

AN EXPERT SYSTEM FOR WEANING LAMBS

G Bishop-Hurley *

P L Nuthall **

April 1994

*** Research Officer
Department of Farm Management**

**** Reader
Department of Farm Management**

RESEARCH REPORT NO. 226

**Agribusiness & Economics Research Unit
PO Box 84
Lincoln University
CANTERBURY**

**Telephone No: (64) (3) 325 2811
Fax No: (64) (3) 325 3847**

The Agribusiness and Economics Research Unit (AERU) operates from Lincoln University providing research expertise for a wide range of organisations concerned with production, processing, distribution, finance and marketing.

The AERU operates as a semi-commercial research agency. Research contracts are carried out for clients on a commercial basis and University research is supported by the AERU through sponsorship of postgraduate research programmes. Research clients include Government Departments, both within New Zealand and from other countries, international agencies, New Zealand companies and organisations, individuals and farmers. Research results are presented through private client reports, where this is required, and through the publication system operated by the AERU. Two publication series are supported: Research Reports and Discussion Papers.

The AERU operates as a research co-ordinating body for the Economics and Marketing Department and the Department of Farm Management and Accounting and Valuation. This means that a total staff of approximately 50 professional people is potentially available to work on research projects. A wide diversity of expertise is therefore available for the AERU.

The major research areas supported by the AERU include trade policy, marketing (both institutional and consumer), accounting, finance, management, agricultural economics and rural sociology. In addition to the research activities, the AERU supports conferences and seminars on topical issues and AERU staff are involved in a wide range of professional and University related extension activities.

Founded as the Agricultural Economics Research Unit in 1962 from an annual grant provided by the Department of Scientific and Industrial Research (DSIR), the AERU has grown to become an independent, major source of business and economic research expertise. DSIR funding was discontinued in 1986 and from April 1987, in recognition of the development of a wider research activity in the agribusiness sector, the name of the organisation was changed to the Agribusiness and Economics Research Unit. An AERU Management Committee comprised of the Principal, the Professors of the three associate departments, and the AERU Director and Assistant Director administers the general Unit policy.

AERU MANAGEMENT COMMITTEE 1994

Professor A C Bywater, B.Sc., Ph.D.

(Professor of Farm Management)

Professor A C Zwart, B.Agr.Sc., M.Sc., Ph.D.

(Professor of Marketing)

R L Sheppard, B.Agr.Sc. (Hons), B.B.S.

(Assistant Director, AERU)

AERU STAFF 1994

Director

Professor AC Zwart, B.Agr.Sc., M.Sc., Ph.D.

Assistant Director

R L Sheppard, B.Agr.Sc. (Hons), B.B.S.

Senior Research Officer

J. R. Fairweather, B.Agr.Sc., B.A., M.A., Ph.D.

Research Officers

C. M. Scully, B.A.

G Greer, B.Agr.Sc. (Hons)

G. F. Thomson, B.Com.

Secretary

J Clark

CONTENTS

LIST OF TABLES		(i)
PREFACE		(iii)
ACKNOWLEDGEMENTS		(v)
SUMMARY		(vii)
CHAPTER 1	INTRODUCTION	1
CHAPTER 2	REVIEW OF WEANING DATE TECHNOLOGY	3
	2.1 Historical Approach to the Weaning Date	3
	2.2 The Weaning Date Decision	3
	2.3 Summary of the Weaning Decision	5
CHAPTER 3	DEVELOPMENT OF THE WEANING DATE EXPERT SYSTEM	7
	3.1 Introduction	7
	3.2 The Questionnaire and Interviews	7
	3.3 Prototyping Revisited	8
	3.4 Results and Discussion	8
	3.4.1 Introduction	8
	3.4.2 Modifications to the Methodology	9
	3.4.3 Getting Information from the User	9
	3.4.4 Feed Quantity	9
	3.4.5 Feed Quality	10
	3.4.6 Weaning Part of the Mob	10
	3.4.7 Sales Prices and Price Differentials	10
	3.4.8 Animal Health and Condition	11
	3.4.9 Explaining the Advice Given	11
	3.4.10 General Comments	12
CHAPTER 4	FARMER COMMENTS ON THE EXPERT SYSTEM	13
	4.1 Introduction	13
	4.2 Survey Results	13
REFERENCES		19
APPENDIX 1	Rule Set for the First Prototype	21
APPENDIX 2	The VP Expert Form of 'Weaning Expert'	25
APPENDIX 3	Explanations Offered for Each Decision Rule	29

LIST OF TABLES

Table		Page
1	Farmers' Views on the Importance of Weaning Determination Factors	14
2	Farmers' Suggestions of Additional Factors to Consider	15
3	Farmers' Comments on the Explanations	16

PREFACE

Computers are becoming an increasing part of the range of tools available to farmers in carrying out their farm management activities. However, there is a range of utilisation of computers within the farming sector. This Research Report provides an application which farmers would find of value in assisting with decisions regarding the time to wean lambs. Further publications in this Series will present systems applicable to drenching decisions and pasture conservation and a farmer evaluation of the use of this type of computer assistance.

The approach taken is to design an "expert system" which provides responses to farmers on the basis of IF a condition exists, THEN this is the rule to follow. The computer approach is based on inputs by experts in the particular field and those expert views are built into the computer response process. An "expert system" approach is seen as a way of providing management assistance/advice on an "on-call" basis and this helps to improve the overall level of farm management expertise and the utilisation of farm consultant skills.

The Agribusiness and Economics Research Unit is pleased to be associated with this work and to participate in its dissemination through this and future publications.

**R L Sheppard
ASSISTANT DIRECTOR**

ACKNOWLEDGEMENTS

The assistance of the experts who provided the knowledge base (the rules) is gratefully acknowledged. Clearly they (Dr G A G Frengley, Mr P Gaul, Mr N Gow and Mr R Plank) are the heart of the system.

The farmers that agreed to use and comment on the system also made an extremely valuable contribution and their assistance is also acknowledged.

We would also like to record the help provided by the typists (Mrs Judy Derby and Mrs Sharon Hunt) as they are a significant component of the team.

The study was funded by AGMARDT and Lincoln University. Their support was, clearly, crucial to the completion of the project.

SUMMARY

The animal grazing industry is a major sector of New Zealand's economy. Managers controlling the utilisation of the nation's massive pasture production tend to make utilisation decisions using experience and intuition in contrast to formal analytical analyses. Yet, when related to the potential, production achieved tends to suggest improvements are possible. That is, greater production is possible with the same resources, or alternatively the same production is possible from a smaller resource input. It appears one of the reasons for the lack of formal planning is the farmers' belief that the work involved is not commensurate with the gains. Thus, if techniques that are simple to use and provide an efficiency gain can be found they clearly have potential. The study reported in this Report concerns the development of an expert system for a small component of the grazing management problem. It is proposed that such an expert system meets these requirements. This report is one of a series describing several expert systems in the area of grazing management. Another contains an evaluation of these expert systems.

An expert system is a set of knowledge and decision rules, usually computer-based for ease of access and retrieval, gleaned from experts (thus the term 'expert system') and made widely available to decision makers so they can gain the benefits of the 'experts' knowledge and experience. Essentially, creating an expert system involves questioning the experts to find out the factors they observe, and the conclusions they reach given the various values the factors or parameters can take on. This information is then computerised.

Grazing management involves many aspects. A single system that would cover all components would be extremely valuable, but it would be unmanageable. Thus, it needs to be broken into practicable sections. Three problems frequently mentioned by farmers are the selection of weaning date, deciding whether to drench, and deciding when to close an area of pasture for conservation. While there are also many others, the importance, in terms of farmers' comments, of these three meant they were selected for study. This Report contains a description of the weaning expert system.

Weaning date has been an area of scientific study. Consequently, there is a body of research available to form an underpinning for advisers. One of the 'experts', therefore, that needs consulting is this body of research. From the literature the set of important factors was isolated, and the rules on whether to wean for a group of ewes and lambs for each set of values was isolated. These 'if-then' rules were then presented to four experts (they were/had been commercial consultants).

The important factors, rules and explanations resulting from this process are listed in the Appendices. This list is the heart of the system and is the result of all the work. People interested in the conclusions and wishing to improve their decision skills in this area should consult these Appendices.

The acceptability of any system must be judged by the potential users as it is they that decide whether it is useful, not the experts. Consequently, a search was made for sheep farmers with suitable equipment that might be prepared to evaluate the system. Of the approximately 400 farmers that might have helped, 25 finally tested the system and completed an evaluation questionnaire.

Eighty-four percent agreed with the advice provided, and with the explanations given for each conclusion. In that it is most unlikely to find complete agreement, this must be regarded as a very positive outcome. The farmers did make some comments on how to improve the system - these tended to involve a request for more depth, more detail, and the inclusion of some quantitative data. This might suggest mixed expert system calculation based systems could be worth exploring.

CHAPTER ONE

INTRODUCTION

New Zealand relies heavily on pastoral products for its economic well being. Approximately \$8000 million of its exports (NZ Meat and Wool Board's Economic Service, 1993) are from pasture, and these are mainly animal products. When compared to all other exports, pastoral products contribute some 45% of the total. Clearly, efficiency in utilising available pasture is crucial to the economic and social benefit of farmers, and New Zealanders in general.

When animal output is compared with pasture production from cutting trials (Nuthall and Bishop-Hurley, 1994) it is clear efficiency of pasture utilisation could be improved. Yet few farmers spend time formally calculating feed supply and demand and committing plans to paper. Feed management is very much a matter of experience and mental figuring.

Formal feed budgeting, the business of estimating expected feed supplies and demand and adjusting plans to ensure appropriate animal intake levels period by period, is a well-recognised management technique. The few that use the procedure believe it is extremely valuable (Nuthall and Bishop-Hurley, 1994). Managers, therefore, do have techniques available to help improve the efficiency of feed management, but they are seldom used. When asked why feed management is not formally planned, most simply note the benefits do not outweigh the time and effort involved (Nuthall and Bishop-Hurley, 1994). Some might hypothesise, however, that the real reason is a lack of understanding and a dislike for 'office work'. Given systems that simplified the procedures, perhaps computer-based, the situation may well change.

Even with computerised feed budgeting, there is still an appreciable time input required, as well as a reasonable knowledge of the procedures. Consequently there could well be a place for simple question and answer systems that in part rely on the farmer's experience. The study reported in this Report is one of a series designed to explore this hypothesis.

A likely 'simple question and answer system' that many authors believe has promise for assisting farmers' decision analysis is an 'expert system' (Bramer, 1986). Bramer defines an expert system as:

"A computing system which consists of organised human knowledge concerning some specific area of expertise, sufficient to perform as a skilful and cost effective consultant."

Effectively, an expert system attempts to mimic an expert and uses the simple methods of an expert - namely observation and questioning, though in a computer system the observation frequently reduces to additional questions. Expert systems are regarded as being a branch

of the general area of artificial intelligence in which machines are used to perform human tasks requiring intelligence.

Clearly, some humans are intuitively very good at managing animal grazing - these are the experts. If systems can be devised that capture this expertise and are simple to operate, the resulting computer systems could provide real benefits to producers and still be very easy to use.

There are a large number of decisions to be made when managing animals and their feeding. It is not possible to include all these in one expert system. The particular decision for which a description is contained in this Report is that of weaning lambs. Expert systems for the drenching and pasture conservation decisions are described in other Reports. These three decision areas were selected to explore expert systems as they represent different decision types and are frequently mentioned problems (Nuthall and Bishop-Hurley 1994). They also cover a range of problem types all effecting the efficiency of pasture utilisation.

The procedure in developing an expert system (Forsyth and Naylor, 1986) involves elucidating the rules used by an expert/s when coming to a conclusion, incorporating these into a computer programme, and after checking the completeness of the programme, checking that the rules, and therefore conclusions reached, are generally acceptable (validation). Of course, experts do not all agree, and indeed in many situations a range of answers might provide a similar end result. In the end, if a farmer believes the system is useful in assisting the decision process the expert system must be regarded as being at least adequate. Ironically, a perfect expert system is of little use if the intended users do not in fact use it.

Most expert systems use IF-THEN type rules. IF, for example, the lambs are less than four weeks old, THEN do not wean no matter what the feed quantity and quality and other conditions might be. Developing an expert system, therefore, means finding out all these conditions for a wide range of situations and then incorporating them into a computer based question and answer system.

This Report contains firstly a review of the technical factors and research relating to lamb weaning. The development of the associated expert system is then described. Farmers were exposed to the system for testing purposes and their opinions are also reported. The appendices contain a full list of the rules used as well as the explanations provided. It has been found expert systems should provide not only a conclusion, but also an explanation of the conclusion. Experts tend to operate through explanation and so users of expert systems tend to demand the same output.

CHAPTER TWO

REVIEW OF WEANING DATE TECHNOLOGY

2.1 Historical Approach to the Weaning Date

Prior to the mid 1970s weaning date tended to follow traditional rules and often coincided with the first draft of lambs (Shadbolt, 1982; Herlihy, 1970). Shearing date was also tied to weaning date, especially on hill blocks. The weaning policy was to wean at 12 or 16 weeks of age with a high proportion of the lambs being sold off their mothers for the export market (Geenty, 1979). The carcasses produced were lightweight with a liberal covering of fat (Geenty, 1980). It was considered that this policy was inflexible with regard to both efficient pasture utilisation and leaner lamb carcasses (Purchas, 1979). With industry pressure for leaner lamb carcasses, through changes in the grading standards, researchers began to investigate weaning date (Geenty, 1979, 1980; Purchas, 1979; Munro and Geenty, 1983; Geenty and Sykes, 1981). While many researchers concentrated on the lamb, some considered the ewe (Smeaton et al., 1983). By the mid 1980s this research had filtered through to the farm level.

2.2 The Weaning Date Decision

The period of lamb growth from parturition to slaughter can be broken up into two basic periods, pre-weaning and post-weaning. Geenty (1979) divided the pre-weaning period into three stages based on the lamb's growth rate. The first is from birth to four weeks of age when the lamb's diet consists mainly of milk. During stage two, from four to nine weeks, there is a depression in the lamb's growth rate. This is in response to changes in the lamb's digestive system as it adapts to the intake of pasture. The final stage sees a further reduction in growth rate as the ewes and lambs begin to compete for high quality pasture. Ewe milk production has the largest influence on the lamb's growth rate for the first six weeks of life (Geenty, 1979). Nicol (1983) reported from a survey that the average growth rate for lambs from tailing to weaning was 230 g/day. This ranged from 150 to 320 g/day. Liveweight change was found to be unaffected by farm type, liveweight change of the ewe, grazing management system, or mineral supplementation. Post-weaning growth rate was lower at 106 g/day and varied markedly (-64 to 190 g/day) both within and between farm types (dryland, high rainfall, irrigated) (Everest and Scales, 1983).

Early weaning, at eight or nine weeks of age, can eliminate the third stage provided good quality pasture is available to the lambs. Under high stocking rates or intensive systems, early weaning can be used to reduce overall feed requirements and assist management (Rattray et al, 1976). The cull ewes can be sold, further reducing the feed demand. Following weaning, lamb growth rates can be depressed for two to three weeks while they adapt to a diet of total pasture. Subsequent growth rates are often more rapid than for later

weaned lambs and can compensate any weight difference (Geenty, 1980; Rattray et al., 1976). During the time period from weaning until 12 weeks of age the growth rate of the early weaned lamb is generally less than those lambs still on their mothers. Growth rates after twelve weeks of age have been found to be greater for early weaned lambs. This compensatory growth, however, is variable.

It is fairly well established that the earlier lambs are weaned, the greater the tendency for fat to be mobilised and therefore the leaner the carcasses at slaughter. This fat mobilisation effect is very strong if the lambs are weaned at four weeks of age, but small if they are weaned at eight weeks of age, and of little effect if they are weaned at 12 - 16 weeks. However, very early weaned lambs require high quality legume dominant pastures for survival. Weaning lambs at nine weeks of age or earlier will reduce fatness proportionately more than it will reduce carcass weight. The effect will increase with decreasing age. In addition, earlier weaning has advantages for the ewe. Her feed requirement drops 60 - 80 % at weaning allowing recovery of body weight for the next mating and increased wool production. The potential growth rate for wool is at its highest during the spring and summer. Weaning lambs at four to six weeks of age can assist in reducing overfatness (Jagusch and Rattray, 1979; Buxton, 1985). This would only be an option if high quality legume dominant pasture were available since the growth check is reflected in the final weights (Geenty, 1979). Compensatory growth, if seen, does not totally compensate.

During the period from birth to weaning, the quantity of pasture is the most important factor determining lamb growth rate. To maximise lamb growth, through milk production, a herbage allowance of 6 kg DM (dry matter)/ewe/day and a post grazing residual of no less than 1000 - 1500 kg is suggested (Buxton, 1985; Geenty, 1983). This implies that herbage mass prior to grazing should be above 2000 kg DM/ha (Geenty, 1983; Geenty and Sykes, 1983).

Post-weaning, the quality of the feed made available to the lamb is the most important factor affecting growth rate. It is important to maintain pasture quality into the summer period for the lambs to be weaned onto. Pasture quality has the tendency to decrease over this period. For set-stocking, Buxton (1985) recommends a minimum of 1000 kg DM/ha on light land (where the dominant legume is subterranean clover) and 1200 - 1400 kg DM/ha on heavy land (ryegrass/whiteclover, 25 - 50 mm long). When rotationally grazed, lambs should enter paddocks with 2500 kg DM/ha and leave with a residual of 1000 - 1400 kg DM/ha. They require an intake of at least 1.2 kg pasture dry matter per day to achieve good growth rates. Under rotational grazing the lambs should be shifted when only 30 - 50% of the available pasture is eaten. To achieve high liveweight gains green leafy pasture with a high proportion of clover (about 30%) is required. Lambs should be put onto parasite free pasture and drenched at weaning and then at 21, 42, 70, and 98 days (Buxton, 1985). It is also necessary to ensure they get the required amounts of vitamins and minerals, including trace elements.

When dealing with prolific flocks, including mobs with a tailing percentage of over 130, special management is required. Multiple birth lambs do not grow as fast as singles. This results in a lower weight at any given age when multiple birth lambs are compared to singles (Woodhouse, 1985). The recommendation is to wean these lambs at twelve weeks of age unless feed is extremely short and all other options have been exhausted. The lambs should be provided with enough good quality legume dominant pasture so they can achieve an intake

of 1.2 kg DM/day each when weaned at the "normal" time. Paddocks that have been cut for hay or topped are ideal, since they provide leafy pasture with a high clover content. The drenching regime referred to above is recommended to overcome the susceptibility of young lambs to internal parasites.

As noted, early weaning can reduce the incidence of overfat lambs. Geenty (1986) suggests that lambs raised by ewes with high milk production should be weaned early at approximately 8 - 9 weeks of age. Lambs reared by high milk producing ewes (Corriedale and Dorset) had more carcass fat than lambs reared by low milk producing ewes (Romney). For early weaning there are some management and health measures to consider to ensure that the weaning check is minimised. It is important that lambs be well grown, parasite free, and offered good quality lucerne or clover dominant pasture. The post weaning growth check can be minimized if the lambs are creep grazed on good quality pasture from 1 - 2 weeks of age (Geenty, 1986). Weaning as early as 4 weeks of age is mentioned under these conditions, with 'well grown' being defined as over 12 kg liveweight at this age.

Binnie and Ritchie (1983) report on early lamb weaning onto lucerne. During periods of feed shortage early weaning onto lucerne allows lamb growth rates similar to those in a normal season. By weaning, the total feed demand can be reduced by 25 % initially. The quality and quantity of feed given to the ewes can be reduced. Ewes suckling lambs need 2 kg DM / day compared to weaned lambs at 0.3 - 0.5 kg and the restricted ewes at 0.7 kg, giving a total of 1.0 to 1.5 kg. At this level, ewes will lose about 0.5 kg liveweight a week, but this can be recovered when feed supplies improve. Ewe weights need to be built up again prior to tupping to ensure a good lambing.

Lambs can be weaned as early as 5 weeks of age provided they are at least 10 - 12 kg liveweight. Mature weedy stands are preferable since pure lucerne stands can give rise to poor growth rates and lamb mortality. Lucerne, especially young lucerne, is low in sodium, but weeds are high. Salt licks can be used to supplement sodium. Weedy stands also minimize deaths from red gut, as can feeding meadow hay when grazing young clean stands. The ewes can be used to clean up while the lambs graze selectively the best parts of the plant. Total grazing time should not exceed 2 weeks in any paddock to preserve maximum lucerne growth.

2.3 Summary of the Weaning Decision

While reviewing the literature a number of factors were identified as being important to the determination of weaning date. Although weaning date has been the focus of this report there are two underlying objectives a weaning date system must consider. Firstly, subsequent production must not be unduly affected by the advice given, that is, the ewe's weight must be built up again before tupping. Secondly, the goal is to optimise production in the current season. The combined net return from meat and wool production from the flock should be maximised, though this must depend on the farmer's objectives.

The weaning decision is temporal in nature with the age of the lamb being of prime importance. As the lambs get older some of the factors become less important while others become more important in the determination of weaning date.

The following is a list of the factors identified from the literature as important in a weaning date expert system.

From birth to four weeks of age lambs should not be weaned under any circumstances.

From four to six weeks of age weaning is possible but not advisable unless feed is in very short supply and there is some high quality legume dominant pasture for weaning onto (severe drought conditions).

Between six to ten weeks of age lambs can be weaned onto good quality legume dominant pasture.

Over ten weeks of age is the "normal" weaning time. They should only be left with the ewes if pasture quality is very poor, but quantity good, and they have not done well up to this point.

At any age lambs should not be weaned if they are less than 13 kg liveweight, especially if they are from four to six weeks of age.

Prolific flocks should not be weaned until the lambs are 10 to 12 weeks of age. These should be given priority and weaned last in drought conditions.

Feed quantity is more important than quality for lactation although high quality feed is better.

Feed quality is more important for weaned lambs, and utilisation is expected to be low.

Weaning early can decrease the total feed required by the ewes and lambs.

The weaning check is greater the earlier the lambs are weaned. It can be minimised with good quality feed for the lamb combined with good animal health practices. This check can be used to decrease the proportion of overfatness.

High milk producing ewes can produce overfat lambs. Early weaning at 8 to 9 weeks of age can help.

Lambs that have not done well should not be weaned unless there is a severe feed shortage.

A high cull ewe price can be the deciding factor in the weaning decision.

CHAPTER THREE

DEVELOPMENT OF THE WEANING DATE EXPERT SYSTEM

3.1 Introduction

Development involves obtaining experts, elucidating their knowledge into a set of rules, programming these into the expert system, and then testing and validation. Essentially four experts were used and then once the package was complete twenty-five farmers were asked to use and comment on the system. The results of the farmer survey are reported in the next chapter.

A pilot study was initially carried out using the results of discussion with a single expert. As a result of this work it was decided a good understanding of the decision problem was necessary prior to talking to the experts. Thus the review reported in the previous chapter. Additionally, it was concluded a prototype system, based on the literature review and initial discussion, would be useful to show the experts.

The advantage of this approach is that the experts, who are unfamiliar with expert systems, have something real to look at and comment on. This should make the best use of the experts' time. Comments made by the experts can then be put into effect and the system taken back for further scrutiny. This technique should see a succession of systems, each being better than the last.

Rather than entering the knowledge into the expert system shell ¹ as a series of 'if then' (rules) statements it was put into a table on a spreadsheet as examples (see Appendix 1). This allowed the knowledge to be checked for completeness and correctness in a much simpler fashion than would have been otherwise possible. When the table had been completed induction was used to create the rules required by the shell to run a consultation. Once the user interface had been tidied up the first version of the prototype was ready to be viewed and commented on by the experts.

3.2 The Questionnaire and Interviews

So that as much information as possible could be obtained from the experts it was decided to develop clear objectives and questions prior to meeting. A comprehensive questionnaire was constructed to be filled out during the interviews by the enumerator. The first questions

¹ An expert system shell is a computer package designed specifically for creating expert systems. It is the expert system creator's equivalent of a spreadsheet.

were designed to determine if the respondents had had any previous contact with expert systems and whether they thought they have a place in agriculture and, if so, the areas that could be useful. Who would use expert systems and why, was the subject of the next group of questions. Then the respondents were asked general questions about weaning dates and how this decision might be incorporated into an expert system. More specific questions on weaning dates and the factors involved in the decision were then covered, followed by questions specific to the prototype system they had been shown. Finally respondents are asked to comment on how the system might be improved and for any other general comments. Documentation on the system (see Appendix 2) was provided. Following the sessions the experts were asked to comment on the explanations for each question (see Appendix 3).

The aim of the questionnaire was to give the sessions direction and ensure that relevant factors were considered by each expert. The experts were encouraged to expand on any points they considered relevant. The option to follow up on any points raised through the questions and get clarification during the sessions was obviously available.

At this point arrangements were made with the four experts to have sessions in their offices. These interviews were split into three sections. During the first, general questions on expert systems and weaning dates were asked, followed by a look at the prototype weaning date expert system, and finishing with questions specific to the system. The interviews were run from the questionnaires outlined above. Responses were recorded on the questionnaire by the interviewer as the respondent answered. In addition to the written record each session was recorded with a dictaphone. These recordings were used to ensure that no points had been missed with the written record and to clarify poorly recorded points.

3.3 Prototyping Revisited

Upon completing all four interviews records were used to identify the changes suggested by the experts. These changes included modifications to the system, the methodology and the questionnaire and were generally included in the next version of the system. At this stage it was shown to other agriculturalists to obtain their comments and opinions on the system. Since this type of project is never really finished, but becomes useable, this process of improvement will cease when the gains made become small. The package was also given to four agricultural commerce degree students who had spent at least one year working on farms. The objective was to check on the 'ease of use' and 'ease of understanding' factors.

3.4 Results and Discussion

3.4.1 Introduction

The eight factors in the current system that were used as the decision criteria were considered by all four experts to be relevant to the decision on weaning date. However, the breed of the ewes was not considered to be very important by some. It must be remembered that not all factors in the system have been given the same priority. While included in the system,

this factor is not given a high priority meaning that it has a small influence on the weaning date decision. A number of new factors were suggested by the experts (3.4.6 and 3.4.7).

3.4.2 Modifications to the Methodology

To avoid interruptions interviews should be conducted in quiet rooms away from the expert's office (Hart, 1986). Interruptions can cause both the expert and the developer to lose their train of thought which can cause incomplete and inadequate information. Perhaps the background of each expert needs to be considered so that the information given can be interpreted correctly. On the whole, however, the methodology developed for this study proved to be sound.

3.4.3 Getting Information from the User

It became clear that there is more than one way of getting the same information from the user. To get the age of the lambs the question can be asked as 'what is the age of the lambs', or determined from, 'the date lambing started'. Another example is finding the quantity of feed available. This can be defined by asking the user for kilograms of dry matter, or alternatively asking them to estimate the length of time a certain number of ewes can be fed. While both give the same information, and both are equally valid answers, it is essential that the question be asked in a way familiar to the user. It is important not to alienate potential users by asking questions during the consultation that they cannot answer or in a way they are not familiar with. The user has to be comfortable with the system. Similarly, the amount of detail required in explanations by users may vary.

To find out what is the best way of obtaining the required information a number of prototypes could be developed that have different user interfaces. A number of potential users would then be asked to rank the systems so that their requirements can be determined. Should all, or a number, of the possibilities put forward be chosen then the system could be constructed that includes these options. The user would then be able to have the question asked in a different way if preferred. A range of explanations could also be offered to the user. Those that require more information on the system's decision could ask for it.

It was suggested that the age of lambs should be found by asking the starting, finishing and average date of lambing rather than simply inputting the average age. However, it was felt that agriculturalists know this information accurately. Similarly for the weight of lambs, it was suggested that the range of weights should be considered and not just the average. Users can either estimate the lamb weight, possibly after weighing samples to calibrate estimates, or ask the drafter to estimate the average weight. If sheep scales are not available then the user can obtain an estimate from standing on bathroom scales holding the lambs.

3.4.4 Feed Quantity

Feed quantity was considered by all respondents to be one of the hardest figures for the user to get. Although estimating the available feed on hand presented little problem, the same cannot be said for estimating feed quantity in the future. Eye appraisal is considered by many to be the best of the practical methods for determining feed on hand. Cutting and drying is used periodically to calibrate the estimates. Since some users may be unfamiliar with kilograms of dry matter they should have the option to use other units, for example,

estimating remaining grazing days for a given mob, cubic metres of feed, or using height as a measure of quantity. Estimating expected pasture production was considered to be important but difficult. One suggestion is to get users to estimate soil moisture and perhaps weather prospects as an indication of feed availability in the future. Soil type could also be used to help estimate expected feed quantity since farmers on light soils would normally have to wean early, due to feed shortages, unless there is a lot of rain.

3.4.5 Feed Quality

All respondents considered potential users to be good at estimating feed quality. The contribution made to the sward by clover is a good indication of pasture quality. To be suitable for lambs legumes need to comprise greater than 30 percent of the sward. To better determine quality other factors also need to be considered. The height of the pasture and proportion of leaf to stem can be used to assist with quality estimation. The more stem there is the poorer quality the pasture is. Quality is also inversely proportional to pasture height.

3.4.6 Weaning Part of the Mob

While the lambs within a mob are usually weaned at the same time, weaning part of a mob is practised especially in the high country. Two of the options are to wean the black faced lambs and leave the white ones with the ewes, or to wean the wethers and leave the ewe lambs with the ewes. The later option is important if paddock numbers are limited, and the former to reduce the likelihood of the black faced lambs becoming overfat.

If the quantity of feed is expected to decrease over the farm then the best option may be to target one mob, perhaps the mob of largest lambs, or the ram lambs, so that they can be sold prime. This strategy can increase the average price for lambs and is particularly applicable to dryland farms where subclover is the dominant legume.

3.4.7 Sale Prices and Price Differentials

All four experts thought that stock prices are a factor to consider. In addition to the price for cull ewes the system needs to consider at the very least price projections and premiums for the lambs. One of the experts suggested that the price projections for other stock on the farm can also be important. However, since a large price fluctuation is required for the marginal cost to change markedly, other stock prices can be ignored, at least for the moment.

The price a farmer receives for a particular lamb is determined by the current schedule. This schedule is constantly changing to approximate the market the meat companies are exposed to. If the company requires more of a particular grade and/or weight of lamb it adjusts the schedule in the hope that farmers will supply them. This often results in price differentials in conjunction with absolute price movements, both of which are constantly changing over time. However, while the market is volatile most market players use current prices combined with predictions of changes as an indication of the future price. These predictions include expectations of price shifts and changes in differentials.

Because prices and premiums change, the price received for a lamb pre and post weaning is likely to differ so that the weaning date decision needs to consider prices. It is usual to wait a period of time (approximately 3 weeks) after weaning before drafting to allow the lamb to

regain condition lost through the weaning check. Growth rates have to be taken into account so that some estimate of the weight of the lamb in the future can be made. The decision is between getting \$x now for a milk fed lamb (beta) as opposed to waiting and getting another price later. The aim from weaning is to put more weight on the lamb before sale.

3.4.8 Animal Health and Condition

Two experts thought that the condition of the ewes and lambs was important in the decision of when to wean the mob. Lambs that are not doing well with the ewes might benefit from being weaned onto high quality legume dominant pasture. The reason for poor growth rates from the lambs may be the result of ewe milk production declining. While the decision to wean is often based on the lambs' welfare, one expert suggested that the ewes' welfare should also be considered. By weaning early the pressure can be taken off the ewes so that they are in good condition for the next mating. Without the burden of lactation the ewe can take advantage of the high potential for wool growth over the summer period.

Animal health was suggested by one expert to be a factor in the decision of when to wean. Although there is plenty of feed available weaning may be necessary to allow dipping and shearing, or crutching, to reduce flystrike. Hill or high country farms tend to wean, draft, and shear at the same time. On these properties the flock spends most of its time roaming around the hills with mustering occurring as infrequently as possible. When the flock is brought to the yards as many operations as possible are performed at the same time. This can mean that weaning occurs either because a draft of lambs is ready to be sold or because shearing has been scheduled.

3.4.9 Explaining the Advice Given

While all the experts thought the explanations were better than they expected, they felt that different users would require different amounts of information. Some users might want a complete explanation of how the system arrived at the decision while others may be satisfied with a summary. While the explanations must be informative, care must be taken not to alienate the users with explanations that 'point out the obvious'. It was suggested that the user be given a brief explanation by the system, as required, and the ability to get a more detailed explanation provided if required. When asked if the detailed explanations should include references for further reading the experts thought that it was a possibility, but did not know if users would use it. While all the experts thought graphs, diagrams, and tables could be included, they did not think pictures should be. It was suggested that pictures would not offer anything to the system, and that users could be alienated by their presence.

Two of the four experts interviewed said that the user would probably want to know why the decision had been made and felt the explanations were not detailed enough with respect to this. They also felt that if the decision is marginal this should be pointed out to the user, along with an explanation of the consequences of accepting or rejecting the system's advice. That is, the possible implications of accepting or rejecting the system's 'yes' or 'no' weaning decision.

3.4.10 General Comments

For mobs with greater than 125 percent lambing at tailing multiple lamb management techniques need to be adopted. This is allowed for in the package.

It was suggested that farmers deciding to wean in response to a shortage of feed should first decide to wean and later decide which mob to wean. While the decision to wean a particular mob is determined by mob specific factors, whole farm factors also play an important part in the decision. Other stock policies and the feed situation on the rest of the farm are two examples of factors that may need to be considered. Weather can influence the decision since, with a forecast predicting heavy rain, weaning is not advised due to the added shock to the lambs.

The experts felt that any method of ensuring factors important to the decision was not overlooked was useful. The ability of the system to rank the factors was seen to be just as important. For example, is the climate more important than soil moisture in determining future feed availability? It was felt that this type of system could benefit the lamb selling date decision. This decision involves a lot of factors and an expert system could ensure that all the factors are considered and that each is given the appropriate weighting.

CHAPTER FOUR

FARMER COMMENTS ON THE EXPERT SYSTEM

4.1 Introduction

As a result of the experts' evaluation and comments the weaning date system was modified. The final system was also converted to work under Windows using an object orientated programming system designed for expert system development.² The result was a mouse controlled system that enabled selections and provided help messages, conclusions and explanations at the push of a button. The full set of rules and explanations used is provided in Appendix Three.

The real test of any system is whether farmers find it acceptable and useful. To this end as many sheep farmers as possible with suitable equipment were located and asked to use the package. The result was twenty-five completed questionnaires.

Location involved searching a data base of farmers receiving a computer newsletter. Those with suitable computers were selected. All Ministry of Agriculture of Fisheries offices were also contacted with a request for farmers' names. In the end, nearly 400 farmers that might well have had Windows were written to asking if they would be happy to assist in an evaluation. Ninety-two responded with an offer to use the system, but 54 of these did not have a sufficiently powerful computer. The remaining 38 were sent the package (disks and manual), installation system and questionnaire. After reminders and phone calls twenty-five completed evaluations were received. The following sections document the responses. The questionnaire contained a wide range of topics aimed at elucidating the farmers' views on not only the weaning date topic itself, but also on topics such as the format, screen presentation, and value of the system. This information, and its analysis, is presented in another Report.

4.2 Survey Results

The farmers were given a list of the factors used to decide on whether to wean and were asked to put an importance ranking on each (1 = very important to 10 = not important).

² Knowledge Pro system 'KPWin Gold' supplied by Effective Learning, Wellington.

Table 1
Farmers' Views on the Importance of Weaning Determination Factors
 (Scale of 1 = very important to 10 = not important)

	Average Score	Standard Deviation	Rank
Quality of Feed	2.48	2.26	1
Age of Lambs	2.71	1.81	2
Quantity of Feed	2.76	2.14	3
Weight of Lamb	3.04	2.17	4
Proportion of Twins	4.76	1.79	5
Cull Ewe Price	6.40	2.17	6
Breed of Ewes (milking)	6.52	2.04	7

The experts have a slightly different view in that their ordering was age of lamb, weight of lamb, proportion of twins, pasture quantity, pasture quality, breed of ewes and cull ewe price. Looking at the scores, however, the factors form two groups - those with a score in the range 2.48 - 3.04, and those with scores 4.76 - 6.52. In this sense there is not a big difference in opinion between the farmers and the experts. It is also probably fair to note that in considering the age of the lamb most farmers probably do not entertain weaning unless the lambs are at least a certain age and consequently inherently place this factor first even though it is not ranked first.

Some farmers also believed additional factors ought to be considered. Table 2 lists these together with the percentage of the group mentioning the factor.

Table 2
Farmers' Suggestions of Additional Factors to Consider

Factor	% Mentioning the Factor
Expected pasture growth	16
Lamb price (works, store)	16
Labour availability at proposed date	12
Regional variations	8
Health Status (worms, chance of fly strike)	8
Current liveweight gain	8
Breed/sex of lambs	8
Condition of the ewes	4
Weather forecast for weaning date	4

Expected pasture growth is certainly a factor, but one which is assumed to be allowed for in the pasture quantity question. Lamb price is more of a factor in deciding whether to sell the lambs, but in that sense selling may in fact determine whether weaning should occur as clearly a high price, which is likely to decline, may well be a good reason to sell off the mothers. Labour availability must clearly be taken into account so that if several jobs, which must be performed immediately, are on offer the farmer must decide on priorities. The logic embodied by the weaning expert assumes only the farmer can make this decision. Similar comments can be made about the weather on the intended weaning day - the expert may advise weaning should occur but the farmer must then decide whether it is practicable to take the advice on that particular day.

The current liveweight gain is assumed to be taken care of in the lamb weight question in that this, together with feed availability and quality, determine future gain. However, if it is used to reflect the 'thrift' status of the lambs it could then be a factor. This might also be related to health status. In some cases the fly strike potential, for example, might mean weaning has advantages allowing crutching and control measures.

Regional variations are clearly a factor to be considered if in fact the experts believe the conclusions correctly embodied in the rules are incorrect in some areas. Similarly some breeds could perhaps justify varying decisions, as could clear sex differences. Future developments of the weaning expert should consider these points, and, similarly for the factor 'ewe condition', though this may well be a reflection of the quantity and quality of feed available.

When it came to the crucial question of whether the farmers agreed with the conclusions and advice provided 84% said 'agree' and 16% said 'don't agree'. It is most unlikely that a 100% agree figure would ever be obtained so it must be accepted that the farmers generally

believe the system is of benefit. Furthermore, two of the farmers who didn't agree did not have major objections. The other two who did not agree did not provide reasons. One objection was the need to include an allowance for the lamb price, but as noted above, this relates more to whether to sell, and incidentally to wean, rather than directly whether to wean. The other commented that a YES/NO recommendation was not appropriate and that he would prefer to have more of a discussed recommendation that commented like, for example, 'if the poor feed conditions continue you should consider weaning in a week's time, particularly if in fact the lamb growth rate declines', or whatever the case may be.

Associated with every conclusion is an explanation (these are all listed in Appendix Three). As with the conclusions, 84% agreed, in general, with the explanations. The comments made by the others were as shown in Table 3.

Table 3
Farmers' Comments on the Explanations

Comment	Percentage Making the Comment
Require more depth	16
Require reasoning on why/why not wean	8
Do not agree with the ewe milking categories	4
Did not allow for the stage of the season	4
Require detailed grazing recommendations	4

Most of these comments really pertain to providing more extensive information and discussion in the explanations. It might be suggested they would like a verbal discussion similar to what is possible with an expert advisor in person. This is clearly not possible, though use of natural language (Jones and Spahr, 1990) systems might be explored at some stage.

One of the problems in the weaning expert is whether part mobs should be distinguishable. This is borne out by the farmers' response to asking whether this procedure should be included as a possibility - 44% said 'yes' leaving 56% for the negative. The main reason for weaning a part of a mob was, of course, the variation in lamb condition (36%), but another reason was the need to get 'culled-for-age ewes' away to the works as soon as possible. One comment on why part mob weaning was not practicable was 'want to keep ewe groups together'. This reflects that different farm situations demand different procedures. In a high country situation, for example, the number of distinct blocks may mean the large mobs must all be weaned at the same time. This really means a weaning expert does need to allow for a range of situations.

Finally, the farmers were asked to make any additional comments or suggestions they might have. Some (16%) again repeated more factors need to be considered (along the lines previously discussed) and other individual comments included 'enable specific mobs to be named in the reports', 'explain effect of weaning on expected growth rates' (this is really a further comment on increasing the depth of the explanation), and 'allow for schedule movements'. The most important comment, however, (28% made it) was farmers believed the weaning expert should be embedded in a much larger system that provides quantitative data and analysis of feeding. Several specifically mentioned feed budgeting in that they would like an easy to use package that would provide detailed forecasts of feed demand and supply. Thus, the effect of weaning could be explored in a quantitative way on feed demand and supply as well as on growth rates. This requirement is to be expected, but of course one of the reasons for creating an expert system is to remove the need for detailed and extensive calculation. Experts seldom do this, but they do produce acceptable decisions. Perhaps an ideal system that is extensively used will be a compromise between the two. The study reported here is the first step in creating such a system.

REFERENCES

- Binnie, D.B.; I.J. Ritchie, (1983): Sheep Early lamb weaning on to lucerne. Aglink FPP 69, Information Services. MAF. Private Bag Wellington. New Zealand.
- Bramer, M. (1986): Expert Systems: Some Guidelines. Information Technology in the Civil Service, HM Treasury.
- Buxton, D. (1985): Profitable Lamb Production, rev. edition (ed Ian Woodhouse), Waitaki NZR Limited.
- Everest, P.G.; G.H. Scales, (1983): Pre and post weaning growth rates of ewes and lambs in the South Island. Lamb Growth, Animal Industries Workshop Lincoln College, Technical Handbook. ed A.S. Familton. Lincoln College. Ministry of Agriculture and Fisheries.
- Forsyth, R.; C. Naylor, (1986): The hitchhikers guide to artificial intelligence. Chapman and Hall, Methuen, London.
- Geenty, K.G., (1979): Effects of weaning age on export lamb production. *Proceedings of the New Zealand Society of Animal Production*, 39
- Geenty, K.G., (1980): Influence of weaning age, management, and slaughter age on export lamb carcass production and slipe wool weights. *New Zealand Journal of Agricultural Research*, 23: 433 - 440.
- Geenty, K.G., (1983): Pasture feeding for maximum lamb growth. Lamb Growth, Animal Industries Workshop Lincoln College, Technical Handbook. ed A.S. Familton. Lincoln College. Ministry of Agriculture and Fisheries.
- Geenty, K.G., (1986): Sheep: Export lambs, Carcass fatness. Aglink FPP 78, Information Services. MAF. Private Bag Wellington. New Zealand.
- Geenty, K.G.; A.R. Sykes, (1981): Intake and growth performance of grazing lambs weaned at 4 and 12 weeks of age. *Proceedings of the New Zealand Society of Animal Production*, 41: 235 - 241
- Geenty, K.G.; A.R. Sykes, (1983): Feed requirements of the ewe and lamb between birth and weaning. Lamb Growth, Animal Industries Workshop Lincoln College, Technical Handbook. ed A.S. Familton. Lincoln College, Ministry of Agriculture and Fisheries.
- Hart, A., (1986): Knowledge acquisition for expert systems. McGraw - Hill Book Company, New York.
- Herlihy, G.J., (1970): The spread of lamb and mutton kill in Southland from the producer viewpoint. Agricultural Production Council.

- HM Treasury (Central Communications and Telecommunications Agency), (1986): Expert Systems: Some Guidelines. Information Technology in the Civil Service.
- Jagusch, K.T.; P.V. Rattray, (1979): Carcass production for the consumer. Nutritional manipulation of carcass composition of lambs grown in New Zealand. *Proceedings Lincoln College Farmers Conference, 29: 20 - 30.*
- Jones, L.R.; S.L. Spahr, (1990): A knowledge-based natural-language approach to retrieving information from an on-farm database. *Proceedings of the 3rd International Congress for Computer Technology, Deutsche Landwirtschafts-Gesellschaft, Frankfurt am Main.*
- Kreutzer, W.; B. McKenzie, (1989): Programming for artificial intelligence. Methods, tools and applications. Addison - Wesley Publishing Company Inc.
- Munro, J.M.; K.G. Geenty, (1983): Influence of herbage allowance during the suckling period of subsequent growth and carcass fatness of twin lambs weaned at 6 weeks of age. *Proceedings of the New Zealand Society of Animal Production, 43: 41 - 42*
- New Zealand Meat and Wool Boards' Economic Service (1993): Compendium of NZ Production Statistics, Publication No. 92055.
- Nicol, A.M., (1983): Growth and its significance. Lamb Growth, Animal Industries Workshop Lincoln College, Farmers Handbook. ed A.S. Familton. Lincoln College. Ministry of Agriculture and Fisheries.
- Nuthall, P.L.; G. Bishop-Hurley, (1994): Feed Management and Computer Practices on a Sample of NZ Farms, AERU Research Report 225, Lincoln University, Canterbury.
- Purchas, R.W., (1979): A comparison of the fatness of weaned and unweaned lambs. *Proceedings of the New Zealand Society of Animal Production, 39*
- Rattray, P.V.; M.C. Morrison; P.A. Farquhar, (1976): Performance of early weaned lambs on lucerne and pasture. *Proceedings of the New Zealand Society of Animal Production, 36: 179 - 183.*
- Shadbolt, N.M., (1982): Alternative management strategies and drafting policies for irrigated Canterbury sheep farms. Thesis, M. Agr. Sci. Lincoln College, Canterbury, New Zealand.
- Smeaton, D. C.; R.M.W. Sumner; T.W. Knight; T.K. Wadams, (1983): Effects of time of weaning, pasture allowance, and shearing time on ewe and lamb liveweight, wool growth, and subsequent ovulation rate of the ewe. *New Zealand Journal of Experimental Agriculture, Vol. 11: 41 - 45.*
- Woodhouse, I., (1985): Sheep Lamb management Prolific flocks. Aglink FPP 627, Information Services. MAF. Private Bag, Wellington. New Zealand.

APPENDIX ONE

Rule Set for the First Prototype

(see end for codes, * means 'not relevant')

Lamb age range (weeks)	Lamb Wt. (kgs)	Status Single/twin /mixed	Prolificacy \leq or $>$ 125%	Pasture quan.	Pasture qual.	Ewe milking	Cull Price	Wean Decision
>0 <=4	*	*	*	*	*	*	*	No
>4 <=6	<13	*	*	*	*	*	*	No
>4 <=6	>=13	S	*	L	G	*	*	Yes
>4 <=6	>=13	S	*	L	A	*	H	Yes
>4 <=6	>=13	S	*	L	A	*	nH	No
>4 <=6	>=13	S	*	L	P	*	*	No
>4 <=6	>=13	S	*	M	G	*	H	Yes
>4 <=6	>=13	S	*	M	G	*	nH	No
>4 <=6	>=13	S	*	M	A	*	*	No
>4 <=6	>=13	S	*	M	P	*	*	No
>4 <=6	>=13	S	*	H	*	*	*	No
>4 <=6	>=13	M	No	L	G	*	*	Yes
>4 <=6	>=13	M	No	L	A	*	H	Yes
>4 <=6	>=13	M	No	L	A	*	nH	No
>4 <=6	>=13	M	No	L	P	*	*	No
>4 <=6	>=13	M	No	M	G	*	H	Yes
>4 <=6	>=13	M	No	M	G	*	nH	No
>4 <=6	>=13	M	No	M	A	*	*	No
>4 <=6	>=13	M	No	M	P	*	*	No
>4 <=6	>=13	M	No	H	*	*	*	No
>4 <=6	>=13	M	Yes	*	*	*	*	No
>4 <=6	>=13	T	*	*	*	*	*	No
>6 <=10	<13	*	*	*	*	*	*	No
>6 <=10	>=13	S	*	L	G	*	*	Yes
>6 <=10	>=13	S	*	L	A	*	*	Yes

Lamb age range (weeks)	Lamb Wt. (kgs)	Status single/twin/mixed	Prolificacy ≤ or > 125%	Pasture quan.	Pasture qual.	Ewe milking	Cull price	Wean Decision
>6 >=10	>=13	S	*	L	P	*	H	Yes
>6 <=10	>=13	S	*	L	P	*	nH	No
>6 <=10	>=13	S	*	M	G	*	*	Yes
>6 <=10	>=13	S	*	M	A	*	H	Yes
>6 <=10	>=13	S	*	M	A	H	nH	Yes
>6 <=10	>=13	S	*	M	A	nH	nH	No
>6 <=10	>=13	S	*	M	P	*	*	No
>6 <=10	>=13	S	*	H	G	*	H	Yes
>6 <=10	>=13		*	H	G	H	nH	Yes
>6 <=10	>=13	S	*	H	G	nH	nH	No
>6 <=10	>=13	S	*	H	A	H	*	Yes
>6 <=10	>=13	S	*	H	A	nH	*	No
>6 <=10	>=13	S	*	H	P	*	*	No
>6 <=10	>=13	M	No	L	G	*	*	Yes
>6 <=10	>=13	M	No	L	A	*	*	Yes
>6 <=10	>=13	M	No	L	P	*	H	Yes
>6 <=10	>=13	M	No	L	P	*	nH	No
>6 <=10	>=13	M	No	M	G	*	*	Yes
>6 <=10	>=13	M	No	M	A	*	H	Yes
>6 <=10	>=13	M	No	M	A	H	nH	Yes
>6 <=10	>=13	M	No	M	A	nH	nH	No
>6 <=10	>=13	M	No	M	P	*	*	No
>6 <=10	>=13	M	No	H	G	*	H	Yes
>6 <=10	>=13	M	No	H	G	H	nH	Yes
>6 <=10	>=13	M	No	H	G	nH	nH	No
>6 <=10	>=13	M	No	H	A	H	*	Yes
>6 <=10	>=13	M	No	H	A	nH	*	No
>6 <=10	>=13	M	No	H	P	*	*	No
>6 <=10	>=13	M	Yes	L	G	*	*	Yes
>6 <=10	>=13	M	Yes	L	A	*	H	Yes
>6 <=10	>=13	M	Yes	L	A	H	nH	Yes
>6 <=10	>=13	M	Yes	L	A	nH	nH	No

Lamb age range (weeks)	Lamb Wt. (kgs)	Status single/twin/mixed	Prolificacy ≤ or > 125%	Pasture quan.	Pasture quai.	Ewe milking	Cull Price	Wean Decision
>6 <=10	>=13	M	Yes	L	P	*	H	Yes
>6 <=10	>=13	M	Yes	L	P	*	nH	No
>6 <=10	>=13	M	Yes	<>L	*	*	*	No
>6 <=10	>=13	T	*	L	G	*	*	Yes
>6 <=10	>=13	T	*	L	<>G	*	*	No
>6 <=10	>=13	T	*	<>L	*	*	*	No
>6 <=10	>=13	*	*	L	<>P	*	*	Yes
>6 <=10	>=13	*	*	L	P	*	*	No
>10 <=13	<13	*	*	M	<>P	*	*	No
>10 <=13	<13	*	*	M	P	*	*	No
>10 <=13	<13	*	*	H	<>P	*	*	No
>10 <=13	<13	*	*	H	P	*	*	No
>10 <=13	<13	*	*	L	G	*	*	Yes
>10 <=13	<13	*	*	L	A	*	*	Yes
>10 <=13	>=13	*	*	L	P	*	*	Yes
>10 <=13	>=13	*	*	M	G	*	*	Yes
>10 <=13	>=13	*	*	M	A	*	*	Yes
>10 <=13	>=13	*	*	M	P	*	*	Yes
>10 <=13	>=13	*	*	H	G	*	*	Yes
>10 <=13	>=13	*	*	H	A	*	*	Yes
>10 <=13	>=13	*	*	H	P	*	*	No
>13	*	<13	*	*	*	*	*	No
>13	*	*	*	*	*	*	*	Yes

Notes:

Status	S = Single	M = Mixture	T = Twin
Quantity	H = High	M = Medium	L = Low
Quality	G = Good	A = Average	P = Poor
Ewe milking ability	H = High	nH = Not High	
Cull ewe price	H = High	nH = Not High	
<>L	means 'not equal to L'		

APPENDIX TWO

The VP-Expert Form of 'Weaning Expert'

This Appendix describes weaning expert, an expert system to advise the user on the question of when to wean a mob of ewes and lambs. The described version runs under the expert system shell VP-Expert. The opening screens are explained in section one. The user is led by the system during a consultation with a series of questions and these are the subject of the next section. The final section, section three, gives a listing of the rules and associated explanations.

1. Opening Screens

The following is the first screen seen by the user upon starting the system:-

Weaning Expert

*An expert system to advise you when
to wean a mob of ewes and lambs.*

You would use this expert system if you wish to know whether or not to wean a specific mob of ewes and lambs. It will ask you a series of questions and then render an opinion based on the answers given. Then you will be asked if you wish to be given the reason(s) for the opinion. The question for consideration is: 'should a given mob of ewes and lambs be weaned or not?'

(Press any key to continue.)

After pressing a key the following question is asked:-

Do you want output to go to the Screen/Printer?

Screen

Both

Once a selection has been made with a combination of the arrow keys and the enter key the questions that make up the expert system commence. These are dealt with in section two.

2.0 Questions

Eight factors are considered to be important in the decision of whether or not a mob of ewes and lambs should be weaned. They are:-

- Age of the lamb
- Weight of the lamb
- Status of the lamb, this refers to whether the mob is mainly singles, twins, or mixed
- Prolificacy of the mob, used to determine the proportion of twins in the mob
- Quantity of feed available for the mob
- Quality of the feed available for the lambs if weaned
- Breed of the ewe, (influences overfat problems through milk production)
- Cull ewe price

Initially the age of the lamb is determined. The answer given determines what the next question will be. During a consultation the user may or may not be required to answer questions related to all eight factors. By the end of a consultation a conclusion is reached as to whether the mob in question should be weaned.

2.1 Age of Lamb

The question is asked as follows:-

What is the average age (weeks) of the lambs in the mob?

The response is a numeric entry for the average age of the lambs in the mob. The responses are grouped into the following:-

- between 0 and 4 weeks
- between 4 and 6 weeks
- between 6 and 10 weeks
- between 10 and 13 weeks
- between 13 and 20 weeks

It then follows that lambs 7 weeks old are treated the same as lambs 9 weeks old and so on.

2.2 Weight of Lambs

The question is asked as follows:-

What is the average live weight (kgs) of the lambs in the mob?

The response is a numeric entry for the average weight of the lambs in the mob. Lambs that are under 13 kgs are generally considered to be too small to wean. Those lambs that are heavier than this lower limit can be weaned as young as 4 weeks of age.

2.3 Status of Lamb

The question is asked as follows:-

Select the appropriate birth rank of the lambs in the mob:

- *Singles (i.e. all the lambs are singles)*
- *Mixture (i.e. ewes with singles and twins make up the mob)*
- *Twins (i.e. the mob is made up of ewes with twins).*

Singles

Mixture

Twins

The user selects one of the options with the arrow keys. Generally prolific flocks and mobs of twins are not weaned early.

2.4 Prolificacy of Flock

If the answer to the status of the flock is given as 'Mixture' then the user is asked to indicate the proportion of twins in the mob.

The question is asked as follows:-

Is the percent of lambs tailed to ewes in the mob at tailing greater than 125 percent?

No Yes

The user selects one of the options with the arrow keys. If the status of the flock is mixture and the percentage of lambs tailed to ewes in the mob is greater than 125 then the mob is considered to be prolific (see section 2.3).

2.5 Feed Quantity

The question is asked as follows:-

Indicate how much feed you have for this mob?

Recommended herbage allowance (kg/DM/ewe/day) during lactation for ewes rearing single or twin lambs.

<i>Month of Lactation</i>	<i>1</i>	<i>2</i>	<i>3</i>
<i>Single suckled</i>	<i>5</i>	<i>6</i>	<i>7</i>
<i>Twin suckled</i>	<i>6</i>	<i>7</i>	<i>8</i>

(Source: Lamb Growth, K.G. Geenty)

- High As much or more than the recommended allowance above.*
- Medium Less than recommended above.*
- Low Only enough for maintenance, probably drought conditions.*

High Medium Low

The user selects one of the options with the arrow keys. A selection of low means that feed is very short, probably drought conditions. Under these conditions the lambs will be generally be weaned. If high is selected then the lambs will probably not be weaned.

2.6 Feed Quality

The question is asked as follows:-

What is the quality of the available lamb feed?

- Good quality Pasture with 30% legume content, Lucerne stand preferably older with some weeds.*
- Average quality Pasture that has some legume and fresh grass in bottom.*
- Poor quality Pasture that is rank gone to seed, with no or very little legume.*

There should be at least two weeks of feed in front of the lambs?

Good Average Poor

The user selects one of the options with the arrow keys. Although depending on other factors lambs will generally be weaned when there is good quality pasture about. Poor quality pasture means that lambs would normally be left with the ewes, especially if there is also a lot of feed available.

2.7 Breed of Ewe

The question is asked as follows:-

Indicate whether the ewes are high, average, or low milk producers (e.g. Corriedale and Dorset ewes are high milk producers).

High Average Low

The user selects one of the options with the arrow keys. Some breeds of ewes produce more milk than others. Single lambs suckling high milk producing ewes have a tendency to become overfat. Early weaning removes the lambs from their source of high energy food. The check associated with early weaning can also reduce the amount of fat in the body.

2.8 Cull Ewe Price

The question is asked as follows:-

How do you rate the price for cull ewes? By saying it is high you are indicating that the opportunity to sell the cull ewes is tempting, a choice of low indicates you consider the price to be poor and you would probably wait until it improves before selling the culls.

High Medium Low

The user selects one of the options with the arrow keys. Should the price of cull ewes be high then the lambs may be weaned earlier so that the culls can be sold. This is especially useful if the quantity of feed available is low while the quality is average to good.

2.9 Explanation

Before the completion of the consultation but after the system has given its advice the user is asked whether or not they want an explanation of the recommendation. If they select no then the consultation ends. Upon selecting yes a paragraph of explanation is given.

APPENDIX THREE

Explanations Offered for Each Decision Rule

The explanation associated with each rule is presented in the following section. Only those factors that are relevant to the rule are shown. For age of lambs, a value within the range shown would result in the same rule being "fired". If the weight of lambs is shown in the rule as ≥ 13 , then any value for weight over this value would result in the same rule being "fired".

Rule 0:

Age of Lambs: > 4 and ≤ 6 weeks
Weight of Lambs: < 13 kgs

You should NOT wean this mob of ewes and lambs.

Lambs should not be weaned if they are less than 13 kg liveweight. Although these lambs are old enough to be weaned their small size indicates that they will not have developed enough to enable them to tolerate being weaned.

Rule 1:

Age of Lambs: > 4 and ≤ 6 weeks
Weight of Lambs: ≥ 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 2:

Age of Lambs: > 4 and ≤ 6 weeks
Weight of Lambs: ≥ 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Average
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Under normal circumstances these lambs would have to be weaned onto good quality legume pasture, however the chance to sell the cull ewes at a high price when feed is in short supply is to good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. Ewes could be tightened up and used to clean up pastures after the lambs have had their pick. Because the lambs have some feed of reasonable quality to go onto the growth check associated with weaning should be minimal.

Rule 3:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Average
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

To wean lambs as young as these you need to have high quality legume pasture for them to go onto. Consult weaning expert when the lambs are over six weeks old. If feed is still in short supply they may have to be weaned then. The lambs would be better off left with the ewes in the meantime. You might consider weaning the lambs now if you were able to get rid of the cull ewes at a good price now.

Rule 4:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

With only poor quality feed available the ewes are going to have to support the lambs for now. To wean lambs at this age you need to have good quality legume pasture available for the lambs to go onto. If feed is in really short supply you may need to consider selling ewes and/or lambs or feeding supplements.

Rule 5:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Good
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

While you have a reasonable amount of feed available for the ewes and lambs, the high cull ewe price combined with the availability of high quality legume pasture means that weaning these lambs is a good option. These lambs are heavy enough to allow them to be weaned although they are still quite young. The weaning check that results from weaning these lambs should be minimal.

Rule 6:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Good
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

While it would be possible to wean these lambs there is no real advantage to doing so. Lambs that are over 13 kgs liveweight can be weaned, but when they are under 6 weeks of age they are not weaned unless there is a good reason for doing so.

Rule 7:

Age of Lambs: > 4 and < =6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Average

You should NOT wean this mob of ewes and lambs.

With a medium amount of feed available at an average quality, weaning is not advised. Without any obvious problems that require the lambs to be weaned they are best left with the ewes. Although they are heavy enough to be weaned they are still quite young so are best left with the ewes.

Rule 8:

Age of Lambs: > 4 and < =6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

Without good quality legume pasture for the lambs to go onto weaning at this age is not really an option. You should start thinking about having some good legume pastures ready for the lambs at weaning.

Rule 9:

Age of Lambs: > 4 and < =6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High

You should NOT wean this mob of ewes and lambs.

With a high quantity of feed available there is no reason for the lambs to be weaned at this young. If you don't have some good quality legume pasture available or soon becoming available then you should start thinking about how to remedy this. Perhaps converting some of the surplus feed into hay or silage or selling feed either as grazing or standing hay. These paddocks will provide good lamb feed in a few weeks ready for the lambs at weaning.

Rule 10:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 11:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Average
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Under normal circumstances these lambs would have to be weaned onto good quality legume pasture, however the chance to sell the cull ewes at a high price when feed is in short supply is too good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. Ewes could be tightened up and used to clean up pastures after the lambs have had their pick. Because the lambs have some feed of reasonable quality to go onto the growth check associated with weaning should be minimal.

Rule 12:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Average
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

To wean lambs as young as these you need to have high quality legume pasture for them to go onto. Consult weaning expert when the lambs are over six weeks old. If feed is still in short supply they may have to be weaned then. The lambs would be better off left with the ewes in the meantime. You might consider weaning the lambs now if you were able to get ride of the cull ewes at a good price now.

Rule 13:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

With only poor quality feed available the ewes are going to have to support the lambs for now. To wean lambs at this age you need to have good quality legume pasture available for the lambs to go onto. If feed is in really short supply you may need to consider selling ewes and/or lambs or feeding supplements.

Rule 14:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Good
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

While you have a reasonable amount of feed available for the ewes and lambs, the high cull ewe price combined with the availability of high quality legume pasture means that weaning these lambs is a good option. These lambs are heavy enough to allow them to be weaned although they are still quite young. The weaning check that results from weaning these lambs should be minimal.

Rule 15:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Good
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

While it would be possible to wean these lambs there is no real advantage to doing so. Lambs that are over 13 kgs liveweight can be weaned, but when they are under 6 weeks of age they are not weaned unless there is a good reason for doing so.

Rule 16:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Average

You should NOT wean this mob of ewes and lambs.

With a medium amount of feed available at an average quality, weaning is not advised. Without any obvious problems that require the lambs to be weaned they are best left with the ewes. Although they are heavy enough to be weaned they are still quite young so are best left with the ewes.

Rule 17:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

Without good quality legume pasture for the lambs to go onto, weaning at this age is not really an option. You should start thinking about having some good legume pastures ready for the lambs at weaning.

Rule 18:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High

You should NOT wean this mob of ewes and lambs.

With a high quantity of feed available there is no reason for the lambs to be weaned at this young. If you don't have some good quality legume pasture available or soon becoming available then you should start thinking about how to remedy this. Perhaps converting some of the surplus feed into hay or silage or selling feed either as grazing or standing hay. These paddocks will provide good lamb feed in a few weeks ready for the lambs at weaning.

Rule 19:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: Yes

You should NOT wean this mob of ewes and lambs.

Mobs with a high proportion of twins should not be weaned until they are older. They should be given the best feed available at the expense of mobs containing only singles. Often twin lambs are smaller than singles of the same age. This is because twin lambs are born lighter and they get less milk than a single.

Rule 20:

Age of Lambs: > 4 and < = 6 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Twins

You should NOT wean this mob of ewes and lambs.

Mobs of twins should not be weaned until they are older. They should be given the best feed available at the expense of mobs containing only singles. Often twin lambs are smaller than singles of the same age. This is because twin lambs are born lighter and they get less milk than a single.

Rule 21:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: < 13 kgs

You should NOT wean this mob of ewes and lambs.

These lambs are too small to be weaned. Even if there is a feed shortage it is not advisable to wean lambs that have not reached 13 kgs. Should a feed shortage not be the cause of these lambs being so small then you should seek expert help in trying to determine what the problem is.

Rule 22:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 23:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Average

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Care must be taken to ensure that the quality of the pasture to be given to the lambs does not deteriorate. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 24:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Poor
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Ideally these lambs should be weaned onto good quality legume pasture, however the chance to sell the cull ewes at a high price when feed is in short supply is to good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. The ewes should be tightened up and used to clean up pastures after the lambs have had their pick. Because the lambs have some feed of reasonable quality to go onto the growth check associated with weaning should be minimal.

Rule 25:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Low
Feed Quality: Poor
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

To wean lambs early you need to have high quality legume pasture for them to go onto. These lambs would be better off left with the ewes in the meantime. You might have considered weaning the lambs now had you been able to sell the cull ewes for a good price. If things do not look as though they are going to improve then you should consider de-stocking or feeding supplements.

Rule 26:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now has been suggested since the lambs are singles and there is good quality feed for them to go onto. Single lambs can become overfat if they have been fed well. Removing them from the ewes will help to alleviate the problem. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 27:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Average
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

While you have a reasonable amount of feed available for the ewes and lambs, the high cull ewe price combined with the availability of high quality legume pasture means that weaning these lambs is a good option. While the lambs are still quite young they are heavy enough to be weaned, so any check from weaning should be minimal.

Rule 28:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Average
Breed of Dam: High
Cull Ewe Price: < > High

You should wean this mob of ewes and lambs.

Although the cull ewe price is not high and you have feed available for the mob it is recommended that you wean the lambs because the ewes are high milk producers feeding only one lamb. Single lambs on ewes that are high milk producers are likely to become overfat. Weaning early helps by removing the milk from the diet while the weaning check reduces body fat. The lambs should be put onto the best available feed and the ewes used to clean up pastures after the lambs.

Rule 29:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Average
Breed of Dam: < > High
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

Things appear to be going along quite nicely at the moment. Ensure good quality legume pasture will be available for the lambs when they are weaned. Regrowth on paddocks that have been cut for hay or silage makes good lamb feed.

Rule 30:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: Medium
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

To wean lambs early good quality legume pasture needs to be available for them to go onto. Without this good quality pasture for the lambs to go onto they are better left with the ewes which convert the poorer quality feed to a high quality energy source for the lambs in the form of milk.

Rule 31:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Good
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

The high cull ewe price is a good opportunity to get rid of the cull ewes. Since the lambs are heavy enough to be weaned, and have some good quality legume pasture to go onto, the effects of weaning early will not be to great. However, care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 32:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Good
Breed of Dam: High
Cull Ewe Price: < > High

You should wean this mob of ewes and lambs.

Although the cull ewe price is not high and you have a lot of feed available for the mob it is recommended that you wean the lambs because the ewes are high milk producers feeding one lamb. Single lambs on ewes that are high milk producers are likely to become overfat. Weaning early can help by removing the milk from the diet and the weaning check reduces body fat. However, care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 33:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Good
Breed of Dam: < > High
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

Things appear to be going fairly well at the moment. These lambs can be left with the ewes for the time being. Care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 34:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Average
Breed of Dam: High

You should wean this mob of ewes and lambs.

Because the ewes are good milk producers being well fed the mob should be weaned to help prevent the lambs becoming overfat. Care will be needed to ensure that the quality of the feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. Paddocks that have been cut for hay or silage will produce good quality lamb feed in a few weeks.

Rule 35:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Average
Breed of Dam: < > High

You should NOT wean this mob of ewes and lambs.

These lambs can be left with the ewes for the time being. Care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. Paddocks that have been cut for hay or silage will produce good quality lamb feed in a few weeks.

Rule 36:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Singles
Feed Quantity: High
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

To wean early, good quality legume pasture needs to be available for the lambs to go onto. Without good quality pasture for the lambs to go onto they are better left with the ewes. Ewes convert poor quality feed into a high quality energy source for the lambs in the form of milk. By weaning time some good quality legume pasture needs to be ready for the lambs to go onto. One way of achieving this is to make supplements from the surplus feed. After a few weeks these paddocks will provide the high quality feed needed by the lambs at weaning time.

Rule 37:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 38:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Average

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Care must be taken to ensure that the quality of the pasture to be given to the lambs does not deteriorate. Weaning now will reduce the total feed requirement because the ewes can be tightened up. They could be used to clean up pastures after the lambs have had their pick. It may be an opportune time to sell the cull ewes. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 39:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Poor
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Ideally these lambs should be weaned onto good quality legume pasture, however the chance to sell the cull ewes at a high price when feed is in short supply is to good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. The ewes should be tightened up and used to clean up pastures after the lambs have had their pick. Because the lambs have some feed of reasonable quality to go onto the growth check associated with weaning should be minimal.

Rule 40:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Low
Feed Quality: Poor
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

To wean lambs early you need to have high quality legume pasture for them to go onto. These lambs would be better off left with the ewes in the meantime. You might have considered weaning the lambs now had you been able to sell the cull ewes for a good price. If things do not look as though they are going to improve then you should consider de-stocking or feeding supplements.

Rule 41:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now has been suggested since the lambs are singles and there is good quality feed for them to go onto. Single lambs can become overfat if they have been fed well. Removing them from the ewes will help to alleviate the problem. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal.

Rule 42:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Average
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

While you have a reasonable amount of feed available for the ewes and lambs, the high cull ewe price combined with the availability of high quality legume pasture means that weaning these lambs is a good option. While the lambs are still quite young they are heavy enough to be weaned, so any check from weaning should be minimal.

Rule 43:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Average
Breed of Dam: High
Cull Ewe Price: < > High

You should wean this mob of ewes and lambs.

Although the cull ewe price is not high and you have feed available for the mob it is recommended that you wean the lambs because the ewes are high milk producers feeding only one lamb. Single lambs on ewes that are high milk producers are likely to become overfat. Weaning early helps by removing the milk from the diet while the weaning check reduces body fat. The lambs should be put onto the best available feed and the ewes used to clean up pastures after the lambs.

Rule 44:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Average
Breed of Dam: < > High
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

Things appear to be going along quite nicely at the moment. Ensure good quality legume pasture will be available for the lambs when they are weaned. Regrowth on paddocks that have been cut for hay or silage makes good lamb feed.

Rule 45:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: Medium
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

To wean lambs early good quality legume pasture needs to be available for them to go onto. Without this good quality pasture for the lambs to go onto they are better left with the ewes which convert the poorer quality feed to a high quality energy source for the lambs in the form of milk.

Rule 46:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Good
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

The high cull ewe price is a good opportunity to get rid of the cull ewes. Since the lambs are heavy enough to be weaned, and have some good quality legume pasture to go onto, the effects of weaning early will not be to great. However, care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 47:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Good
Breed of Dam: High
Cull Ewe Price: < > High

You should wean this mob of ewes and lambs.

Although the cull ewe price is not high and you have a lot of feed available for the mob it is recommended that you wean the lambs because the ewes are high milk producers feeding one lamb. Single lambs on ewes that are high milk producers are likely to become overfat. Weaning early can help by removing the milk from the diet and the weaning check reduces body fat. However, care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 48:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Good
Breed of Dam: < > High
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

Things appear to be going fairly well at the moment. These lambs can be left with the ewes for the time being. Care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. This will make good lamb feed in a few weeks time.

Rule 49:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Average
Breed of Dam: High

You should wean this mob of ewes and lambs.

Because the ewes are good milk producers being well fed the mob should be weaned to help prevent the lambs becoming overfat. Care will be needed to ensure that the quality of the feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. Paddocks that have been cut for hay or silage will produce good quality lamb feed in a few weeks.

Rule 50:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Average
Breed of Dam: < > High

You should NOT wean this mob of ewes and lambs.

These lambs can be left with the ewes for the time being. Care will need to be taken to ensure that the quality of the lamb feed does not decrease over the next few weeks. It may be a good idea to conserve some feed or sell it. Paddocks that have been cut for hay or silage will produce good quality lamb feed in a few weeks.

Rule 51:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: No
Feed Quantity: High
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

To wean early, good quality legume pasture needs to be available for the lambs to go onto. Without good quality pasture for the lambs to go onto they are better left with the ewes. Ewes convert poor quality feed into a high quality energy source for the lambs in the form of milk. By weaning time some good quality legume pasture needs to be ready for the lambs to go onto. One way of achieving this is to make supplements from the surplus feed. After a few weeks these paddocks will provide the high quality feed needed by the lambs at weaning time.

Rule 52:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: Yes
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be fed less, and probably used to clean up pastures after the lambs have had their pick. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal. You may also need to consider de-stocking if feed is very short, perhaps selling the culls.

Rule 53:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: Yes
Feed Quantity: Low
Feed Quality: Average
Cull Ewe Price: High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Under 'normal' circumstances these lambs should be weaned onto good quality legume pasture, however, the chance to sell the cull ewes at a high price when feed is in short supply is too good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. Ewes should be tightened up and used to clean up pastures after the lambs have had their pick. Because the lambs have some feed of reasonable quality to go onto the growth check associated with weaning should be minimal.

Rule 54:

Age of Lambs:	> 6 and < = 10 weeks
Weight of Lambs:	> = 13 kgs
Mob Status:	Mixture
Mob Prolificacy:	Yes
Feed Quantity:	Low
Feed Quality:	Average
Breed of Dam:	High
Cull Ewe Price:	< > High

You should wean this mob of ewes and lambs.

Although the cull ewe price is not high it is recommended that you wean the lambs because the ewes are high milk producers and the overall quantity of feed is low. Since the lambs have been on ewes that are good milk producers they should have done fairly well up to this point. The lambs should be put onto the best available feed and the ewes used to clean up the pastures after the lambs.

Rule 55:

Age of Lambs:	> 6 and < = 10 weeks
Weight of Lambs:	> = 13 kgs
Mob Status:	Mixture
Mob Prolificacy:	Yes
Feed Quantity:	Low
Feed Quality:	Average
Breed of Dam:	< > High
Cull Ewe Price:	< > High

You should NOT wean this mob of ewes and lambs.

Because twin lambs are smaller than singles at the same age mobs containing allot of twins are not weaned as early. This mob should have priority and get the best feed available. It may be necessary to consider some options such as de-socking or buying in supplements if the quantity of pasture is very low and does not look as though it is going to improve.

Rule 56:

Age of Lambs:	> 6 and < = 10 weeks
Weight of Lambs:	> = 13 kgs
Mob Status:	Mixture
Mob Prolificacy:	Yes
Feed Quantity:	Low
Feed Quality:	Poor
Cull Ewe Price:	High

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Under normal circumstances these lambs would have to be weaned onto good quality legume pasture, however the chance to sell the cull ewes at a high price when feed is in short supply is too good an opportunity to miss. The remaining stock will benefit from the effects of de-stocking. Give the lambs the best available pasture and watch there progress very carefully. The ewes should be tightened right up and further de-stocking is advised. The ewes should follow the lambs to clean up the paddocks after the lambs have had their pick and feeding supplements should also be considered.

Rule 57:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: Yes
Feed Quantity: Low
Feed Quality: Poor
Cull Ewe Price: < > High

You should NOT wean this mob of ewes and lambs.

Without some good quality legume pasture for the lambs to go onto weaning is not advised. Because the quantity of feed is also low you should consider de-stocking and/or feeding supplements. Mobs that contain a lot of twins should be given priority and mobs that contain few twins could be weaned. The culls from these mobs sold and the remaining ewes used to clean up after the lambs have had their pick.

Rule 58:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Mixture
Mob Prolificacy: Yes
Feed Quantity: < > Low

You should NOT wean this mob of ewes and lambs.

Things appear to be going quite well at this stage. Make sure that good quality legume pasture is available for the lambs when they are weaned. The regrowth on paddocks that have been cut for hay or silage makes good lamb feed.

Rule 59:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Twins
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

Although these lambs are still young they are heavy enough to be weaned. Weaning now will reduce the total feed requirement because the ewes can be fed less, and probably used to clean up the pasture after the lambs have had their pick. Because the lambs have some good quality feed to go onto the growth check associated with weaning should be minimal. You may also need to consider de-stocking if feed is very short, perhaps selling the culls. Another option is to feed supplements to some stock.

Rule 60:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Twins
Feed Quantity: Low
Feed Quality: < > Good

You should NOT wean this mob of ewes and lambs.

Without some good quality legume pasture for the lambs to go onto weaning is not advised. Because the quantity of feed is also low you should consider de-stocking and/or feeding supplements. Mobs that contain a lot of twins should be given priority and mobs that contain few twins could be weaned. The culls from these mobs sold and the remaining ewes used to clean up after the lambs have had their pick.

Rule 61:

Age of Lambs: > 6 and < = 10 weeks
Weight of Lambs: > = 13 kgs
Mob Status: Twins
Feed Quantity: < > Low

You should NOT wean this mob of ewes and lambs.

Things appear to be going quite well at this stage. Make sure that good quality legume pasture is available for the lambs when they are weaned. The regrowth on paddocks that have been cut for hay or silage makes good lamb feed.

Rule 62:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: Low
Feed Quality: < > Poor

You should wean this mob of ewes and lambs.

Something needs to be done here to get these lambs growing. Because the lambs have not grown while with the ewes, they should be weaned and put onto the best available feed. It may also be a good idea to sell some stock and/or feed supplements. You might consider selling the cull ewes or perhaps some store lambs. The ewes should be used to clean up pastures after the lambs have had their pick.

Rule 63:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: Low
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

Something needs to be done here to get the lambs growing. However, without good quality legume pasture for the lambs to be weaned onto, these lambs are going to have to be left with the ewes. More feed is required and this can be done by de-stocking and/or feeding supplements. You might consider selling the cull ewes or perhaps some store lambs.

Rule 64:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: Medium
Feed Quality: < > Poor

You should NOT wean this mob of ewes and lambs.

Finding out why the lambs are so small should be the first priority here. Expert advice should be sought to determine the cause of the problem. Once the lambs are growing again the main priority is to ensure that pasture quality is maintained. High quality pasture will be needed to wean the lambs onto.

Rule 65:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: Medium
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

Finding out why the lambs are so small should be the first priority here. Expert advice should be sought to determine the cause of the problem. Once the lambs are growing again the main priority is to ensure that pasture quality is maintained. Paddocks that have been taken for hay or silage provide good quality lamb feed within a few weeks. High quality pasture will be needed to wean the lambs onto.

Rule 66:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: High
Feed Quality: < > Poor

You should NOT wean this mob of ewes and lambs.

Finding out why the lambs are so small should be the first priority here. Expert advice should be sought to determine the cause of the problem. Feed quality should not be allowed to deteriorate because high quality pasture will be needed to wean the lambs onto. Perhaps surplus feed can be conserved or sold.

Rule 67:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: < 13 kgs
Feed Quantity: High
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

Finding out why the lambs are so small should be the first priority here. Expert advice should be sought to determine the cause of the problem. Once the lambs are growing again the main priority is to ensure that pasture quality is maintained. Paddocks that have been taken for hay or silage provide good quality lamb feed within a few weeks. High quality pasture will be needed to wean the lambs onto.

Rule 68:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Low
Feed Quality: Good

You should wean this mob of ewes and lambs.

These lambs should be weaned now and given the best feed available. The ewes can be tightened up and the culls sold. The ewes can be used to clean up the pastures after the lambs have had their pick. Supplements may be offered to the ewes to stop them from losing too much condition prior to mating.

Rule 69:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Low
Feed Quality: Average

You should wean this mob of ewes and lambs.

These lambs should be weaned now and given the best feed available. The ewes can be tightened up and the culls sold. The ewes can be used to clean up the pastures after the lambs have had their pick. Supplements may be offered to the ewes to stop them from losing too much condition prior to mating.

Rule 70:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Low
Feed Quality: Poor

You should wean this mob of ewes and lambs.

These lambs should be weaned now and put onto the best available feed. While there is no good quality feed for the lambs to go onto they need to be weaned so that the ewes do not compete with them for what feed is available. The ewes should be tightened up and/or fed supplements while cleaning up after the lambs. De-stocking is another option that may need to be considered, perhaps selling some lambs at lighter weights as stores. The culls could also be sold at this time even if the price is not quite as good as you would like.

Rule 71:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Medium
Feed Quality: Good

You should wean this mob of ewes and lambs.

There does not seem to be too many problems here. Give the lambs good quality legume pasture and graze the ewes after the lambs to control pasture quality. If there is surplus feed available then make this into supplements for later. The regrowth on these paddocks makes good lamb feed.

Rule 72:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Medium
Feed Quality: Average

You should wean this mob of ewes and lambs.

Give the lambs good quality legume pasture and graze the ewes after the lambs to control pasture quality. If there is surplus feed available then make this into supplements for later. The regrowth on these paddocks makes good lamb feed.

Rule 73:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: Medium
Feed Quality: Poor

You should wean this mob of ewes and lambs.

Give the lambs the best available pasture and graze the ewes after the lambs to clean up the paddocks and improve pasture quality. If there is surplus feed available then make this into supplements for later. The regrowth on these paddocks makes good lamb feed.

Rule 74:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: High
Feed Quality: Good

You should wean this mob of ewes and lambs.

There don't seem to be too many problems here. Give the lambs good quality legume pasture and graze the ewes after the lambs to control pasture quality. Either make surpluses into supplements or sell feed so that pasture quality does not deteriorate. The regrowth on these paddocks makes good lamb feed in a few weeks.

Rule 75:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: High
Feed Quality: Average

You should wean this mob of ewes and lambs.

There don't seem to be too many problems here. Give the lambs good quality legume pasture and graze the ewes after the lambs to control pasture quality. Either make surpluses into supplements or sell feed so that pasture quality does not decrease. The regrowth on these paddocks makes good lamb feed in a few weeks.

Rule 76:

Age of Lambs: > 10 and < = 13 weeks
Weight of Lambs: > = 13 kgs
Feed Quantity: High
Feed Quality: Poor

You should NOT wean this mob of ewes and lambs.

These lambs are at a stage where they should be weaned, but with only poor quality pasture for them to go onto they are best left with the ewes. The ewes will convert the poor quality feed into a high energy source for the lambs in the form of milk. With a large quantity of feed there is no risk of the ewes competing with the lambs.

Rule 77:

Age of Lambs: > 13 and < = 20 weeks
Weight of Lambs: < 13 kgs

You should NOT wean this mob of ewes and lambs.

Finding out why the lambs are so small should be the first priority here. Expert advice should be sought to determine the cause of the problem. Once the lambs are growing again the main priority is to ensure that pasture quality is maintained. Paddocks that have been taken for hay or silage provide good quality lamb feed within a few weeks. High quality pasture will be needed to wean the lambs onto.

Rule 78:

Age of Lambs: > 13 and < = 20 weeks
Weight of Lambs: > = 13 kgs

You should wean this mob of ewes and lambs.

Wean the lambs and give them good quality legume pasture. Graze the ewes after the lambs to control pasture quality. Either make surpluses into supplements or sell feed so that pasture quality does not deteriorate. The regrowth on these paddocks makes good lamb feed in a few weeks.

Rule 79:

Age of Lambs: > 0 and < = 4 weeks

You should NOT wean this mob of ewes and lambs.

Lambs that are less than 4 weeks of age are too young to be weaned under any circumstances. At this age lambs are only just starting to nibble at grass and still rely on the ewes milk for most of their energy. If feed is in very short supply then you should consider feeding supplements and/or de-stocking to relieve some of the pressure.

RESEARCH REPORTS

- 195 **Milk Purchasing: a consumer survey in Auckland and Christchurch.** R.L. Sheppard, July 1988.
- 196 **Employment and Unemployment in Rural Southland,** J. R. Fairweather, November 1988.
- 197 **Demand for Wool by Grade**
A. C. Zwart, T. P. Grundy, November 1988
- 198 **Financial Market Liberalisation in New Zealand: an Overview,** R. L. St Hill, December 1988.
- 199 **An Economic Evaluation of Coppice Fuelwood Production for Canterbury,** J. R. Fairweather, A. A. MacIntyre, April 1989
- 200 **An Economic Evaluation of Biological Control of Rose-Grain Aphid in New Zealand,** T.P. Grundy, May 1989
- 201 **An Economic Evaluation of Biological Control of Sweet Brier,** T. P. Grundy, November 1989
- 202 **An Economic Evaluation of Biological Control of Hieracium,** T. P. Grundy, November 1989
- 203 **An Economic Evaluation of the Benefits of Research into Biological Control of Clematis Vitalba,** G. Greer, R. L. Sheppard, 1990.
- 204 **The Q Method and Subjective Perceptives of Food in the 1990s,** J. R. Fairweather 1990
- 205 **Management Styles of Canterbury Farmers: a study of goals and success from the farmers' point of view.** J. R. Fairweather, N. C. Keating, 1990
- 206 **Tax Shields: their implications for farm project investment, risk and return.** P. R. McCrea, T. P. Grundy, D. C. Hay, 1990
- 207 **Public Drinking and Social Organisation in Methven and Mt Somers.** J. R. Fairweather and H. Campbell, 1990.
- 208 **Generations in Farm Families: Transfer of the Family Farm in New Zealand.** N. C. Keating, H. M. Little, 1991
- 209 **Determination of Farmland Values in New Zealand: the Significance of Financial Leverage,** G. A. Anderson, G. A. G. Frengley, B. D. Ward, 1991.
- 210 **Attitudes to Pests and Pest Control Methods** R. L. Sheppard, L. M. Urquhart, 1991.
- 211 **Administered Protection in the United States During the 1980's: Exchange Rates and Institutions,** D. A. Stallings, 1991
- 212 **The New Zealand Consumer Market For Cut Flowers in the 90s,** C. G. Lamb, D. J. Farr, P. J. McCartin, 1992
- 213 **Agrarian Restructuring in New Zealand,** J. R. Fairweather, 1992.
- 214 **Actual and Potential Computer Use by a Group of Primary Producers,** P. L. Nuthall, 1992.
- 215 **A Tree Model for Hawkes Bay Farmers' Tree Planting Decisions,** J. R. Fairweather, 1992.
- 216 **History of the New Zealand Milk Board,** S. Gilmour, 1992.
- 217 **Changing Export Markets for New Zealand Sheepmeat: 1983-1991,** L. Storey, 1992.
- 218 **An Economic Evaluation of Changes in the Allocation of Water for Irrigation from the Ashburton River,** G. Greer, G. Rae, 1992.
- 219 **Farming in Hurunui and Clutha Counties: current attitudes and practices compared to survey results in 1986,** J. R. Fairweather, S. S. F. Gilmour, 1993.
- 220 **Intending Smallholder's and Existing Smallholder's Perceptions of the Rural Lifestyle around Christchurch, New Zealand,** J. R. Fairweather, 1993.
- 221 **Contingent Valuation of Improved Water Quality in the Lower Waimakariri River,** R. Sheppard, G. Kerr, R. Cullen, T. Ferguson, 1993.
- 222 **Social Organisation of Large Herd Dairy Farms in New Zealand,** J. R. Fairweather, 1994.
- 223 **A Forecasting Model of New Zealand's Lamb Exports,** G. F. Thomson, 1994.
- 224 **Preferences for Land Use Options in the Mackenzie/Waitaki Basin,** J. R. Fairweather, S. Swaffield, 1994.
- 225 **Feed Management and Computer Practices on a Sample of New Zealand Farms,** P. L. Nuthall, G. J. Bishop-Hurley, 1994.
- 226 **An Expert System for Weaning Lambs.,** G. Bishop-Hurley, P. L. Nuthall, 1994.

DISCUSSION PAPERS

- 123 **Do our Experts Hold the Key to Improved Farm Management?** P. L. Nuthall, May 1989
- 124 **Some Recent Changes in Rural Society in New Zealand,** J. R. Fairweather, July 1989
- 125 **Papers Presented at the Fourteenth Annual Conference of the N.Z. Branch of the Australian Agricultural Economics Society,** Volumes 1 and 2, October 1989
- 126 **Marketing Boards and Anti-Trust Policy,** E. McCann, R. G. Lattimore, 1990.
- 127 **Marketing of Agricultural and Horticultural Products — selected examples,** K. B. Nicholson, 1990
- 128 **Methven and Mt. Somers: Report on Socio-Economic History and Current Social Structure.** H. R. Campbell, J. R. Fairweather, 1991
- 129 **Proceedings of the Rural Economy and Society Section of the Sociological Association of Aotearoa (NZ),** April 1991
- 130 **Evolutionary Bargaining Games**
J. K. D. Wright, May 1991
- 131 **Papers Presented at the Sixteenth Annual Conference of the N.Z. Branch of the Australian Agricultural Economics Society,** August 1991.
- 132 **Topics for Rural Social Research,** J. R. Fairweather, 1992.
- 133 **Papers Presented at the Seventeenth Annual Conference of the NZ Branch of the Australian Agricultural Economics Society,** August 1992.
- 134 **Capital Budgeting and Policy Evaluation using Option Pricing Theory,** P. Seed, November 1992.
- 135 **New Zealand Agricultural Policy Change: Some Effects,** R. L. Sheppard, July 1993.
- 136 **Papers Presented at the Eighteenth Annual Conference of the N.Z. Branch of the Australian Agricultural Economics Society,** July 1993.
- 137 **Competing in the Global Marketplace: Issues, Trends and Challenges Facing New Zealand's Sheepmeat Industry,** R. M. Nayga, D. B. Waggoner, January 1994.
- 138 **Ownership and Control of Maori Land: Some Lessons for South Africa,** M. Lyne, January 1994.
- 139 **Classifying New Zealand's Export Markets: A Behavioural Approach,** G. Thomson, R. Lattimore, March 1994.