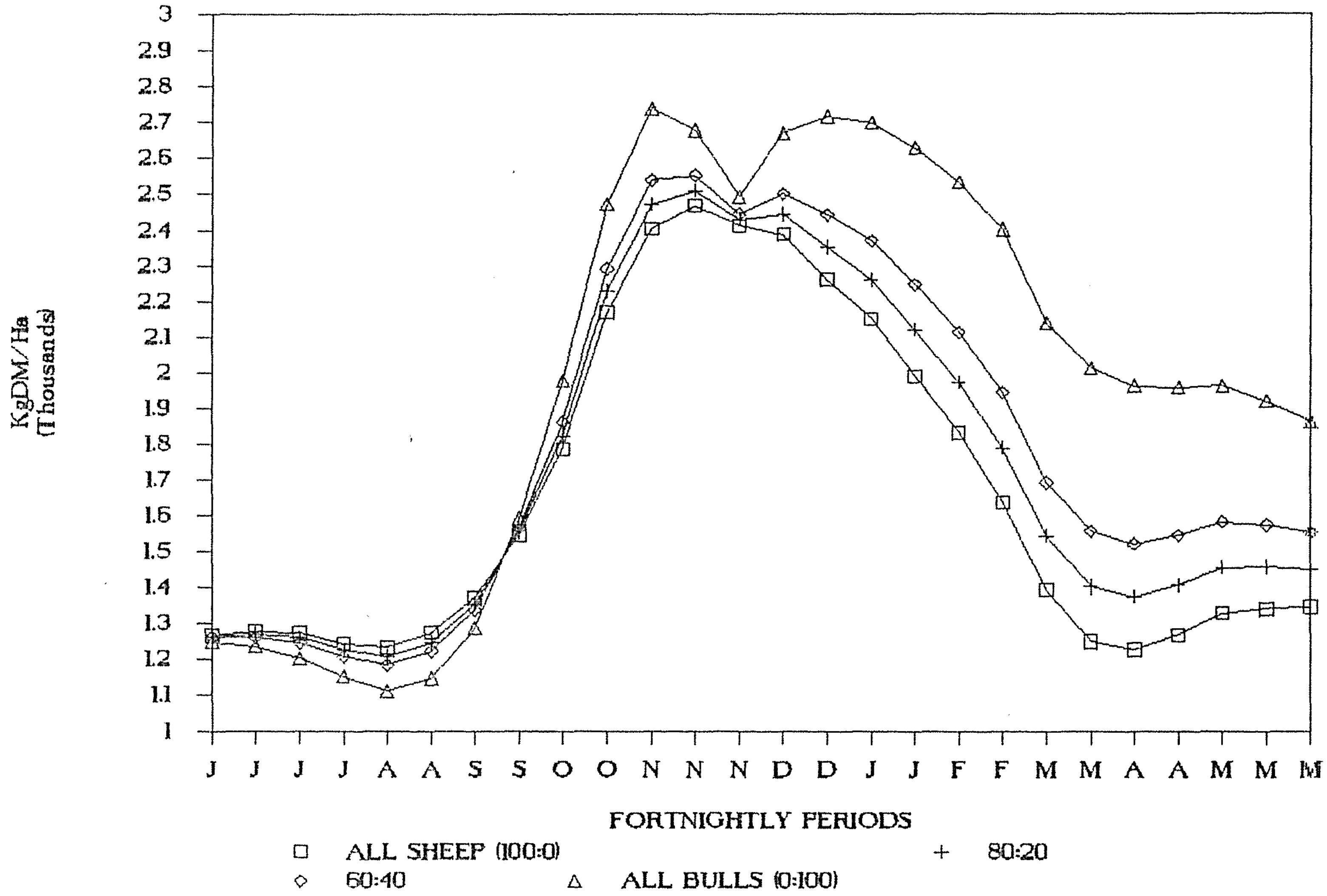
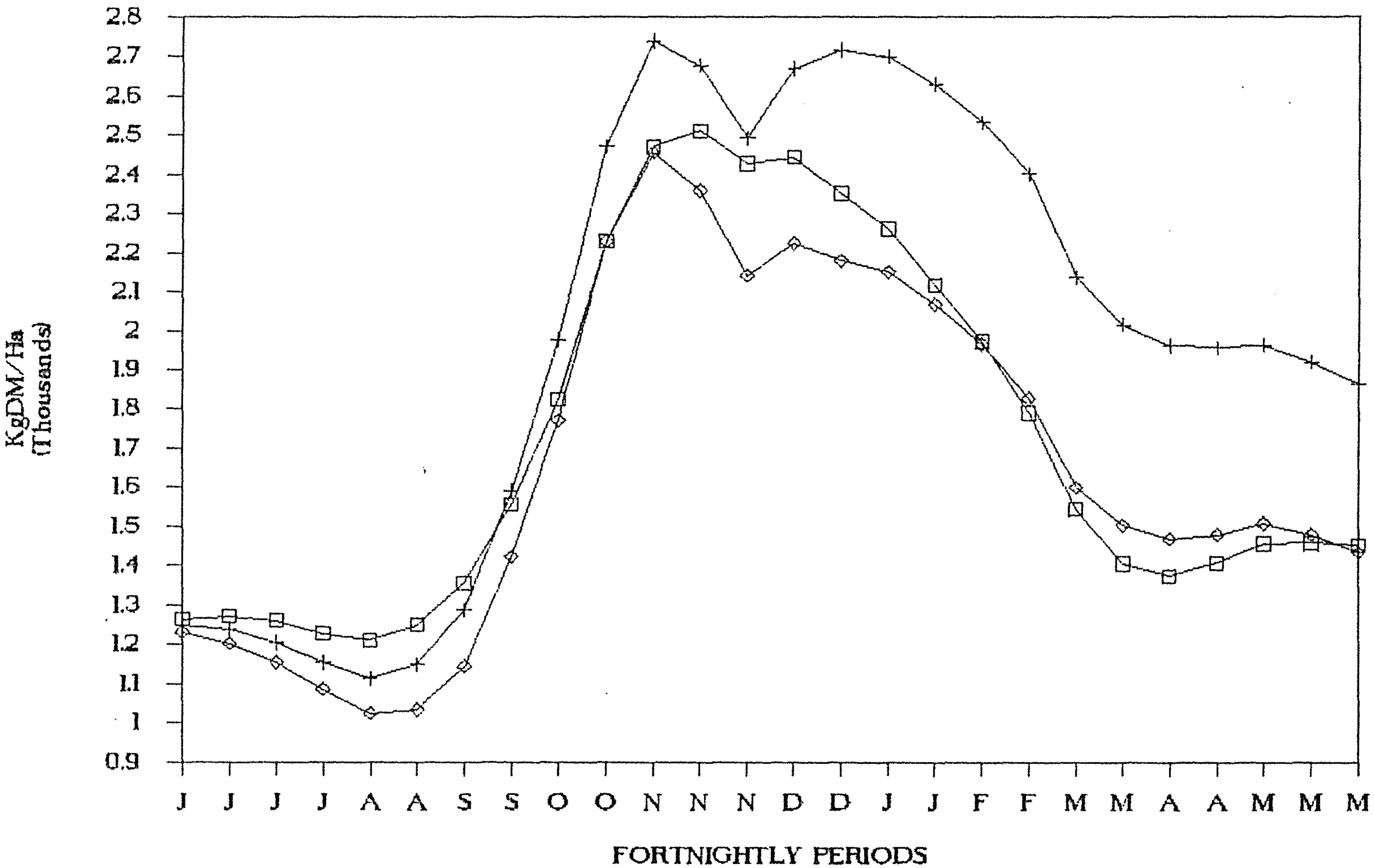


Figure 4.8 Pasture Covers Generated by Altering the Proportion of Bulls in Policy 1 and Combining 70% of Policy 1 and 30% Policy 3 in the Summer Dry Environment




□ 20% BULLS POLICY 1 (10.5 su/ha)
◇ 70% POL 1,30% POL 3 (All Bulls 12.0 su/ha)
\+ 100% BULLS POLICY 1 (10.5 su/ha)

investigated for each of the bull policies by increasing the proportion of bulls wintered (or purchased in the case of policies 5 and 6). An example of the results obtained are shown in Figure 4.7 for Policy 1 in a summer dry environment. Increasing the proportion of bulls resulted in higher pasture covers, in both the summer dry and summer wet situations.

This was mainly due to an effective lower number of stock units (ie no lambs) over the spring-summer-autumn. This suggests that if 100% bulls were farmed either a higher winter stocking rate could be sustained, or higher LWG's in bulls could be achieved. If the stocking rate of Policy 1 in the summer dry environment was increased to 12 su/ha (from 10.5 su/ha), and 100% bulls run, the pasture covers generated by the model were very similar to those generated by Policy 1 at 10.5 su/ha, with 80:20 sheep to bulls (Figure 4.8). The logical conclusion (when combined with the financial analysis discussed in the next chapter) is that farmers should run all bulls. This ignores the financial risks involved in producing a single commodity, and the physical suitability of the land - both of which are discussed in Chapter Six. The other problem which would arise from running all bulls and attempting to growth them as fast as possible, would be that of maintaining pasture quality. One possibility would be to run a proportion of bulls as a control mob, with in slower liveweight gains (and therefore a later slaughter date) (ie Policy 3). Figure 4.8 shows that the pasture covers generated by the model from a combination of 70% Policy 1 and 30% Policy 3 (100% bulls), at 12.0 su/ha, is very similar to pasture covers generated by Policy 1, at 80:20 sheep to bull ratio and 10.5 su/ha. It would therefore appear that combining bulls in this manner would give the opportunity to run all bulls in hill country. The results of one season of running a combination of bulls (very similar to 70% Policy 1 - 30% Policy 3 as defined in this study) has been successful in terms of maintaining pasture control/bull LWG on Massey University's Tuapaka hill country farm (Gray pers com).

## 4.5 CONCLUSION

The model output indicated that all the bull policies considered were viable in both the summer dry and summer wet environments, in terms of their relationship between feed supply and demand, and the resultant pasture covers generated. Since all policies were viable, no one policy could be said to be "best" in terms of its physical suitability. The most suitable policy for a particular farm, would therefore depend on other considerations such as management inputs, risk and capital requirements.

The model indicated that the most sensitive periods to changes in feed demand were: summer in the summer dry environment, and late winter-early spring in the summer wet environment. The model also indicated an advantage - in terms of the pattern of pasture cover - to increasing the proportion of bulls run in respect to sheep, and showed that a combination of two of the policies could be used as a means of running all bulls and ensuring adequate pasture control.

# CHAPTER FIVE: FINANCIAL ANALYSIS

## 5.0 CHAPTER OUTLINE

In this chapter the methods used to evaluate the financial returns from the various bull policies modelled, and an all sheep policy in both the Summer Dry and Summer Wet environments are presented. The sensitivity of the bull policies to varying inputs and physical performance levels is also discussed. Lastly, the financial viability of supplementary feeding of bulls is investigated.

## 5.1 GROSS MARGIN ANALYSIS

A Gross Margin (GM) is defined as the total income from a particular enterprise less the direct costs of production associated with that enterprise ($MAF_3$ 1985). Costs common to all enterprises such as rates, interest and principal payments, labour and repairs and maintenance are excluded. Allowance is made for the opportunity cost of capital invested in livestock because it is unavailable for other purposes. In this analysis, interest was charged at the rate of 1.667% per month (20% per year) on the cost of purchasing the bull, for the number of months the bull was farmed. The capital cost of the flock for the sheep policies was charged at an interest cost of 20% per annum.

A GM analysis program was built using the LOTUS SYMPHONY (Lotus Corporation 1985) spreadsheet to calculate the GM for each bull policy (expressed per stock unit and per 500 kg DM consumed). The latter was derived to obtain a better indication of the relative profitability in terms of feed utilisation. The program also enabled the sensitivity of GMs to changes in input costs and schedule returns to be determined quickly.

The figures used in the GM analysis were from 1986/87 estimates of costs and returns for the Wairarapa MAF farm monitoring models, the current MAF GM figures used for bull beef in the Manawatu, and the actual schedule prices for both bulls and lambs for the week starting September 15 1986 (Refer to Section 2.5). For simplicity it was assumed that all lambs graded YL. Wool weights obtained from the survey were also used.

An example of the GM calculations are shown in Table 5.1[1].

A summary of the GM's for the various bull and sheep policies used in the model is presented in Table 5.2.

Table 5.2 shows the high profitability of bulls relative to the sheep systems (4-5 times greater per kg DM consumed). Table 5.2 also shows the dvantage in the efficiency of DM usage (GM/500 kg DM) of having young bulls growing rapidly (as discussed earlier in Section 2.6). This is also shown in the GM/500 kg DM for policies (1) and (2) since the only difference between these two systems is the time taken to reach the target slaughter weight (ie growth rates of policy (2) are slower).

## 5.2 SENSITIVITY ANALYSIS

The bull GMs are primarily affected by the meat schedule and replacement bull costs. A range of GMs due to differing schedule and replacement costs is shown in Table 5.3. This allows for comparisons between the bull systems depending on movements in purchase and schedule prices, and between bulls and the base sheep policies, with variations in the lamb schedule and wool prices.

However, comparisons between the bull policies within a year, with changes in the schedule, are difficult to model. This is because farmers often attempt to maintain their margins, by lowering replacement purchase prices in the face of reducing schedules. For example, from Table 5.3, the GM for policy 5 at a purchase price of $280 and a schedule of 200 ¢/kg is $31.61. If the schedule drops to 160¢/kg, the GM at the same purchase price drops to $4.74. However, the farmer, attempting to maintain the margin, would lower the purchase price (to say $250 as shown in Table 5.3, with the GM then only dropping to $14.77).

The main factor affecting this variation is the replacement purchase price. This is particularly so in Policies 4-7, which usually require buying store

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[1]The GM's for each bull and sheep system are shown in Appendix III.

TABLE 5.1

Gross Margin Analysis for Bull Policy (1)

| | | $ |
|---|---|---|
| **Income** | | |
| 1 bull @ 221 kg c/c @ 213¢/kg | | 470.73 |
| **Expenditure** | | |
| Bull purchase @ $180/bull | | 180.00 |
| Animal health per bull | | 10.00 |
| Cartage per bull | | 20.00 |
| Interest (1.667% month) | | 39.01 |
| | Total | 249.01 |

Surplus: $221.72

GM per SU: $49.27

TABLE 5.2

Summary of Gross Margin Analysis of Bull and Sheep Systems Modelled

| | | GM/SU ($) | GM/500 kg DM ($) |
|---|---|---|---|
| Bulls: | Policy (1) | 49.27 | 46.68 |
| | (2) | 47.60 | 41.08 |
| | (3) | 41.61 | 37.83 |
| | (4) | 37.64 | 41.36 |
| | (5) | 29.49 | 40.35 |
| | (6) | 33.18 | 42.54 |
| | (7) | 42.12 | 42.54 |
| Sheep: | Summer Dry | 14.35 | 9.07 |
| | Summer Wet | 15.14 | 9.64 |

TABLE 5.3 Sensitivity Analysis of Bull and Base Sheep Policies to Varying Bull Purchase, Meat Schedule and Wool Prices.
GM ($)/500 kg DM

POLICY 1:GM/500KgDM

| SCHEDULE :c/kg: | 160 | 200 | 240 |
|---|---|---|---|
| PURCHASE PRICE $/wnr: | | | |
| 150 | 29.70 | 48.31 | 66.92 |
| 180 | 22.02 | 40.63 | 59.24 |
| 200 | 16.90 | 35.51 | 54.12 |

POLICY 2:GM/500KgDM

| SCHEDULE :c/Kg | 160 | 200 | 240 |
|---|---|---|---|
| PURCHASE PRICE $/wnr | | | |
| 150 | 25.83 | 42.77 | 59.70 |
| 180 | 18.60 | 35.53 | 52.47 |
| 200 | 13.78 | 30.71 | 47.65 |

POLICY 3:GM/500KgDM

| SCHEDULE :c/kg: | 180 | 220 | 260 |
|---|---|---|---|
| PURCHASE PRICE $/wnr: | | | |
| 150 | 28.02 | 38.92 | 49.83 |
| 180 | 24.46 | 35.37 | 46.28 |
| 200 | 22.09 | 33.00 | 43.91 |

POLICY 4:GM/500KgDM

| SCHEDULE :c/Kg | 160 | 200 | 240 |
|---|---|---|---|
| PURCHASE PRICE $/wnr | | | |
| 200 | 21.31 | 42.90 | 64.48 |
| 230 | 12.76 | 34.35 | 55.94 |
| 260 | 4.21 | 25.80 | 47.39 |

POLICY 5:GM/500KgDM

| SCHEDULE :c/kg: | 160 | 200 | 240 |
|---|---|---|---|
| PURCHASE PRICE $/bull | | | |
| 250 | 14.77 | 41.65 | 68.52 |
| 280 | 4.74 | 31.61 | 58.49 |
| 320 | -8.64 | 18.24 | 45.11 |

POLICY 6:GM/500KgDM

| SCHEDULE :c/Kg | 180 | 220 | 260 |
|---|---|---|---|
| PURCHASE PRICE $/bull | | | |
| 350 | 14.79 | 28.78 | 42.76 |
| 400 | 8.43 | 22.42 | 36.40 |
| 450 | 2.07 | 16.05 | 30.04 |

POLICY 7:GM/500KgDM

| SCHEDULE :c/kg: | 180 | 220 | 260 |
|---|---|---|---|
| PURCHASE PRICE $/bull | | | |
| 320 | 24.73 | 46.77 | 68.81 |
| 350 | 18.30 | 40.34 | 62.38 |
| 380 | 11.87 | 33.91 | 55.95 |

SUMMER DRY SHEEP GM/500KgDM

| LAMB SCHEDULE:c/Kg | 140 | 160 | 180 |
|---|---|---|---|
| WOOL PRICE c/Kg: | | | |
| 300 | 7.56 | 8.39 | 9.22 |
| 340 | 8.70 | 9.53 | 10.36 |
| 380 | 9.84 | 10.67 | 11.49 |

SUMMER WET SHEEP GM/500KgDM

| LAMB SCHEDULE: c/Kg | 140 | 160 | 180 |
|---|---|---|---|
| WOOL PRICE c/Kg: | | | |
| 300 | 9.01 | 9.99 | 10.97 |
| 340 | 10.29 | 11.26 | 12.24 |
| 380 | 11.56 | 12.54 | 13.51 |

stock from stockyards, and hence prices are dependent on the vagaries of the market; eg the availability and differing expectations of sellers and buyers, as well as the existence or otherwise of a "grass market". A grass market occurs when pasture growth is accelerating (eg in early spring) and farmers are requiring extra stock to control the extra feed. At such times farmer experience shows that the purchase price of replacement stock can often bear no relationship to current schedules/levels of profitability.

Another example of the difficulties of comparing policies within a year can be shown as follows:

A farmer who has been operating Policy 2 [buy in 100 kg weaner in early November - selling at 220 kg carcass weight at 18 months (January)] expects the schedule to drop, and that it therefore may be more profitable to delay purchase until the late summer-autumn (ie Policy 4) - depending on the purchase price of the autumn weaner. The calculation to derive the relative price of the autumn weaner, to equate with the spring weaner price is shown below:

Time: November

Current schedule is 200¢/kg. The purchase price of a 100 kg weaner is $200. Assuming the 200¢ schedule remains, the GM/500 kg DM for Policy 2 is $30.71 (Table 5.3). To return the same or better GM, the purchase price for the replacement weaner in Policy 4 would need to be $243 or lower.

However, if the expectation was for a drop in the schedule in the autumn (to say 160¢/kg), how would this affect the relative GM's?

At a purchase price of $200/weaner, and a schedule of 160¢/kg the GM for Policy 2 drops to $13.78.

In the case of Policy 4 however, several factors are involved. If the purchase of weaners is delayed for 4 months (from early November to late February) there will be extra feed available, either for the R2yr bulls, or for lambs. The delay in purchase will also mean a saving in interest cost on the purchase of replacement bulls over the four months - in this example $13.32 per bull ($200 x 1.667% for 4 months).

(a) Assuming no increase in the bulls weight (from the "extra" feed), the purchase cost of the replacement bull in Policy 4, to equal or better the GM for Policy 2, would need to be < \$214.

(b) Assuming half the extra feed is utilised by the bulls, resulting in a 227 kg carcass weight, the replacement cost in Policy 4 would need to be < \$222.

(c) If all the extra feed is utilised by the bulls, resulting in a 233 kg carcass weight, the replacement cost in Policy 4 would need to be < \$232.

Assuming no increase in final weight, and before any savings in interest charges, the maximum price for a weaner bull in Policy 4, in order to return the same GM as for Policy 2, is given by the equation;

Policy 4 weaner price =

[ 0.397 (expected January) Schedule (¢/kg) - 5.819]

+ [0.845 spring weaner price] [2]

A summary of these prices are given in Table 5.4.

Thus the decision to delay purchase of replacement weaners would depend on the likelihood of purchasing at or below the prices indicated earlier. This example highlights the difficulty in making such analysis - whether the assumptions made would occur in reality. The main problem is anticipating movements in the schedule (discussed in Section 8.3.1) and the relative purchase price of the replacement bulls. Other factors, such as future rainfall/pasture growth, can never be known with certainty. Therefore actual relative profitability between policies will be difficult due to the factors illustrated.

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[2] This equation only holds under the assumptions made in the GM analyses used in this study.

TABLE 5.4

Maximum Price for Replacement Bulls in Policy 4 in order to return the same GM as for Policy 2, under different schedule prices, and varying weaner prices for Policy 2

| Policy 2 Weaner Price $/hd | Scheduled ¢/kg | | |
|---|---|---|---|
| | 160 | 200 | 240 |
| 130 | $168 | 184 | 200 |
| 150 | 184 | 200 | 217 |
| 180 | 209 | 226 | 242 |
| 200 | 227 | 243 | 259 |
| 230 | 252 | 268 | 285 |
| 250 | 269 | 285 | 302 |

TABLE 5.5

Sensitivity of Bull Policy (1) to
Final Carcass Weight and Weaner Price

GM/500 kg DM Schedule at 15.9.86

| Weaner Purchase Price $ | | 150 | 180 | 200 |
|---|---|---|---|---|
| Final Carcass Wt (kg) | 190 | $30.46 | 22.78 | 17.65 |
| | 200 | 41.58 | 33.89 | 28.77 |
| | 221 | 53.91 | 46.23 | 41.11 |
| | 250 | 69.47 | 61.79 | 56.66 |

Another very important aspect affecting profitability, as discussed in Section 2.5, is the effect of discrete lifts in the meat schedule prices at certain carcass weights (Table 5.5). This emphasises the importance of growing bulls to carcass weights of 196 kg or heavier.

For bull returns to decline to the GM for sheep, the weaner purchase price for Policy (1) would need to either increase to $310/hd, or the meat schedule fall to 142¢/kg (220.5-245 kg range).

## 5.3 FINANCIAL ANALYSIS OF SUPPLEMENTARY FEEDING

Two main feed deficit periods were indicated by the model; February-March in the summer dry environment, and July-August in the summer wet environment. These were buffered by reducing pasture covers. Alternatively they could be met by supplementary feeding.

While the practical considerations of supplementary feeding are important (and are discussed later in this section), the most important determinant of whether to use supplements or not is their economic viability.

For the purposes of this study, four forms of supplementary feeding for bulls were considered; nitrogen and hay for the winter months, and silage and meal for the summer period.

The following assumptions were also made with respect to bull growth rates and feeding levels:

1. Winter period: 250 kg bull

(a) Growing at 0.2 kg LWG/day. Supplements are fed to increase LWG to 0.8 kg/day. Energy requirement (Table 3.3) = 20.4 MJME/bull/day

(b) Feed is very short and bulls are only being fed a half maintenance ration. Supplements are fed to "maintain" growth at 0.2 kg LWG - the "gain" therefore is in avoiding liveweight loss. Energy requirement = 24.9 MJME/bull/day

2. Summer period: 150 kg bull

(a) Growing at 0.2 kg LWG/day. Supplements are fed to increase LWG to 0.6 kg/day. Energy requirement = 9.4 MJME/bull/day

(b) As in assumption 1(b) - supplement is fed to maintain LWG at 0.2 kg LWG. Energy requirement = 18.4 MJME/bull/day

A problem arises in determining the level of liveweight loss from the assumed half maintenance restriction, due to the complex physiological changes such a feeding regime causes. Normally, lipid (fat) is metabolised preferentially until the body reaches an equal ratio of fat to protein, at which stage both are metabolised at equal rates (Moughan pers com). At the risk of gross over-simplification, it was assumed that the 250 kg bull lost an equal amount of fat and protein over the deficit period (42 days), while the 150 kg bull (having less fat) lost 40% fat/60% protein in its liveweight loss over the deficit period.

Given 39 MJME /kg fat and 24.4 MJME /kg protein (Holmes and Wilson 1984), the following LW losses were calculated:

250 kg bull: 50% fat, 50% protein = 31.7 MJME /kg tissue
½ maintenance: losing 13.1 kg MJME
therefore: losing 0.42 kg LW/day (0.16% bodyweight)

150 kg bull: 40% fat, 60% protein = 30.24 MJME /kg tissue
½ maintenance: losing 9.9 MJME
therefore: losing 0.33 kg LW/day (0.22% of bodyweight)

The rate of liveweight loss was reasonably insensitive to the proportion of fat/protein loss:

eg 250 kg bull
40% fat/60% protein = 0.43 kg LW loss
60% fat/40% protein = 0.40 kg LW loss

150 kg bull

50% fat/50% protein = 0.31 kg LW loss

60% fat/40% protein = 0.30 kg LW loss

The gain to supplementary feeding, in bodyweight terms, would be:

1. (a) 250 kg bull increasing LWG from 0.2 to 0.8 kg/day for 42 day period = 25.2 kg LW.

   (b) 250 kg bull at ½ maintenance for 42 days loses 17.2 kg
   250 kg bull at 0.2 kg LWG/day for 42 days gains 8.4 kg
   total "gain" = 25.6 kg

2. (a) 150 kg bull increasing LWG from 0.2 to 0.6 kg/day for 42 days = 16.8 kg LW

   (b) 150 kg bull at ½ maintenance for 42 days loses 13.9 kg
   150 kg bull at 0.2 kg LWG/day for 42 days gains 8.4 kg
   total "gain" = 22.3 kg

Another problem arises in relation to the below maintenance feeding example, in the form of compensatory growth. Compensatory growth is manifested in the ability of animals, previously restricted in feed or nutrient intake, to outgain their better fed counterparts when given free access to good quality feed (O'Donovan 1984). This is the result of both increased intake, and more efficient metabolism. This means that the "gain" shown above from maintaining LWG as opposed to allowing some liveweight loss, would be reduced by compensatory gain in the under-fed situation once adequate feeding levels was restored. However, the degree of compensatory gain is dependent on several factors; the severity and duration of the feed restrictions, age and weight of the animal, subsequent feeding level, and the length of time the animals have to "catch up". Numerous trials have given widely varying responses, from nil to 80% compensation (Scott et al 1979, O'Donovan 1984). The average compensation in 44 New Zealand trials was 19.5% (Range 0 to 50%) (Scott et al 1979). If this figure is applied to the cases outlined in 1(b) and 2(b) above, the nett "gain" in the 250 kg bull scenario is 22.25 kg LW, and 19.6 kg LW in the 150 kg bull scenario. If no compensatory gain is achieved, then the profitability in case (b) in the following examples would increase. This would not alter the conclusions reached.

### 5.3.1 SUPPLEMENTARY FEEDING DURING WINTER/EARLY SPRING FEED DEFICITS

(i) Nitrogen

Nitrogen fertiliser has been successfully used to increase winter-early spring pasture growth in New Zealand for many years (Sherlock and O'Connor 1973, Luscombe 1979, Lambert and Clark 1985). The largest responses to nitrogen have been measured on ryegrass dominant pastures (Ball 1969, During 1972), however, significant responses to nitrogen have also been measured on browntop/poa hill country pastures (Ball et al 1976, Luscombe 1979), with responses varying from 8.5 to 33 kg DM/kg N applied. In some cases large residual responses spread over several months significantly increase the efficiency of response (Ball et al 1976, Sherlock and O'Connor 1973, Luscombe 1979). Similar responses to nitrogen to those noted above have been recorded on Wairarapa hill country ($MAF_2$ 1986).

An example of the economics of nitrogen fertiliser usage is given below:

Assumptions: Applied cost of urea (46% N) is $500/tonne. There is also an opportunity cost of 20% for six months (from time of application of N to sale of bull)
Response rate is 10 kg DM/kg N
Therefore, cost of each kg DM is 12 cents.

Case (a):

250 kg Bull is fed to increase LWG from 0.2 to 0.8 kg/day

Energy requirement = 20.4 MJME
= 1.85 kg DM (@ 11 MJME/kg DM)

Total requirement over 42 day period = 77.7 kg DM
Cost = $9.32

Total gain over 42 day period = 25.2 kg LW
at 50% dressing out = 12.6 kg carcass weight
At nett schedule value of 213¢/kg = \$26.84 (schedule at 15.9.86)

Thus, nett return to nitrogen = \$26.84 - \$9.32
= <u>\$17.52/bull</u>

Case (b):

250 kg bull is fed to maintain LWG at 0.2 kg/day, and prevent liveweight loss.

Energy requirement = 24.9 MJME
= 2.26 kg DM/day

Total feed requirement over 42 day periods = 94.9 kg DM
Cost = \$11.39

Total "gain" (as described earlier) = 22.25 kg LW
= 11.13 kg carcass
worth \$23.71

Nett return to nitrogen = \$23.71 - \$11.39
= <u>\$12.32/bull</u>

Nitrogen is therefore profitable (at the 15.9.86 schedule) as a supplement to increase liveweight gains or prevent liveweight loss. Thus profitability is enhanced if the liveweight "gained" through the use of the supplement ensures that the bull falls into a higher weight bracket in the schedule.

eg bull falls into 220.5-245 kg range instead of 195.5-220 kg range

Case (a)

12.6 kg carcass weight gain
208.4 kg @ 205c = \$427.22
221 kg @ 213c = \$470.73
Gain = \$43.51

TABLE 5.6 Return per Bull to Differing Urea and Schedule Prices
250 kg Bull, 10 kg DM:1 kg N, 20% cost of capital, 42 day period

| Urea Price $/tonne Applied | Liveweight Gains Returns ($) | | | | | | Schedule Return* | |
|---|---|---|---|---|---|---|---|---|
| | Case (a) | | | Case (b) | | | | |
| | 160¢/kg | 200¢/kg | 240¢/kg | 160¢/kg | 200¢/kg | 240¢/kg | Case (a) | Case (b) |
| 450 | 11.61 | 16.65 | 21.69 | 7.64 | 12.16 | 16.68 | 34.96 | 30.06 |
| 500 | 10.84 | 15.88 | 20.92 | 6.69 | 12.21 | 15.73 | 34.19 | 29.11 |
| 550 | 10.06 | 15.10 | 20.14 | 5.74 | 10.26 | 14.78 | 33.41 | 28.16 |
| 660 | 9.28 | 14.32 | 19.36 | 4.79 | 9.31 | 13.83 | 32.63 | 27.21 |

* Return from bull falling into 220.5-245 kg range instead of 195.5-220 kg range. Schedule at 15.9.86.

TABLE 5.7 Profit (Loss) per Bull to Differing Hay and Schedule Prices
250 kg Bull, 42 day period, 1 bale hay = 20 kg DM @ 8.5 MJME/kg DM, 20% wastage

| Hay Price $/bale fed out | Liveweight Gains Returns ($) | | | | | | Schedule Return* | |
|---|---|---|---|---|---|---|---|---|
| | Case (a) | | | Case (b) | | | | |
| | 160¢/kg | 200¢/kg | 240¢/kg | 160¢/kg | 200¢/kg | 240¢/kg | Case (a) | Case (b) |
| 450 | (5.04) | 0 | 5.04 | (12.93) | (8.48) | (4.03) | 18.31 | 9.76 |
| 500 | (8.19) | (3.15) | 1.89 | (16.78) | (12.33) | (7.88) | 15.16 | 5.91 |
| 550 | (11.34) | (6.30) | (1.26) | (20.62) | (16.17) | (11.72) | 12.01 | 2.07 |
| 660 | (17.64) | (12.60) | (7.56) | (28.31) | (23.86) | (19.41) | 5.71 | (5.62) |

* Gain from bull falling into 220.5-245 kg range instead of 195.5-220 kg range. Schedule at 15.9.86.

Nett gain to nitrogen = \$43.51-\$9.32
= \$34.19/bull

Similarly, in case (b) the profit would increase to \$29.11/bull.

The sensitivity of bull returns to differing Urea and chedule prices is shown in Table 5.6.

(ii) Hay

Hay has been the traditional supplement for cattle on hill country. Pasture cover figures through the late spring-early summer for each of the bull policies studied indicated that there is pasture surplus to animal requirements which could be used for hay (or silage) conservation.

The economics of hay usage for bulls, given the same assumptions as in the nitrogen case, are shown in Table 5.7.

Table 5.7 indicates that hay as a supplement is basically only profitable when the liveweight gain achieved, or liveweight loss prevented, ensures that the bull falls into a higher schedule weight bracket at slaughter. It would therefore appear to be economic only when the farmer faces a severe feed shortage.

### 5.3.2 SUPPLEMENTARY FEEDING DURING A SUMMER FEED DEFICIT

(i) Silage

Silage is a common method of conserving spring pasture surpluses (Barry et al 1980). The use of silage on hill country is generally restricted to the summer and autumn because of access problems.

The economics of silage, outlined in Table 5.8, are based on the 150 kg bull scenarios discussed in Section 5.3; ie (a) fed to increase LWG from 0.2 to 0.6 kg/day, (b) fed to maintain LWG at 0.2 kg/day in the face of a (½ maintenance) feed shortage.

TABLE 5.8 Profit (Loss) per Bull to Differing Silage and Schedule Costs

| Silage Cost $/tonne fed out | Liveweight Gains Returns ($) Case (a) | | | Case (b) | | | Schedule Return* | |
|---|---|---|---|---|---|---|---|---|
| | 160¢/kg | 200¢/kg | 240¢/kg | 160¢/kg | 200¢/kg | 240¢/kg | Case (a) | Case (b) |
| 25 | 9.24 | 12.60 | 15.96 | 7.46 | 11.38 | 15.30 | 30.70 | 29.55 |
| 29 | 8.57 | 11.93 | 15.29 | 6.14 | 10.06 | 13.98 | 30.03 | 28.23 |
| 35 | 7.56 | 10.92 | 14.28 | 4.16 | 8.08 | 12.00 | 29.02 | 26.25 |
| 40 | 6.72 | 10.08 | 13.44 | 2.52 | 6.44 | 10.36 | 28.18 | 24.61 |

* Schedule at 15.9.86.

TABLE 5.9 Profit (Loss) per Bull to Differing Meal and Schedule Prices
Meal = 85% DM at 12.25 MJME/kg DM

| Silage Cost $/tonne fed out | Liveweight Gains Returns ($) | | | | | | Schedule Return* | |
|---|---|---|---|---|---|---|---|---|
| | Case (a) | | | Case (b) | | | | |
| | 160¢/kg | 200¢/kg | 240¢/kg | 160¢/kg | 200¢/kg | 240¢/kg | Case (a) | Case (b) |
| 300 | (1.43) | 1.93 | 5.29 | (12.04) | (8.12) | (4.20) | 20.02 | 22.90 |
| 385 | (5.64) | (2.28) | 1.08 | (19.89) | (15.97) | (12.05) | 15.82 | 18.69 |
| 450 | (8.86) | (5.50) | (2.14) | (25.90) | (21.98) | (18.06) | 12.60 | 15.47 |
| 550 | (13.82) | (10.46) | (7.10) | (35.14) | (31.22) | (27.30) | 7.64 | 10.51 |

* Schedule at 15.9.86.

Other assumptions: Silage is 30% DM @ 9.8 MJME/kg DM (Ulyatt et al 1980). 80% utilisation. 42 day feeding period.

(Average silage costs at 15.9.86: $10/T into stack, $4/T cover, $15/T fed out)

Table 5.8 indicates that the use of silage as a supplement could be very profitable, in a summer dry environment.

(ii) Meal

The attraction of meal as a supplement is its ready availability and ease of handling. The economics of meal feeding, for the same assumptions as silage, are illustrated in Table 5.9. This indicates that meal is similar to hay, ie, it is only profitable when the liveweight gain achieved, or liveweight loss prevented, ensures the bull falls into a heavier schedule weight range bracket, and hence would only be viable if the farmer was facing a severe feed shortage.

### 5.3.3 PRACTICAL CONSIDERATION OF SUPPLEMENTARY FEEDING

Practical considerations relating to supplementary feeding for bulls on hill country involve hay and silage more than nitrogen and meal. On many hill country properties there is limited (or no) area of easier/flat country suitable for conservation. Moreover, this area is usually intensively used for stock grazing already. This topographical factor may also restrict feeding out, especially in the winter. Another consideration is the machinery requirement for conservation and feeding out. If competitively priced, reliable contractors are unavailable in the district, then the capital costs of harvesting equipment are high. Labour requirements, especially for feeding out, may also preclude supplementary feeding on hill country.

Against these "problems", conservation can aid late spring pasture control, and as a result subsequent summer-autumn pasture growth and quality is improved (Korte 1982, Hughes 1983), which in turn leads to higher animal performance, especially of young stock.

### 5.3.4 SUMMARY

In the examples given, both nitrogen fertiliser (as a boost to pasture growth) and silage are profitable forms of supplementary feed for both increasing liveweight gain in the face of sub optimal feed availability, and maintaining liveweight gain in the face of a feed deficit. Hay and meal would only be worthwhile in a severe feed deficit if the liveweight loss that would ensure without supplementation resulted in the bull falling into a lower schedule carcass weight range.

## 5.4 CONCLUSION

The high profitability of bulls relative to sheep was outlined in this chapter, with the major determinants of profitability being initial purchase price, final carcass weight and schedule price.

The economic viability of various forms of supplementary feeding were discussed, outlining the current profitability of nitrogen use over the winter-spring, and to a slightly lesser extent, the use of silage over the summer.

# CHAPTER SIX: WAIRARAPA BULL BEEF SURVEY

## 6.0 CHAPTER OUTLINE

The design of the survey questionnaire, the selection of farmers, and the administration of the survey is discussed in the first sections of this chapter. This is followed by an analysis and discussion of the survey data, broken down into five main areas; Farm Details, Stock Policies and Performance, Bull Animal Health Practices, Grazing Management, and General Factors relating to Bull Beef. Discrepancies between survey data and assumptions made for model construction are discussed in the final section.

## 6.1 OBJECTIVES OF THE SURVEY

The objectives of the survey were two fold; first to obtain further data to validate the information used (particularly the assumptions relating to animal performance) in the construction of the model, and secondly, to obtain a description of current management systems, stock policies and performance on Wairarapa hill country bull beef farms.

## 6.2 PREPARATION OF THE SURVEY QUESTIONNAIRE

Based on the experience of Parker (1984), it was decided to survey the farmers via personal interview survey, as opposed to either a telephone or mail survey. This method allowed for the collection of specific information on the farm and farming system, general discussion on wider production and management aspects with the farmer, and inspection of the farm.

Several farming questionnaires were studied to formulate ideas about layout and question design (MacGillivary 1972, Clarkson 1974, Walker 1984, Parker 1984, and the DSIR Wairarapa Survey of 1982,. The questionnaire used by Parker (1984) was used as the basic guide for layout of questions and coding boxes. From the inception of the questionnaire design, it was decided to analyse the survey results on the PRIME computer at Massey University, using the SPSS$^{X}$ programme (SPSS Inc 1985). This computer programme provides a comprehensive set of procedures for data transformation and manipulation, plus a large number of statistical routines for analysis of data. A right hand margin enclosing data entry coding boxes was therefore incorporated in the questionnaire.

The formulation of questions was based on an imagined draft of the final report. The types of questions asked could be categorised into four groups; dichotomous, multiple choice, open-ended, and tabulated (Payne 1951, Wesney 1964).

**Dichotomous questions** provide two definite options, eg: Do you weigh your bulls - Yes/No. These are quick to answer, code and analyse.

**Multiple choice questions** were used where there was a variety of possible responses. These questions are relatively simple and quick to answer, code and analyse. To avoid excluding a possible answer, the questions included an "other option" to allow the farmer to specify an appropriate response.

**Open ended questions** were asked where the farmers' views, opinions or reasons were sought.

**Tabulated questions** were used for the collection of information about time related variables - mainly to summarize bull buying and selling policies in this study.

The questionnaire was designed to be as easy as possible to answer, and to analyse. Hence the vast majority of questions were designed to fall into the dichotomous or multiple choice categories. Open-ended and/or tabulated questions were only asked where the range of possible answers could not easily be accomodated by a multiple choice question.

An initial questionnaire was drawn up and discussed with a number of staff in the Agricultural and Horticultural Systems Management Department at Massey University. After making modifications on the basis of their suggestions/criticisms, the questionnaire was pre-tested by two Massey staff involved in farm supervision, the manager of a Massey sheep/bull beef farm and a commercial hill country sheep/bull beef farmer.

Pre-testers were asked to comment on the time taken to complete the questionnaire, logic of question order, the relevance of information sought, question wording, and whether there was sufficient space provided to answer open ended questions. Following this process a few further changes were made, before printing the final questionnaire (two copies per farmer interviewed).

The questionnaire was divided into six sections totalling 18 pages (Appendix IV). Section A related to information about the Farm and Farmer; such as farm area, years of farming experience, stock numbers wintered, and stock breeds. Section B dealt with stock policies and productive performance of sheep and bulls, while Section C covered animal health policies relating to bulls. Pasture growth information and the use of supplements were included in Section D, and details of grazing management in Section E. The last section (F) covered general areas such as information sources on bull beef, and the future of bull beef farming.

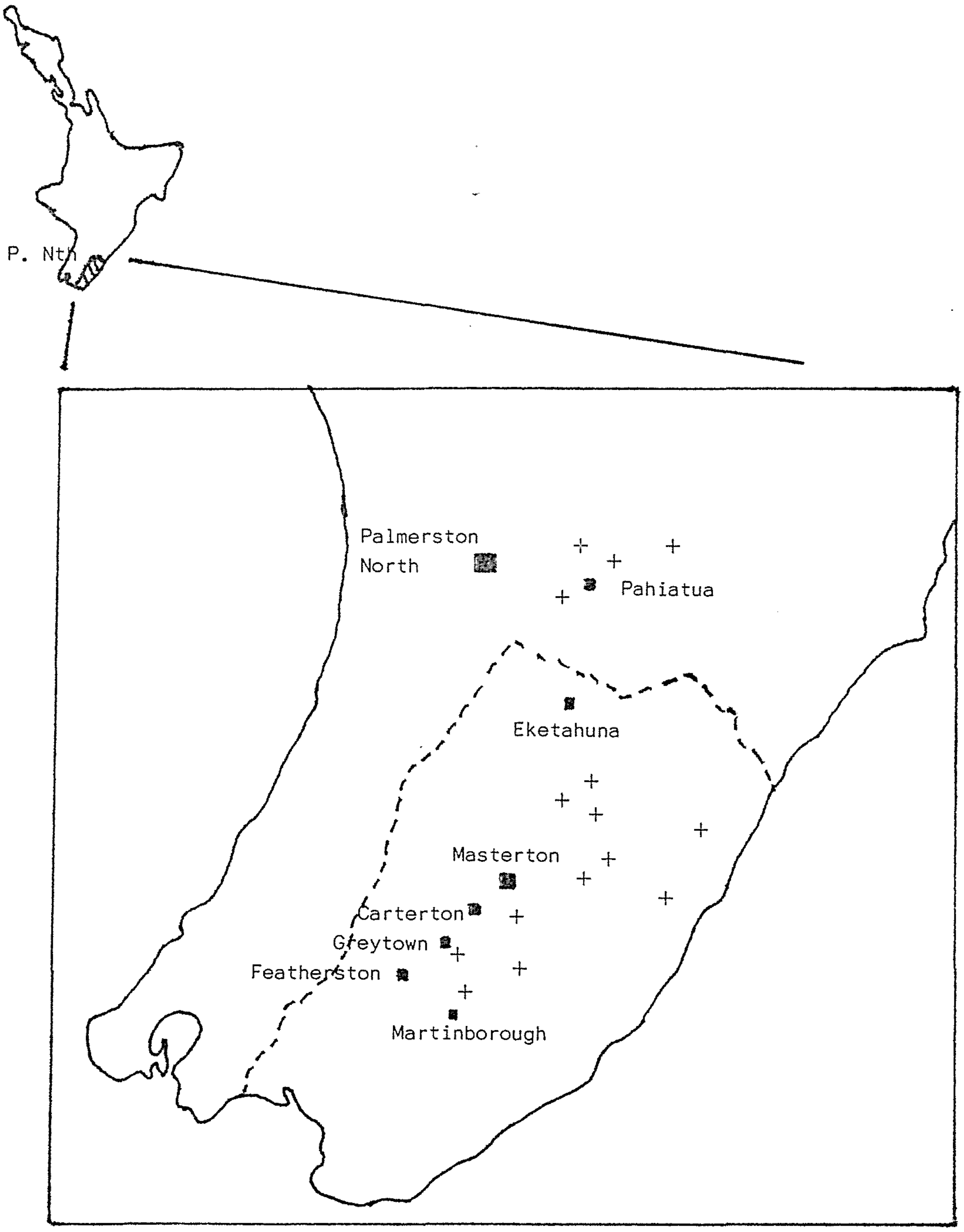
The only questions to pose problems during the survey were those which required the farmers to rank options in order of importance (ie from 1 to 6). Several farmers ignored the instructions given and instead gave two or more options an equal ranking (this may have been quite justifable in their minds). In these cases the codes used for analysis were those specified by the farmer. This did not affect the outcome of any of the results.

### 6.2.1 SELECTION OF FARMERS AND SURVEY AREA

The original criteria for selection of farmers to be surveyed was; to be farming both sheep and bulls on hill country within the Wairarapa region. However, when it became apparent that few farmers fell into this category, the guidelines were relaxed to include sheep and bull farmers on easier country. To find the names of farmers operating sheep/bull farms, MAF advisors in Masterton and Dannevirke were consulted, along with a private Wairarapa farm consultant and stock firms operating in the Wairarapa. Finally, farmers identified by the above process were asked if they knew of other sheep/bull farmers. In this manner 14 farmers within the Wairarapa were identified as being suitable; 10 in "summer dry" areas and 4 in "summer wet" areas. In view of the low numbers of summer wet farmers, it was

MAP 6.1

Location of the Wairarapa Region
and Location of Survey Farms (+)



decided to relax the criteria further to include sheep and bull farmers in the Pahiatua and Pongaroa districts of southern Hawkes Bay. These districts are similar to the Wairarapa region. A total of 19 farmers who fitted the criteria were finally identified.

### 6.2.2 THE SURVEY AREA

The survey region covered the Wairarapa region and the area of southern Hawkes Bay around Pahiatua.

The Wairarapa region is located in the south-eastern portion of the North Island (Map 6.1), comprising the counties of Ekatahuna, Featherston, Masterton, and Wairarapa South; about 2.6% of New Zealand's land area. Apart from an inland plain which contains Lake Wairarapa, and the central area south of Pahiatua, the topography is mostly rolling to steep. Agriculture is the major economic activity; involving mainly semi-extensive sheep and beef farming, with some arable cropping, dairying, market gardening, orcharding and forestry.

Masterton (population 20,000) is the major urban area. Waingawa Freezing Works - the only one within the survey area - is located 3 km south of Masterton. There are major stockyards at Masterton and Pahiatua. Milk from the Wairarapa and Hawkes Bay is processed at the Tui Dairy Company in Pahiatua ($MAF_2$ 1985, Thompson 1982).

Within the sheep and beef farming industry in the Wairarapa, sheep predominate over cattle, with sheep making up 70-90% of the stock units wintered on sheep and beef farms. Over the last ten years (1974-1984) stock units within the Wairarapa have increased by 9%. During this period sheep stock units have increased by 36.9% while cattle stock units have decreased by 36.6%. The decrease in cattle stock units has mainly been in the form of breeding cows, with farmers switching to sheep and dry cattle. Lambing percentages in the Wairarapa have averaged 93% over the last 4 years, with calving percentages generally in the range 70-90%. Wool production has average 4.5 kg per sheep stock unit. Stocking rates vary from 8-15 su/ha ($MAF_2$ 1985, $MAF_1$ 1986).

### 6.2.3 ADMINISTRATION OF THE SURVEY

An explanatory letter was initially sent out to each of the prospective survey farmers outlining the purpose of the survey, areas of special interest and stating that the author would phone in approximately two weeks to determine their willingness to take part in the survey. A copy of the survey questionnaire was attached to the letter to indicate the type of information required. It was emphasized that all information provided by the farmer would be treated confidentially. If the farmer agreed to participate when contacted by phone, a time and date to visit the farm was then arranged. Of the 19 farmers contacted, 2 were not willing to take part and 2 others, who had only been farming bulls for 6 months, were excluded. This left 15 valid cases (7 summer dry, 8 summer wet) in the survey. The location of these farms is shown in Map 6.1.

Farm visits commenced in early April 1986. Generally, two farms were visited per day; one in the morning and the other in the afternoon. Approximately half the farmers had filled in the questionnaire by the time the author called. This allowed more time for general discussion, and farm inspection. Completion of the questionnaire on the farms where no data had been filled in took 1½-2 hours.

The severe drought during the 1984/85 season in the Wairarapa affected the quality of data collected. Dry conditions seriously affected stock performance in terms of killing weights and the growth of young stock during 1984/85, and had a carry over effect into the 1985/86 season. It also meant a disruption to normal buying and selling patterns. The following season (1985/86) was a complete contrast, with excellent spring/summer growth. This again distorted killing weights and "normal" buying and selling patterns, and many lambs and bulls were retained on farms for longer than usual. This was compounded by a six week national Freezing Industry strike during March and April. These factors should be kept in mind when comparing survey data with the regional data used for model construction.

## 6.3 FARM DETAILS

### 6.3.1 THE FARMERS

The 15 farmers surveyed included 14 owner-operators, and 1 manager (in a partnership agreement). The average age of the farmers was 37.5 years, the average number of years of possession was 10, and the number of years running bulls for bull beef ranged from 1 to 21 years (Table 6.1).

TABLE 6.1

Farmer Details
(Number of Farmers)

| Number of Years | Years of Farm Possession | Farmer Age | Years Full Time Farming | Years Farming Bull Beef |
|---|---|---|---|---|
| < 1 | | | | 1 |
| 2 - 5 | 4 | | 1 | 11 |
| 6 - 10 | 5 | | 5 | |
| 11 - 20 | 3 | | 5 | 2 |
| 21 - 30 | 2 | 5 | 2 | 1 |
| 31 - 40 | | 7 | 2 | |
| 41 - 50 | | 1 | | |
| < 50 | | 2 | | |
| Mean ± SD | 10.14 ± 6.96 | 37.5 ± 9.8 | 16.2 ± 10.45 | 5.8 ± 6.1 |

If the three farmers who had been running bulls for more than 10 years are excluded, the average number of years of farming bull beef drops to 2.9.

## 6.3.2 STOCK NUMBERS

Winter (June 30 1985) stock numbers, stocking rates and sheep:cattle ratios (1983-85) for all the survey farms are shown in Tables 6.2 and 6.3.

Stocking rates on the survey farms, which are tending to decrease, are slightly higher than those used in the model while sheep:cattle ratios, which are increasing in favour of cattle are (for 1985/86) almost exactly the same as used in the model. Bulls comprised, on average 44%, 66% and 73% of cattle stock units wintered in 1983, 1984 and 1985 respectively.

The main sheep breed was Romney (60%), with Coopworths being second most popular (40%). All the farmers reared their own breeding ewe replacements, with the average replacement rate being 27.3% ($\pm$4.3). The predominant breed run for bull beef was Friesian. One farmer (O) also ran some dairy crosses (Jersey x Friesian, Ayrshire), while another farmer (G) ran cross bred bulls produced from his breeding cow herd. The latter farmer had also started to farm Friesian bulls in 1985/86. Breeding cows/other dry cattle run were mainly Angus or Hereford. Most of the farmers were aiming to increase the number of bulls wintered and either decrease or retain the present number of sheep, over the next two years (Table 6.4). Of the farmers looking to increase cattle numbers, all except one (C) were going to increase the number of bulls. Farmer (L) intended to increase steer numbers and maintain current bull numbers.

TABLE 6.2

1985 Winter (June 30) Stock Numbers and Stocking Rates

| Farm Code | Effective Area (ha) | Breeding Ewes | Sheep su | R1 yr Bulls | R2 yr Bulls | Cattle su | Other su Goats (G) Deer (D) | Stocking Rate TSU/Eff ha |
|---|---|---|---|---|---|---|---|---|
| A | 210 | 1500 | 1683 | 200 | 200 | 1910 | | 17.54 |
| B | 481 | 4071 | 4978 | | 57 | 834 | | 12.08 |
| C | 745 | 4095 | 4811 | 600 | | 2730 | 182 (G) | 10.37 |
| D | 377 | 2837 | 3477 | 52 | | 769 | | 11.26 |
| E | 702 | 4900 | 5789 | 300 | 5 | 2375 | 331 (G) | 11.96 |
| F* | 240 | | | 480 | 10 | 2215 | 250 (G) | 10.27 |
| G | 495 | 2515 | 3303 | 9 | | 1512 | | 9.75 |
| H | 226 | 2070 | 2518 | 36 | | 162 | | 11.86 |
| I | 250 | 2300 | 2790 | 65 | 11 | 805 | | 14.38 |
| J | 150 | 1650 | 1986 | 43 | | 193 | | 12.29 |
| K | 229 | 2400 | 2929 | 83 | | 374 | 140 (G) | 15.03 |
| L | 245 | 1815 | 2264 | 70 | | 496 | | 11.27 |
| M | 240 | 2000 | 2032 | | 40 | 220 | 70 (G) | 9.67 |
| N | 340 | 2267 | 3191 | 28 | 2 | 137 | | 9.79 |
| O | 155 | 1200 | 1612 | 54 | 34 | 472 | 210 (D) | 14.80 |
| Mean ± SD | 339 | | 3097±1243 | | | 1013±864 | | 12.24±0.6 |

* Farmer F went out of sheep at the end of the 1984/85 season, and is developing a bull beef/goat enterprise

TABLE 6.3

Summary of Stocking Rates and Sheep Cattle Ratios
on the survey farms during the period 1983/1985

| | | Winter Stocking Rate (July 1) | | | Sheep:Cattle Ratio (ssu/csu wintered) | |
|---|---|---|---|---|---|---|
| | | Range | Mean | ± SE | Range | Mean |
| 1983/84 | Overall | 9.9 - 16.1 | 13.35 | 0.63 | 76:24 - 100:0 | 91:9 |
| | Summer Dry | | 12.35 | 1.075 | | 92:8 |
| | Summer Wet | | 14.18 | 0.62 | | 90:10 |
| 1984/85 | Overall | 10.0 - 19.26 | 13.19 | 0.65 | 51:49 - 100:0 | 82:18 |
| | Summer Dry | | 12.35 | 0.93 | | 81:19 |
| | Summer Wet | | 13.92 | 0.87 | | 82:18 |
| 1985/86 | Overall | 9.67 - 17.54 | 12.24 | 0.61 | 46:54 - 98:2 | 79:21 |
| | Summer Dry | | 10.93 | 0.71 | | 80:20 |
| | Summer Wet | | 13.38 | 0.78 | | 78:22 |
| MODEL: | | | | | | |
| | Summer Dry | | 10.5 | | | 80:20 |
| | Summer Wet | | 12.5 | | | 80:20 |

TABLE 6.4

Change in Stock Numbers over the Next Two Years

| | | Cattle Numbers Increase | Decrease | Same | Number of Farmers |
|---|---|---|---|---|---|
| Sheep Numbers | Increase | | 1 | | 1 |
| | Decrease | 4 | | 2 | 6 |
| | Same | 3 | 1 | 3 | 7 |
| | Undecided | 1 | | | 1 |
| | Number of Farmers | 8 | 2 | 5 | 15 |

The farmers indicated that the magnitude of increase/decreases in cattle would depend largely on the profitability of sheep; if the returns for lambs kept on decreasing, then breeding ewes would be replaced with bulls. Farmer (C) was aiming to change his bull policy from younger to older bulls. In this case the same number of bull stock units of fewer older bulls were to be wintered, and breeding ewes increased. Farmer (F) intending to decrease bull numbers in order to increase goat numbers.

## 6.4 STOCK POLICIES AND PERFORMANCE

### 6.4.1 SHEEP

Lambing Performance

The average lambing percentage on the survey farms over the last 3 years (1983-1985) was 105%, with a range of 70-135% (Table 6.5). This table

TABLE 6.5

Lambing % 1983-1985

| | Range | Mean | ± SE | |
|---|---|---|---|---|
| 1983 | 87 - 130 | 103.3 | 3.36 | Overall |
| | 87 - 130 | 109.5 | 5.58 | Summer Dry |
| | 88 - 115 | 97.9 | 3.14 | Summer Wet |
| 1984 | 91 - 135 | 110.1 | 2.98 | Overall |
| | 91 - 135 | 113.4 | 5.94 | Summer Dry |
| | 98 - 115 | 107.2 | 2.10 | Summer Wet |
| 1985 | 70 - 129 | 102.0 | 3.88 | Overall |
| | 70 - 129 | 103.0 | 9.0 | Summer Dry |
| | 90 - 108 | 101.2 | 2.31 | Summer Wet |

(Wairarapa average 1980-1984: 93.2% $MAF_2$ 1986)

Model: 95% SD 100% SW

shows that, against expectations, the summer dry farms achieved higher lambing percentages than summer wet, although the variation was greater. Average lambing percentages on the survey farms were 8% and 1% higher than those used in the summer dry and summer wet models respectively. This is discussed further in Section 6.8.

Mating

On average, rams were introduced to the ewes on March 25 on summer dry farms, and April 5 on summer wet farms (Table 6.6).

TABLE 6.6

Mating dates on the survey farms (1983-1985)

| | Range | Mean | |
|---|---|---|---|
| 1983 | 28 February - 10 April | 25 March | Summer Dry |
| | 30 March - 10 April | 5 April | Summer Wet |
| 1984 | 28 February - 10 April | 3 April | Summer Dry |
| | 1 April - 15 April | 7 April | Summer Wet |
| 1985 | 15 March - 3 April | 25 March | Summer Dry |
| | 28 March - 10 April | 5 April | Summer Wet |

These mating dates correspond almost exactly with those used in the model; March 23 for summer dry and April 6 for summer wet. The average mating period for all farms was 7 weeks in each year since 1983 (7.3 weeks in the model).

Five farmers had mated a group of ewes (usually the older ewes, or culls that normally would have been sent to the works) earlier than usual in the 1986 year. Tupping dates for these flocks varied from late January to early March. The main aims of this practice were to obtain premiums on early lambs and to allow for the early sale of cull ewes.

Only one farmer (E) did not normally try to flush ewes prior to mating. The average flushing period in 1984 and 1985 was 3 weeks, with no difference between summer dry and summer wet farms (2 weeks for summer dry and 4 weeks for summer wet in the model).

The overall three year average bodyweights at the commencement of mating of mixed age (MA) ewes, two tooths, and ewe lambs were 54.3 kg, 51.0 kg, and 34.1 kg respectively (Table 6.7). The low number of farmers who had sheep bodyweight figures means that comparisons between the two environments should be made with caution. However, these average weights are similar to those used in the model; 55 kg ewes at mating and 30-35 kg ewe lambs in April-May.

Weaning

Lamb weaning dates varied between years, depending on climatic conditions and pasture availability. Generally, weaning took place 2-3 weeks later on the summer wet farms (Table 6.8). In the model, weaning took place on December 1 for the summer dry situation, and December 15 for the summer wet situation.

TABLE 6.7

Autumn Bodyweights of Sheep (kg) on the survey farms

| Mixed Age Ewes | Number of Farmers Weighing | Range | Mean ± SE | |
|---|---|---|---|---|
| 1983 | 5 | 51 - 60 | 54.4 ± 1.5 | Overall |
| | 4 | 51 - 60 | 54.5 ± 1.9 | Summer Dry |
| | | | Insufficient data | Summer Wet |
| 1984 | 9 | 49 - 60 | 54.55 ± 1.2 | Overall |
| | 4 | 53 - 60 | 56.5 ± 2.0 | Summer Dry |
| | 5 | 49 - 55 | 53.0 ± 1.1 | Summer Wet |
| 1985 | 10 | 50 - 60 | 54.1 ± 1.1 | Overall |
| | 5 | 50 - 57 | 53.6 ± 2.7 | Summer Dry |
| | 5 | 50 - 60 | 54.6 ± 1.9 | Summer Wet |
| **Two tooth Ewes** | | | | |
| 1983 | 5 | 46 - 57 | 51.0 ± 2.1 | Overall |
| | 4 | | 51.0 ± 2.7 | Summer Dry |
| | | | Insufficient data | Summer Wet |
| 1984 | 9 | 47 - 57 | 52.25 ± 1.2 | Overall |
| | 4 | | 54.25 ± 1.5 | Summer Dry |
| | 5 | | 50.25 ± 1.1 | Summer Wet |
| 1985 | 10 | 45 - 53 | 49.5 ± 0.75 | Overall |
| | 5 | | 49.4 ± 1.3 | Summer Dry |
| | 5 | | 49.75 ± 0.75 | Summer Wet |
| **Ewe Lambs** | | | | |
| 1983 | 5 | 30 - 40 | 34.8 ± 1.8 | Overall |
| 1984 | 6 | 30 - 40 | 34.5 ± 1.5 | Overall |
| 1985 | 6 | 30 - 38 | 33.0 ± 1.3 | Overall |

TABLE 6.8

Time of Lamb Weaning on the
Survey Farms (1983-1985)

| | | Range | Average |
|---|---|---|---|
| 1983 | SD | end October - mid December | end November/early December |
| | SW | early November - mid December | end November/early December |
| 1984 | SD | end October - mid December | mid-late November |
| | SW | mid November - mid December | early-mid December |
| 1985 | SD | late November - early January | late November - early December |
| | SW | late November - mid January | mid December |

Lamb Selling Policies

Lamb selling policies varied between years, due to climatic conditions, market values, and disruptions caused by Freezing Work strikes. The vast majority (95%) of lambs were sold prime, with the rest, usually the "tail enders", being sold store. Most lambs were killed locally (Waingawa) although some were also sent to the Hawkes Bay. The pattern of selling between summer dry and summer wet varied. Summer dry farmers sold between 45-75% of lambs by the end of December, 80% by the end of January and virtually all by the end of February. Summer wet farmers had a much slower rate of selling, with around 40% drafted by the end of December, and then in approximately equal numbers each month through to the end of April. These patterns are very similar to those used in the model (Section 3.8). Some farmers in both groups were intending to carry some lambs through the 1986 winter into the early spring. This was due to higher than normal pasture covers being carried into the winter and the desire to grow the lambs to heavier weights to improve returns.

Carcass weights of lambs killed were mainly between 11 and 12 kg (Table 6.9). The 1984/85 weights were lower than normal because of the dry season and the high schedule paid for alpha lambs (<9 kg carcass weight). The carcass weights shown in Table 6.9 are very similar to those used in the model (Section 3.8).

Selling Policy for Other Sheep

None of the farmers had a regular policy of carrying surplus hoggets over the winter to sell either as hoggets or surplus two tooths. Ewes were culled from September through to February, and generally averaged 17% of MA ewes wintered. Most culling was done from November-January. A culling rate of 20% at the end of December was assumed in the model.

Wool Production

Average wool production per sheep stock unit on the survey farms was 4.6 kg (Table 6.10). This compares with the Wairarapa average (1981-1984) of 4.69 kg/ssu ($MAF_1$ 1986).

6.4.2 BULLS

Buying Policy

Over the last two years (1984/85, 85/86), all of the survey farmers had bought in young bulls as their main bull buying policy. Half (7) the farmers bought bulls either as 3 months weaners in the spring (November-December), or as 6-8 month weaners in the autumn (February-April). The remaining farmers bought in some weaner bulls at these times, as well as buying in 4-day old bull calves in the early spring (July-September) which they reared themselves. In addition, 4 farmers (B, E, N, O) bought in 15-18 month bulls in the late spring-summer (November-February), while 2 farmers (L, M) bought in some yearling bulls in July-September.

Bulls were purchased from three sources; dairy farmers, other sheep and beef farmers, and via stock yards. Seven farmers handled all bull purchases themselves, 5 farmers bought some bulls themselves and some through stock agents, while 3 farmers dealth solely through agents.

While the majority of bulls were bought within the Wairarapa-southern Hawkes Bay, farmers also travelled into the major dairying areas to buy bulls - Manawatu (5 farmers), Taranaki (2), and the Waikato (3 farmers, including one who bought all his bulls from this area). If competition for bulls increased within the Wairarapa, most farmers would look for bulls elsewhere in the North Island. Transport costs were considered to be insignificant.

The average liveweight of the 3 month weaner bulls (in early November) was 80-100 kg (compared with 100 kg in the model), while the average liveweight

TABLE 6.9

Lamb Carcass Weights (kg)

| | Range | Mean ± SE | |
|---|---|---|---|
| 1984/85 | 6.9 - 13.5 | 11.07 ± 0.595 | Overall |
| | | 10.97 ± 0.938 | Summer Dry |
| | | 11.12 ± 0.803 | Summer Wet |
| 1985/86 | 8.8 - 15.5 | 12.03 ± 0.649 | Overall |
| | | 11.67 ± 0.568 | Summer Dry |
| | | 12.23 ± 0.996 | Summer Wet |

TABLE 6.10

Wool Production per Sheep Stock Unit wintered (kg)

| | Range | Mean ± SE | |
|---|---|---|---|
| 1984 | 3.6 - 5.81 | 4.56 ± 0.175 | Overall |
| | | 4.3 ± 0.215 | Summer Dry |
| | | 4.77 ± 0.352 | Summer Wet |
| 1985 | 2.61 - 5.95 | 4.68 ± 0.242 | Overall |
| | | 4.44 ± 0.248 | Summer Dry |
| | | 4.90 ± 0.335 | Summer Wet |

(The GM analysis assumed 4.5 kg and 5.0 kg/ssu in the summer dry and summer wet environment respectively) of the 7-8 month weaners was 170-180 kg (140 kg in the model). The average liveweight of yearling bulls bought in varied from 235-300 kg (200 kg in the model). Thus the initial liveweights used in the model were similar to, or lower than those on the survey farms. If higher liveweights had been used in the model then either lower liveweight gains would be required to achieve the final weight, or if the same liveweight gains were used, a higher weight at sale would have been achieved, or alteratively the bulls sold earlier.

The farmers were asked to rank the criteria used when buying bulls (Table 6.11).

TABLE 6.11

Ranking of Importance of Factors When Buying Bulls
(Number of Farmers)

| | Mean Score(1) | Most Important 1 | 2 | 3 | 4 | Least Important 5 | Not Considered |
|---|---|---|---|---|---|---|---|
| Buy-Sell same market | 2.92 | 2 | 5 | 1 | 2 | 3 | 2 |
| Buy certain number to make up stock numbers | 3.53 | | 2 | 5 | 6 | 2 | |
| Maximum price willing to pay | 1.93 | 4 | 7 | 3 | | | 1 |
| Minimum Liveweight | 1.93 | 5 | 6 | 2 | 1 | | 1 |
| Other | 2.50 | 3 | 2 | 3 | 1 | 1 | |

(1) Mean score is derived by multiplying the number of farmers in each ranking by the ranking, and dividing by the total number of farmers in that category.

The most important criteria appeared to be "maximum price willing to pay" and "minimum liveweight", which were usually linked together. "Other criteria" covered two main areas; the bulls had to be predominantly Friesian (5 farmers), and the farmer's perception of the profitability of bulls over the next 12-18 months (4 farmers). Thirteen farmers "priced" bulls on their estimate of liveweight or carcass weight prior to purchase.

Buying Selling Policies

The majority (12) of the farmers aimed to sell bulls at 15-18 months of age, 4 (A, F, I, O) farmers had a policy of selling some bulls at 15-18 months of age and some at 2 years, while 2 (B, E) farmers kept bulls through to 2½-3 years of age before slaughter. The buying/selling policies used by the farmers were therefore variations of all the policies modelled, except system 6.

During the last two seasons (1984/85, 85/86), the bulk of the bulls were sold for slaughter, at Freezing Works as far away at Taumarunui. Five farmers regularly "shopped around" the various Freezing Works to obtain the best meat price. One farmer had a regular policy of selling bulls store at 15-16 months of age. The remaining farmers only sold some bulls store occasionally.

Carcass weights varied considerably, due in part to the drought in 1984/85 and the combination of good pasture growth and the autumn Freezing Works strike (which meant bulls were kept on longer) in 1985/86. Carcass weights for 16-18 month bulls varied from 175-230 kg, averaging around 215 kg.

Carcass weights of 2½-3 year bulls varied from 224-333 kg, averaging around 265 kg.

When asked to rank factors influencing selling decisions, the farmers indicated that the two most important factors were availability of premiums, and the feed situation on the farm (Table 6.12).

TABLE 6.12

Ranking of Factors Affecting Selling Decisions
(Number of Farmers)

| | Mean Score | Most Important 1 | 2 | 3 | 4 | 5 | Least Important 6 | Not Considered |
|---|---|---|---|---|---|---|---|---|
| Cash Flow | 2.93 | 3 | 4 | 1 | 4 | 1 | 1 | 1 |
| Feed Position | 2.13 | 4 | 5 | 6 | | | | |
| Always sell at same time | 4.50 | | 1 | 2 | 1 | 6 | 2 | 1 |
| Premiums available | 2.00 | 5 | 6 | 3 | 1 | | | |
| Expectn of schedule change | 2.27 | 5 | 3 | 5 | 2 | | | |
| Other* | 4.25 | | 1 | | 1 | 1 | 1 | |

* "Other" factors included: Expected future LWG
Weight of bulls
Availability/cost of replacements

The two main "market indicators" readily available to farmers to help in selling decisions are the bull schedule announced weekly by the Meat Companies, and the New Zealand $ exchange rate.

Eleven of the farmers followed the bull schedule on a weekly basis, and all but one followed the NZ $ exchange regularly (Table 6.13).

TABLE 6.13

Crosstabulation of Farmers following the Bull Schedule and the NZ $ exchange

| | Follow $ Exchange | | |
|---|---|---|---|
| Follow Schedule | Weekly | Hardly Ever | Total |
| Weekly | 11 | | 11 |
| Fortnightly | 2 | | 2 |
| Monthly | | 1 | 1 |
| Hardly Ever | 1 | | 1 |
| TOTAL | 14 | 1 | 15 |

Most of the farmers did not regularly attend weekly stock sales; 4 attended monthly, 9 attended 5-6 times a year, and 2 only attended 2-3 times a year. The main reason for attending was for buying bulls rather than for gathering information on bull prices for selling decisions.

As well as those mentioned above, other sources of information used in making selling decisions were:

Stock Agents (7 farmers)
Contacts at Freezing Works (6)
Articles in Press/Radio (8)
Other Farmers (4)
Advisors (2)
Meat Board reps (2)
Contacts in United States (2)

Bull Liveweight Gains

Eleven farmers weighed their bulls. However, of those that did weigh, only 4 weighed bulls on a regular basis throughout the year. Hence, records of average liveweight gains on the survey farms in general were poor. The liveweight gain figures obtained for the 1984/85 and 1985/86 seasons are shown in Table 6.14. Although there is considerable variation in average liveweight gains between seasons and farms, the better liveweight gains shown in Table 6.14 are higher than the average liveweight gains used in the model simulations (see Tables 4.1 and 4.9).

The farmers who weighed bulls attempted to achieve target weights at certain ages of bull/times of the year. For 7 farmers the target weight was simply to achieve a 220 kg carcass weight by 16-18 months of age (ie Policies 1 and 2), while 4 farmers had various target weights throughout the year - mostly based on those of Smith (1985). Bulls were usually weighed immediately prior to sale - to indicate whether to sell or not, and to check the dressing out percentage at slaughter. Most of the farmers who weighed felt that scales were a very valuable management tool and intended to weigh at more regular intervals in the future. The main reason given by farmers who did not weigh/own scales for not weighing, was lack of time/labour and the capital cost of buying scales.

## 6.5 BULL ANIMAL HEALTH PRACTICES

The main animal health problem in bulls was internal worm parasites. Nine farmers drenched young (<1 year) bulls on a 3-4 weekly basis through to 12 months of age, 5 farmers drenched every 4-6 weeks, while 1 farmer carried out a 3 x 21 day followed by 4 weekly drenching programme. Three farmers regularly gave 1-2 drenches to bulls older than 1 year (usually through to November). Yearling bulls were occasionally drenched in August/September by the other farmers. Older bulls were only drenched if they "looked poorly". Four of the farmers were interested in obtaining faecal egg counts from their bulls to assist drenching decisions, although faecal egg counts from cattle are not as reliable as those from sheep (McKenna 1981).

Other animal health problems were relatively minor; ryegrass staggers, injury due to fighting/riding, and pinkeye being the more important amongst others

TABLE 6.14

Average Liveweight Gains of bulls (kg/day)

| | | Summer | Autumn | Winter | Spring |
|---|---|---|---|---|---|
| Summer Dry Farms | R1 yr | | 0.3 | 0.3 | 1.2 |
| | R2 yr | 0.8 | | | |
| | R1 yr | 0.9 | | | 1.2 |
| | R1 yr | 0.5 | | | |
| Summer Wet Farms | R1 yr | 0.4 | 0.55 | 0.75 | 1.3 - 1.5 |
| | R2 yr | 0.8 | | | |
| | R2 yr | 1.2 | 0.25 | | 0.9 - 1.45 |
| | R1 yr | | 0.7 | 0.35 | |
| | R1 yr | | | 0.65 | 0.9 |
| | R1 yr | 0.25 | 0.25 | 0.8 | 1.4 |
| Massey Tuapaka Hill Farm* | | | | | |
| R1 yr | 1984 | 0.87 | 0.49 | 0.60 | 1.4 |
| R1 yr | 1985 | 0.5 | 0.57 | 0.80 | |

* Gray (pers com). This farm is similar to the summer wet survey farms

TABLE 6.15

Other Bull Animal Health Problems
(Number of Farmers)

| | SERIOUSNESS | | | | | | FREQUENCY | | | BULL MOB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Score | Most 1 | 2 | 3 | 4 | Least 5 | Every Year | Every Other Year | Less than every 2 years | <1yr | >1yr | Both |
| Copper Deficiency | 4.13 | 1 | | 3 | 3 | 8 | 5 | | 2 | 1 | 2 | 4 |
| Ryegrass Staggers | 3.27 | 3 | 2 | 3 | 2 | 5 | 5 | 3 | 2 | 9 | | 1 |
| Bloat | 4.00 | 1 | 1 | 3 | 1 | 8 | 3 | 2 | 1 | 1 | 1 | 4 |
| Clostridial Diseases | 4.73 | | | 1 | 2 | 12 | 1 | | 2 | 1 | | 2 |
| Injury | 3.27 | 1 | 1 | 8 | 3 | 2 | 8 | 1 | 4 | 4 | 7 | 2 |
| Pink eye | 3.53 | 2 | 4 | | 2 | 7 | 2 | 1 | 5 | 2 | 1 | 5 |
| Facial Eczema | 4.93 | | | | 1 | 14 | | | 1 | | | |
| Other* | | | | 1 | | 1 | 1 | | | 1 | | |

* Woody tongue and pneumonia

mentioned (Table 6.15). Strategies to overcome ryegrass staggers included low stocking rates, feeding silage and avoiding "at risk" paddocks over the danger months. Attempts to alleviate the problem of bloat included; grazing lambs ahead of the bulls to reduce clover content, the use of lick blocks, and placing anti-bloat oil in water troughs. Injury problems were alleviated by removing the affected bull from the mob, regular shifting of mobs to maintain a high (consistant) feeding level, running smaller mobs and the use of Ralgro to quieten bulling behaviour.

Ralgro

Nine farmers had used ralgro. Their (subjective) evaluation of its effectiveness is shown in Table 6.16.

TABLE 6.16

**Evaluation of the Effectiveness of Ralgro (Number of Farmers)**

| | | Yes | No |
|---|---|---|---|
| Increased LWG | <1 yr Bulls | 1 | 7 |
| | >1 yr | | 2 |
| Decreased Bulling Behaviour | <1 yr Bulls | 4 | 3 |
| | >1 yr | 2 | |

From this it appears that farmers mainly used Ralgro to decrease bulling behaviour (see Section 2.4.1).

## 6.6 GRAZING MANAGEMENT

There was some variation in grazing management strategies, both with different mobs within a farm and between farms. Generally, rotational grazing was adopted for most of the year. However, set stocking of bulls often occurred if pasture covers were high, as a means of overcoming riding/fighting problems, and as the bulls became older (>18 months of age, partially because of increased riding/fighting). One farmer who had high stock losses over the winter-spring when rotating large mobs (100 bulls) on hill country (due to bulls being pushed over bluffs or into gullys), overcame this by saving autumn pasture and set stocking bulls over the winter-spring in groups of 50-80 head. Several (5) farmers break-grazed their bulls behind electric fencing during the autumn and winter.

Only 1 farmer (E) grazed his sheep and bulls together for most of the year. Bulls and sheep were grazed over the same area, but not together, by 5 farmers. The majority (9) of farmers grazed bulls on a separate block, occasionally bringing in lambs to graze this area in the late spring-summer. These separate bull blocks were on the easier country.

Four farmers attempted to reduce sheep worm burdens by preparing pasture with bulls - this mainly consisted of grazing lambs at low stocking rates amongst bulls. Three farmers attempted to reduce bull worm burdens by preparing pastures with sheep. The main problems the survey farmers faced in using bulls to prepare feed for sheep was the low numbers of bulls relative to sheep. However, in converse, there was considerable scope for farmers to use their sheep to prepare pastures for bulls, both in terms of worm burdens and pasture quality.

Several of the farmers currently restricting bulls to flat-easier country perceived some difficulties in grazing bulls on the hills, in terms of grazing management (ensuring adequate intake) and physical problems (such as bulls fighting, resulting in broken legs from falls). This is in contrast to the two-thirds of the survey farmers who were already grazing bulls on hills with no difficulties.

The use of bulls for cleaning up long (rank) feed to maintain pasture quality was generally not favoured. Only 6 farmers said that they would use bulls for this purpose, and only if it did not seriously compromise bull growth rates.

Pattern of Feed Supply and Feeding Priorities

The pasture deficit in summer/autumn and winter/spring was almost exclusive to summer dry farmers and summer wet farmers respectively (Table 6.17).

TABLE 6.17

Months of Most Severe Shortage of Pasture on the Survey Farms

| Month | Number of Farmers | Month | Number of Farmers |
|---|---|---|---|
| January | 3 | June | 3 |
| February | 8 | July | 8 |
| March | 5 | August | 8 |
| April | 1 | September | 5 |
| | | October | 2 |

The deficit in the winter-early spring was normally one of quantity of feed, while the summer shortage was a combination of both quantity and quality. Under the assumptions used for the construction and operation of the model, the main feed shortage in the summer dry environment occurred during February-March, and during July-early September in the summer wet environment - the same as recorded by the survey farmers.

During a feed deficit period, younger (<1 year) bulls were given highest feeding priority, followed by replacement ewe hoggets in both a dry summer and wet winter (Tables 6.18 and 6.19). This was because these animals had the highest potential for profit and had a large effect on the future

PLATE 6.1 9 month bulls and ewe hoggets rotationally grazed on Wairarapa hill country

PLATE 6.2 18 month bulls and breeding ewes rotationally grazed on Wairarapa hill country

TABLE 6.18

Priority Ranking for Feed in a Dry Summer
(Number of Farmers)

| | Ranking | | | | | |
|---|---|---|---|---|---|---|
| | Mean Score | Highest 1 | 2 | 3 | 4 | 5 | Lowest 6 |
| R1 yr Bulls | 1.67 | 8 | 5 | 1 | 1 | | |
| R2 yr Bulls | 2.36 | 2 | 5 | 2 | 2 | | |
| Other Cattle | 5.29 | | | | 2 | 1 | 4 |
| Breeding Ewes | 3.21 | 2 | 3 | 2 | 4 | 3 | |
| Replacement Ewe Lambs | 1.71 | 6 | 6 | 2 | | | |
| Other Lambs | 2.40 | 2 | 4 | 2 | 2 | | |

TABLE 6.19

Priority Ranking for Feed in a Wet Winter
(Number of Farmers)

| | Ranking | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean Score | Highest 1 | 2 | 3 | 4 | 5 | Lowest 6 |
| R1 yr Bulls | 1.67 | 8 | 5 | 1 | 1 | | |
| R2 yr Bulls | 2.70 | 2 | 3 | 2 | 2 | 1 | |
| Other Cattle | 4.71 | | | 1 | 3 | | 3 |
| Breeding Ewes | 2.71 | 3 | 4 | 3 | 3 | | 1 |
| Replacement Ewe Lambs | 2.00 | 4 | 7 | 2 | 1 | | |
| Other Lambs | 4.29 | | 1 | | 2 | 4 | |

profitability of the flock respectively. It could have been expected that R 2 yr bulls would have had the highest priority in a dry summer, having the greatest immediate potential for profit. However, most of the farmers who carried R 2 yr bulls into the summer felt that it was more important to keep young stock growing well.

All the farmers appreciated the need to grow their bulls as fast as possible, and generally tried to feed them accordingly (Tables 6.20 and 6.21).

On the basis of data collected at Riverside using an Ellinbank Pasture Meter and pasture cuts the following broad relationships between pasture height and mass have been predominantly ryegrass/clover swards established (Parker 1984);

| *Height Category | Pasture Score |
|---|---|
| 0 - 1.25 cm | 400 kg DM/ha |
| 1.25 - 2.50 cm | 650 kg DM/ha |
| 2.50 - 5.0 cm | 1000 kg DM/ha |
| 5.0 - 7.5 cm | 1250 kg DM/ha |
| > 8 cm | 600 kg DM/ha |

* This relationship will vary according to sward type. For example unimproved browntop dominant hill country will have much higher DM content per unit height in the lower horizons of the sward.

If this data is related to Tables 6.20 and 6.21, it would appear that the bulls are being relatively well fed apart from during the winter period. This may help to explain the low autumn-winter liveweight gains recorded on some farms (Table 6.14).

### 6.6.1 SUPPLEMENTARY FEEDING

Five farmers made hay, and 3 others bought hay in over the summer (December-February). This was almost exclusively fed to the bulls/other cattle over the winter period (June-August). Six farmers made silage (average area 15 ha) in the late spring (November-December). This was predominantly fed to the breeding ewes and/or young bulls over the late

TABLE 6.20

Feeding Levels - Length of Pasture not grazed below by Young (Weaner-lyr) Bulls

(Number of Farmers)

| | Pasture Length | | | |
|---|---|---|---|---|
| | 0-2.5 cm | 2.5-5.0 cm | 5.0-7.5 cm | > 7.5 cm |
| Summer | | 6 | 7 | 2 |
| Autumn | | 5 | 8 | 2 |
| Winter | 3 | 5 | 6 | 1 |
| Spring | | 3 | 6 | 6 |

TABLE 6.21

Feeding Levels - Length of Pasture not grazed below by Older (>1 yr) Bulls

(Number of Farmers)

| | Pasture Length | | | |
|---|---|---|---|---|
| | 0-2.5 cm | 2.5-5.0 cm | 5.0-7.5 cm | > 7.5 cm |
| Summer | | 8 | 5 | 2 |
| Autumn | | 7 | 6 | 2 |
| Winter | 3 | 4 | 5 | 1 |
| Spring | | 3 | 5 | 5 |

summer-autumn period (February-April). Twelve farmers said that they had a large enough area suitable for making hay or silage if required. Six farmers used no conserved feed.

Nitrogen fertilizer was a popular source of supplementary feed. Over the last 3 years (1983/85), 13 farmers had used nitrogen in one or all of those years (Table 6.22).

TABLE 6.22

Use of Nitrogen Fertilizer 1983-1985
(Number of Farmers)

| | Type of Fertilizer | | | Average Applcn Rate kg N/ha | Months applied | Main Month |
|---|---|---|---|---|---|---|
| | Urea | DAP | Other | | | |
| 1983 | 1 | 8 | | 18 | June - August | July |
| 1984 | 3 | 9 | 1 | 18.7 | May - September | July |
| 1985 | 4 | 4 | 2 | 22.5 | April - August | May and July |

The main reason for using nitrogen was to boost late winter-early spring feed supplies. A second reason was that in 1983 and 1984 DAP (DiAmmoniumPhosphate) was a relatively cheap source of phosphate and nitrogen. The heavier usage and earlier application times of nitrogen in 1985 was to encourage pasture growth during the late autumn-winter following the drought. The farmers who had used nitrogen felt that they had gained a worthwhile pasture response (from visual assessments) and continuation of its use would be largely dependent on the applied cost (see Section 5.3.1).

## 6.6.2 BULL BEHAVIOURAL PROBLEMS

Bull "behaviour" was not considered a major problem on most of the farms. The main problems were bulls riding each other, damage to fences and gates, and fighting (Table 6.23).

TABLE 6.23

Ranking of Seriousness of Bull Problems
(Number of Farmers)

| | Seriousness | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean Score | Most 1 | 2 | 3 | 4 | 5 | 6 | 7 | Least 8 | No Problem |
| Pushing fences/gates | 2.77 | 4 | 2 | 4 | | 2 | 1 | | | 2 |
| Riding each other | 2.65 | 5 | 4 | 2 | | 1 | 1 | 1 | | 1 |
| Fighting | 2.93 | 2 | 5 | 3 | 3 | | | | 1 | 1 |
| Digging holes | 4.14 | | 2 | 1 | 8 | | 2 | 1 | | 1 |
| Pacing (up and down fence lines) | 4.59 | | | 3 | 1 | 6 | 2 | | | 2 |
| Chasing stock (ie lambs) | 5.86 | | | | | 4 | 1 | 1 | 1 | 4 |
| Keeping separate from own heifers/cows | 6.72 | | | | 1 | 1 | | 2 | 3 | 5 |
| Keeping separate from neighbours stock (cattle) | 5.72 | | 1 | 2 | 1 | | 2 | 1 | 4 | 3 |

Preventative action taken by farmers to overcome or alleviate these problems are listed below (number of farmers in brackets).

**Pushing Fences:** electrify fences/use electric outriggers (13).

**Riding:** Run smaller mobs (2) (the definition of small mobs varied from 25-80, depending on the total number of bulls farmed). Set stock in mobs of 50-60 (1). Keep bulls rotating/avoid feed stress by above maintenance feeding (2). Use Ralgro (2).

**Fighting:** Split mobs up into smaller mobs (1) (see above). Take care when joining mobs (1). Keep adult bulls rotating to prevent territorial problems (1). Avoid transferring bulls between mobs (1). Keep bulls of similar size together (1). Avoid feed stress by above maintenance feeding (3). Use Ralgro (1).

Digging holes: Fill in (1). Keep rabbit population down (1).

Pacing up and down fence lines: Keep mobs of bulls away from adjacent paddocks (1). Use electric outriggers (3).

Keeping separate from own other cattle/neighbours stock: electrify fences (13).

Electric fencing was identified as an important factor in successfully running bulls. The need to prevent stress, particularly in terms of feed shortages (especially with older bulls) was also emphasised.

## 6.7 GENERAL FACTORS RELATING TO BULL BEEF

The last section of the questionnaire included questions of a general nature. The first of these related to how farmers had found the labour requirements for bull beef relative to a breeding sheep and cattle situation. Most indicated a lower labour requirement (Table 6.24).

TABLE 6.24

Labour requirements (relative to Sheep) for Bull Beef

| | Number of Farmers |
|---|---|
| Higher | 2 |
| Lower | 11 |
| Same | 2 |

One farmer who said that bulls had a higher labour requirement related this mainly to the rearing of calves and the additional drenching requirements of bull calves compared to breeding cows.

Other farmers were the main source of information about bull beef farming. This has also been found by other New Zealand researchers (Fairgray 1969, Greer 1982) (Table 6.25).

TABLE 6.25

Sources of Information on bull beef farming used by survey farmers

| Source of Information | Number of Farmers using sources |
|---|---|
| Other Farmers | 14 |
| Massey Staff | 8 |
| Massey Publications | 8 |
| MAF Advisor | 8 |
| MAF Publications | 10 |
| Private Consultant | 4 |
| Other Publications (eg Farming Journals) | 4 |
| Other Sources (DSIR) | 1 |

When asked what aspects of bull beef they would like more information about (Table 6.26), farmers indicated a wide range of topics.

TABLE 6.26

Bull Beef Topics more Information is Required On
(Number of Farmers in brackets)

More market information (7)

Use of worm counts/drenching policies (4)

Effectiveness of Ralgro on LWG and behaviour (2)

Target liveweight profiles (2)

Behaviour modification by management (2)

Mineral requirements of bulls (1)

How to visually estimate bull liveweights (1)

Grazing with sheep as an alternative to breeding cows for profit and pasture control (1)

Schedules and killing charges at different Freezing Works (1)

The most common areas in which information was sought, were marketing and internal parasite control. Most of the farmers were vague when asked what sort of "market" information they required. Generally, "market" information related to a better understanding of the United States market whether price rises/falls could be anticipated in the short term (in order to assist in selling decisions within New Zealand) as well as longer term trends (whether bull beef was going to remain profitable at least in the next 1-2 years).

The farmers were also asked about their concerns for the futur eof bull beef farming, both on and off farm. The main concern for all 15 farmers was the current dependence of the New Zealand bull beef trade on a single market -

the US. Allied to this was the farmers concern about the ANZUS dispute between the US and New Zealand and whether retaliatory trade action by the US would be taken against New Zealand.

The second main concern (voiced by 7 farmers), was the increasing competition created by other New Zealand farmers switching to bull beef. This was mainly manifested in terms of increasing prices for weaner bulls - thereby squeezing profit margins.

Other concerns for the future of bull beef are listed in Table 6.27.

TABLE 6.27

Other Concerns for the Future of Bull Beef
(Number of farmers in brackets)

NZ $ fluctuations - upset timing of finishing (2)

Interest cost of capital involved - difficult to increase bull numbers (2)

Wintering problems - behavioural factors (1)

If have high bull numbers and get caught by drought (3)

Bulls and conservation plantings don't mix - difficult to run bulls on hillsides planted with trees for catchment control (1)

Damage to pastures and fences (1)

Some of the factors relating to markets, effect of exchange rates, and supply of bulls within New Zealand, are discussed in Chapter 7.

The last question in the survey was prefaced with a leading question - whether the farmers had found bulls to be more profitable than sheep. The answer expected - that all the farmers had found bulls to be more profitable - was obtained. The farmers were then asked, if this was the case, why not run predominantly bulls with some sheep, if not all bulls.

Generally, the farmers were not in favour of this. The main reason was one of risk - the farmers were reluctant to have their income dependent on one commodity (beef), preferring instead to have a mix of both sheep and bulls and hence three sources of income - wool, lambs and beef. Two other factors which received equal mention (6 farmers each) were; limited area of easier country on which to run bulls (the farmers were reluctant to run bulls on hill country) and the capital cost (high cost of borrowing) of getting into more bulls. Five farmers felt that the variability of the climate (dry summers) would create difficulties in finishing larger numbers of bulls and this was directly related to the income risk factor. Three farmers were reluctant to run all bulls because they felt some form of stock, other than bulls were required for pasture control measures, and saw breeding ewes as being complementary to bulls in this role.

Other reasons for not running predominantly/all bulls were:

(a) Practical problems - more bulls would mean more behavioural problems, more damage to fences.

(b) "Marginal" effect on sheep - if all bulls on easier country, and sheep restricted to hills, then sheep performance will drop.

(c) Wife is a significant labour input - some danger in handling bulls (ie size). Wife doesn't like bulls.

(d) More bulls would require more "off-farm" skills, ie buying/selling, marketing.

(e) Existing system is simple, easy to run, and profitable - reluctant to change.

## 6.8 ALTERATION OF MODEL BASED ON SURVEY RESULTS

The majority of survey data was very similar to the assumptions used in the construction of the model. The two main discrepancies were in average stocking rates and average lambing percentages, where the survey farms were slightly higher for both than the model (Sections 6.3.2 and 6.4.1). One explanation of the higher stocking rates is that 5 of the farms surveyed were on flat-easy rolling contour, and these farms tended to have higher stocking rates. The lambing percent figures collected in the survey were docking figures; (lambs docked/number of ewes mated). This figure is higher than that used in the model (survival to sale) because deaths from docking to sale are not accounted for.

Increasing the stocking rate by 0.5 su/ha, and the lambing percentage (survival to sale) by 5%, at an 80:20 sheep:bull ratio, had similar effects in both environments; the winter pasture covers decreased by around 50 kg DM/ha, the spring pasture covers decreased by 100 kg DM/ha, and the summer-autumn pasture covers decreased by 150-200 kg DM/ha. In the summer dry environment the bull policies remained feasible, despite lower pasture covers. However, the farm would be far more vulnerable to periods of low pasture growth, particularly in the summer. In the summer wet environment the increased stocking rate/lambing performance resulted in insufficient pasture build up at the end of autumn (ie the pasture cover at the end of May was less than the 1200 kg DM/ha at the start of June). In this situation an alteration in either lamb selling strategies, or bull LWG, or both would be necessary to allow for a sufficient build up of feed to go into the winter.

With some variations in the selling of cull ewes on the survey farms, the timing of selling of cull ewes within the model was also altered to reflect these policies. An earlier culling date improved summer pasture cover figures in both environments, while a later culling lowered the summer pasture cover figure - this was of greater importance in the summer dry environment, but did not affect the overall viability of the bull systems.

## 6.9 CONCLUSIONS

The results of the survey justified the assumptions made for model construction, and indicated that the range of bull policies investigated were appropriate and that the model results could be related to the Wairarapa hill country environment. The experience of farmers running bulls on hill country indicated there are few problems in doing so, and that high levels of liveweight gain in bulls can be achieved. While bulls received priority in feeding, the survey indicated that winter feeding levels may need to be increased (discussed further in the next chapter).

The survey also indicated that the farmers were more interested in obtaining information relating to off farm factors (ie markets) than for on-farm management information.

# CHAPTER SEVEN: FARMER REACTION TO THE PROPOSED BULL BEEF SYSTEMS

## 7.0 CHAPTER OUTLINE

Following the analysis of the survey data and re-running of the model modified to incorporate performance levels typical of the survey farms, as discussed in Section 6.8, six of the survey farmers were visited again invidually to gauge their reaction to the modelled bull beef production systems. A final group meeting with the survey farmers to present a progress report on the research and to discuss the practical implications of implementing the bull beef systems which had been studied was then held.

In the first section of this chapter the visits to the individual farmers and the issues raised with them are described. The remainder of the chapter reports on the group meeting discussion.

## 7.1 INDIVIDUAL FARMER VISITS

In June 1986, six of the survey farmers (3 summer dry (M, N, O) and 3 summer wet (B, E, K) were visited to gauge their reaction to the bull systems modelled. Visits took place on consecutive days with a half day allocated per farm. The interactive process outlined by Walker (1984) was followed. This involved developing a commonality of understanding between the interviewer and the farmer (e.g. with respect to bull beef/hill country farming), after which the information pertaining to the model and model output were introduced and discussed. From this the farmer's reaction to the results of the modelled systems were noted. Other than a brief outline the construction of the model and its operation was not discussed.

All the farmers visited felt that the pasture cover figures generated by the model were typical of those observed on their farms. However, farmers in the summer wet areas tended to carry more pasture into the winter than the 1200 kg DM/ha used in the model (up to 2000 kg DM/ha on one farm). Pasture covers at the start of lambing on all of the farmer revisited usually varied from 800-1100 kg DM/ha. This compared favourably with the levels of 900-1200 kg DM/ha obtained using the model. How (or why) the farmers who carried more pasture into the winter than the model arrived at similar covers at lambing was not readily explained. Possibly they had higher rates of pasture decay as a result of the higher covers, or had high levels of animal performance through the early winter which depeleted the pasture bank.

In terms of the practicality of the systems modelled, there appeared to be a general acceptance. (However, in some cases it was difficult to ascertain whether the farmers were unsure, felt unqualified to comment, or in fact genuinely perceived the model results to be "good"). Some of the comments made were as follows:

One farmer felt that the profitability of systems 4 to 7 (4 and 7 involved buying 7 month/18 month bulls in the autumn, 5 and 6 involved buying R1 yr/R2 yr bulls in the late winter) could alter markedly dependent on buying skills. This was likely to occur where there was a "grass market" in the autumn or spring and prices rose above the bull's schedule carcass value. This was illustrated in Section 5.2, where a $10 movement in the purchase cost of the bull in the above policies varied the GM/500 kg DM by $2-$3. Because of this, the farmer felt that these policies were "riskier" than Policies 1 to 3, in which 3 month weaner bulls were bought and farmed through to slaughter.

Two farmers said that 100 kg weaner bulls (assumed for policies 1-3) were difficult to obtain - their weaners averaged 80 kg LW at purchase in early November. A modified pattern of liveweight gain for a bull with an initial liveweight of 80 kg grown to reach a 220 kg carcass weight by the end of the following year (Policy 1) in a summer day area is shown in Tables 7.1 and 7.2. This demonstrates that average pasture cover differs only slightly from that generated for a 100 kg weaner bull (Table 4.2) and indicates that policy 1 is still feasible under these circumstances. This would also indicate that it would be possible to grow the 100 kg weaner faster if desired, to end up at a heavier liveweight. However, the model was not designed to maximise growth rates.

TABLE 7.1 MODEL OUTPUT for BULL POLICY 1 (80kg WEANER) on SUMMER DRY WAIRARAPA HILL COUNTRY

| | | | |
|---|---|---|---|
| Bull policy (1-7): | 1 | Lambing%: | 95 |
| Stocking rate(su/ha): | 10.5 | Initial wt of Bull(kg): | 80 |
| %Sheep: | 80 | | |
| %Cattle(Bulls): | 20 | Pasture cover at 1st June: (kgDM/Ha) | 1200 |
| Bulls/Ha: | 0.47 | | |
| Ewes/Ha: | 7.15 | | |
| Hoggets/Ha: | 1.79 | | |

| PERIOD | Number | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:K | 2nd Year BULL LWG. Kg/Day | WEIGHT AT END PERIOD | FEED CARRYOVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOTAL STOCK REQS.kgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|---|
| JUNE 1-14 | 1 | | | 0.80 | 234.60 | 0 | 771.12 | 1264 | 166.60 | 36.63 |
| 15-28 | 2 | | | 0.80 | 245.80 | 717.14 | 905.36 | 1271 | 164.89 | 37.05 |
| JULY -12 | 3 | | | 0.80 | 257.00 | 841.98 | 859.33 | 1260 | 166.42 | 38.13 |
| -26 | 4 | | | 0.80 | 268.20 | 799.18 | 583.99 | 1226 | 173.21 | 38.50 |
| AUG -9 | 5 | | | 1.00 | 282.20 | 528.91 | 533.31 | 1209 | 195.61 | 43.93 |
| -23 | 6 | | | 1.10 | 297.60 | 488.82 | 1140.51 | 1247 | 223.33 | 47.09 |
| SEPT -6 | 7 | | | 1.20 | 314.40 | 1054.57 | 2926.07 | 1351 | 274.04 | 50.52 |
| -20 | 8 | | | 1.20 | 331.20 | 2508.54 | 5605.67 | 1552 | 365.29 | 52.37 |
| OCT -4 | 9 | | | 1.50 | 352.20 | 4797.95 | 8648.78 | 1815 | 407.15 | 63.37 |
| -18 | 10 | | | 1.50 | 373.20 | 7335.07 | 12847.68 | 2220 | 422.16 | 66.28 |
| NOV -1 | 11 | | | 1.50 | 394.20 | 10693.23 | 14448.87 | 2462 | 375.65 | 69.27 |
| -15 | 12 | 0.60 | 88.40 | 1.50 | 415.20 | 11586.07 | 13260.80 | 2504 | 365.75 | 89.70 |
| -30 | 13 | 0.60 | 97.40 | 1.30 | 434.70 | 10089.47 | 10650.89 | 2424 | 383.02 | 93.58 |
| DEC -14 | 14 | 0.60 | 105.80 | | | 7314.65 | 8223.95 | 2443 | 277.40 | 20.90 |
| -28 | 15 | 0.60 | 114.20 | | | 4971.29 | 4795.57 | 2353 | 269.93 | 23.39 |
| JAN -11 | 16 | 0.60 | 122.60 | | | 2974.17 | 2816.35 | 2264 | 212.44 | 24.88 |
| -25 | 17 | 0.60 | 131.00 | | | 1774.35 | 1138.30 | 2123 | 223.14 | 26.99 |
| FEB -8 | 18 | 0.60 | 139.40 | | | 733.64 | 76.44 | 1978 | 214.68 | 29.27 |
| -22 | 19 | 0.60 | 147.80 | | | 53.17 | -927.14 | 1797 | 227.33 | 31.37 |
| MARCH -8 | 20 | 0.75 | 158.30 | | | 0.00 | -270.24 | 1547 | 198.03 | 33.50 |
| -22 | 21 | 0.75 | 168.80 | | | 0.00 | 206.31 | 1406 | 216.51 | 32.66 |
| APRIL -5 | 22 | 0.75 | 179.30 | | | 176.64 | 1153.34 | 1373 | 170.25 | 31.89 |
| -19 | 23 | 0.75 | 189.80 | | | 1036.56 | 2522.43 | 1406 | 166.49 | 32.09 |
| MAY -3 | 24 | 0.80 | 201.00 | | | 2279.04 | 3902.63 | 1455 | 167.37 | 34.16 |
| -17 | 25 | 0.80 | 212.20 | | | 3497.98 | 4600.92 | 1459 | 163.88 | 34.37 |
| -31 | 26 | 0.80 | 223.40 | | | 3939.21 | 4873.67 | 1451 | 165.48 | 35.50 |

TABLE 7.2

Comparison of Average Liveweight Gain (kg/day) of 80 kg weaner to 100 kg weaner, grown through to 220 kg carcass weight (Policy 1 Summer Dry)

| | Summer | Autumn | Winter | Spring | Average Purchase Sale |
|---|---|---|---|---|---|
| 80 kg Wnr | 0.60 | 0.77 | 0.88 | 1.39 | 0.90 |
| 100 kg Wnr | 0.57 | 0.68 | 0.83 | 1.34 | 0.85 |

The bull growth rates for the R2 yr bulls in the late winter-early spring and the final weights of the 2½ year bulls in Policy 3 (3 month weaner to 330 kg carcass weight at 2½ years) were high relative to those achieved by one summer wet farmer. He felt that, because of low winter pasture growth rates it was better to hold the R2 yr bulls at (or near) maintenance in order to adequately feed his breeding ewes. Bull growth rates, were therefore lower in the winter but better in the spring than those used in the model. As a result the bulls failed to achieve the target weight of 635 kg LW, or 330 kg carcass weight. The practicality of this system, in the farmer's opinion, depended largely on devising suitable grazing strategies over the winter/early spring period. This observation was also made at the group meeting and is discussed further in Sections 7.2.1 and 7.2.2. The main area of concern in relation to the practical implementation of the bull systems modelled was ensuring the appropriate pasture allowances (especially where the grazing management of bulls was integrated with sheep) to achieve the liveweight gains used in the model. Again this issue was raised at the group meeting, and is discussed in Section 7.2.1.

## 7.2 GROUP MEETING

Following the completion of nearly all the research involved in this study, a meeting with the 15 survey farmers was arranged. This was held in the

Woolshed at Massey University's Riverside farm, 10 km north of Masterton, on the afternoon of August 13. The farmers were notified by mail 10 days prior to the meeting. Eight farmers attended, with two apologies. Two of the local MAF Farm Advisory Officers also attended.

The objectives of the group meeting were first to provide feedback to the farmers in terms of outlining the results and conclusions of the study, and secondly to obtain further farmer reaction to implementing the proposed bull beef systems on Wairarapa hill country. As with the individual farmer visits, discussion was restricted to the model results rather than the model itself.

Most farmer comments related to the grazing management of bulls, the "marginal cost" of feeding 2 year bulls over the winter/early spring period (discussed in the next two sections) and the general market situation relating to bull beef. This "market" interest centered mostly on the beef situation within the United States and the outlook over the next 1-3 years. This is discussed in Chapter 8.

### 7.2.1 BULL GRAZING MANAGEMENT

As mentioned in Section 6.6, the majority of farmers in the survey grazed their bulls on a separate block located mainly on land of easier contour. Several farmers perceived difficulty in grazing bulls on hill country, mostly in relation to ensuring adequate feeding levels. The main query was with respect to suitable residual dry matter (RDM)[1] and rotation lengths for bulls on hill country, so as to achieve the modelled liveweight gain profiles.

Using the RDM's for cattle suggested by Milligan (1981) and Armstrong (1982) the RDM's and rotation lengths outlined in Table 7.3 and 7.4 are suggested for the bull growth rates, pasture growth rates and pasture quality factors used in the model. The rotation lengths shown in these Tables are assumed for bull-only grazing. If the bulls were followed by sheep, then the rotations

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[1]RDM is the dry matter left behind in a paddock following grazing (Milligan 1981).

TABLE 7.3

Residual Dry Matter Levels and Rotation Lengths for Bull Policy 1

| | Bull Growth Rates kg LWG/day | | RDM kg DM/ha | | Rotation Length (days) | |
|---|---|---|---|---|---|---|
| | Summer Dry | Summer Wet | Summer Dry | Summer Wet | Summer Dry | Summer Wet |
| Summer | 0.57 | 0.71 | 1000 | 1100 | 40 | 30 |
| Autumn | 0.68 | 0.79 | 1100 | 1200 | 30-40 | 40 |
| Winter | 0.83 | 0.48 | 1200 | 800 | 40-50 | 50-60 |
| Spring | 1.34 | 1.40 | 1400 | 1400 | 15-20 (or set stock till sale) | 15-20 |

TABLE 7.4

Residual Dry Matter Levels and Rotation Lengths for Bull Policy 3

| | Bull Growth Rates kg LWG/day | | RDM kg DM/ha | | Rotation Length | |
|---|---|---|---|---|---|---|
| | Summer Dry | Summer Wet | Summer Dry | Summer Wet | Summer Dry | Summer Wet |
| Summer | 0.37 | 0.43 | 800 | 1000 | 40 | 30 |
| Autumn | 0.44 | 0.49 | 900 | 1100 | 30-40 | 40 |
| Winter | 0.33 | 0.30 | 800 | 800 | 40-50 | 50-60 |
| Spring | 1.01 | 0.97 | 1200 | 1200 | Set Stock | Set Stock |
| 2 x Summer | 0.58 | 0.62 | 1000 | 1000 | 40 | Set Stock |
| Autumn | 0.54 | 0.60 | 1000 | 1100 | 40 | 40-50 |
| Winter | 0.69 | 0.51 | 1100 | 1000 | 40-50 or Set Stock | 50-60 |
| Spring | 1.33 | 1.33 | 1400 | 1400 | 15-20 till sale | 15-20 |
| 3 x Summer | 1.10 | 1.20 | 1200 | 1200 | | |

would need to be altered. For example, if breeding ewes followed the bulls through the winter grazing down to a residual of 400-500 kg DM/ha (compared with 800-1100 kg DM/ha left by the bulls) the rotation would need to be extended to around 100 days to allow sufficient time for pasture regrowth to a length suitable for bull grazing. This longer rotation could be achieved by grazing a larger area; i.e. instead of grazing separate blocks the bulls and ewes could graze both blocks together.

An additional important factor in determining animal production is pasture allocation. The relationship between pasture allowance, RDM, and feed intake can be used as the basis of feed allocation. Pre-grazing yield is used to allocate feed, and RDM sets the grazing interval and the upper and lower limits of animal production (Milligan and Smith 1984). Accurate rationing of pasture is most easily achieved by grazing stock at high densities for short durations (1-3 days). Extending grazing to 5-7 days obviously reduces subdivision needs, and is of no disadvantage to pasture and animal performance. However, where grazing durations are extended to 5-7 days or more, feed budgets that rely on pre-grazing pasture assessments are a more reliable means of allocating feed than RDM. This is because the intake of animals in the initial stages of grazing will exceed the desired "average" level, and the timing of stock shifts to designated residuals will tend to promote over-feeding and potential feed shortages (Sheath and Bryant 1984).

A second query arose in relation to integration of sheep and bull grazing, as several farmers were opposed to grazing sheep and bulls together. They had found that when grazing sheep and bulls together they tended to concentrate more on the sheep requirements. As a result the sheep usually grazed out the bulls because of their different grazing habits (Section 2.4.2) [2]. This lowered bull LWG's as well as creating problems in re-establishing appropriate RDM's for bulls. Integrated grazing does not only refer to sheep and bulls grazing simultaneously, but also includes the grazing of pastures by both animal species at different times (i.e. in a leader-follower system) or in different seasons. The purpose of integrated grazing is to maintain pasture

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[2]Common farmer quote: "Sheep will eat out cattle, but cattle will never eat out sheep."

density/quality. An example of integrated grazing is illustrated in Figure 7.1.

Figure 7.1 shows that all classes of stock are being grazed over the entire farm over the course of a year. Where the RDM's of both sheep and bulls are similar, such as over the summer months for bulls and lambs, and during autumn for bulls and hoggets, the two groups could be grazed together (Plate 6.1). This is shown in Figure 7.1 by the broken lines. Similarly, because bulls and ewes with lambs at foot have similar target RDM's through the spring, bulls can be lightly set stocked amongst ewes and lambs, as is the practice at Massey University's Keeble farm (Morris pers com).

Achieving the desired winter feeding level (and hence liveweight gains) was identified as being the major grazing management limitation on the survey farms. Operating a bull-only block over the winter, similar to what many farmers use for wintering ewe hoggets, may provide the best solution to this problem. A suitable bank of feed could be built up in the late autumn-early winter on this area, using supplements if necessary, for use by the bulls later in the winter-early spring.

The advantage of integrating the grazing of the sheep and bulls is that the breeding ewes can be used to control pastures - by virtue of their lower RDM:production requirements - thereby providing bulls with access to high quality pasture throughout the year.

### 7.2.2 MARGINAL FEEDING COSTS IN THE LATE WINTER-SPRING

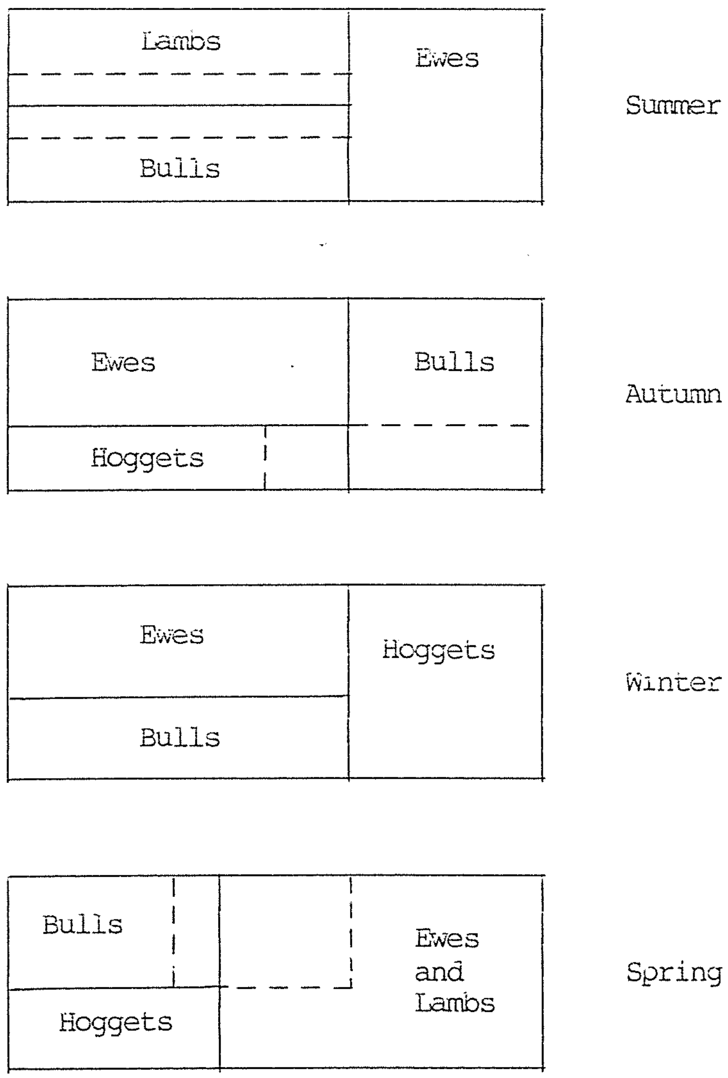
The procedure for allocating feed between bulls and sheep in late winter-early spring was discussed. This issue was mainly raised in conjunction with the management of R2 yr bulls, where the farmers felt that in the advent of below average pasture growth rates they would be better off to restrict older bulls to a maintenance feeding level in order to ensure that sheep, particularly the breeding ewes, were adequately fed. The farmers questioned whether this was the correct decision in terms of financial returns.

To answer this question the marginal cost of DM fed to bulls, and ewes both pre- and post-partum needs to be estimated. This proved to be difficult,

FIGURE 7.1

An Example of Integrated Grazing

showing the relative areas of the farm grazed by the different classes of stock both within and between seasons (80:20 Sheep:Bulls). Dotted lines indicate an overlap of areas



with some data indicating bulls are more profitable, while one trial indicated an advantage to fully feeding the breeding ewes through this period (a discussion of this analysis is given in Appendix V). More research will be required in order to resolve this question.

## 7.3 CONCLUSION

The reaction of the survey farmers to the bull production systems developed using the model was positive. They felt that the model enerated results which they could identify witn their farming situation. The farmers were interested in obtaining further information in relation to the practical aspects of implementing bull grazing management on hill country. The discussion on the integration of sheep and bull grazing indicated how this could be achieved on a whole farm basis, and suggested an advantage to a "bull only" area for the winter period. In relation to a feed shortage in the late winter-early spring, there is conflicting evidence as to whether bulls or ewes should be fully fed.

# CHAPTER EIGHT: EXTERNALITIES

## 8.0 CHAPTER OUTLINE

Factors outside the farm gate can have a significant effect on the financial returns for the bull production systems modelled in this study. In this chapter some of these external factors and the impact they may have are investigated.

In the first section the supply of bulls within New Zealand, including the area under study, and the killing capacity available to bull beef farmers within the Wairarapa region are discussed. The bull beef schedule within New Zealand and the impact of changes to the United States beef prices as well as changes in the exchange rate are then considered. This is followed by sections on the US beef market, whether opportunities exist for farmers to predict changes in that market, and alternative markets for New Zealand bull beef. The possibility of using beef and/or dollar futures in hedging strategies to improve financial returns to the New Zealand bull beef farmer is considered in the final section.

## 8.1 SUPPLY OF BULLS

The New Zealand dairy industry is virtually the sole supplier of bulls to the bull beef industry. Some beef-type bulls from the national beef herd are reared for bull beef, but the numbers are small (exact statistics are not available). As discussed in Sections 2.3 and 6.3.2, the predominant breed of bull run for bull beef is Friesian.

Of the differing dairy breeds run in New Zealand, approximately 60% of the national herd is either Friesian or Friesian/Jersey cross (Table 8.1).

TABLE 8.1

Proportion of Dairy Breeds in New Zealand (%)

| | Friesian | Jersey | F x J | Other |
|---|---|---|---|---|
| Hawkes Bay | 32 | 48 | 19 | 1 |
| Wairarapa | 38 | 41 | 18 | 3 |
| North Island | 45 | 35 | 18 | 2 |
| New Zealand | 45 | 35 | 17 | 3 |

Source: NZ Dairy Board 60th Farm Production Report 1983/84

The proportion of cows being inseminated with Friesian semen was 67% in the Wellington/Hawkes Bay Livestock Improvement Association (LIA) area, and 64% for all of New Zealand, from 1 February 1984 to 31 January 1985 (Crabb pers com). This suggests that the proportion of Friesians in the national herd is likely to increase further.

The estimated number of dairy cows in New Zealand at the start of the 1986/87 season was 2,481,000 (Crabb pers comm). If approximately 60% of the national herd is Friesian, the following number of bull calves would be available:

| | | |
|---|---|---|
| Total Friesian, Friesian cross cows | = | 1,500,000 |
| Total viable[1] calves (93%)[2] | = | 1,395,000 |
| Heifer calves (48%)[2] | = | 669,600 |
| Bull calves (52%)[2] | = | 725,400 |

[1] Viable = alive to bobby calf stage

[2] LIA estimates

The LIA estimate that the number of Dairy Beef calves to be reared in 1986/87 will be 610,000.

A problem arises in estimating the number of bull calves included in the estimate of dairy beef calves reared. To this extent, examination of Table 2.1 can give an approximation. The number of bulls shown slaughtered in any one year would be made up of 15-18 month bulls reared in the previous year, and 2-2½ year bulls reared two years previously, and hence it is difficult to ascertain exactly the number of bulls reared in any one year. If the number of bulls slaughtered is related solely to the number of calves reared two years previously (from 1975-1985), the average number of bulls slaughtered relative to dairy beef calves reared is 77%. This figure is probably a slight over estimation because a number of bulls shown in the bull kill figures are cull breeding bulls from beef herds. However, if the 77% figure is assumed, then of the expected 610,000 dairy beef calves to be reared this season (1986/87), 470,000 will be bulls. This figure of 470,000 represents 65% of the total number of Friesian bull calves available to be reared. In the last two seasons (1985-1986) the number of bulls killed equates to 67% and 53% respectively of the dairy beef calves raised during the two years previously. If these figures are related to the expected 610,000 dairy beef calves reared in 1986/87, then 330-360,000 bulls will be reared, or approximately 55-60% of available Friesian bulls.

The relevant figures for the Wairarapa/Hawkes Bay region are:

Estimated number of Friesian/Friesian cross cows = 72,400
Therefore number of viable bull calves = 35,000

At the end of June 1984, there were 933,013 cattle stock units in the Wairarapa region ($MAF_1$ 1985). Thus if all the bull calves mentioned above were reared for bull beef, it would represent only 17% of the total cattle stock units. Alternatively, if 18.5% of the sheep and beef farmers in the Wairarapa (approximately 200) ran 20% of their stock units as bulls, all of the 35,000 bull calves would be required. Exact figures on the number of bulls being run in the Wairarapa for bull beef are not readily available, but it appears that even a minor expansion within the Wairarapa would require many farmers to travel outside the region to the main dairying areas to obtain bulls. However the dairy industry in the Wairarapa may continue its exapansion of the last 5 years and this will have some impact on the supply of calves ($MAF_1$ 1985).

The above data would suggest that there is considerable scope for expansion of the New Zealand bull beef industry. However, the extent to which the greater profitability of bull beef leads to more calves being reared is at this stage uncertain. Unless more calves are reared, competition between farmers for bulls (identified as one of the major concerns in the survey) is likely to increase .

One uncertainty which may affect the bull beef industry is the current problems facing the NZ dairy industry. With dairy farmers facing a 25-40% reduction in milkfat returns in the 1986/87 season, and problems with the marketing of some of New Zealand's dairy produce overseas, the rearing of extra dairy beef animals is being promoted as a short term solution for dairy farmers.

The current high level of farmer interest in bull beef farming and the higher profitability relative to sheep, suggest that the industry will continue to expand in the short term. This was also indicated in the survey by the majority of farmers who said they would be increasing bull numbers.

The survey farmers indicated that there appears to be no shortage of young weaner bulls, necessary for policies 1-3. The supply of 12-24 month bulls for policies 5-7 was difficult to assess because of the lack of data. However, all of the survey farmers who ran these systems had experienced no problems in obtaining older bulls from within the Manawatu-Hawkes Bay-Wairarapa regions.

### 8.1.1 KILLING CAPACITY

The only freezing works within the study area is Waingawa near Masterton. The normal catchment area for Waingawa includes southern Hawkes Bay and the Wairarapa. The daily killing capacity is in the vicinity of 450 head per day, and over the last few years 6,000-8,000 bulls have been killed per year (Watson pers com). Waingawa would have ample capacity to handle an increase in bull numbers. However, as the survey indicated, significant numbers of bulls (and other cattle) are sent to freezing works outside the Wairarapa. Freezing Works which kill Wairarapa beef in the lower North Island include: Whakatu (beef killing capacity 850 hd/day), Tomoana (700 hd/day), and Pacific (Export Abattoir - 650 hd/day) at Hastings, and Waitaki (535 hd/day) at Feilding. The total beef killing capacity within the Wellington region, including the Wairarapa, is currently 1485 head/day, and for the East Coast/Hawkes Bay region, 3010 head/day. Thus there is a considerable surplus beef killing capacity available to bull farmers within the study area (Table 8.2).

Nationally, the peak beef kill is in the late autumn-early winter (April-June). The kill drops off over the spring, before increasing again in January-February. Individual works within the two regions (Table 8.2) would kill their individual kills within a similar time span to those shown in Table 8.2, as well as having a similar kill pattern to the national situation[3].

However, this situation of surplus killing capacity could alter as a result of current problems in the New Zealand Meat Industry. Rumours in the popular press (eg "Country Wide") suggest that Waingawa may close. If this was the case, the number of 5 day weeks at capacity shown in Table 8.2 would increase by around 10 weeks for the Wellington region, but by only 2-3 weeks for the combined regions. The closure of Waingawa may therefore not have direct effect on bull farming in the Wairarapa. However it could have effects because of the disruption to sheep selling policies and an increase in transport costs. There is also the possibility of other works in the lower North Island closing. This would have a major impact on killing capacities and farming practices. For example, if a Freezing Works with a large beef killing capacity (such as Whakatu) was to close, as well as Waingawa, the number of 5 day weeks required to kill all the adult cattle in both the Wellington and East Coast/Hawkes Bay regions would increase by 8-10 weeks. [Not long after this was written, Whakatu did in fact close].

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[3]With the current rationalization within the Meat Industry, access to individual kill records was only given on the provision that the actual figures/works would not be reported.

TABLE 8.2

Cattle Slaughter: Days Required at Capacity
Wellington, East Coast/Hawkes Bay Regions
(September Year)

| Year | Total Adult Cattle Kill[1] (Wellington Region) | Total Kill Capacity hd/day | Number of days at Capacity to kill all stock | Number of 5 day weeks at Capacity |
|---|---|---|---|---|
| 1982 | 194925 | 1485 | 131 | 26 |
| 1983 | 108180 | | 140 | 28 |
| 1984 | 182766 | | 123 | 25 |
| | East Coast/Hawkes Bay | | | |
| 1982 | 381495 | 3010 | 127 | 25 |
| 1983 | 398209 | | 132 | 26 |
| 1984 | 274672 | | 91 | 18 |
| | Both Regions Combined | | | |
| 1982 | 576420 | 4995 | 128 | 26 |
| 1983 | 606389 | | 135 | 27 |
| 1984 | 457438 | | 102 | 20 |

[1] Source: NZ Livestock Slaughtering Statistics, Economics Division, MAF 1985.

The bull systems modelled in this study are sensitive to the availability of killing space because all the systems produce bulls to be killed over the December-February period. If the bulls were unable to be killed when required this would have a major affect on pasture cover and affect other stock classes on the farm. Pasture covers for the summer dry model were particularly sensitive to supporting R2yr bulls over their second summer (ie Policy 1 vs Policy 2 - Section 4.2), while the summer wet model was also sensitive to big bulls being carried for longer, in terms of autumn pasture covers. This was reflected in a reduced bank of feed carried into the winter (Section 4.3). Therefore, problems with availability of killing capacity could mean that the entire farming system, including bull beef production, may have to be redesigned.

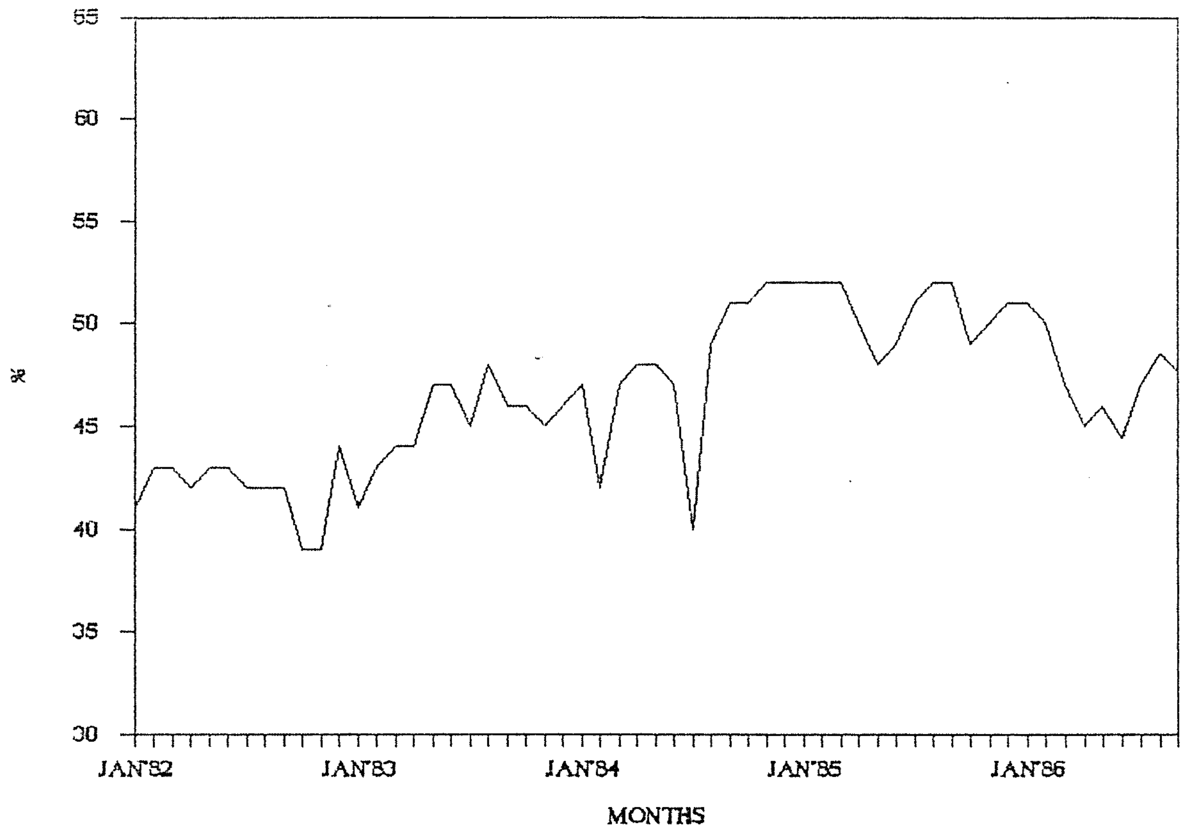
## 8.2 FACTORS AFFECTING THE BULL BEEF SCHEDULE

The bull beef schedule operating in New Zealand (described in Section 2.5) includes eight carcass weight ranges with discrete lifts in schedule value between those weight ranges. The bull beef schedule (as with all other meat schedules in NZ) is a residual schedule - the farmer receives the residual value of the carcass after all costs have been removed, plus a credit for the hide value. During the last 4 years the New Zealand farmer has only received an average of 40-50% of the New York price for bull manufacturing beef, as shown in Figure 8.1.

All New Zealand manufacturing beef sold to the US is quoted in New York prices - either as bull manufacturing (bull beef) or cow manufacturing (cow plus steer/heifer forequarters). Therefore, the three main factors affecting the New Zealand bull beef schedule are; the New York price for bull manufacturing beef and the differential between the NZ \$ and US \$ value, and processing and transport costs. Using information supplied by Williams (pers com), and a model originally built by MAF staff (Stewart and McCrone pers com), the author was able to build a derived bull beef schedule for the various weight ranges, to show the effect of varying the New York price and the NZ:US exchange rate. This is shown in Tables 8.3 and 8.4.

Table 8.4 shows that a 1 cent movement in either the New York price, or the NZ:US exchange rate is worth 3-4 cents/kg in the bull beef schedule to the New Zealand farmer.

Figure 8.1 Average Weighted New Zealand Bull Schedule as % of New York Bull Manufacturing Price




(Source: MAF Economics Section Commodity Reports.)

TABLE 8.3

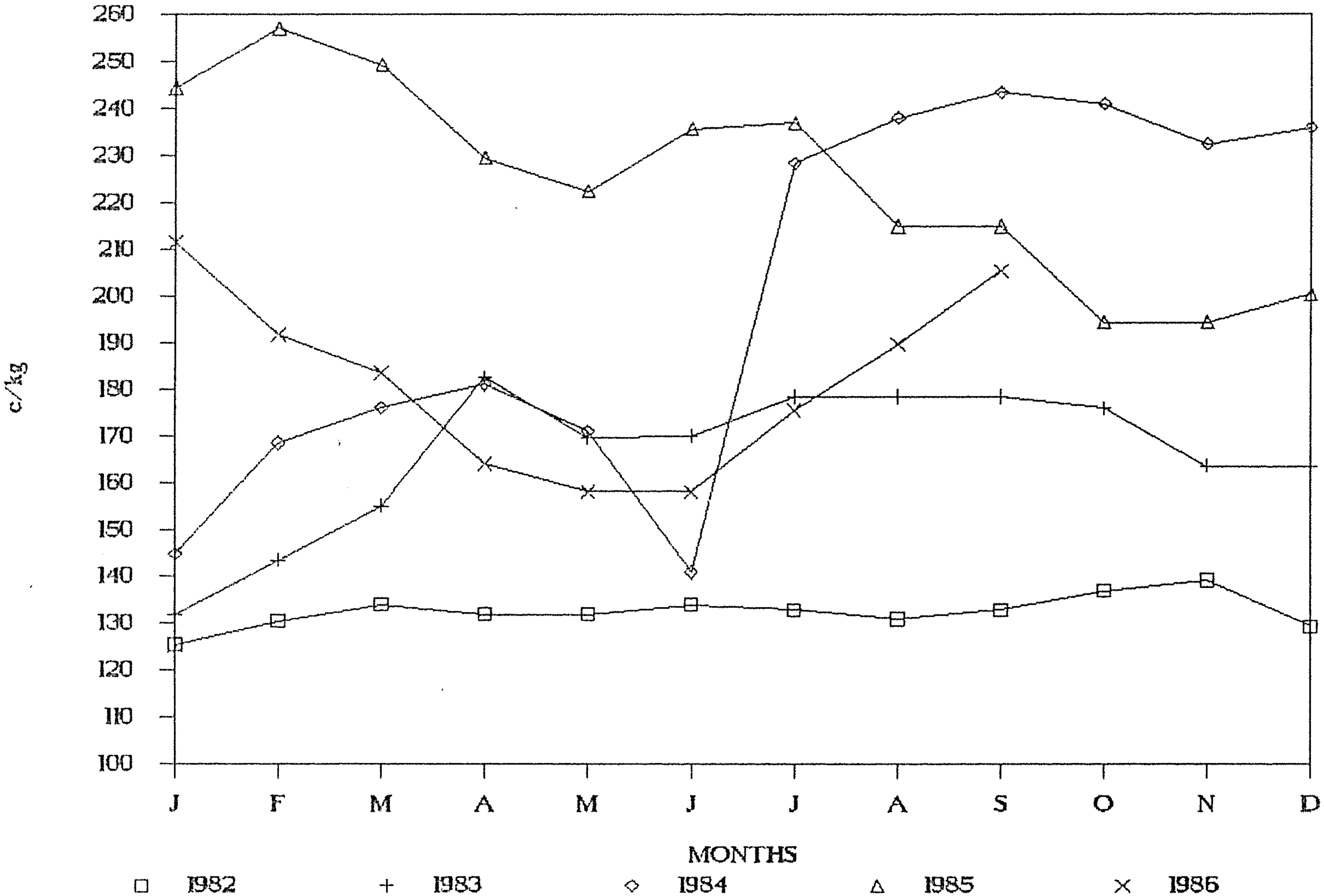
Background Assumptions to Bull Beef Schedule
(as at 22.5.86)

| | |
|---|---|
| Schedule Weight Range | 220.5-245 kg |
| Insurance % | 0.3 |
| External Freight US ¢/kg | 27.6 |
| % Boneless Bull | 0.9746 |
| % Tenderloin | 0.0211 |
| % Flank Steak | 0.0043 |
| Tenderloin ¢/kg | 1030 |
| Flank steak ¢/kg | 670 |
| Railage ¢/kg | 1.1 |
| Boneless - Bonein factor | 0.685 |
| Killing and Processing $/hd | 132.9 |
| Buying and Admin $/hd | 8.09 |
| Interest % (9 weeks) | 20 |
| Company Margin % | 2 |
| Hide credit ¢/kg (hide) | 165.3 |

TABLE 8.4 DERIVED BULL BEEF SCHEDULE for 220.5-245kg Carcass Weight Range (c/Kq)
(as at 22/5/86)

| EXCHANGE RATE: c.US:$.NZ | NEW YORK PRICE (c.i.f) US c/lb: 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | 147 | 149 | 151 | 154 | 156 | 158 | 161 | 163 | 166 | 168 | 170 | 173 | 175 | 178 | 180 | 182 | 185 | 187 | 190 |
| 57 | 150 | 152 | 154 | 157 | 159 | 162 | 164 | 167 | 169 | 172 | 174 | 176 | 179 | 181 | 184 | 186 | 189 | 191 | 193 |
| 56 | 153 | 155 | 158 | 160 | 163 | 165 | 168 | 170 | 173 | 175 | 178 | 180 | 183 | 185 | 187 | 190 | 192 | 195 | 197 |
| 55 | 156 | 159 | 161 | 164 | 166 | 169 | 171 | 174 | 176 | 179 | 181 | 184 | 186 | 189 | 191 | 194 | 196 | 199 | 202 |
| 54 | 160 | 162 | 165 | 167 | 170 | 172 | 175 | 178 | 180 | 183 | 185 | 188 | 190 | 193 | 196 | 198 | 201 | 203 | 206 |
| 53 | 163 | 166 | 168 | 171 | 174 | 176 | 179 | 181 | 184 | 187 | 189 | 192 | 195 | 197 | 200 | 202 | 205 | 208 | 210 |
| 52 | 167 | 169 | 172 | 175 | 177 | 180 | 183 | 185 | 188 | 191 | 193 | 196 | 199 | 201 | 204 | 207 | 209 | 212 | 215 |
| 51 | 171 | 173 | 176 | 179 | 182 | 184 | 187 | 190 | 192 | 195 | 198 | 201 | 203 | 206 | 209 | 211 | 214 | 217 | 220 |
| 50 | 175 | 177 | 180 | 183 | 186 | 189 | 191 | 194 | 197 | 200 | 202 | 205 | 208 | 211 | 213 | 216 | 219 | 222 | 225 |
| 49 | 179 | 182 | 184 | 187 | 190 | 193 | 196 | 199 | 201 | 204 | 207 | 210 | 213 | 216 | 218 | 221 | 224 | 227 | 230 |
| 48 | 183 | 186 | 189 | 192 | 195 | 198 | 200 | 203 | 206 | 209 | 212 | 215 | 218 | 221 | 224 | 226 | 229 | 232 | 235 |
| 47 | 188 | 191 | 194 | 197 | 199 | 202 | 205 | 208 | 211 | 214 | 217 | 220 | 223 | 226 | 229 | 232 | 235 | 238 | 241 |
| 46 | 192 | 195 | 198 | 201 | 204 | 207 | 210 | 213 | 216 | 220 | 223 | 226 | 229 | 232 | 235 | 238 | 241 | 244 | 247 |
| 45 | 197 | 200 | 203 | 207 | 210 | 213 | 216 | 219 | 222 | 225 | 228 | 231 | 234 | 237 | 240 | 244 | 247 | 250 | 253 |
| 44 | 202 | 206 | 209 | 212 | 215 | 218 | 221 | 224 | 228 | 231 | 234 | 237 | 240 | 243 | 247 | 250 | 253 | 256 | 259 |

Figure 8.2 Monthly Movements in the New Zealand Average Weighted Schedule 1982-86 ¢/kg



In comparison a $10/hd movement in killing and processing costs is worth 4-5 cents/kg in the schedule to the New Zealand farmer. On a percentage basis movements in the New York price have the greatest effect. The interactions between the New York price, exchange rate, and costs, means that the New Zealand schedule does not follow a regular pattern within and between years, as shown in Figure 8.2.

## 8.3 THE BEEF SITUATION IN THE UNITED STATES

The United States is virtually the sole market for New Zealand bull beef. As mentioned in Chapter 2, the lean nature and dark colouring of bull beef make it particularly suitable for mixing with fat trimmed from domestically produced US prime beef, while its water absorbant nature makes it an ideal processing meat (Craig pers com). Thus the end product of New Zealand bull beef is in US processed meat products (ie hamburger patties). The US manufacturing meat market is affected by many factors including:

### Domestic Beef Production

Domestically, the size of the US national cattle herd (beef + dairy) has generally been declining since reaching a peak of 132 million head in 1975, and is estimated to reach a low of 101 million head in 1987 (Table 8.5).

The number of beef cows on January 1 1986 was 33.6 million, the lowest level since 1966 ($USDA_1$ 1986). The national beef calf drop has also been declining, along with the beef heifer replacement rate ($USDA_3$ 1986). The reduction in grain prices in 1985/86 has increased the demand for cattle on feedlots. This is expected to result in; a decline in the rate of cow slaughter through 1986 and 1987 and an increase in heifer retentions during 1986 and 1987, and a decrease in nonfed (ie not on feedlots) steers and heifers through 1986 ($USDA_2$ 1986). The medium term outlook is for the national herd to start increasing in 1988 ($USDA_3$ 1986), although the rate of expansion could be at a much slower pace than previous cycles.

### Domestic Consumption

The consumption of beef and other meats is shown in Table 8.6. This shows a drop in beef consumption through to 1980, after which it has remained reasonably stable (including 1985 and 1986 - Abraham and Associates 1986).

TABLE 8.5

US National Cattle Herd 1969-1987
'000 head as at January 1

| Year | Number | Year | Number |
|---|---|---|---|
| 1969 | 110015 | 1979 | 110864 |
| 1970 | 112369 | 1980 | 111192 |
| 1971 | 114578 | 1981 | 114321 |
| 1972 | 117862 | 1982 | 115604 |
| 1973 | 121539 | 1983 | 114800 |
| 1974 | 127788 | 1984 | 113700 |
| 1975 | 132028 | 1985 | 109700 |
| 1976 | 127980 | 1986 | 105500 |
| 1977 | 122810 | 1987 | 101000* |
| 1978 | 116375 | | |

Source: USDA[1] Agricultural Statistics * Estimate

(1) USDA: United States Department of Agriculture

TABLE 8.6

Per Capita Consumption of Meat in the US
(lbs)

| | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|---|---|
| Meat | 153.0 | 152.0 | 146.9 | 144.8 | 147.7 | 145.2 | 139.3 | 144.1 | 143.7 |
| Beef | 94.4 | 91.8 | 87.2 | 78.0 | 76.5 | 77.2 | 77.2 | 78.7 | 78.6 |
| Veal | 3.3 | 3.2 | 2.4 | 1.7 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 |
| Lamb and Mutton | 1.6 | 1.5 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 |
| Pork | 53.7 | 55.8 | 55.9 | 63.8 | 68.3 | 65.0 | 59.0 | 62.2 | 61.7 |
| Fish | 12.9 | 12.7 | 13.4 | 13.0 | 12.8 | 12.9 | 12.3 | 13.1 | 13.6 |
| Chicken | 42.7 | 44.1 | 46.7 | 50.6 | 50.1 | 51.7 | 53.1 | 53.9 | 55.7 |
| Turkey | 9.1 | 9.1 | 9.2 | 9.9 | 10.5 | 10.7 | 10.8 | 11.2 | 11.4 |

Source: USDA Agricultural Outlook 1986

At the same time consumption of poultry has steadily increased, to the point where per capita consumption of poultry is expected to exceed that of beef by 1987-1988 (Meat Producer 1986).

Expenditure on beef, as a percentage of all food, has been steadily declining since 1980, from 11% to an expected 8.5% in 1986 (Abraham and Associates 1986). Associated with this decline is a decline in consumption sensitivity to beef prices; in 1982 a 1.5% drop in beef prices would result in a 1% increase in beef consumption. By 1986, a 2.5-3.0% decrease in beef prices is required to lift consumption by 1% (Charlier 1986).

Recently the American beef industry has launched a publicity campaign promoting beef, which it is hoped will at least hold the current level of beef consumption. Perhaps of more importance to New Zealand is that hamburger consumption is holding steady (Meat Producer 1986).

Grain Production

Over the last 2-3 years (1984-1986) the US production of all grains has been very high, with resulting record levels of storage of grains within the US, and a steady downward trend in prices. This has naturally decreased feedlot costs within the US, and has stimulated demand for nonfed steers and heifers to be placed in feedlots. This is the major factor decreasing the level of slaughter of the national cattle herd. A recent study by the USDA ($USDA_4$ 1986) has shown that 70% of the variation in beef production is accounted for by corn (maize) price changes of 1 year and 5 years earlier. These relationships reflect the biological lags in beef production adjustments after changes in feed prices.

As feed prices decline and feeder cattle prices are consequently bid higher, producers initially withhold female stock from slaughter to expand future beef production. Therefore, current beef production declines. However, after 5 years, lower feed prices (ceteris paribus) result in expanded beef production. Based on recent studies, a 25% decrease in corn prices lowers beef production 2.6% in one years time, but increases beef production 2.4% over initial levels in 5 years time ($USDA_4$ 1986). [This 5 year lag is illustrated in Table 8.8).

The impact of lower feed prices on US beef production through to 1990 is shown in Table 8.7.

The current problems within the US agricultural sector have had a greater impact on the cattle and hog sectors than the poultry industry. The poultry sector is now better able to take advantage of current low feed prices; if the broiler industry does expand, it is expected that beef and pork will face stiff competition in their recovery ($USDA_2$ 1986). The broiler industry also has a major advantage because of a shorter biological time lag before lower feed grain prices are reflected in increased production (Table 8.8).

Increased poultry production tends to compete with manufactured beef in the fast food arena.

Dairy Production

To combat record milk surpluses, the US introduced a dairy "buyout" scheme in early 1986 to reduce dairy cow numbers. Under this scheme, the USDA had to buy an extra 400 million lb of beef, which equates to approximately 1 million dairy cows. The scheme is to run for 18 months from April 1986, with approximately 67% of the cows to be slaughtered by August 31 1986. This scheme has had some impact in lowering beef prices. This scheme was estimated to reduce milk production by around 12 billion lbs ($USDA_1$ 1986). However, the forecast of milk production for 1986 by the USDA was 148 billion lb (a record), with a total commercial usage of 132 billion lb - giving a surplus of 16 billion lb ($USDA_3$ 1986). Thus the effect of the buyout will not be to wipe out surplus production. There could be further problems with high dairy cow numbers, because currently (1986) there is a very high average ratio of replacement heifers to milking cows (43:100) being held by US dairy farmers. This means there is a huge potential for a large increase in the national US dairy cow herd (and hence milk production).

In addition there will be sizeable reductions in milk support prices under current US Federal budget measures, starting in fiscal 1987 (1 October 1987-30 September 1988). In other sectors (ie grain), farmers have reacted in the short term to reduced price support by increasing production in an effort to maintain incomes. If this also eventuates in the dairy sector, there may well be increased pressure to continue the "buy out" scheme - which will continue to depress beef prices.

TABLE 8.7

Selected US Cattle Sector Impacts of a 25% Drop in Feed Grain Prices (1987-1990). Figures are % changes

| | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|
| Cow Slaughter | -1 | 4 | 10 | 10 |
| Replacement Heifers Kept | 1 | 2 | 1 | -1 |
| Calf Drop | 3 | 4 | 3 | -2 |
| Feeder Steer Price | 4 | -6 | -11 | -12 |
| Fed Steer Price | -1 | -1 | -12 | -13 |
| Beef and Veal CPI | 1 | -4 | -6 | -7 |
| Feedlot Placements | 17 | 18 | 18 | 18 |
| Fed Steer and Heifer Slaughter | 8 | 14 | 17 | 18 |
| Nonfed Steer and Heifer Slaughter | -81 | -74 | -43 | -32 |
| Total Steer and Heifer Slaughter | -2 | 10 | 15 | 16 |

Source: USDA Agricultural Outlook, May 1986

TABLE 8.8

Biological Time Lag Before Cheaper Feed is Reflected in Livestock Production

(months)

| | Cattle | Hogs | Broilers | Eggs | Turkeys |
|---|---|---|---|---|---|
| Conception to slaughter production (1) | 26-28 | 9-10 | 3 | 5-6 | 6 |
| Conception to entering breeding stock (2) | 23-27 | 11-13 | 7 | 6 | 8 |
| Conception to slaughter production from added breeding stock | 49-55 | 20-23 | 10 | 11-12 | 14 |

(1) Additional 2-3 months may pass before producers respond to an economic stimulus as they confirm the permanance of the change.

(2) Process can be shortened by retaining for breeding current mature stock that was destined for slaughter, this lowers current or near-term production.

Source: ERS Model USDA Agricultural Outlook May 1986

Imports

The main exporters of beef into the US are Australia, Canada and New Zealand, with numerous other small exporters (particularly Central and Southern America) (Abraham and Associates 1986).

New Zealand's main competitor in terms of US imports of manufactured beef is Australia. Currently the Australian beef herd is increasing; by 2% to 23.2 million head in 1986, and an estimated 4% to 24.1 million head by the end of March 1987 (BAE 1986). This means that Australian exports, particularly to the US, will be increasing. (In 1986 - 63% of total beef exports or 285,000 T went to the US.)

The US operates a "trigger level" of total beef imports. If this is exceeded restrictions (or quotas) are imposed. The "trigger level" on imports is set each year by a counter-cyclical formula[4] which relates to internal beef production over a 5 year rolling period - if domestic production is high, the trigger level is lowered, and vice versa. When the import estimate for the (calendar) year ahead exceeds the trigger level by 110%, quotas are imposed. Quotas, or import levels, are allocated "among supplying countries on the basis of the shares in the US market for meat articles such countries supplied during a representative period". The total expected beef imports into the US in 1986 is 1.395 billion lbs - 45 million lbs under the trigger level. This is mainly due to lower imports from Canada and New Zealand (Frazer pers com). With the current high slaughter of cows within the US, particularly the dairy buy out scheme, it is highly likely that the 1987 trigger level (to be announced in December) will be lower than 1986. With imports from Australia and New Zealand expected to increase in 1987 (over 1986 levels), it is therefore also highly likely that the 1987 trigger level will be exceeded, and voluntary restraints applied.

With the increasing number of dairy beef animals being reared in New Zealand from 1983 onwards (Table 2.1), a corresponding rise in the bull kill could be expected through 1986-1988. The exact rise in New Zealand

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[4]This trigger level formula is given in Appendix VI

manufacturing beef exports is difficult to forecast because of the reduction in beef breeding cow numbers. [Up to July 3 1986 the bull kill from October 1 1985 was up by 8.1%, cow kill down by 8.65%, and total cattle kill down by 9.24%.] Thus the rise in bull beef production may be negated somewhat by the drop in cow (and hence steer and heifer) beef production. Nevertheless, with increased production forecast for 1987 (Frazer pers com), a restriction on imports into the US would have a major impact.

Australian exports to the US are expected to increase by 4% in 1986 and 1987. This will be a major factor in determining whether the import trigger level is reached, and if so, there would also be a major impact on the beef industry in Australia.

At time of printing (January 1987) the US import trigger level for 1987 has been announced at 1.44 billion lbs - the same as for 1986. In addition, estimates of Australian production in 1987 have been recently reduced.

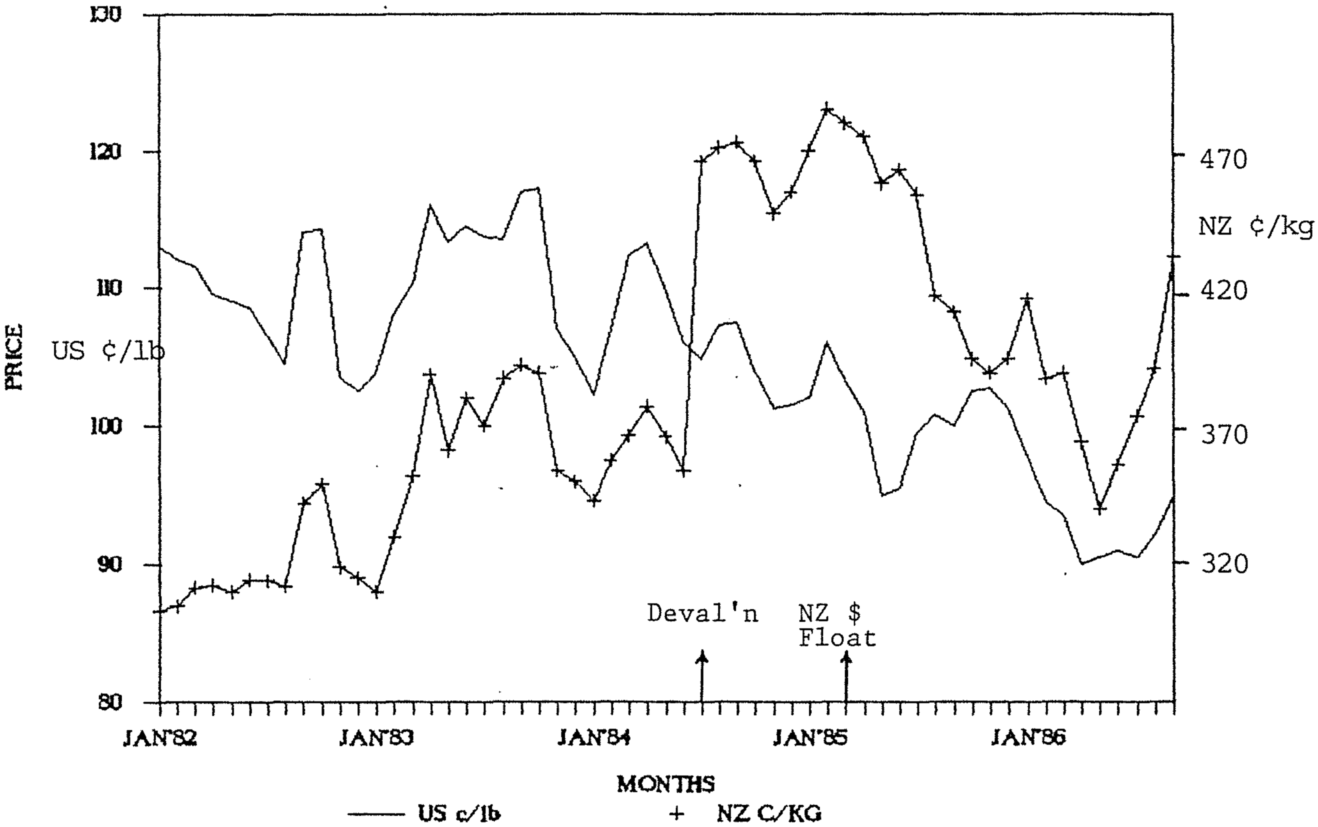
Summary

All the above factors mean that the immediate outlook for bull beef is uncertain. However, it appears that US beef production will decrease in the next 1-2 years (then start to increase), which should result in a corresponding firming of prices. The longer term outlook is for meat supplies to remain high through to the end of the decade, and US meat prices to rise by less than the general rate of (US) inflation. However, with a static or even declining market in terms of volume, an increase in New Zealand bull beef exports to the US could only take place at the expense of exports from another country. If bull beef production increases within New Zealand there would either need to be a substitution for bull beef within the volume exported to the US, or the creation of other markets. If the former occurs, then other markets would need to be found for the cow manufacturing beef displaced by the bull beef.

### 8.3.1 SOURCES OF INFORMATION: MARKET PREDICTORS

With the advent of the "more market" economy within New Zealand, one of the problems facing New Zealand farmers, as voiced by several farmers in the survey, is obtaining pertinent data about the market(s). This is

Figure 8.3 Comparative Movements in New York Bull Manufacturing Prices in terms of US ¢/lb : NZ ¢/kg



illustrated in Figure 8.3, which shows the US price, when expressed in NZ $ terms, on a generally upward trend (until the NZ $ was floated), while the actual US price is trending downwards. Thus the "market" signal was being altered by a factor (exchange rate), which masked the "true" trend in prices.

However, general information about US beef markets, within New Zealand, is relatively scarce, outside of brief reports in the popular press (eg NZ Farmer). New Zealand bull beef farmers could subscribe to magazines such as the USDA Agricultural Outlook, and USDA Livestock and Poultry Situation and Outlook, which give a general review/outlook on all sectors of US agriculture and specific details on livestock and poultry. However these are often several months out of date by the time they arrive in New Zealand. The USDA operates a computer based information service (AGNET) which could also be a source of information.

Predictions of "movements" in the US market could be useful in making short term buying or selling decisions (ie whether to buy/sell now or in a months time, or to sell on schedule or owners account), or longer term decisions (ie to buy now rather than in six months time, or vice versa, or even not to farm bulls). Two factors were therefore considered to determine whether they could be followed as a guide to price movements in the US bull beef markets.

The first "market predictor" considered was the Chicago Live Steer Futures. These futures, quoted by the Chicago Mercantile Exchange, relate to "choice" grade steers, 900-1100 lb liveweight, at the Omaha stockyards. The future contracts, in 40,0000 lb units, are deliverable every second month - February, April, June, August, October, December. As could be expected, there was a close relationship between the actual commodity spot price and the closest future ($R^2$ = 91.5% (1982-1985)). Relating futures prices 1 to 12 months back to actual spot price yielded a deteriorating relationship. Several American researchers have attempted to use futures as price forecasters. They found that with cattle, futures performed no better (and in some cases worse) then econometric or other simple price forecasting models, and that all types of models did not perform well in predicting future cattle prices (Leuthold 1974, Oliveria et al 1979, Martin and Garcia 1981, Just and Rausser 1981, Helmers and Held 1977, Brandt 1985, Wilkinson 1985). Live cattle futures are important (but do not dominate) the price discovery process for cash cattle and carcass beef, with live cattle futures closely inter-related to cash slaughter steer prices (Hudson and Purcell 1985).

Correlating New York (NY) bull manufacturing prices with Chicago Live Cattle futures shows a very tenuous relationship;

Actual NY Bull to Closest Future: $R^2$ = 32.6%
Actual NY Bull to Fugure one month back: $R^2$ = 8.5%

Given this poor relationship, plus the fact that the futures were poor forecasters of the actual cattle commodity spot price, it would appear that Chicago live steer futures would not be useful predictors of bull manufacturing prices.

The second group of factors considered as predictors were the actual beef prices received by farmers in the US. Both prime beef (Omaha Choice Steer) and manufacturing beef (Omaha Utility Cow, Commercial Cow and Cutter Cow) prices were compared with the New York Bull Manufacturing price (Figure 8.4). This shows a reasonable cyclical relationship between 1982 and 1985, after which the steer, cow, and bull prices diverge. The reason for the large drop in the choice beef prices in early-mid 1985 was due to large cattle stocks on feedlots, which, with the low price of grain, were grown through to heavier-than-normal slaughter weights. This resulted in an over-supply of choice beef and hence prices dropped. The reason why the New York bull price tended to follow the choice beef price downwards while the other cow manufacturing grade prices firmed is not clear. The bull manufacturing price actually showed a closer correlation with the choice steer price ($R^2$ = 16.9%) than with the Utility cow price ($R^2$ = 14.5%). Multiple regression against all the cow grades showed a higher correlation ($R^2$ = 25.6%), while regression against the cow grades and the choice steer grade was slightly higher ($R^2$ = 28.8%), but still a weak relationship. Thus, it appears that individual actual prices are not particularly good predictors - although obviously the general movement in US beef prices would have a major affect on the bull manufacturing price. The New York bull manufacturing prices does not follow a regular pattern (Figure 8.5), which means that it is difficult for a New Zealand farmer to pick any one time of

Figure 8.4

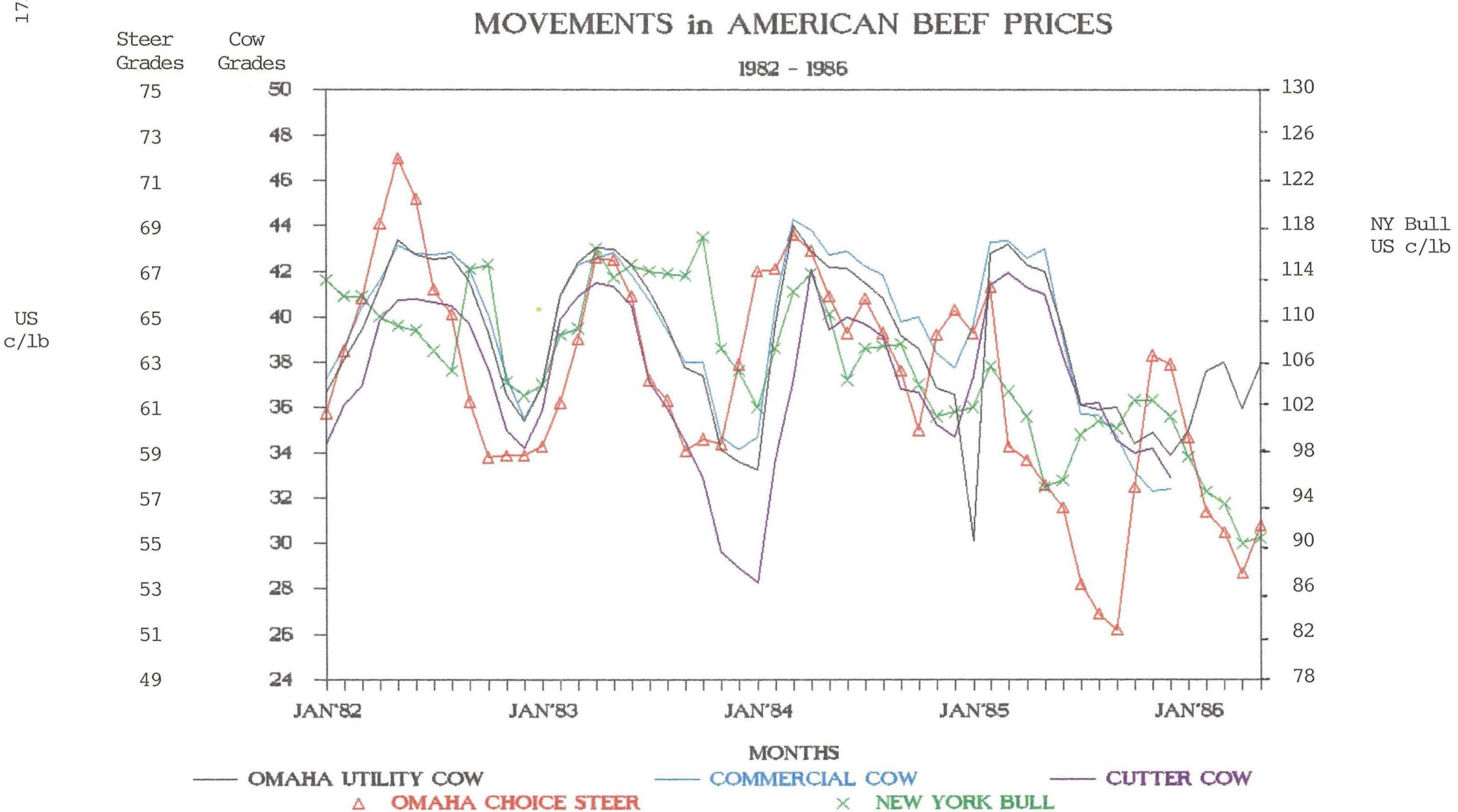
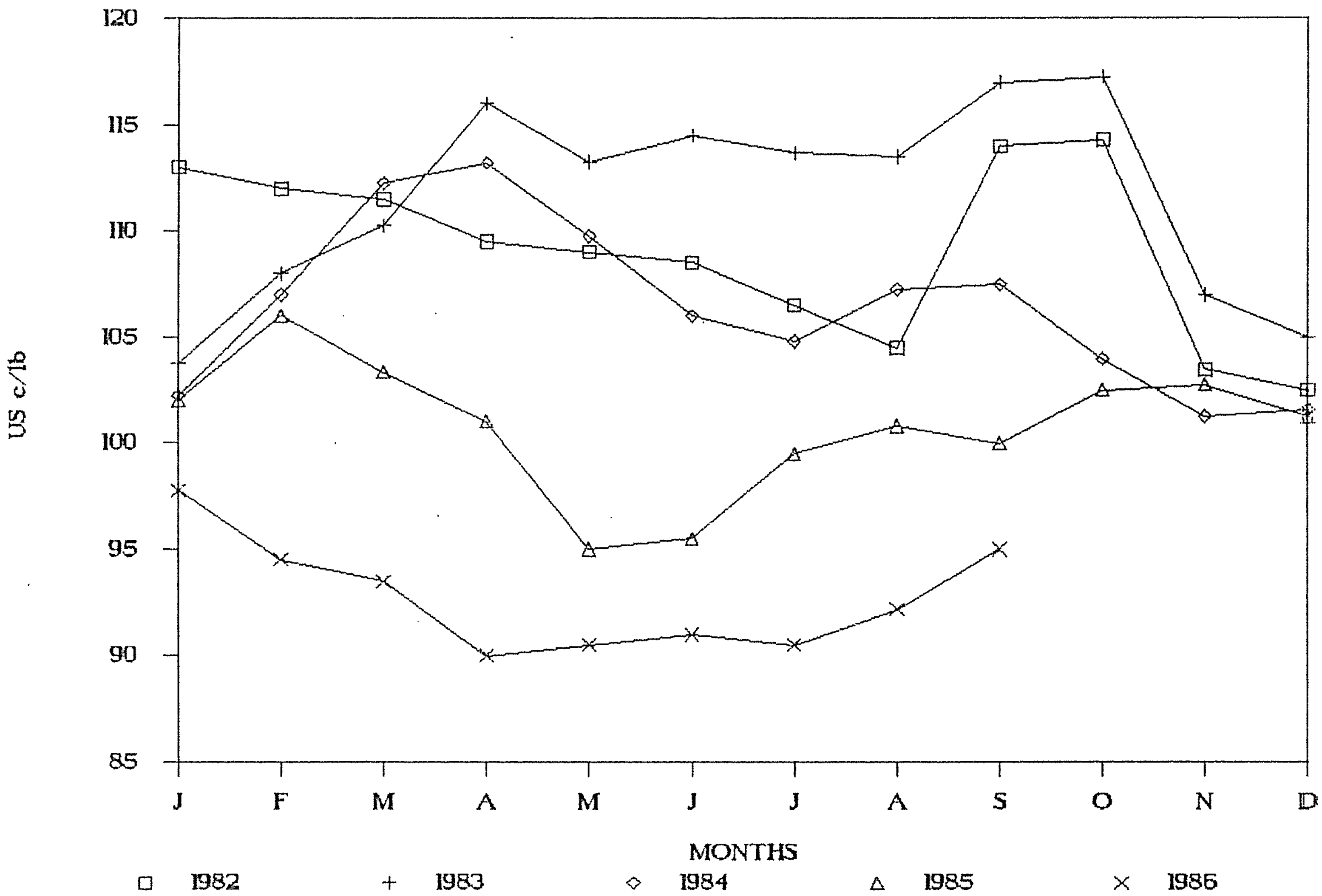

MOVEMENTS in AMERICAN BEEF PRICES
1982 - 1986
Steer Grades
Cow Grades
US c/lb
75
73
71
69
67
65
63
61
59
57
55
53
51
49
50
48
46
44
42
40
38
36
34
32
30
28
26
24
130
126
122
118
114
110
106
102
98
94
90
86
82
78
NY Bull US c/lb
JAN'82
JAN'83
JAN'84
JAN'85
JAN'86
MONTHS
OMAHA UTILITY COW
COMMERCIAL COW
CUTTER COW
OMAHA CHOICE STEER
NEW YORK BULL

Figure 8.5 Monthly Movements in the New York Bull Manufacturing Prices 1982-86 US ¢/lb



the year when it would be best to sell his bulls, or "owners account" them. The problem of sources of information suitable for the New Zealand bull beef farmer to follow general market trend therefore remains.

## 8.4 OTHER MARKETS

The reliance on one market was the major concern voiced by farmers in the survey. New Zealand exports manufacturing beef to other markets, including Canada and Asia (Frazer pers com). Presumably bull beef is included in this (no exact statistics are kept). However, these are lower priced markets than the US and volumes are relatively small. A large proportion of beef reared and sold in Western Europe is bull beef (Harrington 1979, Riordan 1985, Craig pers com), although with large beef surpluses within the EEC, New Zealand has no access into this market (Hemsley pers com).

Some bull beef is used internally in New Zealand (Table 8.9) for processing purposes, but the quantity is small.

TABLE 8.9

**Number of Bulls Slaughtered for Domestic Use in New Zealand**

| Year (Year ending September) | Number of Bulls |
|---|---|
| 1982 | 1230 |
| 1983 | 1245 |
| 1984 | 682 |

The main problem with developing other markets is that while the US pays the highest return, and is relatively under-supplied, it is unlikely that any serious market diversification will take place.

### 8.4.1 BULL BEEF AS A TABLE MEAT

A major possibility, connected with market diversification is the use of bull beef as a table meat. As mentioned in Section 8.4, a high proportion of beef produced and consumed in Europe is bull beef. The main advantages of bull beef are its leanness, and greater yield of higher priced cuts (Preston and Willis 1974).

In terms of eating quality, bull meat has generally been found to be less tender than steer meat (Barton 1970, Field 1971, Jones 1969, Seideman et al 1982, Hunter et al 1985), although some studies have found little difference (Dransfield 1983). The meat tenderness of young bulls (<400 days) is similar to that of steers (Field 1971, Fredeen et al 1971). Taste panel studies in Europe comparing bull meat to steer meat have given variable results, depending on factors such as age of bull, ageing of meat prior to cooking, and cooking techniques used (Jones 1969, Field 1971, Seideman et al 1982).

While New Zealand has the potential to produce table quality bull beef, there are currently limited markets because prices for beef within New Zealand are lower than those received in the US. Diversification into this area is unlikely to proceed until the American market is over-supplied.

## 8.5 HEDGING STRATEGIES

With the current deregulation of the New Zealand economy and the resultant exposure of farmers to direct market fluctuations, one strategy farmers can use to protect themselves from fluctuations is to hedge on a futures market. The main advantage of hedging, for the producer, is the opportunity to establish, months in advance, an approximate commodity selling price.

The premise which underlies hedging, and which makes hedging possible, is that cash market prices and futures market prices move upwards and downwards in an almost synchronised manner.

This makes it possible to lessen the risk of a loss in the cash market by taking an opposite (offsetting) position in the futures market.

For example: (i) If cattle prices decline [US example]

| CASH MARKET | FUTURES MARKET |
|---|---|
| May: Omaha Choice Steer price $60/cwt | May: Sell (go short) November Chicago Live Steer Futures $60/cwt |
| November: Sell cattle @ $55/cwt | November: Buy November contract $55/cwt, gain $5/cwt |

| | |
|---|---|
| Cash price cattle sold | $55/cwt |
| Profit in futures | $5/cwt |
| Effective selling price | $60/cwt |

Example (ii): Cattle prices increase

| CASH MARKET | FUTURES MARKET |
|---|---|
| May: Cattle price $60/cwt | May: Sell November contract $60/cwt |
| November: Sell cattle at $65/cwt | November: Buy November contract $65/cwt, loss $5/cwt |

| | |
|---|---|
| Cash price when cattle sold | $65/cwt |
| Loss in futures | $5/cwt |
| Effective selling price | $60/cwt |

In this example, the hedge locked the farmer into a selling price of $60/cwt in November. The opportunity to benefit from a price increase was given up in order to obtain protection from a price decrease.

The main cattle futures market of relevance to New Zealand farmers is the Live Cattle futures described in Section 8.3.1. As could be expected, the futures prices and spot cash prices are closely correlated (Section 8.3.1). The main influences on the Live Cattle futures are the cost of feeder (store) cattle and the feedlot feed costs (Ehrich 1969, Tomek and Robinson 1981).

However, the relationship between the Live Cattle futures and the New York bull manufacturing price is weak (Section 8.3.1) - which is not surprising given that they are different commodities. This implies that there are differing influences on the New York bull price relative to the Choice steer price. Given this weak relationship, it would not be possible for a New Zealand farmer to hedge in the simple manner outlined in the earlier examples.

The correlation between New York bull price and the Feeder Cattle Futures[5] over the last 12 months[6] was higher than for the Live Cattle futures over the same period. A double regression of both the Feeder Cattle and Live Cattle futures against the New York bull price gave an $\bar{R}^2$ = 48%. Although weak, there appears to be some relationship between the New York bull price and these futures and hence a hedging strategy may be possible. Brokers within New Zealand consider hedging possible, even if it is less than perfect (Knutson pers com).

Although hedging on the cattle side looks doubtful, one hedging strategy which New Zealand bull beef farmers should definitely consider to protect themselves from movements in the NZ:US exchange rate is to hedge in US dollar futures. As described in Section 8.2, the exchange rate has an equal impact on the New Zealand bull beef schedule as movements in the New York price. Movements in the exchange rate also have a strong positive relationship ($R^2$ = 94.3%) with movements in the schedule price. Therefore, the New Zealand bull beef farmer when selling bulls, should look at hedging using a US dollar contract to protect himself from upwards movements in the NZ:US \$ exchange rate. Some farmers are already successfully doing this (Schroder pers com).

The main danger with hedging on both the cattle and dollars futures (apart from any weakness in association between the futures and the commodity) is that the degree of exposure would need to be sufficient to justify the risk of margin calls - a 1 cent movement in the above futures contracts is equal to US\$400 (live cattle) and US\$500 (dollar).

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[5]Traded on the Chicago Mercantile Exchange

[6]The Wall Street Journal, June 1985-July 1986

The biggest problem facing New Zealand farmers wishing to hedge (apart from the US dollar contract) is again collecting sufficient data on which to base their decisions. Currently, information about the US beef market and US futures is scarce and often out of date within New Zealand.

## 8.6 CONCLUSION

In this chapter several "off farm" factors which impact on bull beef farming, both within the Wairarapa study area, and in general, have been discussed.

Although a significant number of Friesian bulls are already being reared for bull beef, there is still room for considerable expansion. With the currently (1986) existing killing capacity, an increase in bull beef production within the study area would pose no problems. However, a closure of one or some of the lower North Island Freezing Works could have a major effect on the nature of the seasonal kill. This could require systems to be redesigned to produce animals for slaughter at different times of the year.

The United States imports 90% of New Zealands manufacturing beef exports. This beef/meat market is affected by many different factors which often interact together and make it difficult to predict outcomes. However, it appears that it may be difficult to dispose of any increase in New Zealand beef production within the US in 1987, and possibly 1988. This in turn will create more pressure to look for alternative markets.

One of the major difficulties facing New Zealand farmers is in obtaining more (or any) market information with which to forward plan. While the use of US cattle futures for hedging strategies is doubtful, farmers should definitely look to hedging against currency fluctuations.

# CHAPTER NINE: EVALUATION AND CONCLUSION

## 9.0 CHAPTER OUTLINE

The methodology used in this study is evaluated in the first section of this chapter. The problems/opportunities for hill country beef production identified in this study are then discussed, and recommendations are made with respect to improving the efficiency and profitability of bull beef production on North Island hill country, as well as to requirements for further research and extension.

## 9.1 EVALUATION OF RESEARCH METHODOLOGY

One role of modelling is "as an exploratory tool in examining alternative agricultural systems with a view to identifying those that might best be examined in the field" (Wright et al 1976). It was within this context that modelling was used in this study to "explore" the suitability of widely differing bull systems on Wairarapa hill country. As optimization of beef production was not the purpose of the model, once an acceptable liveweight gain profile for each system (as defined by liveweight by age targets which could be realistically obtained under commercial practice) was derived, no further alteration was attempted. An obvious further expansion of the study would have been to model alternative sheep systems as well, but this was not considered in view of the limited time available. It may have also been possible, as discussed in Section 3.2, to have built a model that derived pasture supply from first principals (eg McCall 1984). However, the inomplete data base for, and the increased complexity of such a model, is unlikely to have yielded more practically applicable results (Gray pers com[1]).

A further refinement of the model would have been to incorporate "grazing management" features into the model, such as the inter-relationships between pasture cover, pasture allowance, and animal intake/performance. While the

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[1]Gray is currently comparing results generated by McCall's approach and a simple feed budgeting model.

relationships between pasture covers, pasture growth and senescence and decay rates were linked subjectively (and manually) it may also have been possible to inter-relate them in an automatic fashion within the model. These refinements were not attempted primarily because of the absence of quantitative research data which would have allowed these relationships to be incorporated into meaningful mathematical routines.

In his study McRae (1975) distinguished between verification and validation of models - verification being concerned with assessing the descriptive nature of the model in relation to the real life situation, and validation with assessing the capability of the model for analysing management problems. The assumptions made for model construction in this study (eg stocking rates, performance levels) and the results generated (eg patterns of pasture cover) were verified by farmer surveys as discussed in Chapters 4, 6 and 7. In terms of validation, the model could not be used to analyse "applied" management problems (eg daily grazing management). However, it could be used to gain an overview of different whole-farm management scenarios (eg effect of the different bull systems, alteration of stocking rates, or sheep:bull ratios), and hence in that respect could be considered valid.

This study illustrates the usefulness and ease of building models on microcomputer spreadsheet programs (the model in this study occupied a space 19 columns by 100 rows). In addition, the increasing power and simplicity of use of both spreadsheets and microcomputers places the possibility of such modelling within the reach of farmers as well as researchers.

The interview survey provided a successful method of collecting detailed information from farms. By posting the questionnaire two weeks prior to the farm visit, the information required was indicated to the farmer, and time was given to consider the questions asked. In addition, meeting with the farmer and inspecting the farm together provided the interviewer with a better appreciation of the farming systems and the physical environment of the region in which the study was set. Although there was a limited population of Wairarapa hill country bull beef farmers (which in itself was one of the reasons this study was undertaken), the information gained was sufficient to verify the model and to indicate management problems/opportunities facing Wairarapa bull beef farmers (such as wintering bulls, and the use of supplements).

The follow-up visits to individual farmers, and the group meeting provided the opportunity to give feedback outlining progress in the study and some results, as well to obtain farmer reaction to these. This latter aspect was particularly useful in gaining a better understanding of how the model results could be applied on farms. For example, while farmers found the liveweight gain profiles for most bull policies acceptable, they expressed concern as to how these could be practically implemented, especially in relation to the integration of sheep and bull grazing management (Chapter 7). This exchange between researchers and farmers should be regarded as a necessary part of modelling agricultural systems, and is a factor which is often neglected (Sands 1986, Simmonds 1986).

The study of externalities gave a better "global view" of off-farm factors and their potential impact on the systems modelled (eg killing capacities) and their profitability (eg markets, hedging). The main limitation to this aspect of the study was the amount of readily available market data, and the time available to complete anything other than a superficial investigation. This was particularly so in relation to the United States situation and hedging strategies. However, some potential problems and opportunities that bull beef farmers should consider were highlighted.

Despite some weaknesses within the components of the methodology used in this study - as discussed above it is felt that this methodology was successful in achieving the desired objective. In particular it allowed for the evaluation of the suitability of various bull beef systems in Wairarapa hill country in both a theoretical and practical environment.

## 9.2 DISCUSSION ON, AND SUGGESTED IMPROVEMENTS TO MANAGEMENT OF BULL BEEF IN HILL COUNTRY

Ways in which management of bull beef on hill country can be improved, and areas for further research, identified by this investigation, are discussed in the following sub-sections.

### 9.2.1 INCREASING THE NUMBER OF BULLS ON HILL COUNTRY

Several of the survey farmers felt constrained in increasing the number of bulls they ran, by the amount of easy contour land on the farm. They commented that "bulls can't be run on hill country", despite other farmers in the region running bulls on hill country successfully and profitably. This indicates that an extension effort is required to increase farmer's confidence. This could be achieved by closely monitoring a (or some) commercial hill country farm(s) for demonstration purposes (similar to the approach used by McCall (1986)). Potential bull behavioural problems can be minimised by; electrification of fences, sorting bulls into mobs of similar liveweight and not interchanging animals between mobs, and avoidance of feeding stress through above maintenance feeding levels. If these guidelines are followed, bulls are generally no more difficult to run on hill country than other classes of fattening cattle.

Several reasons were given by the survey farmers for not running the majority of/all stock as bulls (Section 6.7). The first, and major, reason was the high risk associated with the production of a single commodity - which historically has been price volatile (Section 2.1). This risk has increased with the removal of the guaranteed price support scheme. It is difficult to comment further on this aspect, because no assessment of farmers' attitude to risk was made in this study. A second reason for not running more bulls was the capital cost involved in establishing a bull beef system. Again this is associated with the farmers attitude to risk and level of indebtedness. However, the financial analysis in Chapter 5 indicates that the current profitability of bulls (around four times greater than sheep), would allow a higher debt burden to be supported.

A third reason given for not running more bulls was the variability of seasonal pasture production, especially because of dry summers. This was forseen as creating problems in attaining target slaughter weights, particularly for policies with sales at 16-18 months of age and carcass weights exceeding 220 kg. However, seasonal feed shortages need to be considered in perspective since a summer drought, for example, can have an equal or greater effect on a traditional breeding ewe and cattle fattening system. Bull beef systems in these situations have a substantial positive advantage because they are more flexible. This flexibility is manifest in several ways; (a) purchase of replacement weaners could be delayed (eg Policy 4 versus Policy 1 or 2), (b) the greater profitability of bulls would allow for a higher (or longer) level of supplementary feeding (Section 5.3.2), and (c) as discussed in Section 2.5, because the bull schedule is based solely on weight, bulls can easily be slaughtered at a lighter weight (albeit at a lower price) compared with steers or heifers, where the lighter carcass weights would also be affected by the grading system. In contrast to this, the main market for lightweight lambs (given the limited numbers required for the alpha grade) is the store market, which is likely to be depressed, particularly if the dry conditions are regionally widespread. A summer drought would also have an impact on sheep systems via lower wool weights and potentially reduced lambing percentages.

The impact of a winter feed deficit would be reasonably similar on both bulls and sheep, although this may vary depending on the timing of the deficit; an early-mid winter deficit may affect bulls more, while a late winter-early spring (during early lactation) deficit may affect the ewes more, as discussed in Section 7.2.2. Again the higher profitability of the bulls would allow for a greater level of supplementary feeding during winter.

In terms of the model results, increasing the proportion of bulls gave higher pasture covers (Section 4.4). The lowest covers were generated by all-sheep systems, the highest by all bulls.

### 9.2.2 GRAZING MANAGEMENT

A significant component of successful bull beef production on hill country is grazing management. In order to achieve the modelled weight gain profiles, bulls should have access to high quality/quantity pasture throughout the year - although this is not always necessary for some of the 2 year policies (eg Policy 3). In policies requiring high liveweight gains, the use of bulls for pasture control in terms of hard grazing (ie in the autumn to encourage grasses to tiller) is restricted. However, during late spring-early summer, fast growing bulls can be used to control pastures by restricting reproductive development. Through this period bulls have a large capacity to increase intakes (and hence LWG), and thereby maintain pasture in an actively growing state. Thus, some bull beef policies (eg Policies 5 and 6) were designed specifically for this purpose (Chapter 4). On most hill country farms though, with low bull numbers (ie 20% of winter stock units), breeding ewes will continue to fulfil the major pasture control role. Integration of sheep and bulls is therefore important, as discussed in Section 7.2.1. If all bulls were to be run, hard grazing of pastures (ie RDM < 800 kg DM/ha) and cleaning up of rank pastures could be achieved by running a proportion of older (R2 yr) bulls for this purpose (Section 4.4).

The problem of low bull growth rates over the autumn and winter, caused mainly by restricted feeding levels, may best be solved by operating a bulls-only block through these periods, similar to those used for hoggests on many hill country farms. This block would need to be of sufficient size in order to ensure adequate feeding. Strategic use of nitrogen in years when pasture growth rates were below average would enhance the use of a bull only block, as discussed in Section 5.3.

### 9.2.3 FARM MANAGEMENT - OBJECTIVE MEASUREMENTS

Effective farm management involves a continuous learning-information gathering process. This involves the need to collect objective data on the effects of management, eg pasture covers, animal liveweight gain. Thus once a problem is identified, data can be collected to evaluate it and allow for appropriate action to be taken (Barnard and Nix 1976). However, often a problem can not be identified or defined until some objective data is first collected and evaluated.

The main requirements in terms of collection of objective data in order to evaluate management of bulls would be to measure pastures (ie in terms of pasture cover) and animal performance (eg by weighing stock). Measurement of pastures could be done simply in terms of pasture scoring, or measurement of pasture height, rather than kg DM/ha (eg Parker 1985(b), Piggot 1986). This would enable farmers to assess the amount of pasture on hand, estimate pasture growth rates, and to relate this to required feeding levels (eg Webby and Pengelly 1986). The best way to objectively measure animal performance is by weighing and comparing those weights obtained against a comparative scale, or target weights. To be effective, weighing should be carried out regularly (eg monthly) - however, given the practical considerations of hill country (eg distance to cattle yards, labour restrictions), weighing should occur at least 3 monthsly, at the start of each season. This would indicate the growth of the bulls through the previous season, and hence (a) allow for evaluation of the management through that period and help to plan suitable management for the same period next year and (b) allow for the necessary grazing management for the forthcoming season to be planned. Bulls should also be weighed upon arrival at the farm to ascertain a purchase or "starting off" weight, and immediately prior to sale (to obtain information on dressing out percentages and to assist with subsequent selling decisions). It is suggested that, in view of the lack of other quantitative data, the liveweight profiles used in the model systems in this study (Chapter 4) serve as reference target weight profiles.

The collection of objective data can then be used to improve planning (and control) of grazing strategies, and hence animal performance (eg Ridler and Hurley 1984). Similarly, the collection of objective data can be used to evaluate decisions made, and so continue the learning-information gathering process.

### 9.2.4 OFF-FARM FACTORS

The main requirement for further information about bull beef farming, as voiced by the survey farmers, was for "market" information (Section 6.7). This was mainly in reference to information about the United States beef market and how it may affect the New Zealand situation. As discussed in Section 8.3, the main difficulty is obtaining information, and then having obtained it, interpreting or anticipating price movements. It would appear that short term (1-6 months) predictions of price movements, which would allow decisions on whether to sell on local schedule or on owners account to be made for example, are not possible. However, longer term trends, such as the possibility of increase or decrease in the US import trigger level coupled with likely export levels from other countries could be determined, and there is an opportunity for an organisation such as the Meat Board or MAF to monitor these trends and publish the information in order to help New Zealand bull beef farmers to better understand the situation.

New Zealand bull beef farmers are not in a position to affect the US market, since any move by New Zealand to restrict supply in an attempt to increase prices would only result in another country increasing production (in the long term) to take over the New Zealand share of the US market. For example, the EEC has stockpiles of beef to the supply the equivalent of New Zealand's share immediately if the US allowed imports from that source.

With the cyclical and currently uncertain nature of the beef market, the need is for farmers to "protect" their profitability as much as possible. On the international front, this could be done via hedging strategies; while the scope for hedging on the US beef futures is limited, there is a definite opportunity to hedge against currency fluctuations. Within New Zealand, farmers may be able to; (a) take collective action to lower costs, or enhance returns from Freezing works, or (b) contract to buy and/or sell bulls (which could be a part of (a)), both to increase profitability and to create a more stable planning base.

### 9.2.5 REQUIREMENTS FOR FURTHER RESEARCH/EXTENSION

This study indicates that the following areas require further research and extension;

1. In this study, only one sheep policy was considered for each environment. More work is necessary to quantify the interactions of different sheep policies (eg all wool farming, heavyweight lamb production) with the bull systems studied. This would be particularly useful in relation to impending changes in the structure of the Freezing Industry, especially reduced killing capacity. There is also the need to quantify the interactions between two or more bull policies on the same farm - this was only touched on slightly in this study (Section 4.4). This form of research could easily be handled by the research methodology used in this study.

2. Further research is necessary to consider the overall profitability of using nitrogen as a means of increasing winter stocking rates and/or liveweight gains. While this may require more technical research (eg farmlet trials - Lambert and Clarke 1986), data that is available could be used for a modelling-farmer interview survey approach, as used in this study.

3. The integration of grazing of sheep and bulls (or if in an all bull system R2yr and R1yr bulls) on hill country requires further quantification in terms of achievement of required liveweight gains. This could be done as a consulting/extension exercise (eg by MAF), whereby having defined the problem, a system, designed to achieve the desired results, is then monitored over time on one or more commercial farms (similar to McCall 1986).

4. There is a need to monitor the United States beef market closely (eg via reports from the USDA Economic Research Service) and make this information available to farmers. While this may not yield immediately useful tactical information (ie enabling a farmer to decide to sell on owners account), it should at least give a better strategic view (ie whether the US import trigger level is likely to rise or fall and the ramifications of that). An approach, similar to the Australian Bureau of Agricultural Economics, who operate an econometric model of the US beef complex for analytical and predictive purposes, could be developed for the New Zealand situation to study the impact of factors such as changing supply or demand. This sort of monitoring/analysis could be carried out by the Economics Division of MAF (who are already involved with this) and then the information sold to farmers, either directly or via the media.

5. The deregulation of the agricultural sector within New Zealand has created the need for farmers to act on their own to "protect" their incomes from price fluctuations. The increased sophistication of agricultural trading has create the opportunities to do this via hedging on futures markets. More research is required to understand the relationships between the futures and commodity markets, particularly in the beef sector. An extension effort is also necessary to help farmers understand and take advantage of the opportunities provided by the futures markets (eg Schaffner 1986). This could involve a joint approach by MAF advisors and Futures Brokers.

6. There is a hesitancy in the minds of some farmers with respect to running bulls on hill country. To help overcome this, an extension effort is necessary to indicate the practicalities of bull beef production on hill country. As discussed in Section 9.2.1, it would be worthwhile considering the development of a closely monitored hill country farm for demonstration purposes. Again this could be done within the parameters of a commercial

MAF operation - with the farm(s) monitored free, and field days held on a paying basis. Alternatively, one of the University farms could be developed as a sheep/bull beef unit (eg Massey's Tuapaka Hill Farm, which is already running both sheep and bulls), could be used for demonstation purposes by the University. Or, the monitoring could be done within a discussion group framework.

## 9.3 CONCLUSION

The methodology used in this thesis was successful in achieving the desired objective. In particular, it allowed for the evaluation of new production systems in both a theoretical and practical environment.

The study has shown that there are a number of bull beef systems which are viable and profitable on Wairarapa hill country. The survey results indicate that an increasing number of bulls are likely to be farmed on hill country in the future, both through increased numbers on farms with existing beef systems, and through the entry of new farmers. While some farmers are achieving the levels of production which the model indicated were feasible, most were producing well below these levels. There is therefore considerable opportunity to increase meat production and hence profitability on these farms. In some cases this may require a significant departure from present practices and the learning of new management techniques.

Although bull beef has been very profitable in recent years - the major factor contributing to the industry's growth - this may diminish in the medium term. Two factors could contribute to this; (a) higher prices of replacement stock resulting from increased competition amongst farmers, and (b) lower meat schedule prices through oversupply of the present main market. Thus, while the overall conclusion from this study is that bull beef offers considerable scope to increase the profitability of North Island hill country farming, the above mentioned factors are likely to regulate the industry's rate of expansion.

## FOLD OUT SUMMARY OF BULL POLICIES MODELLED

**Policy 1** Buy in spring weaner bull (3 months of age, 100 kg LW) at beginning of November. Sell at 221 kg carcass weight at 16 months of age (end of November the following year).

**Policy 2** Buy in spring weaner, as for Policy 1. Sell at 221 kg carcass weight at 18 months of age (January).

**Policy 3** Buy in spring weaner, as for Policy 1. Sell at 330 kg carcass weight at 29 months of age (December).

**Policy 4** Buy in autumn weaner (6-7 months of age, 140 kg LW) at the end of February. Sell at 221 kg carcass weight at 17-18 months of age (December-January).

**Policy 5** Buy in rising 1 year bull (200 kg LW) at the end of July. Sell at 221 kg carcass weight at 18 months of age (January).

**Policy 6** Buy in rising 2 year bull (380 kg LW) at the end of July. Sell at 300 kg carcass weight at 30 months of age (January).

**Policy 7** Buy in 18 month bull (365 kg LW) at the end of February. Sell at 300 kg carcass weight at 29 months of age (December).

# APPENDIX I

## Reference Pasture Rates of Growth

Pasture Rate of Growth from Masterton Site
(kg DM/ha/day) Source: Radcliffe 1975

| | Average of 5 years | SE |
|---|---|---|
| 14 June | 16.9 | 6.1 |
| 28 June | 15.9 | 4.2 |
| 12 July | 15.9 | 4.2 |
| 26 July | 15.9 | 4.2 |
| 9 August | 17.0 | 5.4 |
| 23 August | 38.3 | 13.7 |
| 6 September | 38.3 | 13.7 |
| 20 September | 59.2 | 13.2 |
| 4 October | 63.9 | 17.8 |
| 18 October | 70.3 | 20.2 |
| 1 November | 73.2 | 11.7 |
| 15 November | 66.5 | 8.0 |
| 30 November | 34.7 | 20.7 |
| 14 December | 27.5 | 25.6 |
| 28 December | 34.4 | 22.5 |
| 11 January | 18.2 | 17.2 |
| 25 January | 12.8 | 18.2 |
| 8 February | 12.9 | 18.2 |
| 22 February* | 7.6 | 17.0 |
| 8 March | 22.0 | 22.8 |
| 22 March | 23.9 | 24.8 |
| 5 April | 14.1 | 21.2 |
| 19 April | 23.6 | 14.1 |
| 3 May | 32.5 | 5.3 |
| 17 May | 25.8 | 8.9 |
| 31 May | 23.2 | 4.9 |
| Average: | 10880 | 2400 |

* Zero yields because of drought in 4 out of 5 years

Pasture Rate of Growth from Gladstone Site
(kg DM/ha/yr) Source: $MAF_1$ 1986

| | 1975/75 | 76/77 | 77/78 | Average |
|---|---|---|---|---|
| January | 32 | 59 | 4 | 32 |
| February | 40 | 26 | 0 | 22 |
| March | 19 | 11 | 5 | 12 |
| April | 21 | 23 | 27 | 27 |
| May | 20 | 28 | 33 | 27 |
| June | 17 | 15 | 23 | 18 |
| July | 20 | 11 | 11 | 14 |
| August | 20 | 40 | 16 | 25 |
| September | 64 | 90 | 31 | 62 |
| October | 56 | 63 | 69 | 63 |
| November | 34 | 73 | 28 | 45 |
| December | 22 | 36 | 22 | 27 |

Pasture Rate of Growth from Bideford Site
(kg DM/ha/day) $MAF_1$ 1986

| | 1981 | 1982 | 1983 |
|---|---|---|---|
| January | | 30 | 0 |
| February | | 12 | 0 |
| March | | 6 | 4 |
| April | | 19 | |
| May | | 7 | |
| June | | 21 | |
| July | | 22 | |
| August | | 22 | |
| September | 18 | 18 | |
| October | 47 | 63 | 78 |
| November | 66 | 62 | 73 |
| December | 49 | 26 | |

Pasture Rate of Growth from Rawhiti Site
(kg DM/ha/day) Source: Barker pers com

| | Average (September 1981-December 1983) |
|---|---|
| January | 21 |
| February | 12 |
| March | 17 |
| April | 15 |
| May | 17 |
| June | 10 |
| July | 15 |
| August | 20 |
| September | 43 |
| October | 77 |
| November | 35 |
| December | 28 |

Pasture Rate of Growth from Riverside
(kg DM/ha/day) Source: Parker 1984

| | Estimated Average |
|---|---|
| January | 16 |
| February | 10 |
| March | 18 |
| April | 25 |
| May | 20 |
| June | 10 |
| July | 8 |
| August | 18 |
| September | 40 |
| October | 73 |
| November | 65 |
| December | 40 |
| TOTAL: | 10463 |

Pasture Rate of Growth from Marima Site
(kg DM/ha/day) Source: $MAF_2$ 1986

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | Average |
|---|---|---|---|---|---|---|---|
| January | 50 | 28 | 63 | 35 | 59 | 76 | 47.0 |
| February | 32 | 28 | 35 | 57 | 38 | 19 | 38.0 |
| March | 29 | 36 | 33 | 40 | 25 | 40 | 32.6 |
| April | 14 | 25 | 35 | 27 | 21 | 27 | 24.4 |
| May | 9 | 8 | 8 | 24 | 5 | 14 | 10.8 |
| June | 11 | 6 | 5 | 10 | 14 | 11 | 9.2 |
| July | 6 | 5 | 3 | 8 | 6 | 5 | 5.6 |
| August | 4 | 13 | 5 | 15 | 9 | 10 | 9.2 |
| September | 15 | 20 | 21 | 32 | 17 | 23 | 21.0 |
| October | 40 | 22 | 44 | 36 | 46 | | 37.6 |
| November | 59 | 54 | 44 | 48 | 73 | | 55.6 |
| December | 46 | 45 | 54 | 36 | 59 | | 48.0 |
| TOTAL | 9570 | 8801 | 10640 | 11120 | 11293 | | 10285 |

Pasture Rate of Growth from Ruawhata Site
(kg DM/ha/day) Source: $MAF_2$ 1986

| | North Facing Slope | | | South Facing Slope | | |
|---|---|---|---|---|---|---|
| | 1983 | 1984 | Mean | 1983 | 1984 | Mean |
| January | 44 | 21 | 32.5 | 24 | 15 | 20 |
| February | 40 | 26 | 33 | 34 | 26 | 30 |
| March | 37 | 38 | 37.5 | 21 | 28 | 24.5 |
| April | 36 | 16 | 26 | 16 | 22 | 19 |
| May | 15 | 23 | 19 | 6 | 17 | 11.5 |
| June | 7 | 11 | 9 | 2 | 18 | 10 |
| July | 7 | 17 | 12 | 9 | 13 | 11 |
| August | 18 | 13 | 15.5 | 11 | 13 | 12 |
| September | 33 | 36 | 34.5 | 30 | 25 | 27.5 |
| October | 52 | 32 | 42.0 | 60 | 18 | 39 |
| November | 22 | 34 | 38.0 | 49 | 46 | 47.5 |
| December | 50 | 37 | 43.5 | 54 | 45 | 49.5 |
| TOTAL | 10973 | 9849 | 10411 | 9597 | 8708 | 9153 |

# APPENDIX II A

## Total Model Output for the Summer Dry Environment

## (Bull Policy 1)

WAIRARAPA HILL COUNTRY/BULL SYSTEMS MODEL          SUMMER DRY

| | | | | | WINTER | SPRING | SUMMER | AUTUMN |
|---|---|---|---|---|---|---|---|---|
| Bull policy (1-7): | 1 | Lambing%: | 95 | | | | | |
| Stocking rate(su/ha): | 10.5 | Initial wt | | SENESCENCE RATE (%/day): | 0.50 | 1.00 | 1.80 | 0.70 |
| %Sheep: | 80 | of Bull(kg): | 100 | DECAY RATE (%/day): | 0.30 | 0.80 | 0.40 | 2.00 |
| %Cattle(Bulls): | 20 | Pasture cover | | DEAD MATERIAL: (Start) | 15.00 | 37.36 | 49.81 | 50.69 |
| Bulls/Ha: | 0.47 | at 1st June: | 1200 | (% OF COVER) (End) | 35.45 | 45.32 | 65.93 | 22.47 |
| Ewes/Ha: | 7.15 | (kgDM/Ha) | | | | | | |
| Hoggets/Ha: | 1.79 | | | | | | | |

| PERIOD | | Number | NO.DAYS | PASTURE RATE OF GROWTH KgDM/Ha/Day | PASTURE QUALITY MJME/KgDM | TOTAL ENERGY/ PERIOD | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | 3rd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | TOTAL BULL ENERGY REQS. (MJME) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 14.00 | 17.00 | 10.80 | 2570.40 | | | 0.75 | 242.00 | | | 392.54 |
| | 15-28 | 2 | 14.00 | 13.00 | 11.00 | 2002.00 | | | 0.75 | 252.50 | | | 403.34 |
| JULY | -12 | 3 | 14.00 | 12.00 | 11.00 | 1848.00 | | | 0.75 | 263.00 | | | 414.04 |
| | -26 | 4 | 14.00 | 11.00 | 11.20 | 1724.80 | | | 0.75 | 273.50 | | | 424.64 |
| AUG | -9 | 5 | 14.00 | 14.00 | 11.30 | 2214.80 | | | 1.00 | 287.50 | | | 502.65 |
| | -23 | 6 | 14.00 | 20.00 | 11.50 | 3220.00 | | | 1.00 | 301.50 | | | 518.96 |
| SEPT | -6 | 7 | 14.00 | 31.00 | 11.70 | 5077.80 | | | 1.10 | 316.90 | | | 565.27 |
| | -20 | 8 | 14.00 | 45.00 | 11.70 | 7371.00 | | | 1.20 | 333.70 | | | 615.97 |
| OCT | -4 | 9 | 14.00 | 53.00 | 11.50 | 8533.00 | | | 1.30 | 351.90 | | | 663.24 |
| | -18 | 10 | 14.00 | 65.00 | 11.30 | 10283.00 | | | 1.50 | 372.90 | | | 748.68 |
| NOV | -1 | 11 | 14.00 | 51.00 | 11.10 | 7925.40 | | | 1.50 | 393.90 | | | 768.59 |
| | -15 | 12 | 14.00 | 37.00 | 11.00 | 5698.00 | 0.60 | 108.40 | 1.50 | 414.90 | | | 1010.75 |
| | -30 | 13 | 15.00 | 29.00 | 10.80 | 4698.00 | 0.60 | 117.40 | 1.30 | 434.40 | | | 1035.80 |
| DEC | -14 | 14 | 14.00 | 26.00 | 10.50 | 3822.00 | 0.60 | 125.80 | | | | | 242.50 |
| | -28 | 15 | 14.00 | 18.00 | 9.80 | 2469.60 | 0.60 | 134.20 | | | | | 251.86 |
| JAN | -11 | 16 | 14.00 | 14.00 | 9.60 | 1881.60 | 0.55 | 141.90 | | | | | 253.10 |
| | -25 | 17 | 14.00 | 11.00 | 9.20 | 1416.80 | 0.55 | 149.60 | | | | | 261.12 |
| FEB | -8 | 18 | 14.00 | 10.00 | 8.80 | 1232.00 | 0.55 | 157.30 | | | | | 269.02 |
| | -22 | 19 | 14.00 | 8.00 | 8.50 | 952.00 | 0.55 | 165.00 | | | | | 276.79 |
| MARCH | -8 | 20 | 14.00 | 12.00 | 9.00 | 1512.00 | 0.55 | 172.70 | | | | | 284.47 |
| | -22 | 21 | 14.00 | 17.00 | 9.60 | 2284.80 | 0.55 | 180.40 | | | | | 292.04 |
| APRIL | -5 | 22 | 14.00 | 19.00 | 10.20 | 2713.20 | 0.55 | 188.10 | | | | | 299.51 |
| | -19 | 23 | 14.00 | 22.00 | 10.50 | 3234.00 | 0.75 | 198.60 | | | | | 346.56 |
| MAY | -3 | 24 | 14.00 | 23.00 | 10.50 | 3381.00 | 0.75 | 209.10 | | | | | 357.90 |
| | -17 | 25 | 14.00 | 19.00 | 10.80 | 2872.80 | 0.80 | 220.30 | | | | | 380.06 |
| | -31 | 26 | 14.00 | 18.00 | 10.80 | 2721.60 | 0.80 | 231.50 | | | | | 392.24 |

# APPENDIX II A Cont.

| PERIOD | | Number | EWE REQS MJME/Day | LAMB REQS MJME/Day | HGT REQS MJME/Day | 2TH REQS MJME/Day | TOTAL SHEEP REQ MJME/Pd | TOTAL ENERGY REQS |
|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 11.10 | | 11.70 | | 1403.69 | 1796.232 |
| | 15-28 | 2 | 11.10 | | 11.80 | | 1406.20 | 1809.540 |
| JULY | -12 | 3 | 11.10 | | 12.00 | | 1411.20 | 1825.241 |
| | -26 | 4 | 12.00 | | 12.30 | | 1508.78 | 1933.419 |
| AUG | -9 | 5 | 14.00 | | 12.50 | | 1713.96 | 2216.611 |
| | -23 | 6 | 17.00 | | 13.00 | | 2026.72 | 2545.678 |
| SEPT | -6 | 7 | 27.00 | | 19.00 | | 2615.22 | 3180.497 |
| | -20 | 8 | 31.00 | 7.00 | 20.50 | | 3661.11 | 4277.085 |
| OCT | -4 | 9 | 27.00 | 7.50 | 21.50 | | 3953.36 | 4616.601 |
| | -18 | 10 | 27.00 | 7.90 | 22.70 | | 4021.42 | 4770.097 |
| NOV | -1 | 11 | 22.00 | 8.40 | 16.00 | | 3400.89 | 4169.478 |
| | -15 | 12 | 18.00 | 8.70 | 16.30 | | 3036.58 | 4047.327 |
| | -30 | 13 | 16.00 | 9.50 | 16.50 | | 3125.87 | 4161.671 |
| DEC | -14 | 14 | 13.00 | 10.30 | 16.50 | | 2693.29 | 2935.795 |
| | -28 | 15 | 11.50 | 10.80 | 10.00 | 12.90 | 2416.05 | 2667.915 |
| JAN | -11 | 16 | 11.10 | 11.10 | 10.50 | 13.00 | 1800.53 | 2053.627 |
| | -25 | 17 | 11.10 | 11.10 | 10.50 | 13.20 | 1804.53 | 2065.653 |
| FEB | -8 | 18 | 11.10 | 11.50 | 11.00 | 13.30 | 1631.64 | 1900.652 |
| | -22 | 19 | 11.50 | 11.50 | 11.00 | 13.40 | 1665.67 | 1942.461 |
| MARCH | -8 | 20 | 11.50 | 11.80 | 11.50 | 13.60 | 1480.76 | 1765.225 |
| | -22 | 21 | 15.00 | 11.80 | 11.50 | 13.80 | 1765.00 | 2057.037 |
| APRIL | -5 | 22 | 11.10 | | 12.00 | | 1411.20 | 1710.711 |
| | -19 | 23 | 11.10 | | 12.00 | | 1411.20 | 1757.757 |
| MAY | -3 | 24 | 11.10 | | 11.50 | | 1398.69 | 1756.585 |
| | -17 | 25 | 11.10 | | 11.50 | | 1398.69 | 1778.753 |
| | -31 | 26 | 11.10 | | 11.70 | | 1403.69 | 1795.934 |

APPENDIX II A Cont.

| PERIOD | | Number | FEED CARRY OVER (MJME's) | ENERGY BALANCE (MJME's) | AV PAST COVER KgDM/Ha | TOT PAST. GROWN KgDM | TOTAL STOCK REQS.kgDM | TOTAL SHEEP REQ.KgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 0 | 774.17 | 1264 | 238.00 | 166.32 | 129.97 | 36.35 |
| | 15-28 | 2 | 719.98 | 912.44 | 1272 | 182.00 | 164.50 | 127.84 | 36.67 |
| JULY | -12 | 3 | 848.56 | 871.32 | 1261 | 168.00 | 165.93 | 128.29 | 37.64 |
| | -26 | 4 | 810.33 | 601.71 | 1227 | 154.00 | 172.63 | 134.71 | 37.91 |
| AUG | -9 | 5 | 544.70 | 542.89 | 1210 | 196.00 | 196.16 | 151.68 | 44.48 |
| | -23 | 6 | 497.31 | 1171.64 | 1250 | 280.00 | 221.36 | 176.24 | 45.13 |
| SEPT | -6 | 7 | 1083.05 | 2980.35 | 1356 | 434.00 | 271.84 | 223.52 | 48.31 |
| | -20 | 8 | 2554.61 | 5648.52 | 1557 | 630.00 | 365.56 | 312.92 | 52.65 |
| OCT | -4 | 9 | 4833.54 | 8749.94 | 1825 | 742.00 | 401.44 | 343.77 | 57.67 |
| | -18 | 10 | 7416.76 | 12929.66 | 2230 | 910.00 | 422.13 | 355.88 | 66.25 |
| NOV | -1 | 11 | 10753.85 | 14509.77 | 2472 | 714.00 | 375.63 | 306.39 | 69.24 |
| | -15 | 12 | 11626.08 | 13276.75 | 2511 | 518.00 | 367.94 | 276.05 | 91.89 |
| | -30 | 13 | 10089.25 | 10625.58 | 2429 | 435.00 | 385.34 | 289.43 | 95.91 |
| DEC | -14 | 14 | 7294.49 | 8180.70 | 2445 | 364.00 | 279.60 | 256.50 | 23.10 |
| | -28 | 15 | 4945.97 | 4747.66 | 2353 | 252.00 | 272.24 | 246.54 | 25.70 |
| JAN | -11 | 16 | 2946.59 | 2774.56 | 2262 | 196.00 | 213.92 | 187.56 | 26.36 |
| | -25 | 17 | 1750.23 | 1101.38 | 2119 | 154.00 | 224.53 | 196.15 | 28.38 |
| FEB | -8 | 18 | 711.18 | 42.53 | 1974 | 140.00 | 215.98 | 185.41 | 30.57 |
| | -22 | 19 | 29.64 | -960.82 | 1791 | 112.00 | 228.52 | 195.96 | 32.56 |
| MARCH | -8 | 20 | 0.00 | -253.23 | 1544 | 168.00 | 196.14 | 164.53 | 31.61 |
| | -22 | 21 | 0.00 | 227.76 | 1405 | 238.00 | 214.27 | 183.85 | 30.42 |
| APRIL | -5 | 22 | 196.32 | 1198.81 | 1375 | 266.00 | 167.72 | 138.35 | 29.36 |
| | -19 | 23 | 1077.08 | 2553.33 | 1407 | 308.00 | 167.41 | 134.40 | 33.01 |
| MAY | -3 | 24 | 2307.18 | 3931.59 | 1464 | 322.00 | 167.29 | 133.21 | 34.09 |
| | -17 | 25 | 3520.86 | 4614.91 | 1471 | 266.00 | 164.70 | 129.51 | 35.19 |
| | -31 | 26 | 3943.99 | 4869.66 | 1465 | 252.00 | 166.29 | 129.97 | 36.32 |

# APPENDIX II B

## Totoal Model Output for the Summer Wet Environment
## (Bull Policy 1)

WAIRARAPA HILL COUNTRY/BULL SYSTEMS MODEL    SUMMER WET

| | | | | | | WINTER | SPRING | SUMMER | AUTUMN |
|---|---|---|---|---|---|---|---|---|---|
| Bull policy (1-7): | 1 | Lambing%: | 100 | | | | | | |
| Stocking rate(su/ha): | 12.5 | Initial wt | | SENESCENCE RATE (%/day): | | 0.40 | 0.90 | 1.40 | 0.90 |
| %Sheep: | 80 | of Bull(kg): | 100 | DECAY RATE (%/day): | | 0.20 | 0.80 | 1.00 | 2.40 |
| %Cattle(Bulls): | 20 | Pasture cover | | DEAD MATERIAL: | (Start) | 15.00 | 42.41 | 36.97 | 35.37 |
| Bulls/Ha: | 0.56 | at 1st June: | 1200 | (% OF COVER) | (End) | 37.33 | 36.06 | 43.63 | 26.82 |
| Ewes/Ha: | 8.51 | (kgDM/Ha) | | | | | | | |
| Hoggets/Ha: | 2.13 | | | | | | | | |

| PERIOD | | Number | NO.DAYS | PASTURE RATE OF GROWTH KgDM/Ha/Day | PASTURE QUALITY MJME/KgDM | TOTAL ENERGY/ PERIOD | 1st Year BULL LWG Kg/Day | WEIGHT AT END PERIOD:Kg | 2nd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | 3rd Year BULL LWG Kg/Day | WEIGHT AT END PERIOD | TOTAL BULL ENERGY REQS. (MJME) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 14.00 | 15.00 | 11.00 | 2310.00 | | | 0.50 | 263.70 | | | 425.75 |
| | 15-28 | 2 | 14.00 | 11.00 | 11.00 | 1694.00 | | | 0.50 | 270.70 | | | 432.75 |
| JULY | -12 | 3 | 14.00 | 10.00 | 11.00 | 1540.00 | | | 0.30 | 274.90 | | | 383.12 |
| | -26 | 4 | 14.00 | 10.00 | 11.20 | 1568.00 | | | 0.30 | 279.10 | | | 386.63 |
| AUG | -9 | 5 | 14.00 | 12.00 | 11.30 | 1898.40 | | | 0.50 | 286.10 | | | 447.97 |
| | -23 | 6 | 14.00 | 16.00 | 11.30 | 2531.20 | | | 0.75 | 296.60 | | | 532.87 |
| SEPT | -6 | 7 | 14.00 | 21.00 | 11.50 | 3381.00 | | | 1.00 | 310.60 | | | 630.32 |
| | -20 | 8 | 14.00 | 35.00 | 11.70 | 5733.00 | | | 1.30 | 328.80 | | | 762.03 |
| OCT | -4 | 9 | 14.00 | 44.00 | 11.70 | 7207.20 | | | 1.50 | 349.80 | | | 864.87 |
| | -18 | 10 | 14.00 | 56.00 | 11.50 | 9016.00 | | | 1.50 | 370.80 | | | 888.90 |
| NOV | -1 | 11 | 14.00 | 62.00 | 11.30 | 9808.40 | | | 1.50 | 391.80 | | | 912.63 |
| | -15 | 12 | 14.00 | 51.00 | 11.10 | 7925.40 | 0.60 | 108.40 | 1.50 | 412.80 | | | 1200.94 |
| | -30 | 13 | 15.00 | 49.00 | 11.00 | 8085.00 | 0.60 | 117.40 | 1.50 | 435.30 | | | 1325.37 |
| DEC | -14 | 14 | 14.00 | 41.00 | 11.00 | 6314.00 | 0.60 | 125.80 | | | | | 288.70 |
| | -28 | 15 | 14.00 | 35.00 | 10.80 | 5292.00 | 0.75 | 136.30 | | | | | 328.07 |
| JAN | -11 | 16 | 14.00 | 32.00 | 10.50 | 4704.00 | 0.75 | 146.80 | | | | | 342.94 |
| | -25 | 17 | 14.00 | 29.00 | 10.30 | 4181.80 | 0.75 | 157.30 | | | | | 357.53 |
| FEB | -8 | 18 | 14.00 | 27.00 | 10.30 | 3893.40 | 0.80 | 168.50 | | | | | 382.81 |
| | -22 | 19 | 14.00 | 22.00 | 10.00 | 3080.00 | 0.80 | 179.70 | | | | | 398.28 |
| MARCH | -8 | 20 | 14.00 | 19.00 | 9.60 | 2553.60 | 0.80 | 190.90 | | | | | 413.51 |
| | -22 | 21 | 14.00 | 18.00 | 9.80 | 2469.60 | 0.80 | 202.10 | | | | | 428.51 |
| APRIL | -5 | 22 | 14.00 | 21.00 | 10.20 | 2998.80 | 0.80 | 213.30 | | | | | 443.31 |
| | -19 | 23 | 14.00 | 23.00 | 10.50 | 3381.00 | 0.80 | 224.50 | | | | | 457.91 |
| MAY | -3 | 24 | 14.00 | 20.00 | 10.50 | 2940.00 | 0.80 | 235.70 | | | | | 472.35 |
| | -17 | 25 | 14.00 | 18.00 | 10.80 | 2721.60 | 0.75 | 246.20 | | | | | 472.47 |
| | -31 | 26 | 14.00 | 16.00 | 10.80 | 2419.20 | 0.75 | 256.70 | | | | | 485.28 |

APPENDIX II B Cont.

| PERIOD | | Number | FEED CARRY OVER (MJME's) | ENERGY BALANCE (MJME) | AV PAST COVER KgDM/Ha | TOT PAST. GROWN KgDM | TOTAL STOCK REQS.kgDM | TOTAL SHEEP REQ.KgDM | TOTAL BULL REQ.KgDM |
|---|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 0 | 213.19 | 1214 | 210.00 | 190.62 | 151.91 | 38.70 |
| | 15-28 | 2 | 201.25 | -211.54 | 1171 | 154.00 | 191.53 | 152.19 | 39.34 |
| JULY | -12 | 3 | 0.00 | -523.12 | 1115 | 140.00 | 187.56 | 152.73 | 34.83 |
| | -26 | 4 | 0.00 | -507.56 | 1061 | 140.00 | 185.32 | 150.80 | 34.52 |
| AUG | -9 | 5 | 0.00 | -351.70 | 1020 | 168.00 | 199.12 | 159.48 | 39.64 |
| | -23 | 6 | 0.00 | -56.99 | 1005 | 224.00 | 229.04 | 181.89 | 47.16 |
| SEPT | -6 | 7 | 0.00 | 159.19 | 972 | 294.00 | 280.16 | 225.35 | 54.81 |
| | -20 | 8 | 137.21 | 1995.41 | 1082 | 490.00 | 331.18 | 266.05 | 65.13 |
| OCT | -4 | 9 | 1743.91 | 3627.09 | 1191 | 616.00 | 455.04 | 381.12 | 73.92 |
| | -18 | 10 | 3170.31 | 6462.94 | 1420 | 784.00 | 497.68 | 420.39 | 77.30 |
| NOV | -1 | 11 | 5641.83 | 9843.13 | 1729 | 868.00 | 496.20 | 415.44 | 80.76 |
| | -15 | 12 | 8447.21 | 11028.27 | 1889 | 714.00 | 481.47 | 373.28 | 108.19 |
| | -30 | 13 | 9250.88 | 11973.27 | 2047 | 735.00 | 487.51 | 367.02 | 120.49 |
| DEC | -14 | 14 | 9538.46 | 11938.66 | 2154 | 574.00 | 355.80 | 329.56 | 26.25 |
| | -28 | 15 | 8435.61 | 10015.71 | 2182 | 490.00 | 343.69 | 313.32 | 30.38 |
| JAN | -11 | 16 | 7062.57 | 8899.90 | 2233 | 448.00 | 273.02 | 240.35 | 32.66 |
| | -25 | 17 | 6112.21 | 7466.98 | 2237 | 406.00 | 274.47 | 239.76 | 34.71 |
| FEB | -8 | 18 | 5208.08 | 6457.52 | 2229 | 378.00 | 256.70 | 219.53 | 37.17 |
| | -22 | 19 | 4563.82 | 4930.47 | 2136 | 308.00 | 271.33 | 231.51 | 39.83 |
| MARCH | -8 | 20 | 3609.63 | 3685.32 | 1916 | 266.00 | 258.12 | 215.04 | 43.07 |
| | -22 | 21 | 2843.92 | 2466.58 | 1689 | 252.00 | 290.50 | 246.78 | 43.73 |
| APRIL | -5 | 22 | 1911.58 | 2322.39 | 1569 | 294.00 | 253.72 | 210.26 | 43.46 |
| | -19 | 23 | 1877.58 | 3120.67 | 1545 | 322.00 | 203.61 | 160.00 | 43.61 |
| MAY | -3 | 24 | 2611.38 | 3413.93 | 1489 | 280.00 | 203.57 | 158.58 | 44.99 |
| | -17 | 25 | 2868.31 | 3452.33 | 1418 | 252.00 | 197.92 | 154.18 | 43.75 |
| | -31 | 26 | 2830.81 | 3093.66 | 1323 | 224.00 | 199.66 | 154.73 | 44.93 |

# APPENDIX II B Cont.

| PERIOD | | Number | EWE REQS MJME/Day | LAMB REQS MJME/Day | HGT REQS MJME/Day | 2TH REQS MJME/Day | TOTAL SHEEP REQ MJME/Pd | TOTAL ENERGY REQS |
|---|---|---|---|---|---|---|---|---|
| JUNE | 1-14 | 1 | 11.10 | | 11.70 | | 1671.06 | 2096.814 |
| | 15-28 | 2 | 11.10 | | 11.80 | | 1674.04 | 2106.791 |
| JULY | -12 | 3 | 11.10 | | 12.00 | | 1680.00 | 2063.122 |
| | -26 | 4 | 11.10 | | 12.30 | | 1688.94 | 2075.562 |
| AUG | -9 | 5 | 12.00 | | 12.50 | | 1802.13 | 2250.097 |
| | -23 | 6 | 14.00 | | 13.00 | | 2055.32 | 2588.192 |
| SEPT | -6 | 7 | 17.00 | | 19.00 | | 2591.49 | 3221.811 |
| | -20 | 8 | 27.00 | 7.00 | 20.50 | | 3112.77 | 3874.792 |
| OCT | -4 | 9 | 31.00 | 7.50 | 21.50 | | 4459.15 | 5324.017 |
| | -18 | 10 | 27.00 | 7.90 | 22.70 | | 4834.47 | 5723.365 |
| NOV | -1 | 11 | 27.00 | 8.40 | 16.00 | | 4694.47 | 5607.094 |
| | -15 | 12 | 22.00 | 8.70 | 16.30 | | 4143.40 | 5344.341 |
| | -30 | 13 | 18.00 | 9.50 | 16.50 | | 4037.23 | 5362.606 |
| DEC | -14 | 14 | 16.00 | 10.30 | 16.50 | | 3625.11 | 3913.802 |
| | -28 | 15 | 15.00 | 10.90 | 10.00 | 12.90 | 3383.83 | 3711.897 |
| JAN | -11 | 16 | 12.00 | 11.30 | 10.50 | 13.00 | 2523.72 | 2866.665 |
| | -25 | 17 | 11.10 | 11.70 | 10.50 | 13.20 | 2469.51 | 2827.037 |
| FEB | -8 | 18 | 11.10 | 12.50 | 11.00 | 13.30 | 2261.15 | 2643.959 |
| | -22 | 19 | 11.50 | 12.80 | 11.00 | 13.40 | 2315.06 | 2713.344 |
| MARCH | -8 | 20 | 11.50 | 13.50 | 11.50 | 13.60 | 2064.40 | 2477.910 |
| | -22 | 21 | 15.00 | 14.20 | 11.50 | 13.80 | 2418.43 | 2846.933 |
| APRIL | -5 | 22 | 15.00 | | 12.00 | | 2144.68 | 2587.986 |
| | -19 | 23 | 11.10 | | 12.00 | | 1680.00 | 2137.913 |
| MAY | -3 | 24 | 11.10 | | 11.50 | | 1665.11 | 2137.452 |
| | -17 | 25 | 11.10 | | 11.50 | | 1665.11 | 2137.576 |
| | -31 | 26 | 11.10 | | 11.70 | | 1671.06 | 2156.344 |

# APPENDIX III

## Gross Margin Analysis for Sheep and Bull Systems

### BULL SYSTEM 1

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @221kg | 213 | 470.73 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 180.00 |
| ANIMAL HEALTH " | 10.00 |
| CARTAGE " | 20.00 |
| INTEREST (1.667%/mnth) | 39.01 |
| TOTAL: | 249.01 |
| SURPLUS: | 221.72 |
| per SU: | 49.27 |

### BULL SYSTEM 2

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @221kg | 213 | 470.73 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 180.00 |
| ANIMAL HEALTH " | 10.00 |
| CARTAGE " | 20.00 |
| INTEREST (1.667%/mnth) | 46.51 |
| TOTAL: | 256.51 |
| SURPLUS: | 214.22 |
| per SU: | 47.60 |

### BULL SYSTEM 3

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @330kg | 229 | 755.70 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 180.00 |
| ANIMAL HEALTH | 10.00 |
| CARTAGE | 30.00 |
| INTEREST (1.667%/mnth) | 78.02 |
| TOTAL: | 298.02 |
| SURPLUS: | 457.68 |
| per SU: | 41.61 |

### BULL SYSTEM 4

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @221kg | 213 | 470.73 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 230.00 |
| ANIMAL HEALTH | 8.00 |
| CARTAGE | 25.00 |
| INTEREST (1.667%/mnth) | 38.34 |
| TOTAL: | 301.34 |
| SURPLUS: | 169.39 |
| per SU: | 37.64 |

### BULL SYSTEM 5

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @221kg | 213 | 470.73 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 280.00 |
| ANIMAL HEALTH | 2.00 |
| CARTAGE | 28.00 |
| INTEREST (1.667%/mnth) | 28.01 |
| TOTAL: | 338.01 |
| SURPLUS: | 132.72 |
| per SU: | 29.49 |

### BULL SYSTEM 6

| INCOME: | c/kg | TOTAL $ |
|---|---|---|
| 1 bull @300kg | 224 | 672.00 |

| EXPENDITURE: | TOTAL $ |
|---|---|
| PURCHASE: per bull | 420.00 |
| ANIMAL HEALTH | 1.00 |
| CARTAGE | 30.00 |
| INTEREST (1.667%/mnth) | 38.51 |
| TOTAL: | 489.51 |
| SURPLUS: | 182.49 |
| per SU: | 33.18 |

## APPENDIX III Cont.

BULL SYSTEM 7

| INCOME: | | c/kg | TOTAL $ |
|---|---|---|---|
| | 1 bull @300kg | 224 | 672.00 |
| EXPENDITURE: | | | TOTAL $ |
| PURCHASE: per bull | | | 350.00 |
| ANIMAL HEALTH | | | 2.00 |
| CARTAGE | | | 30.00 |
| INTEREST (1.667%/mnth) | | | 58.35 |
| | | TOTAL: | 440.35 |
| | | SURPLUS: | 231.66 |
| | | per SU: | 42.12 |

SHEEP: Summer Dry

| INCOME: | $/UNIT | TOTAL $ |
|---|---|---|
| WOOL: 4.5kg/ssu | 3.40 | 128.52 |
| LAMBS:5@11.0kg | 149.00 | 81.95 |
| SKINS: | 513.00 | 25.65 |
| EWES: (nett) | 3.00 | 4.29 |
| | TOTAL: | 240.41 |
| EXPENDITURE: | | |
| KILLING CHARGES (lamb) | 10.30 | 51.50 |
| ANIMAL HEALTH (/su) | 1.20 | 10.08 |
| SHEARING (hd) | 1.30 | 25.84 |
| CARTAGE (/su) | 1.00 | 8.40 |
| INTEREST (1.667%/mnth) | | 24.00 |
| | TOTAL: | 119.83 |
| | SURPLUS: | 120.58 |
| | per SU: | 14.35 |

SHEEP: Summer Wet

| INCOME: | $/UNIT | TOTAL $ |
|---|---|---|
| WOOL: 5.0kg/ssu | 3.40 | 153.00 |
| LAMBS:6.125@12.5kg | 149.00 | 114.08 |
| SKINS: | 513.00 | 31.42 |
| EWES: (nett) | 3.00 | 5.10 |
| | TOTAL: | 303.60 |
| EXPENDITURE: | | |
| KILLING CHARGES (lamb) | 10.30 | 63.09 |
| ANIMAL HEALTH (/su) | 1.50 | 15.00 |
| SHEARING (hd) | 1.30 | 32.08 |
| CARTAGE (/su) | 1.00 | 10.00 |
| INTEREST (1.667%/mnth) | | 32.01 |
| | TOTAL: | 152.18 |
| | SURPLUS: | 151.42 |
| | per SU: | 15.14 |

APPENDIX IV

WAIRARAPA BULL BEEF SURVEY 1986

Please ☑ the appropriate box (or boxes), or where actual numbers or statements are required, please fill in the spaces provided.

For most questions, the years (e.g. 1984/85) for which data is requested will be stated. If not, data relating to your normal or usual situation is being sought.

For questions relating to areas, please ☑ whether you will use

acres ☐ or hectares ☐

## Section A Farm and Farmer Details

OFFICE USE

Record (1)

Code No. ☐☐ | 1 ☐☐

1. (a) Total Surveyed area of farm: ________ | 4 ☐☐☐☐
   (b) Effective (grassed) area of farm: ________ | 9 ☐☐☐☐

   (c) If you are the owner
   In what year did you take possession: 19 ___ | 14 ☐☐

   (d) If you are the manager
   How many years have you managed this property
   ☐ yrs | 17 ☐☐

   (e) How long have you been engaged in full time farming
   ☐ yrs | 20 ☐☐

   (f) How old are you ☐ yrs | 23 ☐☐

   (g) In which year did you first start running bulls for bull beef: 19 ___ | 26 ☐☐

2. Stock

I. Sheep

   (a) Numbers Wintered (on hand 1st July)

| | 1983 | 1984 | 1985 |
|---|---|---|---|
| Two Tooths | | | |
| MA Ewes | | | |
| Ewe hoggets | | | |
| Wether hoggets | | | |
| Rams | | | |
| Others | | | |

29 ☐☐☐☐
34 ☐☐☐☐
39 ☐☐☐☐
44 ☐☐☐☐
49 ☐☐☐☐
54 ☐☐☐☐
59 ☐☐☐☐
64 ☐☐☐☐
69 ☐☐☐☐

(b) Predominant Breed of ewe: Romney ☐

Perendale ☐

Coopworth ☐ 74 ☐

Other (specify) ☐

____________________

(c) Main Flock Replacement Policy:

Rear own replacements ☐

Buy in lambs/ewe hoggets ☐ 76 ☐

Buy in 2 tooths ☐

Buy in older ewes ☐

Other (specify) ____________________ ☐

(d) Over the next 2 years, do you intend to alter sheep numbers:

increase ☐

decrease ☐ 78 ☐

remain the same ☐

don't know/undecided ☐

Comment: (change in numbers, what classes)

________________________________________

________________________________________

II. Cattle

(a) Numbers wintered (stock on hand 1st July)

New Record (2)

| | 1983 | 1984 | 1985 | |
|---|---|---|---|---|
| Bull Beef: | | | | |
| Rising 1 yr Bulls | | | | 1 |
| Rising 2 yr Bulls | | | | 6 |
| Traditional: | | | | |
| Breeding Bulls | | | | 11 |
| Breeding Cows | | | | 16 |
| R 2 yr Heifers | | | | 21 |
| R 1 yr Heifers | | | | 26 |
| R 2 yr Steers | | | | 31 |
| R 1 yr Steers | | | | 36 |
| Others | | | | 41 |

(b) Predominant Bull Beef Breed(s)

________________________________________ 46 ☐ 47 ☐

________________________________________ 48 ☐ 49 ☐

________________________________________

(c) Predominant (traditional) Beef Breed(s)

________________________________________ 51 ☐

(d) Over the next 2 years do you intend to alter cattle numbers

increase ☐

decrease ☐ 53 ☐

remain the same ☐

don't know/undecided ☐

Comment: (change in numbers, what classes)

________________________________________

________________________________________

III. Other Stock

Numbers Wintered

| | 1983 | 1984 | 1985 |
|---|---|---|---|
| Deer | | | |
| Goats | | | |
| Other (specify) | | | |

55 ☐☐☐☐
60 ☐☐☐☐
65 ☐☐☐☐

Comment: ________________________________________

________________________________________

________________________________________

## Section B Stock Policies and Performance

New Record(3)

I. Sheep

(a) Lambing % (lambs docked/ewes mated)

| 1983 | 1984 | 1985 |
|---|---|---|
| | | |

1 ☐☐☐
5 ☐☐☐
9 ☐☐☐

(b) Date Rams went out (to main flock)

Out for How long: days ) weeks ) Please cycles ) specify

/ /83 ☐
/ /84 ☐
/ /85 ☐

13
20
27

Comment: (e.g. if you have an early lambing group)

________________________________________

________________________________________

(c) Date when main weaning of lambs takes place

/ /83
/ /84
/ /85

34
38
42
46

(d) Selling Policy for lambs

Note: You will need to refer to your killing sheets

New Record (4)

1984/85

| Date of Draft | Number | Store | Works | Av. Carcass wt |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

1 3
6
11 13
17
22 24
28
33 35
38
43 45
48
53 55
58
63 66
68

1985/86

New Record (5)

| Date of Draft | Number | Store | Works | Av. Carcass wt |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

1 3
6
11 13
16
21 23
26
31 33
36
41 43
46

Comments: (e.g. reasons for major changes between years)

______________________________________________

______________________________________________

(e) Selling Policy for Other Sheep

| | 1984/85 | | 1985/86 | |
|---|---|---|---|---|
| | Number | Month(s) | Number | Month(s) |
| Hoggets | | | | |
| | | | | |
| 2 tooths | | | | |
| | | | | |
| Cull Ewes | | | | |
| | | | | |

New Record (6)

1, 3, 8, 10, 15, 17, 22, 24, 29, 31, 36, 38, 43, 45, 50, 52

(f) Total Wool Clip sold (kg): 1983/84 [ ] 1984/85 [ ]

57, 63

(g) Do you normally try to flush ewes prior to mating

Yes [ ] No [ ]

69

(h) If yes to (g), how long was the period of flushing (wks)

1983/84 [ ]
1984/85 [ ]

71, 74

New Record (7)

(i) If you weigh your sheep, what was their body-weight at (or near) mating

| | 1983 | 1984 | 1985 |
|---|---|---|---|
| MA Ewes | | | |
| 2 tooths | | | |
| ewe lambs | | | |

1, 4, 7, 10, 13, 16, 19, 22, 25

## II. Cattle

### (a) Buying Policy (Bulls)

1984/85

| Month | No. | Age of Cattle e.g., 4 days 3 mths 1 yr | Purchased by whom, e.g. self, stock agent | Purchased from whom, e.g. Dairy farmer, Stock yards, Other farmers | Where Purchased e.g., Wairarapa Manawatu | Average liveweight (kg) | Price $/hd | Total Transport Cost ($) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
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| 1985/86 | | | | | | | | |
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| | | | | | | | | |

(b) Rank the following items in terms of their importance when buying bulls (1 = most important, 5 = least important, 0 = not considered)

| | Rank | | |
|---|---|---|---|
| Buy and sell on the same market each year | ☐ | 28 | ☐ |
| | | 29 | ☐ |
| Certain number to buy to make up stock numbers | ☐ | 30 | ☐ |
| Maximum price willing to pay | ☐ | 31 | ☐ |
| Minimum liveweight | ☐ | 32 | ☐ |
| Other (specify) | ☐ | | |

(c) Selling Policy

| | Month | Age of Bulls | Number | Works Bulls Average Carcass wt | Store Bulls Average Liveweight | Total Transport Cost |
|---|---|---|---|---|---|---|
| 1984/85 | | | | | | |
| | | | | | | |
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| 1985/86 | | | | | | |
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| | | | | | | |

Comment: (e.g. Why are some bulls sold store, what differences are there between years)

________________________________________

________________________________________

________________________________________

________________________________________

________________________________________

(d) The following is a list of factors which might influence selling decisions for bulls on your farm. Please rank them in order of importance (1 = most, 6 = least, 0 = no importance) on your property.

- Cash flow situation ☐ 35 ☐
- Feed position ☐ 36 ☐
- Always sell at same time ☐ 37 ☐
- Premiums available ☐ 38 ☐
- Expectations of schedule changes ☐ 39 ☐
- Other (specify) ________________ ☐ 40 ☐

(e) Do you follow the bull schedule

- Weekly ☐ 42 ☐
- Fortnightly ☐
- Monthly ☐
- Other (specify) ________________ ☐

(f) Do you follow the NZ $ exchange rate

- Weekly (or more regularly) ☐
- Fortnightly ☐ 44 ☐
- Monthly ☐
- Hardly ever ☐
- Other (specify) ________________ ☐

(g) What sources of information (other than schedule) do you use in making selling decisions (e.g. newspapers, journals)

________________________________________

________________________________________

________________________________________

(h) Do you generally attend stock sales

Weekly ☐
Fortnightly ☐
Monthly ☐
5-6 times a year ☐
2-3 times a year ☐

46 ☐

III. Weighing of Bulls

(a) Do you weigh your bulls Yes ☐ No ☐

47 ☐

(b) If not, please comment why [then go to question (e)]

________________________________________

________________________________________

(c) Please complete this section.

1984/85

(i) Weaners to 1 yr

New Record (8)

| Weighing Date | No. Weighed | % of mob weighed | Average liveweight (kg) |
|---|---|---|---|
| | | | |
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|---|---|---|---|---|---|---|---|
| 1 | | | | 3 | | | |
| 7 | | | | 9 | | | |
| 13 | | | | 15 | | | |
| 19 | | | | 21 | | | |
| 25 | | | | 27 | | | |
| 31 | | | | 33 | | | |
| 37 | | | | 39 | | | |
| 43 | | | | 45 | | | |
| 49 | | | | 51 | | | |
| 55 | | | | 57 | | | |

(ii) 1 yr to 2 yr

New Record (9)

| Weighing Date | No. Weighed | % of mob weighed | Average liveweight (kg) |
|---|---|---|---|
| | | | |
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| | | | |
|---|---|---|---|
| 1 | | 3 | |
| 7 | | 9 | |
| 13 | | 15 | |
| 19 | | 21 | |
| 25 | | 27 | |
| 31 | | 33 | |
| 37 | | 39 | |
| 43 | | 45 | |
| 49 | | 51 | |
| 55 | | 57 | |
| 61 | | 63 | |
| 67 | | 69 | |
| 73 | | 75 | |

(iii) 2 yr and older

New Record (10)

| Weighing Date | No. Weighed | % of mob weighed | Average liveweight (kg) |
|---|---|---|---|
| | | | |
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| | | | |
|---|---|---|---|
| 1 | | 3 | |
| 7 | | 9 | |
| 13 | | 15 | |
| 19 | | 21 | |
| 25 | | 27 | |
| 31 | | 33 | |
| 37 | | 39 | |
| 43 | | 45 | |
| 49 | | 51 | |
| 55 | | 57 | |

(d) Do you attempt to achieve target liveweights at certain ages of bull/times of the year

Yes ☐ No ☐ 61 ☐

Comment: (ages/months/weights)

________________________________________

________________________________________

________________________________________

(e) Before purchase, do you "price" bulls on your estimate of either liveweight or carcass weight value

Yes ☐ No ☐ 63 ☐

(f) Do you weigh your bulls immediately prior to selling them

Yes ☐ No ☐ 65 ☐

## Section C Animal Health

New Record (11)

(a) Drenching policy (for worms)

Young bulls (weaner to yearling)

________________________________________

________________________________________ 1 ☐

________________________________________

Older Bulls

________________________________________

________________________________________ 3 ☐

________________________________________

(b) Other Animal health problems

Please indicate the seriousness and frequency of occurrence of the following problem, using the following scales:

Seriousness: 1 = very serious 2 = serious
3 = moderate 4 = minor
5 = no problem
Frequency: 1 = every year 2 = every other year
3 = less frequently than every 2 years
Bull mob: 1 = young bulls (under 1 yr)
2 = older bulls 3 = both

| Problem | Seriousness | Frequency | Bull Mob | Preventative Action | |
|---|---|---|---|---|---|
| Copper Deficiency | | | | | 5 |
| Facial Eczema | | | | | 9 |
| Ryegrass Staggers | | | | | 13 |
| Bloat | | | | | 17 |
| Clostridial disease e.g. Blackleg | | | | | 21 |
| Injury due to fighting/riding etc | | | | | 25 |
| Pink eye | | | | | 29 |
| Other (specify) | | | | | 33 |
| | | | | | 37 |

(c) Have you used Ralgro on Bulls Yes ☐ No ☐ 41

If yes: In Young bulls (up to yearling) did it

Increase liveweight gains Yes ☐ No ☐ 43
Decrease "bulling" behaviour Yes ☐ No ☐ 44

In older bulls

Increase weight gains Yes ☐ No ☐ 46
Decrease "bulling" behaviour Yes ☐ No ☐ 47

**Section D** **Pastures** New Record (12)

(a) Do you have pasture growth rate information (in kg Dry Matter) for your farm Yes ☐ No ☐ 1

If no, go to question (c).

(b) Total Pasture production: kg DM/ha/yr ☐ 3

(c) Do you record rainfall on your farm Yes ☐ No ☐ — 8 ☐

If no, go to (e)

(d) Average annual rainfall (mm) ☐ — 10 ☐☐☐☐

(e) In which month(s) do you normally experience your most severe shortage of pasture.

| J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

15 ☐☐ 17 ☐☐
19 ☐☐ 21 ☐☐
23 ☐☐ 25 ☐☐
27 ☐☐ 29 ☐☐
31 ☐☐ 33 ☐☐
35 ☐☐ 37 ☐☐

Comment: (reasons why, was it quality or quantity lacking?)

______________________________

______________________________

______________________________

______________________________

(f) Do you normally make ☐ or buy in ☐ hay. No ☐ — 40 ☐

Average number of bales: ☐ — 42 ☐☐☐☐

Month normally harvested/bought in: ☐ — 47 ☐☐☐☐

This is normally fed to:

| | | Month(s) |
|---|---|---|
| Ewes | | |
| Hoggets | | |
| Lambs | | |
| Young bulls (up to 1 yr) | | |
| Older bulls | | |
| Other cattle | | |

52 ☐ 53 ☐☐☐☐
59 ☐ 60 ☐☐☐☐
67 ☐ 68 ☐☐☐☐

(g) Do you normally make silage: Yes ☐ No ☐ — 74 ☐

New Record (13)

If yes:
Average area harvested: ☐ — 1 ☐☐☐
Month normally harvested: ☐ — 4 ☐☐☐☐

This is normally fed to:

| | | Month(s) |
|---|---|---|
| Ewes | | |
| Hoggets | | |
| Lambs | | |
| Young bulls (up to 1 yr) | | |
| Older bulls | | |
| Other cattle | | |

9 ☐ 10 ☐☐☐☐
16 ☐ 17 ☐☐☐☐
23 ☐ 24 ☐☐☐☐
30 ☐ 31 ☐☐☐☐

(h) If you don't make hay or silage, do you have suitable land to harvest hay or silage if you wanted to

Yes ☐ No ☐ 37 ☐

(i) Have you used any form of nitrogen fertiliser on pasture in the last 3 years

Yes ☐ No ☐ 39 ☐

If no, go to Section E.

(j) N Fertiliser Use

| | Type of N Fertiliser | | Application rate kg/ha | Area applied to (ha) | Month(s) applied | Comment on why used (e.g feed shortage) Results | |
|---|---|---|---|---|---|---|---|
| 1983 | Urea | | | | | | 41 ☐ 43 ☐☐ |
| | S of A* | | | | | | |
| | DAP | | | | | | 46 ☐☐☐☐ |
| | Other (specify) | | | | | | |
| 1984 | Urea | | | | | | |
| | S of A* | | | | | | 51 ☐ 53 ☐☐ |
| | DAP | | | | | | 56 ☐☐☐☐ |
| | Other (specify) | | | | | | |
| 1985 | Urea | | | | | | |
| | S of A* | | | | | | 61 ☐ 63 ☐☐ |
| | DAP | | | | | | 66 ☐☐☐☐ |
| | Other (specify) | | | | | | |

* Sulphate of Ammonia

## Section E Grazing Management

New Record (14)

(a) Grazing of Bulls & Sheep

1. Do you normally graze sheep and bulls together for most of the year

   Yes ☐ No ☐ 1 ☐

or

2. Do the sheep and bulls normally graze the same area, but separately (i.e. in a leader-follower system) for most of the year

   Yes ☐ No ☐ 3 ☐

or

3. (i) Are the bulls normally grazed on their own separate block

Yes ☐ No ☐ 7 ☐

(b) Do you try to reduce sheep worm burdens by preparing pasture for sheep, with bulls

Yes ☐ No ☐ 9 ☐

(c) Do you try to reduce bullworm burdens by preparing pasture for bulls, with sheep

Yes ☐ No ☐ 11 ☐

(d) Do you use bulls to "clean up" long (rank) feed in the summer/autumn

Yes ☐ No ☐ 13 ☐

(e) During a feed shortage, which classes of stock would take priority:
(Rank from 1 = most important to 7 = least important)

| Class of Stock | Dry Summer | Wet Winter | |
|---|---|---|---|
| Rising 1 yr Bulls | | | 15 |
| Rising 2 yr Bulls | | | 17 |
| Other Cattle | | | 19 |
| Ewes | | | 21 |
| Replacement ewe lambs | | | 23 |
| Other lambs | | | 25 |

(f) What length of pasture do you attempt to leave behind the bulls when shifting them out of a paddock (or never let them get below if set stocked)

| | | | | |
|---|---|---|---|---|
| Summer (Dec-Feb) | Young bulls (Wnr - lyr) | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 28 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| | Older bulls (lyr +) | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 30 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |

| | | | | |
|---|---|---|---|---|
| Autumn (Mar-May) | Young bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 32 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| | Older bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 34 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| Winter (Jun-Aug) | Young bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 36 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| | Older bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 38 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| Spring (Sep-Nov) | Young bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 40 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |
| | Older bulls | bet. 0 cm - 2.5 cm (0-1") | | |
| | | 2.5 cm - 5 cm (1-2") | | 42 ☐ |
| | | 5 cm - 7.5 cm (2-3") | | |
| | | more than 7.5 cm (3"+) | | |

(g) Are you troubled by any of the following problems with bulls (Please rank from 1 = most serious, to 8 = least serious. If it is no problem rank as 0)

| Problem | Rank | Preventative Action (Comment) | |
|---|---|---|---|
| Pushing fences/ gates | | | 44 ☐ |
| Riding each other | | | 45 ☐ |
| Fighting | | | 46 ☐ |
| Digging holes | | | 47 ☐ |
| Pacing (up & down fence lines) | | | 48 ☐ |
| Chasing Stock | | | 49 ☐ |
| Keeping separated from (own) heifers/ cows | | | 50 ☐ |
| Keeping separated from neighbours stock (cattle) | | | 51 ☐ |

Section F General — New Record (15)

(a) Compared to sheep and a breeding cattle system, bull beef labour requirements are:

Higher ☐ — 1 ☐
Lower ☐
Same ☐

(b) What information sources have you used for your bull beef operation:

Other farmer(s) ☐ — 3 ☐

Massey University - staff ☐ — 4 ☐
publications ☐

MAF - advisors ☐ — 5 ☐
publications ☐

Private Consultants ☐ — 6 ☐

Other publications (specify) ............. ☐ — 7 ☐

Other (specify) ......................... ☐

(c) What aspects of bull beef would you like to have more information about:

______________________________

______________________________

______________________________

(d) What concerns do you have about the future of bull beef farming

(i) On farm: ________________________

______________________________

(ii) Off farm: ________________________

______________________________

(e) Have you found, per stock unit carried, that your bull beef has been consistently more profitable than your sheep

Yes ☐ No ☐ — 9 ☐

(f) If your answer to (e) is yes - why don't you run predominantly bulls with some sheep, or even all bulls:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

APPENDIX V

## Calculation of Marginal Feeding Costs of Ewes and Bulls in the late Winter-early Spring

In reference to Section 7.2.2

Allocating an extra 1 kg DM (11 MJME) to a 450 kg bull being fed at maintenance would yield a LWG of 0.25 kg/day (Table 3.5), equal to 0.13 kg carcass weight. At current (15.9.86) schedule value this would be worth 30 cents.

The calculation for the breeding ewe are not so straight forward. Generally ewe feeding restrictions during mid- to late-pregnancy have a lesser effect on production than restrictions during lactation (Monteath 1971, Rattray *et al* 1982, Smeaton and Rattray 1984) and in some cases underfeeding during pregnancy can be compensated for by improved feeding during lactation (Rattray *et al* 1982). Hence, it is worthwhile to conserve pasture during a winter storage by restricting intakes until lambing commences. However, the extent to which pasture can be transferred or used for other classes of livestock, is dependent on ewe condition. In cases where ewe liveweights can be reduced without affecting subsequent performance, some pasture could be reallocated to bulls.

Sheep production is more sensitive to changes to post-partum nutrition. Thus, Coop *et al* (1971) by restricting lactating ewes to half their requirements for 3 weeks after lambing, reduced weaning weights of twin lambs by up to 1.5 kg. Ewe weight losses of 5-7 kg at weaning indicated that underfeeding was buffered by ewe liveweight. No wool production figures were provided. A 1.6 kg difference in carcass weight between lambs slaughtered at 18 weeks of age from ewes fed allowances of either 2 kg DM/day or 8 kg DM/day for 6 weeks after lambing was measured by Munro and Geenty (1983). Similarly, by restricting pasture through lactation (2.0 kg DM/day vs 10.7 kg DM/day allowance) Rattray *et al* (1982) generated a 10 kg difference in lamb weaning weight and a 310 gram reduction in ewe wool weights. Further trials by Smeaton and Rattray (1984) with varying feeding levels from mid pregnancy to weaning resulted in a maximum difference of 4 kg and 5.7 kg in lamb and ewe weaning weight respectively. Underfeeding during pregnancy and lactation hve also resulted in lower (by 60%) tensile strength in ewe wool (Monteath 1971). These trials indicate that ewes can buffer lambs growth rates from low feeding levels by reducing liveweights. An additional factor is the magnitude of carry over effects of lower ewe body weight resulting from underfeeding during lactation.

Determining the marginal value of pasture fed to ewes during lactation is therefore difficult. However, this cost over the first six weeks of lactation could be calculated as follows:

Assume feeding at half feed requirements for 6 weeks result in a 1.5 carcass weight reduction in lamb produced, 200 gms less wool with a 25% lower return due to "break", and a 4 kg ewe bodyweight reduction which remains through to tupping, giving an 8% lower lambing the following spring.

| COST: | $ |
|---|---|
| 1.5 kg lower lamb carcass weight @ 149¢/kg | 2.24 |
| 200 gms wool @ 320¢/kg | 0.64 |
| 25% of 4.3 kg wool @ 320¢/kg | 3.44 |
| 0.08 x $11 (nett return from 1 lamb) | 0.88 |
| | $7.20 |

The feed requirements for a 55 kg ewe in the first 6 weeks of lactation are about 91 kg DM (Scott et al 1979).

Therefore, the average cost per kg DM for feeding at half ration:

= $7.20/45.5
= 15.8¢/kg

However, using Rattray et al's (1982) results of a 3 kg lower ewe weight and 3 kg lower lamb weight at weaning, plus 110 gms less ewe wool; the effect of underfeeding a ewe throughout lactation by 0.1 kg DM/day of intake, gives a marginal value of 46.4¢/kg DM. The marginal return of feeding the extra 1 kg DM to a 450 kg bull, as mentioned earlier, is approximately 30¢/kg DM. Thus, if the first example is correct, it is more profitable to feed bulls than ewes, while if the second example is correct, ewes are more profitable. This is still the case with yearling bulls, where the marginal return from feeding an extra 1 kg DM (11 MJME) to a 250 kg bull at maintenance, at current (15.9.86) prices is 38.1¢/kg DM. The problem therefore, is unresolved.

The sensitivity of this problem of feed allocation to differing meat schedule and wool prices is illustrated in the following Table.

Sensitivity of Bull and Sheep Marginal[1]
Returns in ¢/kg DM to Differing Prices

| Schedule ¢/kg | 450 kg Bull Marginal | 250 kg Bull Marginal |
|---|---|---|
| 160 | 20.8 | 28.6 |
| 180 | 23.4 | 32.2 |
| 200 | 26.0 | 35.8 |
| 220 | 28.6 | 39.4 |
| 240 | 31.2 | 43.0 |
| 260 | 33.8 | 46.5 |
| 280 | 36.4 | 50.1 |
| 300 | 39.0 | 53.7 |

Sheep

| Wool Price ¢/kg | 250 | | 300 | | 350 | | 400 | |
|---|---|---|---|---|---|---|---|---|
| | Marginal (1) | Marginal (2) | Marginal (1) | Marginal (2) | Marginal (1) | Marginal (2) | Marginal (1) | Marginal (2) |
| Lamb Schedule ¢/kg | | | | | | | | |
| 120 | 37.3 | 12.5 | 38.1 | 13.9 | 38.8 | 15.3 | 39.6 | 16.7 |
| 140 | 43.6 | 13.6 | 44.4 | 15.0 | 45.2 | 16.4 | 46.0 | 17.8 |
| 160 | 50.0 | 14.7 | 50.7 | 16.7 | 51.5 | 17.5 | 52.3 | 18.9 |
| 180 | 56.3 | 15.8 | 57.1 | 17.2 | 57.9 | 18.6 | 58.7 | 20.0 |
| 200 | 62.6 | 16.9 | 63.4 | 18.3 | 64.2 | 19.7 | 65.0 | 21.1 |
| 220 | 69.0 | 17.9 | 69.8 | 19.3 | 70.6 | 20.7 | 71.3 | 22.1 |

---

(1) Bull marginal returns based on an increase of 1 kg DM above maintenance,

450 kg bull = 0.13 kg c/c wt          250 kg bull = 0.179 kg c/c wt

Sheep marginal (1) returns based on Rattray *et al* (1982) as in text.

Sheep marginal (2) returns based on the example given earlier in this section.

APPENDIX VI: United States Meat Import Formula (in Meat Import Act of 1979)

| | | Base Quota | | Adjustment Factor for Domestic Production Growth | | Counter cyclical Adjustment Factor ie for cyclical changes in Domestic Production |
|---|---|---|---|---|---|---|
| Import Level for year ahead | = | 10 year average (1968-77) imports | x | 3 year (current year and 2 preceeding years) moving average of domestic cow production / 10 year average (1968-77) of domestic production<br><br>(percentage) | x | 5 year (estimated year ahead and 4 preceeding years) moving average of per capital domestic cow beef production* / 2 year (estimated year ahead and preceeding year) moving average of per capita cow beef production*<br><br>(fraction) |

* Domestic cow beef production = "cow slaughter"

Product Coverage: Fresh, chilled and frozen beef, veal, mutton and goat and certain processed beef and veal products (except sausages)

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