EVALUATION OF LINEAR PROGRAMMING AS A PRACTICAL TOOL FOR FARM PLANNING ON A DRY LAND MIXED FARM ON THE SOUTH WEST SLOPES OF NEW SOUTH WALES

by

Leslie Alfred Wason Mactier, B.Sc.Agr.

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DECLARATION

This sub-thesis is based on original work done by the writer himself

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ABSTRACT

Linear programming is not a new farm planning tool but it is seldom used in practical situations which is in contrast to the situation in the petroleum industry. This is almost certainly due to the fact that even most Farm Advisers do not fully understand the technique and do not appreciate its value for planning in complex situations. There is also concern about the cost of data preparation and computer time and the apparent paucity of data with which to estimate the matrix coefficients.

It is considered that linear programming does have a very real place in planning the operations of large and relatively complex mixed farms, particularly when several properties are being operated in combination; when there is a diversity of soil types; when there is a large number of alternative enterprises; and when cropping enterprises often have no clear advantage over livestock enterprises. This situation is not uncommon in the higher rainfall South Western Slopes region of New South Wales and the gain will be in calculation precision, range of investigation and time if the matrix is reasonably standard.

Gross margins analysis and simple budgeting techniques are normally used under these conditions and it is commonly assumed that an experienced adviser will arrive at a plan that is close to the optimum; but gross margins assume no change in marginal revenue and do not indicate how far to expand enterprises or when to introduce new enterprises. The constraints of time usually demand the use of short cut methods and this will impede, often preclude, exploration

of the effect of price changes and restraint relaxation. This exploration is possible using linear programming and a computer and the cost is reasonable. Unless it is done the adviser has no check that his plan is close to optimal nor does he know how stable it is in the face of changing product prices and input costs.

Given the uncertainties of prices and production in agriculture this is not good enough, and this study is an attempt to formulate a model of an existing farm using actual performance and cost data, long run price estimates and the restraints imposed by the operators. The basic plan has been produced and then a number of alternative plans have been generated by using different prices and by relaxing particular restraints. At the same time the plans produced have been compared with existing plans derived using ordinary budgeting techniques. The model developed will be available for future planning reviews when new information on prices or physical parameters is obtained. It can also be used to test the effect of the introduction of new or improved enterprises and to assess by identifying marginal enterprises, slack and limiting resources.

It had been hoped that the use of linear programming on a district level could have been investigated in depth because it was hoped that standard matrices could be prepared and the coefficients for a particular farm substituted in order to generate solutions. This proved too complex a task with the time and resources available due to the heterogeneity of farms in the particular region but it is considered that linear programmes for farms typical of different parts of the region could be developed and used.

It would appear that linear programming is a very valuable planning technique for fairly complex dryland farms and that once the user has gained sufficient experience the cost and time involved will be small relative to the likely gains. Its use will be confined to situations where experienced practical advisers can establish the necessary rapport with farmers. Compilation and interpretation are both critically important and in such a situation the computer bureau can only ever be an intermediate service.

Simple budgeting will still be important in the majority of situations and even with linear programming will be used to plan the actual implementation of a chosen plan especially where cash flow is a problem.

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CHAPTER 1
INTRODUCTION

Aim

The aim of this study was to investigate the value of linear programming as a practical farm planning technique in a relatively complex mixed farming situation where cropping and livestock activities are competitive.

For this purpose it was necessary to set up a basic matrix from which a basic plan was calculated and then to investigate the effect of altering activity gross margins and product prices, relaxing restraints and varying matrix coefficients.

Implicit in the study was the necessity to compare the results obtained using linear programming with those obtained using alternative techniques currently in use, viz. using gross margins analysis and simple budgeting.

Farm Planning Techniques in Common Use

The farm planning techniques in most common use are activity budgeting and gross margins analysis. These have been well described (Rickards, 1967). Cash flow budgeting is used after the plans have been derived to investigate the effect of the implementation of alternative plans because credit limits, financial costs and taxation have to be taken into consideration. Comparative analysis of groups of farms is another tool which is used to measure the absolute and relative performances of individual farms on both an enterprise and whole farm basis and it is a valuable diagnostic tool and a source of data. It is an historical analysis and thus has limitations and though it cannot replace the above techniques, it does to some extent complement them.

Planning with activity budgets and gross margins is straightforward. The gross margins for each activity are calculated and the planning restraints established. These will be concerned with physical and financial resource availability and institutional and personal restraints. In a simple situation it is then fairly straightforward to maximise the activities with the highest gross margins subject to the restraints imposed. Partial budgeting can be used to extend the analysis and an example is the investigation of the effect on total gross margin of the hiring of additional labour.

These planning techniques are valuable but suffer from the weakness that only one choice criterion (usually gross margin per acre) is used to select activities in the farm plan. This results in the formulation of plans which maximise returns per unit of the factor selected but which may not in fact be the most limiting. Linear programming identifies all limiting resources among those specified and optimises their allocation among the available enterprises.

The plans adopted on the typical farm range from traditional enterprise mixes based on personal, family, district and bankers' historical experience to apparently sophisticated plans produced by the more enlightened managers or derived for them by their professional advisers. While prices are high and stable and technical progress is slow it is reasonable to assume that most of these approaches will be fairly satisfactory because even the most conservative plan will generate sufficient income despite its "sub-optimal" nature. In the face of multi-dimensional changes in prices and markets and technology, simple budgeting techniques do not permit sufficient exploration of the implications of change with the result that imperfect knowledge is compounded with the climatic uncertainty under which an agricultural business is normally forced to operate. This is a problem when farmers are being forced to seek to maximise their returns because of low product prices and are thus forced to operate in regions where risk and uncertainty are of considerable importance.

Restricted investigation by budget and gross margins is dictated by the time, cost and limited accuracy of boring repetitive calculations. The approach is reasonably satisfactory and feasible when a farm is uniform, when the alternative enterprises are few and when there is a clear cut comparative advantage in favour of some of the activities so that the plans are stable for a wide range of prices. This is the case in many farming areas in New South Wales and in this situation linear programming is more likely to be used as a check on plans already formulated or to produce a standard farm model which can be used for many farms in a region provided the coefficients are altered if necessary to suit each individual farm.

On the South West Slopes district generalisation is possible but the situation is more variable. Farms are made up of varying proportions of land and soil types and may be completely different to farms only a short distance away. Climate also varies over short distances because altitude affects the growing season and temperature severity while annual rainfall declines from east to west. The district has a reliable rainfall so farmers need be less conservative than in the more unreliable areas of the State.

The mixture of different types of arable and non-arable soils, the diversity of crops and pastures that can be grown and the variety of livestock enterprises that can be undertaken all mean that a full examination of any given situation is a complex process. This is the more so when the gross margins for crop and livestock enterprises do not differ as greatly as they do in many other farming regions in New South Wales. Enterprise choice and profitability and differences in policies between farms, to a degree, will thus often depend on operator preference and efficiency or credit availability because there may be no clear cut comparative advantage.

The Advantages of Linear Programming

A linear programme model has many attractions in the situation described in the previous chapter. It can be set up using real data except when a new activity is being investigated. The operator will have confidence in the data and coefficients used because they will be based on his own experience and records instead of being estimates derived from experimental station or district farm results. He may also be prepared to relax some of the mass of restraints he usually tends initially to specify once he is made aware of their cost.

Once a basic plan has been generated using "most likely" prices, costs and yields, it is possible to investigate the changes that will result from relaxing the restraints or altering the prices and yields. Technical factors may change too; an example is the increasing efficiency of chemical control of grassy weeds and the introduction of biological control of skeleton weed in crops which will both ease rotation restraints. It is also possible to explore the implications for a chosen plan if below average seasonal conditions occurred. This can be done quite simply by altering the feed supply and crop yield coefficients and allowing a feed purchasing activity to fill the gap.

As the district being investigated is one in which the major development work has been completed, there is little justification for using a dynamic programming technique. It will be more complicated and costly and would probably yield only artificial precision. It might be useful for investigating a changeover from sheep to cattle but even this is probably a fairly simple budgeting operation after a linear programme solution has been obtained to indicate the desirable ultimate enterprise pattern.

A degree of flexibility can be introduced by compelling the accumulation of drought reserves or by introducing labour hire, capital borrowing and feed buying activities into the programme matrix. This is obviously not "dynamic" programming, which is a cumulative and continuing process, but it does introduce flexibility into a basically static technique.

The theory and use of linear programming in agriculture has been well described elsewhere (e.g. Heady and Chandler, 1958, P.1), (Baumol, 1965, P.70), (Waring, 1962, P.27).

It is a mathematical technique for maximising a linear function of variables subject to linear inequalities (Dantzig, 1951, P.399) and is thus a means of obtaining optimising solutions to problems of resource allocation in agriculture provided appropriate equalities can be formulated. Easy access to computer facilities means that it is quick and relatively cheap to use.

Economising is the allocation of scarce means to competing ends to maximise satisfactions over time. These may be monetary or otherwise in agriculture where decision making, even when the operator is well informed of the likely financial outcome of his actions, has to be accomplished against the background of his individual tastes and cultural background and in the light of his personal assessment of, and attitudes to, risk and uncertainty (Bradford and Johnson, 1953) which may change over time (Johnson, 1950, P.1151).

The ends that the operator is attempting to maximise may be several and the skilful insertion of restraints into L.P. models can simulate these personal preferences in the matrix. The final L.P. solution is then optimal subject to the nominated restraints.

It is possible to investigate a very wide range of activities with varying prices and production levels and subject to various restraints. The impact of these restraints can be investigated by their variation. This is valuable for current decision making and planning and for future use. As new information becomes available the coefficients can be changed and revised solutions obtained.

This kind of approach is not otherwise possible except when gross margins analysis and simple or parametric budgeting are used in very simple situations. When the situation is at all complex these techniques will still be used but short cuts have to be taken and the result relies heavily on the experience of the adviser. This experience must be suspect if all the alternatives have not been looked at.

There is already quite enough climatic and market uncertainty surrounding agriculture and any technique which allows a much wider investigation to be undertaken at low cost with infinitely less tedious and repetitious calculation is attractive.

The mere fact of having to set up the linear programme matrix compels the farmer and his adviser to look more closely for the coefficients applicable to the particular farm rather than to accept without question the applicability of commonly accepted district values or even their own previous assumptions. The need for specification forces them to critically appraise all aspects of the current operations.

It is likely that the use of the technique will be limited to the more complex situations where there is an adviser and where the operator is sufficiently sophisticated to be able to supply the basic data and to specify his restraints. If this is not the case the adviser may still use L.P. but it is more satisfactory when the farmer has complete confidence in the input as well as the adviser.

This does not mean that the specification of all coefficients will always be certain but it does mean that the operator must understand how the estimates were derived. Specification of the weaker areas will improve once they have been isolated particularly if they can be related to some other measure in more common use. Feed production can, for example, be related to livestock carried even though different units are used in the matrix.

It has been pointed out (Heady, 1956, P.67) that budgeting restricts the analysis to a nominated section of the production possibilities surface, and may beg questions which are likely to be important, such as kinks or curvature in the factor-factor functions, the nature of limiting resources and the marginal revenue products of factors in use. Also that linear programming is marginal analysis tailored to the case of a finite number of activities (Dorfman, 1958) though its precision can be spurious because it depends on the data on which it is based.

Waring (1962) points out that a particular virtue of linear programming is the ease with which it permits those familiar with its use to conceptualise complicated enterprise patterns and the simplicity with which the mechanical mathematical techniques involved permit simultaneous consideration of the production possibilities offered by a large number of inter-acting activities and restraints observable in empirical farm practice.

At a comparatively low cost it does seem possible to improve practical on-farm decision making under uncertainty provided real data are used and provided informed interpretation is undertaken by someone familiar with the technique and technology.

District and Farm Studied

The district is part of the South West wheat belt of New South Wales and is part of the Murrumbidgee River Basin. It is bounded in the north by latitude 34°S and in the south by latitude 36°S. The 20" rainfall isohyet bounds the area to the west and 30" isohyet to the east. There is a slight winter rainfall dominance and the winter rainfall is more reliable. The average annual rainfall decreases from east to west. Summer rainfall is usually in the form of thunderstorms, the effectiveness of which is reduced by high temperatures and evaporation and excessive run-off.

TABLE 1

AVERAGE DISTRICT RAINFALL (INCHES)

Month	Cootamundra	Wagga Wagga
	Height above Sea Level 1082'	612'
January	1.91	1.48
February	1.50	1.49
March	1.92	1.67
April	1.86	1.66
May	1.92	1.84
June	2.55	2.47
July	2.22	1.93
August	2.20	1.97
September	1.91	1.83
October	2.32	2.14
November	1.80	1.60
December	1.82	1.48
TOTAL	23.93	21.56

Temperature patterns vary little across the area. The highest average monthly temperatures occur in January and February and the lowest in July-August. The lowest temperatures correspond with the months of maximum rainfall and the highest temperatures with months of lowest rainfall. Table 2 shows the average maximum and minimum monthly temperatures and Table 3 shows the average number of days in each month that frosts have occurred in the area. The winter temperatures restrict worthwhile pasture growth although the introduction of improved pastures has considerably reduced this unproductive period.

Improved pastures have been based mainly on annual Subterranean clover (T.subterranean) and as these pastures produce little late summer and early autumn feed surplus spring feed has to be carried over to fill the gap. Extensive sowings of lucerne in recent years have meant that the feed production pattern has altered and summer rains will now produce worthwhile growth but this is not reliable.

TABLE 2

AVERAGE MAXIMUM AND MINIMUM TEMPERATURES (^{o}F)

Month	Cootamundra		Wagga Wagga	
	Max.	Min.	Max.	Min.
January	89.0	60.1	87.4	60.9
February	87.7	60.0	85.3	61.3
March	81.5	55.1	81.3	57.6
April	72.2	46.6	70.7	50.2
May	63.3	40.5	61.4	44.3
June	56.0	36.8	56.0	40.6
July	54.7	35.6	54.4	38.0
August	58.4	36.6	57.9	39.3
September	65.2	40.0	64.5	43.1
October	72.0	45.2	68.5	47.7
November	80.2	50.9	76.5	50.5
December	86.3	56.7	83.8	56.6

TABLE 3

AVERAGE NUMBER OF FROST DAYS PER MONTH

Month	Cootamundra	Wagga Wagga
January	-	-
February	-	-
March	-	-
April	3	-
May	8	3
June	13	7
July	18	13
August	16	10
September	10	3
October	5	1
November	1	-
December	-	-
TOTAL	74	37

The managerial unit under investigation is in fact three farms. Separate records are kept to facilitate an annual physical and financial comparative analysis with other farms in the region.

They are in the south western corner of the district and have a 22" average annual rainfall. The climate is intermediate between Wagga Wagga and Cootamundra.

Farm A and Farm B are situated on the lower portion of a broad shallow valley and consist of creek flats or gently rising land. Farm C is situated towards the head of this creek and consists of lower quality soils with a low fertility history. It ranges from creek flats and undulating land through hilly but arable land to non arable hill land.

TABLE 4

SUMMARY OF LAND TYPES ON FARMS

	Farm A	Farm B	Farm C	Total
Type A arable land acres	1,820	190	-	2,010
Type B arable land acres	1,530	637	-	2,167
Type C arable land acres	-	-	408	408
Type D arable land acres	-	-	1,405	1,405
Type E arable land acres	-	-	700	700
TOTAL ARABLE LAND	3,350	827	2,513	6,690
Type A-D non arable land	375	85	350	810
Type E non arable land	-	-	965	965
TOTAL NON ARABLE	375	85	1,315	1,775
TOTAL	3,725	912	3,828	8,465

Type A land comprises the creek flat area with silty loam soils
Type B land is undulating with red soils

Type A land comprises the creek flat area with silty loam soils

Type B land is undulating with red soils

Both these land types are fertile with a long history of pasture improvement and phosphate top dressing - the silt loams require less crop fertiliser and are slightly more productive but are more subject to frost.

Type C land comprises creek flats with slightly lower fertility soils

Type D land is undulating with lower fertility red soils

Type E land is steep and consists of erodable soils which can become too wet or dry

The non arable land is divdded into the better soil areas (A-D) and the steep rock areas (E).

The Current Enterprise Mix

The author has been associated with the managers for six years and therefore has a close understanding of their management ability and their farms. This has assisted greatly in the construction of the matrices.

Planning to date has involved gross margins analysis, maximisation within physical and financial restraints and cash flow budgeting. An annual comparative analysis has been undertaken to check performance. The approach has been reasonably satisfactory but all those involved have been very conscious of the inadequacy of the planning investigation undertaken. This has become more critical as the number of possible livestock and cropping activities has increased, as additional resources in the forms of different land and soil types were acquired and as product prices varied. Current gross margins calculations have been shown in the appendices and the situation over the last six years is described below. Current activities reflect the relative enterprise gross margins in previous years subject to the constraints imposed as seen by the owner and adviser.

On the arable land, cropping was normally more profitable per acre than livestock in the past and involved no increase in enterprise capital invested per acre. Of the crops grown wheat was the most profitable although barley and oats were grown for grazing and grain. The low prices for these latter two grains and their low value grazing use meant that their role was secondary to wheat. No other crops were grown at this time. Highest returns came from maximising the crop area and it was sound policy to diversify into cropping even though crop income was lumpy and less reliable. The wheat crop gave the highest returns and required no storage but small areas of grazing cereal crop were grown either for fattening stock or to provide winter feed for breeding stock if the unreliable autumn rains failed. If there was an autumn break winter feed production from pasture was usually adequate but the grazing crops were still harvested for grain.

A maximum cropping programme was undertaken subject to the constraint of the rotation adopted. With the annual grass/sub clover pastures which then predominated, the best rotation was considered to be two years crop and four years pasture although under pressure this was reduced to three years crop and four years pasture. The last crop was undersown with pasture. The rotation was designed to produce a stable situation of maximum net return so that crop yields could not be allowed to decline too far nor could pasture production be depressed too much by the fertility harvesting crops. The criterion is the maximum gross margin from the full rotation sequence rather than from the crop or the livestock enterprise separately. Crops were adequately fertilised and phosphate was applied to the clover based pastures to ensure a quick fertility build up in the pasture phase. Fertility could not be pushed so low as to permit skeleton weed to become a problem nor could high fertility weeds be allowed to take over the pasture.

Some perennial grass pasture has been established in earlier years but it was expensive and risky to establish and the clover ley cropping rotation was more profitable and flexible. Some lucerne had also been grown but this was considered to be more a specialist hay crop rather than a general grazing proposition because continuous grazing meant that it deteriorated very rapidly. The annual pasture was well adapted to the conditions of a reliable winter rainfall and a hot dry mediterranean summer. It was cheap and easy to establish and the only real risk was the unreliable autumn rainfall. The seasonal feed production was very uneven but the big spring surplus stood over in the paddocks and provided grazing until early autumn. The autumn thus tended to be a more unreliable period than the winter.

The Merino sheep enterprise usually yielded a higher return than the beef enterprise and there was little encouragement to diversify away from sheep especially when a higher investment per acre was required and the pastures were more suitable for sheep. Wool prices were fairly stable at this time and there was no indication of the problems to come.

The first disturbance to this pattern occurred following good crops in 1968/1969 when wheat quotas were applied. Quotas were further reduced in the following year and at the same time estimates of returns to the grower fell as payments were delayed, as storage costs were incurred and as wheat was sold overseas for lower prices on a credit basis. The natural reaction was to look for alternative crops and rape in its first trial year gave better returns than wheat. At the same time beef prices began to move up and wool prices to fall. Because of the drought of 1967 the operators were not in a position to buy cattle and anyway were not convinced that the long term trend was permanently against wool and in favour of cattle. A decision was made to breed up cattle and to fill the likely income gap by cropping to the maximum in the interim.

During this time sowings of lucerne were undertaken either as straight sowings or under crop. It was easy to establish and it meant that there was a pasture able to respond to the out of season rainfall. This was particularly valuable when normal seasonal rains had failed. Unless clover was also present winter production was down and also early production but this was compensated for by the fact that seasonal variability was reduced. It was suitable for cattle if managed correctly as well as for young sheep and breeding ewes and could be fitted in with cropping activities.

The increasing cattle numbers and the expansion of the bacon enterprise which used barley grain meant that the grazing cereal crops came back further into favour. Trials were undertaken and very impressive results were obtained with fattening cattle (Communication, University of New England, 1970). These indicated that early sown crops could provide a considerable amount of high quality grazing at a time when such feed was in short supply and that fattening cattle for the peak

August market was a very high return use. This meant that wheat was no longer the dominant cropping enterprise though it was still reasonable to grow sufficient to ensure that the quota was filled. Besides the grazing cereal crops and rape other crops such as sweet lupins, field peas and sunflowers were also technically feasible. In addition beef on pasture was at least as profitable as most of the crops.

The present situation is that the prospects for beef are good, wool prices have recovered and the wheat market is strong. Diversification is financially feasible and the income stability thereby engendered would give much needed confidence for the future. It is also the situation wherein linear programming would seem to offer most potential as a planning aid.

The list of crops currently being grown indicates the wide range of possibilities. Diversification was encouraged by the imposition of wheat quotas in 1968/1969 but the emphasis is still on wheat or dual purpose grain and grazing crops. The newer crops are either still experimental as in the case of lupins, field peas and sunflowers or subject to greater risk as in the case of rape. The technical limits to cropping are those of autumn planting labour or rotation and this is covered by the restraints imposed.

The property is stocked predominantly with sheep although cattle numbers are being increased by breeding. Merino wethers have been purchased in the past and will be in the future but a self replacing flock is more stable because it is less dependent on the vagaries of the market and there is no risk of introducing disease.

All three properties are sufficiently subdivided and watered and all basic facilities are adequate so there is no physical reason why an optimal programme of stocking or cropping should not be adopted. There are no practical limits on capital and labour or on management capability.

TABLE 5

DETAILS OF FARM ACTIVITIES AT JULY 1972

	Farm A	Farm B	Farm C	Total
CROP AND PASTURE (Acres)				
Wheat	240	269	948	1,457
Oats	218	-	-	218
Barley - 2 row	51	-	67	118
Barley - 6 row - grazing	365	-	-	365
Barley - 6 row - grain	26	-	-	26
Rape	194	-	-	194
Lupins	32	-	-	32
Peas	8	-	-	8
Sunflowers	-	-	-	-
TOTAL CROP	1,134	269	1,015	2,418
Non arable area in crop	141	28	82	251
Lucerne pasture	2,080	551	885	3,516
Non arable area in lucerne	403	64	125	592
Permanent phalaris pasture	49	-	-	49
Annual pasture	115	-	1,721	1,836
TOTAL PASTURE	2,788	643	2,813	6,244
SHEEP				
Merino breeding ewes	6,870	-	-	6,870
Ewe weaners	2,490	-	-	2,490
Wether weaners	2,170	-	-	2,170
Wethers	-	3,817	5,659	9,476
Sundry	470	-	-	470
Rams	100	-	-	100
Sale sheep	-	-	3,260	3,260
TOTAL SHEEP	12,100	3,817	8,919	24,836
CATTLE				
Breeding cows beef	267	-	130	397
Heifers 1 year	51	-	20	71
Bulls 1 year	6	-	-	6
Steers 1 year	159	-	70	229
Sundry	11	-	2	13
Bulls	11	-	1	12
TOTAL CATTLE	505	-	223	728
FODDER RESERVES (Tons)				
Hay	64	23	35	122
Silage	2,480	-	-	2,480

CHAPTER 2
PREPARATION OF THE MODEL

Matrix Preparation

The author had not had any previous practical experience with the construction of a linear programming matrix and this one went through stages of development before a practical basic solution was obtained. Optimal solutions were obtained during the development stages but it was obvious on each occasion that the problem had not been sufficiently well specified. Restraints and activities had to be added or altered and physical and financial coefficients changed as additional information became available. The first matrix was constructed following a day with the farm operators during which the bulk of the physical and financial data was obtained. The operators were also asked to specify the personal restraints which they would impose. The tableau was then punched and solved by the Agricultural Business Research Institute at the University of New England.

Close liaison with the farm operators was important because it was essential that the basic solution be derived from input and output coefficients and restraints which were either acceptable to or specified by them. This was necessary to ensure that they would confidently accept the results and be sure that their farm had been adequately specified.

As previously discussed this matrix was mainly developed from information supplied by the operators. They have done their own gross margin calculations as part of previous planning exercises and have also participated in an annual district farm comparative analysis since 1965/1966. They have kept very careful records of income and expenditure and production data over a long period so that the collection of data presented no problem except for the specification of pasture feed production and the specification of yields and prices for crops such as lupins, peas, sunflowers and rape which were either still in the experimental stage or which had only been grown for a few years. Ayres of the Wagga Agricultural Research Institute was able to provide data from pasture production trials which have been conducted on the property.

It should be noted that it is possible to go on refining a matrix indefinitely and this will take place over time but there must come a point where further work will lead to little if any gain in precision and not justify the cost. The basic matrix in this study is believed to have reached this stage.

All gross margin calculations have been rounded off to the first decimal place since claims to greater accuracy could not be sustained on the data available.

Resources and Restraints

The resources and restraints have been listed in full in Appendix C (1) but the following is a brief explanation of the types of restraint included in the Right Hand Side of the matrix.

This chapter and the following one are unavoidably technical, but they should be read in order to gain an understanding of the work undertaken.

Restraints may be physical (land resources), technical or institutional (wheat quota) or they can be subjectively imposed by the farm operators (livestock and crop category limits). An operator has no control over the first type of restraints but he is able to relax or remove a subjectively imposed restraint and is more likely to do is if he is made aware that a high cost attaches to its retention at the margin.

A restraint will be fairly rigid if it is based on a practical limitation such as the area of crop that can be sown at the correct time with the plant available. Rotation relationships are usually less rigid because there is often uncertainty about the precise long term relation between a fertility depleting crop and fertility building pasture activities. Relations which fix livestock proportions are usually subjectively determined: the underlying technical relationship may vary from year to year.

Another device used is the intermediate pool activity and it is valuable because it allows alternative disposal from a single production activity, for example a grain pool permits simulation of the selling or feeding out of grain at different periods and simplifies the investigation of the effect of a selling price change. A production only activity will have a negative gross margin.

Some restraints may duplicate or dominate others. Though it is theoretically desirable to eliminate this kind of situation, there is no practical value in doing so when using a large computer. Indeed, retention of overlapping restraints may clarify the situation for the farmer.

<u>The Principal Types of Restraints</u>

The land types have been listed earlier (page 11) and the restraint ALANAR (1) is the limiting area of arable land. NONNAR (3) is the limiting area of non arable A, B, C, and D land and when an acre of crop is planted approximately one tenth of an acre of NONARR is tied up in the form of headlands, creeks and rock hill areas which is unproductive for cropping or grazing.

MAXACR (4) specifies the maximum area of autumn sown crop that the operators consider they can properly prepare and sow. Their plant is adequate for this area and they are unwilling to increase or decrease plant size.

MINACR (5) specifies the minimum area of crop that the operators are prepared to accept. This restraint is duplicated because they have also set a minimum wheat limit of 500 acres and a minimum grazing crop of 200 acres.

RAPMAX (6) specifies the upper limit to the area of oil seed rape. It has been set because there is uncertainty about market, long term yield and disease problems and because harvesting must be carried out quickly before pod shattering occurs. This same kind of uncertainty restriction has also been placed on the other new crops such as lupins, field peas and sunflowers.

WHMAXQ (7) specifies the present wheat quota applicable to the farm. This is a figure which will change from year to year.

MXCRAL (12) specifies the maximum area of arable A land that can be sown each year. It does not completely duplicate the rotation restraint because legume crops are not subject to the rotation restraint.

AROTAT (14) specifies the relationship between each type of pasture and each type of crop on arable A land. Six acres of minimum phase (six year) lucerne aupply 6 x 0.5 = 3.0 units of fertility toward the three year crop phase which depletes fertility by 3 x 1.0 unit = 3.0.

WHTPOL (16) is the pool into which all wheat production is supplied and from which wheat is disposed of by selling or feeding at various times. The fodder conservation and livestock pools fill the same role of allowing different avenues of disposal.

MXGRST (19) specifies the grain storage limit. Any grain use activity other than immediate sale requires storage.

SPRFED (32) is the spring feed pool. Pasture activities supply feed to this pool. Similar pools exist for the other seasons and for winter crop forage. Quarterly pools were used because they were more realistic than monthly pools under conditions of feed supply uncertainty.

LIVCAP (45) allows interest to be charged against enterprises and accounts for the effect of differing enterprise capital levels.

SUMLAB (47) provides 3,600 hours of available summer labour (permanent labour) and additional labour can be hired using HISULB (Hire Summer Labour) activity.

MAXECP (51) specifies that a maximum area of 300 acres of early sown grazing crop is possible.

MXAWTR (53) limits the transfer of feed from the autumn to winter pool. Only surplus feed produced in the autumn may be allocated to it. It prevents continuing cumulative transfer of feed from feed pool to feed pool.

MAXCAT (74) specifides that breeding cows shall not exceed 50% of breeding sheep. This is an operator imposed restraint.

These are only examples of the main restraint types. Full details are given in Appendix C (1) and in the matrix. In addition the matrix discloses the coefficients used.

Activities

The activities have been listed in full in Appendix C (2) but the following is an explanation of the main types of activity.

Crop Production Activities:

These activities are production activities and they allow the supply of grain to grain pools and forage to feed pools. Wheat and silage production are typical examples. The activities show a negative gross margin because variable costs are shown and no revenue.

It must be noted that labour and capital costs have been excluded from all gross margin calculations.

Special Crop Activities:

For special crop activities the full gross margin has been calculated. Rape growing is an example.

Livestock Production Activities:

These activities have incomplete gross margins because they supply some stock and wool to pools for alternative disposal but some sales are made and this revenue is included in the gross margin calculation. Angus beef breeding is a good example and the gross margin may be positive or negative in activities presented in this way.

Selling and Feeding Activities:

These activities allow produce from pools to be sold or fed at various times. The figure in the Z-C row is the selling price per unit and therefore is positive.

Purchase or Hire Activities:

These activities allow purchase of stock or feed or the hiring of labour or capital. The Z-C row coefficient is the cost of a unit and so is negative.

Pasture Production Activities:

These activities which supply feed to feed pools and units of rotation to the rotation relationship have negative Z-C coefficients representing costs of current inputs in pasture production.

Forage Transfer Activities:

These activities allow the transfer of surplus feed from one pool to another within technically feasible limits. There are appropriate safeguards against continuous cumulative transfer. Most of the crop, pasture and conservation activities have had to be repeated for each land type which has made the list much longer than would be the case on a farm with one land type.

Principal Types of Activities:

WHTGRG (2) is the wheat production activity on A Class land. The coefficients which appear in the matrix column under this activity are explained as follows.

The activity utilises one acre unit of the maximum autumn crop limit restraint (MAXACR); 1 acre of minimum autumn crop requirement (MINACR); 0.1 acre of non arable land available (NONARR); 1 acre of maximum crop limit on A land (MXCRAL); and 1 unit of the rotation relation on A land (AROTAT). It also supplies 30 bushels of grain to the wheat pool (WHTPOL) and 5 livestock months of feed from stubbles to the summer feed pool (SUMFED); required 0.5 hours of summer labour (SUMLAB) and 0.8 hours of autumn labour (AUTLAB); contributes 5 livestock months of feed to the maximum summer to autumn feed transfer (MXSATR); 1 acre of minimum wheat crop level (MINWCP) and 1 acre to the undersown wheat relation (USWHTA).

The coefficients used are set out in the attached matrix and only points of interest concerning other activities have been discussed in this section.

WHTSLQ (3) is the quota wheat selling activity. There is a separate WHTSOQ (4) (Over-quota Wheat Selling) activity which allows an additional quantity of over-quota wheat to be sold at a lower price.

OTGRGR (5) is the early oat production activity on A class land. Grain is supplied to the oat grain pool and winter forage to the winter forage pool. The area of early sown crop has been limited by a restraint so any additional oats would be sown later and thus produce less grazing.

LUPCRP (9) is the sweet lupin activity on A land. Because it is a legume crop it does not draw upon the rotation intermediate resource but it is still restricted by the autumn crop restraint.

HAYPRO (15) is the lucerne hay production activity on A land. The gross margin includes the lucerne pasture cost as well as the hay making and carting cost.

LUCMIN (17) is the minimum phase lucerne activity on A land. Six years of lucerne allows a three year crop phase. Any additional years of lucerne do not add to the fertility bank and do not allow the crop phase to be extended.

ANGBRD (23) is the Angus beef breeding activity. It is in part an intermediate production activity internal resource creating and in part a revenue activity as culls are sold and proceeds accounted for in the gross margin but steers and heifers are supplied to pools to allow alternative disposal.

AUFDPH (37) is the paddock hay production and feeding activity on A land. It is a physical transfer activity so a cost is involved. Feed is transferred from spring to autumn with a 10% loss factor.

SPSUTR (53) is an artificial transfer activity which allows surplus feed to be transferred from spring to summer with a 35% waste factor.

HISULB (58) is the labour hire activity which permits supplementation of the summer labour pool. Table 6 lists the labour coefficients used by most enterprises. This data was provided by the operators.

These are only examples of the main types of activities. Full details are given in Appendix C (2) and in the matrix. In addition the matrix clearly sets out the coefficients used.

TABLE 6

LABOUR REQUIREMENTS OF SOME TYPICAL ACTIVITIES
(Hours per Activity Unit)

Activity	Unit	Total Spring Labour (hours)	Total Summer Labour	Total Autumn Labour	Total Winter Labour	Total
Merino breeding	ewe	0.10	0.10	0.10	0.10	0.40
Merino wethers	wether	0.01	0.01	0.01	0.01	0.04
Angus beef breeding	cow	0.50	0.50	0.50	0.50	2.00
Bacon pigs	sow	15.00	15.00	15.00	15.00	60.00
Cropping	acre		0.50	0.80	0.20	1.50
FODDER CONSERVATION						
Silage	ton	0.50				0.50
Paddock Hay	ton	1.00				1.00
LIVESTOCK FEEDING						
Hay	ton			1.00		1.00
Silage	ton			0.50		0.50

TABLE 7

CAPITAL REQUIREMENTS OF SOME TYPICAL ACTIVITIES

Activity	Unit	Capital per Unit
Wheat growing	acre	$10.00
Beef breeding	cow	$150.00
Beef fattening	steer	$25.00
Merino breeding	ewe	$6.00
Merino wethers	wether	$4.00
Bacon pigs	sow	$50.00

Gross Margins

Conventionally the gross margin for an enterprise is calculated by deducting variable costs from revenue. The results of such a calculation are used for the Z-C row for some activities but in others only a partial gross margin has been given, the balance of enterprise revenue being credited through the pool disposal activity. This has been demonstrated in the following calculations of full and partial gross margins. The full gross margin is used in gross margins planning.

TABLE 8

GROSS MARGIN CALCULATION FOR ANGUS BREEDING HERD OF 100 BREEDING COWS

REVENUE			
Sell cfa cows	12 @ $110	$1,320	
weaners	6 heifers @ $65	390	
steers	44 @ $75	3,300	
heifers	23 @ $100	2,300	$7,310
Less purchase bull replacements	0.7 x $500		350
NET REVENUE			$6,960
VARIABLE COSTS			
Veterinary - cows	100 x $2	$200	
heifers	38 x $1	38	
weaners	88 x 50¢	44	$282
GROSS MARGIN			$6,678
GROSS MARGIN PER COW			$66.8
GROSS MARGIN PER LIVESTOCK MONTH			$0.38

In this case 44 steers will be "sold" to the steer pool and 23 heifers to the heifer pool. The gross margin shown in the first row of the activity column is the full gross margin as calculated above less the revenue from these two sources.

Total gross margin per 100 cows is		$6,678
Less 44 steers @ $78	$3,300	
Less 23 heifers @ $100	$2,300	$5,600
Leaving a partial gross margin of		$1,078 per 100 cows
		$10.80 per cow

This figure is used in the Z-C row of the matrix. A similar adjustment has been made in other gross margin calculations. Labour and interest have not been included as costs because they have been taken into account separately in the matrix.

Some complete crop gross margins calculated have been summarised in Table 9 though only the non-cereals appear in this form in the matrix.

TABLE 9

CROP GROSS MARGIN SUMMARY
(Grain production only. Grazing value excluded)

Crop	A $	B $	C $	D $	E $
Wheat	23.90	23.40	20.25	20.25	16.90
Early oats 55¢	10.50	10.50	10.50	10.50)	8.85
Late oats	12.15	12.15	12.15	10.50)	
Early barley 70¢	15.45	15.45	15.45	15.45)	13.35
Late barley	17.55	17.55	17.55	15.45)	
Malting barley				16.65	14.00
Rape	22.15	20.00	19.00	18.00	
Lupins	17.15	15.00	14.00	13.00	
Peas	16.25	14.00	13.00	12.00	
Sunflower	21.20	20.00	19.00	18.00	
Share wheat				11.10	
Contract wheat				15.75	

Full details of the gross margins calculations can be found in Appendix (A)

The Livestock Month Concept

This section defines this measure of feed production and animal requirement and discusses the reason for its use in linear programming in preference to the traditional DSE unit. The section also discusses the difficulties of estimating average available pasture production and describes the approach adopted to this problem in this study.

In routine farm management advisory work considerable use is made of a measure known as the Dry Sheep Equivalent (DSE). It is used to estimate the carrying capacity of pasture and allows all stock to be considered in terms of a common unit.

The DSE unit is based on one Merino wether of 110 pounds live-weight maintained in good store condition and a pasture carrying one DSE per acre must be able to support this sheep or its equivalent for one year. With dry sheep this may be achieved by over feeding in flush periods and under feeding in scarce periods, but this is less feasible with breeding stock. They have specific feed requirements at certain times and nutritional stress can severely affect their breeding performance.

The feed requirements of types of livestock such as breeding ewes, weaners and breeding cows are well documented so that it is possible to compare them in terms of dry sheep equivalents by dividing their requirements by those of the standard dry sheep.

TABLE 10

TYPICAL DSE FIGURES FOR DIFFERENT CLASSES OF LIVESTOCK

Class of Livestock	DSE
Merino wether in good store condition	1.0
Dry Merino ewe	1.0
Merino ewe up to six weeks before lambing	1.0
Merino ewe over last six weeks of pregnancy	1.7
Ewe with lamb for first eight weeks after lambing	1.7
Mature beef cow (1,000 lbs liveweight) plus vealer up to eight months old	14.0
(after Molnar, 1966)	

The dry sheep is usually treated as having standard feed requirements throughout the year which is so in the more equitable climates but under very cold or very hot conditions or where long distances have to be walked some variation must be allowed for.

In the south there is a marked seasonality of feed production with a large spring flush and low production for the rest of the year. In this situation it is customary to relate carrying capacity to the period of least feed which is the late autumn or winter. If a pasture is described as having a carrying capacity of 5 DSE's this means that the pasture will carry 5 dry sheep or 2.1 Merino ewes and followers for a full year. A ewe rearing a lamb to weaning is equivalent to 1.7 DSE on an annual basis and a 70% lambing percentage means 0.7 following weaners (0.7 DSE) making a total of 2.4 DSE's for a ewe and follower.

In contrast to the dry sheep, the breeding or growing animal has varying requirements throughout the year. After mating the feed requirement of a ewe may be similar to that of a wether but when she is feeding a large lamb at foot she will need twice as much feed. The 1.7 DSE figure for a ewe represents an average for the year (as shown in Table 11) and to use it for a particular time in the winter is only possible because the figure used exceeds the actual ewe requirement at that time and the large spring feed surplus so adequately covers the additional requirements for the lactating ewe that it builds in a safety factor to allow for uncertainty.

TABLE 11

MONTHLY DSE REQUIREMENT OF A 90 LB BODYWEIGHT SPRING LAMBING EWE

Month	DSE
July	1.29
August	1.49
September	1.84
October	1.64
November	1.64
December	2.20
January	2.28
February	2.36
March	2.44
April	1.20
May	1.20
June	1.20
TOTAL	20.78
Average DSE per year $= \frac{20.78}{12} =$ 1.73	

Using 1.7 DSE's per ewe is satisfactory practical approach but it does not allow a more detailed seasonal investigation of animal requirement and pasture supply and utilisation. The feed requirements of livestock at

various times and under various conditions are known and can be set out on a quarterly or monthly basis. The calculation of the seasonal LSM requirements of various livestock activities have been clearly set out in Appendix (B). The same information about pasture feed production is necessary and this is what the Livestock Month tries to achieve. The Standard Livestock Unit (LSU) is a 110 lb dry sheep grazing "medium" quality pastures with no weight change and with an exercise allowance of 35%. An animal with no weight change is said to be at maintenance.

"A Livestock Month (LSM) is the amount of energy required in the feed consumed by the standard sheep in thirty days, i.e. one LSU requires one LSM per month" (Rickards & Passmore, 1971).

The LSM is an important concept because feed at different periods of the year has different values depending on the scarcity of feed and the differing feed needs and returns from the various livestock enterprises.

In the matrix three month period feed pools have been used because seasonal uncertainty makes more precise definition impractical. The values used are based on some available data and have been checked against the known carrying capacity of pastures on the various land types under the present management.

Some available dry matter data was available for the property (Southwood and Ayres 1972) and LSM's can be calculated from this data using factors to allow for trampling losses and differing feed quality (Rickards & Passmore, 1971). More precise estimation than to the nearest whole number would be spurious because the figures finally used were only best estimates of the year in/year out situation based on the data available and the known carrying capacity of the pasture.

TABLE 12

AVAILABLE FEED DATA

Stocked At	Annual Pasture (Kgs per Hectare)	
	2 ewes per acre	4 ewes per acre
1970		
March	4,800	3,200
June	4,000	2,900
July	4,200	3,200
September	6,600	5,400
October	7,600	6,400
December	6,400	5,000
January	6,800	3,900
1971		
March	5,200	3,700
May	4,600	2,400
August	4,300	3,000
October	4,000	3,400
November	2,400	1,800
January	5,400	4,000

Personal Communication (Ayres, 1972) Wagga Agricultural Research Institute

N.B. Kilos per hectare approximate pounds per acre

In the above Table the 1970 data would be described as "typical of the average year". It certainly represents what is expected to happen but the frequency of occurrence and the size of inter-seasonal fluctuation is less well quantified.

It is possible to calculate pasture LSM's from dry matter production data and this has been done in the next Table.

TABLE 13

AN EXAMPLE OF THE CONVERSION OF SEASONAL DRY MATTER PRODUCTION TO LSM's AVAILABLE FOR LIVESTOCK PRODUCTION

Season	Estimated DM Production (lbs per acre)	LSM Production (LSM's)	Usable LSM per Season (LSM's)
Spring	1,960	35.3	30
Summer	915	16.5	14
Autumn	915	16.5	14
Winter	915	16.5	14
TOTAL	4,705	84.8	72

* Assuming 100 lb Dry Matter (DM) equals 1.8 LSM and 15% of LSM is lost during grazing

The above calculations can be checked against the commonly held belief that a pasture producing 1,000 lbs of dry matter per annum will support one dry sheep per year. In the above example 4,700 lbs dry matter should support 4.7 dry sheep but 72 available LSM's should support 5.7 dry sheep.

There is an obvious disparity here but another correction is necessary. Feed cannot be transferred from one season to another without some loss and it cannot be cumulatively transferred. If spring feed is not used during the summer period it is lost completely unless it is harvested and conserved.

Because of the arbitrary nature of LSM calculations from feed production data, it is always wise to check the figures against known stocking rates. This has been done in the following Table.

TABLE 14

THE CHECKING OF A STOCKING RATE AGAINST FEED PRODUCTION

Season	LSM's Available	LSM Requirement of 5 Spring Lambing Ewes Per Acre Rearing Lambs to Weaning	LSM Utilisation	Surplus LSM Inter-season Transfer
Spring	30	4.8 x 5 = 24.0	30.0-24.0 = 6.0	6 x 0.65 = 3.9
Summer	14	3.4 x 5 = 17.0	(3.9-17.0 (= -13.1	
			(14.0-13.1 (= 0.9	0.9 x 0.75 = 0.6
Autumn	14	2.5 x 5 = 12.5	(0.6-12.5 (= -11.9	
			(14.0-11.9 (= 2.1	2.1 x 0.85 = 1.7
Winter	14	3.0 x 5 = 15.0	(1.7-15.0 (= -13.3	
			(14.0-13.3 (= 0.7	
TOTAL	72	68.5		

Thus the actual carrying is approximately five ewes per acre and the calculated LSM production is consistent with the real stocking rate.

The following Tables summarise the LSM production of pastures on the principal land types and the LSM requirements of the main livestock enterprises.

TABLE 15

MAJOR PASTURE TYPE LSM PRODUCTION

	Arable Land Type A	Arable Land Type B	Arable Land Type C	Arable Land Type D
LUCERNE PASTURE				
Spring	30	26	22	20
Summer	14	12	11	10
Autumn	14	12	11	10
Winter	14	12	11	10
TOTAL	72	62	55	50
ANNUAL PASTURE				
Spring	30	26	22	20
Summer	7	7	6	5
Autumn	10	10	10	9
Winter	16	12	11	10
TOTAL	63	55	49	44

TABLE 16

MAJOR LIVESTOCK ACTIVITY LSM REQUIREMENTS

	Spring	Summer	Autumn	Winter	Winter Forage	Total
Merino breeding and followers	6.1	5.7	4.9	5.0	-	21.7
Merino x BL and followers	5.2	6.0	5.9	4.5	-	21.6
Merino wethers	3.5	3.0	3.0	3.0	-	12.5
Angus beef breeding and followers	46	44	40	43	-	173
Angus cross breeding	38	38	33	36	-	145
Fattening Angus steers	11.6	6.0	12.6	-	40.0	70.2
Fattening Angus cross steers	12.0	6.0	13.0	-	40.0	71.0
Fattening purchased steers	12	-	7	-	40.0	59
Fattening cast ewes	-	-	1.8	2.7	-	4.5
Fattening cast wethers	-	3.0	-	-	-	3.0

It must be accepted that the estimation of pasture LSM's is the weakest point in the model but it is possible to check the figure against known stocking rates and thus to be reasonably confident about them and of course to amend the model over time in the light of experience or to test the effect of higher or lower estimates on the plan.

Risk and Uncertainty

Risk refers to variations from expectations which can be measured in some manner. For example it is possible, on past history of losses of lambs between lamb marking and weaning to calculate a variance about the mean loss. If the mean loss is taken on the future expectation, statistical estimates can then be made of the likelihood of departures from this mean.

Uncertainty describes the situation where the farmer decision maker has no quantitive way of predicting yields or prices. Decisions therefore become subjective and are based on optimism, conservatism or pessimism depending on the individual. Agricultural prices are not usually subject to price control and because they cannot be predicted the farmer is faced with uncertainty.

Risk presents less of a problem in decision making than uncertainty. In risk situations average expectation together with the range of variations are known. Covariances between prices can be considered and their use is discussed but it is highly probable, because prices are subject to both risk and uncertainty, that farmer operator estimates based on experience are just as accurate and more acceptable to him than a more formal statistical approach. It may appear less precise but the combined experience of the farmer operator and his farm advisor cannot be denied. Linear programming is being used here in a real situation and if the farmer normally has to make his decision from experience, it seems reasonable to adopt the same approach in a farmer specified linear programming exercise.

There are two main types of uncertainty. Price uncertainty exists because perfect competition usually prevails in agriculture and the farmer has imperfect knowledge. Yield uncertainty exists because the farmer has no control over the weather.

There are also different degrees of uncertainty. Crop production is more uncertain than livestock production because in the latter, alternative strategies are available and production can recover after a setback.

The use of covariances was mentioned earlier during the discussion of risk. That it is possible to use this technique for risk probability estimation is accepted but its use for price range estimation given current conditions is questionable. The fluctuations have been so violent and non-cyclic that it is the author's contention that the use of the technique would lend apparent sophistication but spurious accuracy to a business judgement which the farmer will make in his own way. He will take past prices into consideration but he will also use information from many other sources.

The farmer takes his own measures to minimise risk and uncertainty. He diversifies his production and also sets subjective restraint minima and maxima for enterprises. For the same reasons he may adopt permanent stocking rates which are below the theoretical carrying capacity of pastures. His insistence on the inclusion of various enterprises also gives him flexibility and allows him to switch emphasis with little time lag. He discounts possible returns for the same considerations of uncertainty.

Formal methods have been developed to assist in dealing with variability both as risk and uncertainty. Barlow (1963) examined the worth of these methods in a situation where risk was the main cause of variability. The variances and covariances of expected net revenue were calculated and quadratic programming used to compute an efficient set of enterprise combinations, each of which minimises risk for the level of expected income specified.

Barlow has also described a method for predicting expected yield and yield variance; expected price and price variance and expected revenue and net revenue variance. The worth of these exercises is obvious under the conditions in which he was working but it is doubtful whether this is the case when the activities are almost completely export orientated and thus subject to unpredictable changing international commodity prices.

His techniques were not employed in this study but would be worth detailed investigation in fugure studies. They were not used in this study because the study was an empirical one based on farmer estimates and time did not permit the exploration of refinements in approach.

CHAPTER 3

OPTIMAL FARM PLANS - RESULTS AND DISCUSSION

Solution of the Basic Model

The basic solution has been set out in the Appendix (F). It is significantly and interestingly a practical solution because, as Table 17 indicates, it has a recognisable similarity to the present farm plan in terms of total crop area and total livestock units to be carried.

TABLE 17

COMPARISON OF THE CURRENT FARM PLAN WITH THE BASIC L.P. SOLUTION

	1972 Farm Plan (Acres)		Basic L.P. Solution (Acres)
CROP			
Wheat		1,457	1,394
Oats	218		
Barley - 2 row	118		
Barley - 6 row	391	727	831
Rape		194	-
Lupins		32	-
Peas		8	-
Sunflowers		70	-
TOTAL CROP		2,488	2,225
PASTURE			
Lucerne pasture		3,516	3,672
Non-arable tied up in crop		251	200
Annual pasture on arable land		904	466
Annual pasture on non-arable land		1,524	1,575

Continued:

TABLE 17 (cont.)

	1972 Farm Plan (LSM's)	Basic Solution (LSM's)
LIVESTOCK		
Merino breeding ewes	6870 x 21.7 = 149079	8333 = 180826
Merino ewes x BL		1667 = 36007
Merino wethers	9476 x 12.5 = 118450	648 = 8100
Fattening sale sheep	3260 x 4.0 = 13040	
Breeding cows	397 x 173 = 68681	500 x 173 = 86500
		100 x 145 = 14500
Fattening steers	229 x 70 = 16030	264 = 18480
Fatten purchased steers		127 x 59 = 7493
TOTAL	365280	351906

It might be expected that the result would be similar to the present plan because of the restraint specification but the autumn crop area restraint has not operated at all and the ewe and cow maximum restraints have only operated in the basic model. Table 17 also indicates that the total livestock units carried in the plans are comparable with those presently carried which gives credibility to the results. It would have been perhaps surprising if very different plans had been generated, since the properties have been run by two brothers who are recognised as being amongst the best managers in the region.

The solution to the basic model is in three sections. Limitations of space meant that it was impossible to summarise solution details in this section but there is a full listing in Appendix F. The first section lists the columns (activities) and against each activity shows figures under three headings - Value, Objective and Shadow Price.

The value is the level of activity which is included in the basic solution. For example, 502 under Value against WHTGRG (Wheat Growing on A land) means that 502 acres of this activity have been included in the plan. A zero against OTGRGR (Oat Growing on A land) means that this activity has not been included in the plan.

The Objective column lists the figures from the Z-C or objective row of the matrix. The objectives are gross margins, production costs, selling or buying prices for activities.

The Shadow Price column shows values against the sub-optimal activities. The shadow prices show the amount by which total gross margin would be reduced if one unit of the sub-optimal activity was forced into the solution. Because a solution is stepped it does not indicate how many units could be added before the shadow price would alter. The shadow price also indicates the amount by which the objective would have to increase for the activity to come into the solution.

The second section lists the rows (resources and restraints) and against each row lists figures under three headings - Slack, Right Hand Side and Price.

The Slack column lists the quantity of unused resource or restraint left surplus by the solution. For example, the 70 under MAXACR (Maximum Autumn Crop) means that the plan provides for 70 less acres of autumn crop (2,230 acres total) than would have been the case if the limit of 2,300 acres had operated. In the case of MINACR (Minimum Autumn Crop) the 1,530 means that the minimum of 700 has been exceeded by 1,530 acres as 2,230 acres have been included. If a zero appears under the slack heading it indicates either that the restraint did come into force and that the resource is limiting or that the row is a pool.

The Right Hand Side column merely lists the values shown in the right hand side or basis vector of the matrix. There are positive values against maxima or minima rows or zeros against pool rows.

The Price column lists the marginal value products of the limiting resources and thus shows the amount by which total gross margin would increase if an additional unit of a limiting resource was made available or if a limiting restraint was relaxed by one unit in the short run. It does not indicate how many units could be added before the marginal value product would again change. The marginal value products are quoted in terms of the restraint unit. They allow consideration of the profitability of dispensing with resources whose services have a low productivity and increasing the supply of resources whose services have a high productivity.

The third section is the Objective Ranging section and this is divided into two sub sections of column (activities) and rows (resources and restraints). Against each activity are figures under the heading of Objective, Lower Limit of Objective, Incoming at Lower Limit, Upper Limit of Objective and Incoming at Upper Limit.

The objective is the same figure previously listed and is the Z-C row value - gross margin, production cost, selling or buying price. In the previous two sections the shadow price showed the cost of including a unit of a sub-optimal activity and the price showed the additional return from making available another unit of the resource or relaxing a limiting restraint by one unit. There was however, no indication of how many units could be included before the next "step" at which the solution altered by the introduction of one or more excluded activities or the exclusion of a presently included activity or activities.

Objective ranging provides this information because it indicates not only the range of objective value within which the optimal solution is stable but also the activities (or restraints) which enter the solution instead of/or which restrict the further expansion of the optimal activity at the lower and upper levels of objective value. It follows that only the optimal activities are included in the objective ranging list.

Interpretation

The Activities

The basic solution has been included in Appendix F. This section discusses the solution and the implications of the information presented on the print-out in the order that it is printed though it has been subdivided in separate Appendices.

A large shadow price is important because it shows the high opportunity cost of inclusion of a sub-optimal activity or the large increase in the original objective (or Z-C) value which would need to take place before an activity was included. In the basic solution this means that all the new crops such as rape have been excluded but they would be included if it could be shown that the gross margins used have been calculated on too low yields or prices (or excessive costs).

The only cropping activities which occur on A land are wheat growing and undersown wheat. The latter activity has been forced in because of the specification that one third of the total crop area on each land type must be undersown wheat in order to re-establish pastures. No other crops have been included although early barley and oat growing have low shadow prices of $1.68. An increase in yield of approximately three bushels of grain per acre would ensure their inclusion and yields of that order are realistically possible of attainment.

Wheat is sold (WHTSLQ) right up to the quota limit of 40,000 bushels but the lower price overquota wheat (WHSLOQ) is not produced. The difference in price of quota and overquota wheat is $0.20 and the shadow price of overquota wheat is $0.19 (probably rounded down from $0.20) so that wheat must be sold as quota wheat if wheat growing is to be included. Overquota wheat would compete with quota wheat and if forced in may not supplant other winter crops. Silage production on A land occurs only because of the set minimum of 100 acres. It could have been produced on B land (SIPROB) but the programme has chosen A land. The yield is lower on B land and it would be dearer per unit.

Hay production on A land (HAYPRO) only takes place at the level of 14 acres which would be ignored in practice. The solution has shown a surplus of permanent spring labour so the level of this activity will increase if farm labour rather than contract labour is used.

The pasture activity chosen on A land is minimum phase lucerne - six years (LUCMIN) and all other lucerne pastures plus annual and perennial pastures have been excluded. Maximum phase lucerne (LUCMAX) has the lowest shadow price of $0.08 and is very close to being included. The opportunity cost attached to its inclusion is low on all other land types so the solution is close to indifference between the lucerne activities.

The breeding cow activity (ANGBRD) has been included to the level of 500 and the beef crossbreeding activity (AASANT) to a level of 100. This is consistent with the breeding cow (MXBRCW) limit of 600 and the subjective specification that the cows in the crossbreeding herd can only be 20% of the cows in the pure breeding herd. The programme has also opted to dispose of the pure and crossbred steer progeny as fats in FATANG and SLSFXT rather than to sell them as store weaners or vealers. In each case the vealers would have to sell for \$5.00 more for the activity to be included.

The purchased steer activity (BUYSTR) is only included to the level of 127 against a limit of 200 so the restraint has not operated. The Merino breeding activity (MERBRD) has been included to a level of 8,333 and the first crossbreeding activity (MERXBL) to a level of 1,667. Thus the breeding ewe limit of 10,000 has operated as has the specification that the ewes mated to Border Leicesters shall not represent more than 20% of the purebreeding ewes, i.e. one sixth of total breeding ewes.

Merino wethers (MERWET) enter the solution at the low level of 648 and only appear because of the ewe and cow limits. The objective ranging must be inspected to gain additional information about this activity.

With the figures used it is more profitable to use the cast for age Merino ewes for an additional year for breeding first cross lambs and the programme has opted against selling cast for age ewes as stores or fats. The selling prices would have to increase by $0.44 for stores to be sold and $0.80 for fats to be sold and is thus price sensitive.

Autumn fed paddock hay on A land (AUFDPH) is included to the set limit of 300 acres and there is no paddock hay production on other land types. It is clear that, as specified, autumn is the period of the greatest feed shortage as the shadow price on autumn fed paddock hay is high at $7.37. It is also clear that paddock hay is the preferred conservation activity because of its cost advantage over hay and silage.

The feeding of barley is not attractive in autumn or winter and the shadow prices of these activities range from $0.27 to $0.53 per bushel. The barley is used for pigs and the balance sold in the winter. The minimum grain store (MNGRST) limit of 10,000 bushels did not apply as 20,890 bushels were carried over and sold in the winter. All the hay that is produced is sold in the winter (HASEWI -200) and is not fed out.

The lot feeding activity (LOTFED) does not enter the solution and will not do so unless the selling price for lotfed steers increases by $17.50 per head while other cattle retain their present prices.

The solution shows that 8,153 LSM's have been transferred from the winter forage pool to the general winter feed pool, 32,155 LSM's from spring to summer and 8,805 LSM's from summer to autumn. There is no feed transferred from autumn to winter and the shadow price on this transfer is $0.28 per LSM.

The bacon pig activity (BACPIG) is included up to the level of the restraint on sow numbers (MAXSOW -44).

Enterprise capital for the basic solution is $186,201.

The only casual labour hired is 307 hours of autumn labour and this is consistent with the present situation where casual labour is hired for tractor driving during the autumn crop sowing period.

Late oats (LATOAT) barely fails to enter the solution because the shadow price of \$0.50 is only the value of an extra bushel of oats.

The same situation applies to nearly all the cereal production activities on the other land types. In all cases a slight increase in yield would mean the inclusion of the activity. This of course is suggestive that prices in the market at large are being related to opportunity cost of production and that the "Laws of Supply and Demand" are working.

Early barley on D land (ELBARD) is grown up to the set limit of 300 acres on early sown grazing cereal.

Share hay on B land (SHRHYA) has been included to a level of 207 acres. This activity may have been reduced if stacking labour had been charged at \$2.00 per acre but as spring labour is surplus this is not a problem. This is confirmed by examination of the cost ranging.

The cast for age wethers are sold as stores (SLSTWT) but the shadow price of the fat selling activity (FTSHWT) is only \$0.06 so it is almost a break-even alternative.

Similarly, autumn fed paddock hay from B land (AFDPHB) is almost included because the shadow price is only \$0.89 and hay production from B land (HYPROB) is nearly included because the shadow price is only -\$1.06.

The Restraints

The inoperative maxima include:

MAXACR	Maximum autumn crop
RAPMAX	Maximum rape crop
WHMXOQ	Maximum overquota wheat
MXGRST	Maximum grain store
MXHYPR	Maximum hay area
MXSIAR	Maximum silage area
MXSRPU	Maximum steer purchase
MXSEGR	Maximum autumn/winter transfer
SUMLAB	Summer labour pool although it is very close to being exhausted
SPRLAB	Spring labour pool
MSBCRP	Maximum crop on B, C & D land

The inoperative minima include:

MINACR	Minimum autumn crop
HAYMIN	Minimum hay production
MINFCR	Minimum fodder crop
EWEMIN	Minimum breeding ewe
COWMIN	Minimum breeding cow
MNGRST	Minimum grain storage requirement

It should be noted that crop production is limited by neither the maxima nor the minimum but by the rotation restraint. If this could be relaxed then more crop would enter the plan. Lupins and peas could have entered the solution regardless of the rotation restraint but there is a positive opportunity cost on their so doing.

The maxima and minima listed above are inoperative in this model but they are retained because they could become operative with changed co-efficients and objectives

The marginal value products of the limiting resources and restraints provide important information. The various classes of arable land have very high MVP's but these areas are fixed for the for the existing properties and can only be expanded by purchase.

The quota wheat limit (WHTSLQ) has a very low MVP of 0.008 which is of no practical significance and the same applies to the $0.31 MVP on maximum A land crop restraint.

The rotation limits have MVP's varying from $1.43 to $4.79 and these represent the grain from relaxing the rotation restraint of particular land types.

Hay storage maximum (MXHYST) is the effective limitation on hay production rather than maximum hay area (MXHYAR). The MVP of additional storage is $0.85 per ton and it would be difficult to build extra storage at a lower cost per ton.

The breeding cow limit has an MVP of $7.64 which makes relaxing the restraint attractive but the breeding ewe limit only has an MVP of $0.36 per ewe which is less attractive.

The breeding sow limit has a very high MVP per sow and it is therefore very attractive to consider relaxing this restraint given than existing cost and price relationships could be expected to continue.

The feed pools show that autumn feed has the highest MVP of any seasonal feed and is the most limiting period. It is not a proposition to feed grain during this period.

The maximum early crop and maximum paddock hay restraints have fairly low MVP's of $1.40 which is probably of no practical significance in reducing potential total revenue. The same applies to the undersown wheat activities.

Objective Ranging

Column Information

The objective ranging gives more information about the solution because it shows the range of objective for which the solution is stable. This is valuable because in the case of WHTSLQ a drop of $0.01 means that the activity drops out and another is included.

If silage production on A land (SILPRO) objective changes from -$7.00 to -$8.86 then SIPROB enters the solution. The difference of $1.86 is the shadow SIPROB. At the other end of the range MINSIL becomes operative.

In hay production $14.00 the hay storage restraint becomes operative at $14.86 and the difference is the MVP of hay storage. If the cost of hay production is reduced to $9.86 the summer hay selling activity will enter the solution.

The most stable elements in the solution can be ascertained by reference to the objective ranging section. They are:

Annual pasture on E land
Angus breeding
Angus x Santa crossbreeding
Selling fat Angus steers
Bacon pigs
Share hay production on B land
Contract hay production on A land

General Discussion of Basic Plan

The basic solution is realistic and, as has been stated earlier in this report, it is generally consistent with the existing farm plan. This is not exactly so in terms of types of crops sown and types of livestock run but it is so in terms of total crop area and total carrying capacity.

The plans have been set out in the Appendix D (1) but the following is a summary of the main points.

Wheat is grown up to the quota limit but no overquota wheat is produced. It would have to be almost equal in price with quota wheat for it to enter the solution.

The cereal grain and grazing crops are included up to the maximum of early crop. As quota wheat production is almost at its limit it would take only a very small increase in yield for these crops to come into the solution.

The newer crops do not enter the solution and will not do so unless the long term yields and prices exceed those used in the gross margin calculations.

Silage is only included in the basic solution because a minimum has been set. The minimum of 300 tons production (from 100 acres) includes a specification that 200 tons be removed from the system in order to build up a drought reserve. The balance is autumn fed. Hay production comes into the solution though mainly in the form of share hay production on B land. An insignificant area of contract hay on A land comes into the solution but this does indicate that a greater area is on the verge of entering the solution. This is confirmed in the objective ranging section because the production cost can fall to below $10 per ton before this activity is excluded while at the upper limit it is hay storage which limits further hay production because winter hay selling which offers the best return.

Minimum phase lucerne is the major pasture activity although there is little to choose between it and maximum phase lucerne. Annual pasture cost would have to fall to a much lower figure if it were to be included. This reflects the better seasonal spread and total production of the lucerne pasture.

Beef cattle and Merino ewe breeding and crossbreeding activities are both included in the solution up to the imposed limits and the activity which then enters the basic solution to utilise the feed produced is the Merino wether activity.

The cattle fattening activities enter the solution but not the sheep fattening activities. Surplus sheep are sold as stores.

Paddock hay production for autumn feeding is the major fodder conservation activity. It is limited by the set maximum.

Barley growing is the main crop activity besides wheat growing and the grain is winter sold except for that utilised by the pig activity. The shadow prices indicate that grain feeding activities (except to pigs) are unprofitable in normal years.

Autumn feed is the most limiting and this is shown by the fact that none is transferred to winter and by the fact that the autumn feed pool gives the highest MVP to a LSM unit.

The shadow prices indicate that a number of activities such as barley and oat growing could enter the plan with very little effect on the total gross margin. The inclusion of other activities such as fodder purchase would mean a much more significant reduction in the total gross margin.

There are several important limiting restraints, and others which are limiting but whose relaxation would have little effect on the total gross margin. The arable land restraints are of the first type whereas the wheat quota limit is of the second type.

The crop limits do not have a great effect as the maximum crop restriction on A land has an MVP of \$0.31 and A rotation on MVP of \$1.43.

The hay storage maximum has an MVP of \$0.86 so hay storage expansion must cost less than this figure for expansion to be worthwhile.

The breeding cow restraint has an MVP of \$7.64 which is significant but the breeding ewe restraint MVP is only \$0.36 which is marginally significant and easily altered if prices change even slightly.

The breeding cow restraint MVP is in terms of the cow unit and the ewe restraint in terms of the ewe unit. In order to compare them it must be noted that approximately 8 ewe units are equal to one cow unit in terms of feed requirement. Thus the breeding cow MVP is still very high in terms of the long run assumptions made. It should be noted that since the linear programme was prepared that wool and sheep prices have risen dramatically and at the present time the difference would be reversed.

The bacon sow limit has a very high MVP but this is a subjectively imposed limit which is fairly rigid. This is because the farm operators do not like pigs and because bacon enterprises have suffered from considerable market fluctuation in the past. The farm operators thus consider expansion to be risky. Modern piggeries require large capital investments and the operators fear that large vertically integrated organisations will be able to squeeze them out of the market. On reflection it would appear that the pig activity could have been better appraised if two activities had been considered; the present enterprise and an expanded enterprise. The higher capital requirements of an expanded enterprise could have been shown against this enterprise.

Spring labour is in considerable surplus in the plan which is at odds with the operators normal experience. This is either due to an inadequate livestock activity labour co-efficient specification or the fact that much of overhead tasks such as fencing maintenance are normally carried out at this time. It is suspected that insufficient allowance was made for the extra labour requirement of spring lambing ewes, but even if this was adjusted the surplus is so large that there would be almost no effect on the total gross margin.

Price Variations and Alternative Resource Models

The details of the changes made from the basic model are set out in the following Table.

1. The basic model

2. The basic model (1) with more optimistic selling prices

3. Same as (2) with a higher wool price (SEMRWL) of $1.30 per kilogram

4. Basic model (1) with breeding cow (MXBRCW) restraint lifted from 600 to 1,000 and cattle sheep relationship (MAXCAT) removed.

TABLE 18

THE PRICES USED IN THE OPTIMISTIC MODEL

		1 Basic Model	2 Optimistic Price Model
Quota wheat selling price	WHTSLQ	1.05	1.15
Overquota wheat selling price	WHSLOQ	0.85	0.95
Steer purchase price	BUYSTR	100.00	105.00
Fat purchased steer selling price	FATCAT	115.00	120.00
Angus steer weaner selling price	SELSTR	75.00	80.00
Fat Angus steer selling price	FATANG	100.00	105.00
Cross vealer selling price	SXVEAL	85.00	90.00
Fat cross steer selling price	SLSXFT	110.00	115.00 (not punched by error)
Oats . summer selling price	SUSEOT	0.45	0.50
. winter selling price	WISEOT	0.55	0.60
Barley . summer selling price	SUSEBA	0.60	0.65
. winter selling price	WISEBA	0.70	0.75
Merino wool . selling price	SEMRWL	0.90	1.10

These three variations of the basic model were chosen but many other choices could have been made. The model will be used in the future for farm planning on this property and the effect of other variations will then be investigated as prices and costs change and technological advances alter co-efficients.

Under normal planning conditions it could be expected that some prices may rise and others fall and this should be allowed for. In this case the prices used were taken from those ruling when there was a depression in all farm prices. The assumptions are therefore conservative and by far the most likely movement would be upwards.

Mention has been made earlier of the use of covariances in the discussion on risk and uncertainty but it is doubtful whether their use in this particular situation would add anything to the simplified price assumption approach which has been adopted.

The results of the price and resource variations have been listed in the Appendix D (5). In Model 2 (the optimistic price situation) the main effect is to increase the total gross margin from \$156,505 to \$181,666 while the enterprise capital declines from \$186,201 to \$142,581. This is mainly due to a swing from cattle breeding and to a lesser extent sheep breeding toward Merino wethers. This swing goes further in the next variation where the wool price was again increased.

In model 2, the wheat quota is again filled, a slightly smaller area of barley is grown and some maximum phase lucerne enters the solution. The hay production declines fractionally and the silage area exceeds the minimum but all these crop and pasture changes are insignificant. It is the change from cattle to Merino wethers which is the significant alteration and this increases the total gross margin and reduces the total enterprise capital.

Model 3 is the same as model 2 with the wool price further increased. This price increase has had a further effect on the solution. The total gross margin has increased to \$211,477 and enterprise capital has risen only slightly to \$151,607. The breeding cow numbers remain the same but the purchase of fattening steers is abandoned. The breeding ewe number increases to the limit again and the wether flock increases to 11,453. The wheat quota is no longer filled and wheat growing is down though the barley activity remains static. At this wool price the lucerne area increases and an area of permanent pasture enters the solution for the first time.

In model 4, the basic plan was used but the breeding cow limit was relaxed from 600 to 1,000 and the cattle sheep proportion restraint removed. Removal of this restraint has increased the total gross margin from $156,505 to $158,527 after deduction of interest on enterprise capital which has increased from $186,201 to $228,383. The operators would not consider risking this extra capital for such a gain. The removal of these restraints had almost no effect on the remainder of the solution other than to slightly reduce the wheat area and to let the breeding cows increase at the expense of breeding sheep.

The basic solution is very stable and wool price has such an over-riding influence that all other factors have little effect. It is clear that the cropping area must be maintained at about its present level and that the substitution of other cereals for wheat would have little effect. The newer crops will only come in if long term prices and yields improve. Increasing the breeding cow herd beyond the 600 cow limit has very little attraction because the extra capital required yields little in the way of increased gross margin. The price of wool is the determining factor with regard to the selection of sheep enterprises and the whole flock composition. The operators' present flock of approximately 50% breeders and 50% wethers may be close to the optimum. Their breeding cow herd will increase as this has already been planned.

They will have to look more closely at a system of cheap inter-seasonal feed transfer tlthough they have previously discarded fodder rolling. A system of "Jayhawking" or loose hay handling might be the answer if it allowed hay to be moved off the areas so that they could be prepared for the next crop phase. It is a particularly attractive conservation technique for cattle.

Share haymaking is also an attractive enterprise which would remain in the solution even if contract hay carting was charged as a cost.

Comparison with Gross Margins Planning

Table 17 shows the 1972 farm plan which is a gross margins calculated plan though subject to some important restrictions.

Farm C was only acquired two years ago and therefore the pastures have not yet reached their full capacity. Also the cropping plan for this area has been determined by the need to crop to undersow pastures and cropping on all areas has been determined by paddock size. The operators have previously discarded paddock hay production as an activity so this is a subjective restraint.

The only major difference in cropping is that the operators are presently growing nearly 200 acres of rape. This activity was introduced after the imposition of wheat quotas but it will be phased out unless returns exceed those from cereal cropping.

The breeding ewe number have been limited by breeding up problems rather than intention and the breeding cows by capital or at least the unwillingness to borrow to buy cattle. The Merino wethers have been necessary to fill the gap in stocking. The first cross breeding enterprise has not been undertaken because of the operators basic plan to build up the Merino breeding flock. The surplus sheep have been retained for fattening for sale and this differs from the solution which sells them as stores.

It is, therefore, true to a certain extent that the linear programme solutions have not yielded improved results beyond the plans already derived by much less sophisticated techniques. At the same time confirmation of the validity of the present plans increases confidence.

In addition enterprises such as paddock hay production and share hay production have been highlighted as being worthy of further study and a basic model has been set up which will greatly simplify further investigation when this becomes necessary.

As previously discussed, the difficulty with gross margins is that one does not know where the turning points are. Here, the operators, because of subjective restraints which may in some case arise from true but intuitively appreciated technical or risk considerations have kept the plan short of some important "steps" along the expansion path.

The Role of Linear Programming

General District Application

It had been hoped to investigate the role of linear programming on a district basis. Time did not permit this study but the author has come to the conclusion that his preconceived ideas are probably erroneous.

It had previously been thought that farms in the district were often do dissimilar that the application of results obtained on one farm would be quite invalid in general. Different farm operators will certainly impose different subjective restraints and there will be different physical restraints such as the area of arable ground but rainfall is such a dominant factor that the other factors are much less important.

It is now considered that the results of this study could be applied on other farms provided simple adjustments were made. This conclusion will need to be tested by preparing plans for a number of other farms.

Cost

This study would have been quite uncommercial in terms of labour and computer costs but this is explained by the fact that it was the author's first attempt at a practical application of linear programming.

It is estimated that the average job could be carried out in future using a day on the farm and one to two days preparation. The estimated cost would be $200-$300 for professional time and $100-$200 for computer time. Extra runs and annual revision could be undertaken with a day's work and no more than $50 for computer time.

CHAPTER 4
CONCLUSION

In the logical development of this project the approach was first to determine whether the decision making criteria - both objective input-output relationships and subjective preferences and constraints - influencing the managers of a multiple enterprise, multiple soil type property, with significant variations in terrain, could be codified and represented in a linear programming matrix. Subsequent steps were to test the stability of the solution obtained when prices and constraints were varied to obtain a more generalised and in a sense "dynamic" solution for the subject farm from which economic and technical principles relevant to continuing management could be elucidated - we seek insights for continuing operation, not a static "optimum" solution relevant to only one set of conditions, static technology or a single point in time.

Finally, the management economist must be interested in the possibility of even greater generalisation to seek guidelines to regional management problems in the anticipation that close-to-optimal enterprise combinations for regional farms could be deduced from a single, or a small number of, individual farm in-depth case studies such as that reported here.

Considering first the plan for the case study farm, we find that the programmed solution to the enterprise mix problem is recognisably, in fact quite closely, similar to that at present in operation. This is an interesting result, and is in keeping with similar findings by Dixey and Maunder (1959) and by Waring (1962) who both found that the "optimal" solutions to the resource allocation problems they studied using linear programming differed only slightly from the practical solutions attained through trial and error by the farm operators involved.

Waring comments on such findings. Although linear programming requires the services of a person with technical knowledge and empathy with the farm manager, there is philosophically at least a danger that the conventional wisdom of the farmer and his adviser will be "built in" to the solution obtained. Waring writes of "programming from Known to Known".

The investigator must be aware of the problem that he will unconsciously rationalise the decision makers values to duplicate the latter's practical solution to the farm resource allocation problem. His defense is the maintenance of as open-minded and objective approach as he is capable, and critical evaluation, if necessary by variable price or co-efficient programming, of all restraints, especially those in any degree subjectively determined.

In the present situation that course has been followed to a reasonable degree, and it appears that the "computer" had little to teach the practical manager who has worked closely with a consultant for several years.

On the case study farm it appears that a biological constraint, the rotation constraint, dominates production possibilities, more so than pasture productivity, another variable which is difficult to quantify precisely. This suggests scope for technical investigation - on a district basis - of the determinants of the rotation constraint, which include land slope, weed control, pasture seeding techniques and possibly the use of nitrogenous fertilisers.

The type of crop enterprise and the type of livestock enterprise are both sensitive to price change but the proportions of crop and livestock on pasture are constant over a wide range. In a preliminary solution a marked reduction of cropping did occur and continuous lucerne with additional livestock did enter a solution. A 25% increase in pasture livestock month production was required before this changeover occurred.

The plans also reveal a virtual indifference between cereal crops and the choice of crop will thus depend on operator preference or slight differences in comparative advantage in producing one or other of the alternative cereal grains. The most important empirical finding is the apparent technical ability of the operators, given specific conditions, to substitute cattle for sheep. There is a volatility in the relationship of cattle and sheep which is controlled by the price of wool, in particular, and beef. This interesting finding supports the author's belief that the operators should aim to increase the size of the basic breeding cow herd despite the current high prices for wool. They would then be in a position to move quickly as prices indicate.

The relaxation of the breeding cow restraint increased total gross margin by $2,022 after providing 8% return on marginal capital of $42,182 - a total return on marginal capital of 12.8%. This is a fairly attractive return at the margin though, as capital has to be borrowed, it may not be high enough. The present operator would require at least 15% in these circumstances to risk the increased investment. However, a relatively small change in technical production co-efficients or cost or price advantage including a change in operator expectations for future wool or beef prices would influence a swing to or from cattle.

The study has pointed up the difficulty of estimating pasture production in livestock months and the importance of linear programming studies being done by experienced workers. The calculation of livestock months from dry matter data, even if it is available, is not easy and can be very misleading. Considerable practical experience is necessary to derive the realistic long term estimates of feed production which are essential. It is likely to appeal to a reasonably affluent operator to err on the side of conservatism and fatten on excess feed in the years of surplus feed production.

The investigation has also indicated that the difficulties of deriving linear programmes which typify a district were probably overrated by the author. His prior belief that this farm was a particular and peculiar case may well be erroneous. Rotation needs and rainfall should be relatively stable across a region and dominate the pattern of combination and the level of relative output of possible enterprises so that the regional management principles can be deduced from the results of one, or a few large farms, - not every property should need to be individually programmed.

The initial costs of linear programming would be commercially acceptable and the costs of an annual revision are very low.

BIBLIOGRAPHY

Anderson, J.R. 1972
An overview of modelling in agricultural management.
Review of Marketing and Agricultural Economics Vol.40 No.3
September 1972 P.111

Barlow, C. 1963
Input-output relationships and economic choice, with particular reference to selected farms in Northern Scotland.
Unpublished Ph.D. thesis, The University of Aberdeen

Baumol, W.J. 1965
Economic Theory and Operations Analysis.
New Jersey: Prentice-Hall Inc.

Boulding, K.E. 1948
Economic Analysis. New York: Harper Bros.

Bradford, L.A. and Johnson, G.L. 1953
Farm Management Analysis. New York: Wiley

Chudleigh, P.D. 1967
Enterprise combination on a Cowra property A linear programming study.
Farm Management Vol.3 No.1 March 1967 P.11

Danzig, G.B. 1951
Maximisation of a linear function of variables subject to linear inequalities.
Activities Analysis of Production and Allocation
(T.C. Koopmans Ed.) New York: Wiley

Dixey, R.N. and Maunder, A.H. 1959
Planning again: A study of farm size and layout.
The Farm Economist Vol.IX No.6 1959 P.231

Dorfman, R. et al. 1958
Linear Programming and Economic Analysis.
New York: McGraw-Hill

Egan, R.J. 1968
Optimum combination of enterprises using linear programming.
Technical Bulletin 4 Economic Services Branch, Queensland Department of Primary Industry

Glau, T.E. and Luders, D.J. 1968
Variable price programming and price mapping.
Farm Management Vol.4 No.3 September 1968 P.1

Heady, E.O. 1956
Budgeting and linear programming in estimating resource productivity and cost relationships.
Resource Productivity, Returns to Scale and Farm Size.
Ames: Iowa State College Press

Heady, E.O. and Chandler, W. 1958
Linear Programming Methods. Iowa: The Iowa State University Press. Ames

Johnson, G.L. 1950
Needed developments in economic theory as applied to farm management.
Journal of Farm Economics XXXII December 1950 P.1151

Molnar, J. Ed.
A Manual of Australian Agriculture
Melbourne: Heinemann

Powell, R.A. and Hardaker, J.B. 1968
Planning wheat farms in North Western New South Wales.
Farm Management Report No.14 University of New England

Rickards, P.A., Anderson, F.M. and Kerrigan, R.H. 1967
Farm planning with computers.
Journal of the Australian Institute of Agricultural Science

Rickards, P.A. and McCarthy, W.O.
Linear programming and practical farm plans.
University of Queensland papers Vol.1 No.5 Department of Agriculture

Rickards, P.A. and McConnell, D.J. 1967
Budgeting, gross margins and programming for farm planning.
Professional Farm Management Guide Book No.3 University of New England

Rickards, P.A. and Musgrave, W.F. 1965
Farm planning, linear programming and soil heterogeneity.
Review of Marketing and Agricultural Economics Vol.33 No. 4 December 1965 P.190

Rickards, P.A. and Passmore, A.L. 1971
Planning for profits in livestock grazing systems.
Professional Farm Management Guide Book No.7 University of New England

Renborg, V. 1962
Studies on the Planning Environment of the Agricultural Firm.
Uppsala: Almgvist & Wiksells Boktrycheri A B

Sibree, J.M. 1972
Wagga Wagga Occasional Economic Series No.9. New South Wales Department of Agriculture

Tyler, G.J. 1960
An application of linear programming.
Journal of Agricultural Economics Vol.XIII No.4 January 1960 P.473

Tyler, G.J. 1964
Optimum programmes for wheat farms in the North Western Slope.
Review of Marketing and Agricultural Economics Vol.32 No.1 March 1969 P.5

Waring, E.J., Fahy J.D. and Sturgess, N.H.
Farm planning in the Graman District of New South Wales.
Farm Management Report No.7 University of New England Armidale

Waring, E.J. 1962
Linear programming using farmer estimated input-output coefficients.
Unpublished M.Agr.Ecs. thesis. University of New England

Watson, B.H. 1972
Farm budgeting and planning guidelines for Cootamundra district.
Farm Management Report No.21 University of New England

Wrigley, J. 1966
Linear programming and farm management advice.
Farm Management Vo.2 No.3 September 1966 P.1

LIST OF APPENDICES

LIST OF APPENDICES (Cont.)

APPENDIX A (1)

SHEEP GROSS MARGINS

	Merino Breeding		Merino x Border Leicester		Merino Wethers	
<u>Revenue</u>						
Wool - Wethers					100 x 5.5 Kg = 550	
Breeding ewes	100 x 5 Kg = 500		90 x 4.5 Kg = 405			
CFA ewes	20 x 4.5 Kg = 90					
Ewe weaners	35 x 1 Kg = 35		40 x 4 Kg = 160			
Wether hoggets	35 x 4 Kg = 140					
	765 Kg		565 Kg		550 Kg	
	@ 90c = 688.5	@ 100c = 765.0	@ 90c = 508.5	@ 100c = 565.0	@ 90c = 495.0	@ 100c = 550.0
Sheep - CFA ewes	20 x $3 60.0	20 x $4 80.0	90 x $3 270.0	90 x $4 360.0		
CFA wethers					23x$3.5 80.5	23x$4.5 103.5
Ewe hoggets	10 x $4 40.0	10 x $4 40.0	40 x $7 280.0	40 x $7 280.0		
Wether hoggets	35 x $3 105.0	35 x $4 140.0				
Lambs			40 x $5 200.0	40 x $5 200.0		
	$893.5	$1025.0	$1258.5	$1405.0	$575.5	$653.5
Less Replacement Ewes			100x$3 300.0	100x$4 400.0		
Replacement Wethers					27x$4 108.0	27x$4.5 121.5
Purchase Rams	.5x$100 50.0	.5x$100 50.0	.5x$50 25.0	.5x$50 25.0		
	$843.5	$975.0	$933.5	$980.0	$467.5	$532.0

Continued:

APPENDIX A (1) (Cont.)

	Merino Breeding			Merino x Border Leicester			Merino Wethers	
<u>Net Revenue</u>			843.50			933.50		467.50
Variable Costs	120 Ewes	70 Weaners		90 Ewes	80 Weaners		100 Wethers	
Veterinary per head	.24	.24		.24	.24		.15	
Mulesing per head		.08			.08			
Shearing & Crutching per head	.57	.57		.57	.57		.59	
	.81	.89		.81	.89		.74	
	97.20	62.30		72.90	71.20		74.00	
			159.50			144.10		74.00
Gross Margin			684.00			789.40		393.50
Gross Margin per Ewe			6.84			7.89		3.94
Gross Margin per Livestock Month			0.31			0.36		0.31

APPENDIX A (2)

GROSS MARGIN FOR SHEEP FATTENING ACTIVITIES

	Fatten CFA Ewes	Fatten CFA Wethers
Buy	$3.00	$3.50
Sell	$4.00	$4.50
Gross Margin	$1.00	$1.00
Summer LSMs		3.0
Autumn LSMs	1.8	
Winter LSMs	2.7	
TOTAL LSMs	4.5	3.0
Gross Margin per LSM	$0.22	$0.33

APPENDIX A (3)

BEEF BREEDING GROSS MARGINS

	Angus Breeding (Self Replacing)			Angus x Santa Gertrudis (Breeding 1st Cross)		
Revenue						
Sell CFA cows	12 @ $110	$1320		12 @ $110	$1320	
Weaners	6 heifers @ $65	390				
Steers	44 @ $75	3300		44 @ $85	3340	
Heifers	23 @ $100	2300	$7310	44 @ $80	3520	$8580
Less Purchase Replacement Heifers				15 @ $100		1500
Purchase Replacement Bulls	0.7 @ $500		350			350
			6960			6730
Variable Costs						
Veterinary – Cows	$2 x 100	200		$2 x 100	200	
– Heifers	$1 x 38	38				
– Weaners	$0.50 x 88	44	282	$0.50 x 88	44	244
Gross Margin			$6678			$6486
Gross Margin per Cow			$66.8			$64.9
Gross Margin per Livestock Month			$0.38			$0.45

APPENDIX A (4)

GROSS MARGINS FOR BEEF ATTENING ACTIVITIES

	Angus Steers $	Angus x Santa Steers $	Purchased Steers $	Feed Lot $
Buy	75.0	85.0	100.0	75.0
Sell	100.0	110.0	120.0	125.0
Gross Margin	25.0	25.0	20.0	50.0
Gross Margin per LSM	0.35	0.35	0.34	
Feed	Nil	Nil	Nil	Daily gain 2.5 lbs over 100 day feeding period. Total feed consumption: 36 bus. barley $\frac{1}{3}$ ton hay

APPENDIX A (5)

CROP PRODUCTION COSTS

	Wheat			Grain Graze			
	A	B	E	Early Oats A	Late Oats A	Early Barley A	Late Barley A
Yield bushels	30	30	24	36	36	33	33
LSMs stubble	-5	-5	-5	-8	-8	-8	-8
winter				-45	-20	-40	-25
<u>Variable Costs</u>							
Fertiliser	1.50	2.00	2.00	2.00	2.00	2.00	2.00
Seed	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sprays Treflan	0.40	0.40					
Others	0.25	0.25		0.25	0.25	0.25	0.25
Fuel	0.60	0.60	0.80	0.60	0.60	0.60	0.60
Repairs & Maintenance	1.60	1.60	1.80	1.60	1.60	1.60	1.60
Cartage	0.25	0.25	0.25				
Additional harvesting				0.20	0.20	0.20	0.20
Sundry			0.45				
Total Variable Costs	5.60	6.10	6.30	5.65	5.65	5.65	5.65
Plant Replacement Allowance	2.00	2.00	2.00	2.00	2.00	2.00	2.00
TOTAL COSTS	7.60	8.10	8.30	7.65	7.65	7.65	7.65

APPENDIX A (6)

CROP GROSS MARGINS

	Rape A	Lupins A	Peas A	Sunflower A	Share Wheat D	Contract Wheat D	Malting Barley D
Yield	0.4 ton	0.5 ton	0.6 ton	0.33 ton	14 bus	27 bus	27 bus
Price on farm	$76	$60	$48	$90			$0.90
Revenue	$30.40	$30.00	$28.80	$30.00			$24.30
LSM Summer Winter	-2	-8	-7	-3	-5	-5	-8
Variable Costs							
Fertiliser	2.40	2.40	2.40	2.00	2.00	2.00	2.00
Seed	0.80	2.30	2.00	2.00	1.00	1.00	1.00
Sprays - Treflan	-	3.00	3.00	-	0.35	0.35	-
Other	0.20	0.30	0.30	-	0.25	0.25	0.25
Fuel	0.65	0.65	0.65	0.60	-	-	0.60
Repairs & Maintenance	1.60	1.60	1.60	1.60	-	-	1.60
Additional Harvesting	0.60	0.60	0.60	0.60	-	-	0.20
Contract cultivate/harvest	-	-	-	-	-	9.00	-
TOTAL OPERATING COSTS	6.25	10.85	10.55	6.80	3.60	12.60	5.65
Plant Replacement Allowance	2.00	2.00	2.00	2.00	-	-	2.00
TOTAL COSTS	8.25	12.85	12.55	8.80	3.60	12.60	7.65
Gross Margin	22.15	17.15	16.25	21.20			16.65

APPENDIX A (7)

GROSS MARGINS FOR FODDER CONSERVATION ACTIVITIES

	Baled Hay + Pastures Contract	Silage + Pastures Own Plant	Paddock Hay Part Contract
Yield	1 ton per acre	3 tons per acre	1 ton per acre
LSM Value	30	10	(Autumn 27 (Winter 24
Variable Costs	$	$	$
Mow, rake, bale	8.85	-	-
Cart and stack	4.00	-	-
Plant operating costs	-	6.00	3.00
Hay cost per acre	12.85	6.00	3.00
Pasture cost	1.15	1.00	-
Gross Margin per Acre	-$14.00	-$7.00	-$3.00
Cost per ton fodder	12.85	2.00	3.00
Labour cost per ton	1 hour 2.00	0.5 hr 1.00	-
	-$14.85	-$3.00	-$3.00
Feed out cost	$0.50	$0.50	-

APPENDIX A (8)

PASTURE COSTS

Minimum Phase Lucerne 6 year		Maximum Phase Lucerne 8 year		Continuous Lucerne		Annual Pasture	
4 lb lucerne x 35c	1.40	Lucerne	1.40	Lucerne	1.40	10 lb Sub clover	1.90
4 lb subclover x 20c	0.80	Sub clover	0.80	Sub clover	0.80	1 cwt super	1.70
2 cwt super x 1.70	3.40	3 cwt super	5.10	4 cwt super	6.80		
Spray	1.70	Spray	1.90	Cultivation	4.00		
	$7.30		$9.20		$13.00		$3.60
Per Annum	$1.25		$1.15		$1.625		$0.90

APPENDIX A (9)

PIG ACTIVITY GROSS MARGIN

<u>Revenue</u>	
Sale 15.6 pigs @ $30 net	470
<u>Less Variable Costs</u>	114
	356
<u>Less Feed</u>	
150 bus. barley @ 70c	105
	$251

APPENDIX A (10)

CROP SPRAY DATA

Grass Control Spray ("Treflan")

Material $\frac{3}{4}$ pint	$2.70
Spray application	0.25
Extra working	0.45
	$3.40 per acre

Need to spray	Lupins) Peas)	100% of time
	Rape	50% of time
	Wheat) Barley)	20% of time

NB If 10% humus, rate up by $\frac{1}{3}$ or $0.90
Rape requires 1 pint, so cost up $0.90

Skeleton Weed Spray (24D Amine)

Material	$0.35
Application	0.25
	$0.60 per acre

Need to spray cereals 50% of time

Insect Control

	Earthmite control with Rogor of innoculated undersown clovers and medics		$0.20 per acre
Rape	Aphids - 8 Oz Metasystox	1.60	
	Cabbage Centre moth) Heliothus) 32 oz DDT	0.50	
	Air spray	0.80	$2.90
Sun-flowers	Rutherglen bug		-

APPENDIX B (1)

SEASONAL LSM REQUIREMENTS OF A 100 MERINO EWE FLOCK

Month	Cast Ewes		Breeding Ewes		Lambs		Ewe Hoggets		Hogget Wethers		Rams	Flock Total
	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head		
September			96	1.6	60	x	35	0.9	35	1.2	3.0	Spring
October			96	1.6	80	x	35	0.9	35		3.0	Total
									to young wether pool			= 606.3
November			96	1.6	80	x	35	0.9			3.0	Per ewe = 6.1
December			95	1.6	80	x	35	0.9			3.0	Summer
January			95	0.8			(35	1.0				Total
							(38	1.0	38	1.0	3.0	= 567.5
							Sell 10					
February	20	0.9	75+25	1.0			35	1.0	35	1.0	3.0	Per ewe = 5.7
March	20	0.9	100	0.9			35	1.0	35	1.0	3.0	Autumn
	to CFA ewe pool											Total
April			100	0.8			35	1.0	35	1.0	3.0	= 480.9
May			100	0.8			35	0.9	35	0.9	3.0	Per ewe = 4.9
June			99	0.8			35	0.9	35	0.9	3.0	Winter
July			99	1.0			35	0.9	35	0.9	3.0	Total=499.4
August			99	1.2			35	0.9	35	1.0	3.0	Per ewe = 5.0
												21.7

The breeding ewe unit supplies 0.35 units to the young wether pool and 0.20 units to the cast for age ewe poo.

APPENDIX B (2)

SEASONAE LSM REQUIREMENTS OF A 100 EWE FIRST CROSS BREEDING FLOCK

Month	Cast Ewes		Breeding Ewes		Lambs		Ewes		HoggetWethers		Ram	Flock Total
	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head		
September			96	1.6	60	×	40	1.2			3.0	Spring
October			96	1.6	85	×					3.0	Total = 518.7
November			96	1.6	85	×					3.0	Per ewe = 5.2
December			95	0.8			40	1.0	40	1.0	3.0	Summer
January			95	0.8			40	1.0	40	1.1	3.0	Total = 598.9
February	90	0.9	100	1.0			40	1.1	40	1.2	3.0	Per ewe = 6.0
March	90	0.9	100	0.9			40	1.1	40	1.3	3.0	Autumn
April Sell	90		100	0.8			40	1.2	40	1.2	3.0	Total = 588.9
May			100	0.8			40	1.2			3.0	Per ewe = 5.9
June			99	0.8			40	1.2			3.0	Winter
July			99	1.0			40	1.2			3.0	Total = 450.9
August			99	1.2			40	1.2			3.0	Per ewe = 4.5
												21.6

The ewe unit demands 1.0 replacement ewes per year per ewe mated and supplies 0.9 units to the cast for age ewe pool

APPENDIX B (3)

SEASONAL LSM REQUIREMENTS OF A 100 MERINO WETHER FLOCK

Month	Cast for Age Wethers		Wethers		Flock Total
	Number	LSM per Head	Number	LSM per Head	
September October November	 23 23 (Transferred to CFA wether pool)	 1.0 1.0	98 74 + 27 100	1.0 1.0 1.0	Spring Total = 345 Per wether = 3.5
December January February			100 100 99	1.0 1.0 1.0	Summer Total = 299 Per wether = 3.0
March April May			99 99 99	1.0 1.0 1.0	Autumn Per wether = 3.0
June July August			98 98 98	1.0 1.0 1.0	Winter Per wether = 3.0
					12.5

APPENDIX B (4)

SEASONAL LSM REQUIREMENTS OF 100 COW ANGUS BREEDING HERD (100+ MATED 90 TO CALVE)

Month	Dry&Cull Cows		Wet Cows		Calves		Heifers		Bulls		Herd Total
	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	
September			90	11.8	88	-	37	7.0	3	8.5	Spring
October			89	12.0	88	-	37	7.0	3	8.5	Total = 4550
November			89	12.5	88	-	37	7.0	3	8.5	Per cow = 46
December			89	13.2	88	-	37	7.0	3	8.5	Summer
January			89	14.0	88	-	37	7.0	3	8.5	Total = 4320
February	12	10.0	77	7.0	A.		38	6.0	3	8.5	Per cow = 44
					B.		D.				
					C.		E.				
March	12	10.0	92	7.7			38	6.1	3	8.5	Autumn
April	12	10.0	92	9.1			38	6.2	3	8.5	Total = 3930
May	F.		92	10.5			38	6.3	3	8.5	Per cow = 40
June			90	11.0	50	-	38	6.5	3	8.5	Winter
			calving								Total = 4300
July			90	11.2	88	-	38	6.7	3	8.5	Per cow = 43
August			90	11.5	88	-	38	6.9	3	8.5	
											173

Per cow unit there are:

A. 44 steers transferred to steer pool
B. 6 heifers sold
C. 38 heifers retained for replacement selection
D. 23 transferred to heifer pool
E. 15 to herd as replacements
F. 12 dry or culled cows sold

The Angus breeding cow activity supplies 0.5 (0.44 steers, 0.6 heifers) to the Angus pool for disposal as stores or as winter fattened stock.
0.23 mated heifers are supplied to the heifer pool for sale or for use as replacements in the first cross breeding herd.

APPENDIX B (5)

SEASONAL LSM REQUIREMENTS OF 100 COW CROSS BREEDING HERD

Month	Dry Cows		Wet Cows		Calves		Bulls		Herd Total
	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	No.	LSM/ Head	
September			90	12.0	88		3	8.5	Spring
October			89	12.2	88		3	8.5	Total = 3750
November			89	12.8	88		3	8.5	Per cow = 38
December			89	13.6	88		3	8.5	Summer
January			89	14.5	88		3	8.5	Total = 3760
February	12	10.0	77+15 ex heifer pool	7.5	88 to crossbred pool		3	8.5	Per cow = 38
March	12	10.0	92	8.2			3	8.5	Autumn
April	12	10.0	92	9.6			3	8.5	Total = 3290
May	12 dry or culled cows sold	10.0	92	11.0			3	8.5	Per cow = 33
June			90	11.5	50		3	8.5	Winter
July			90	11.7	88		3	8.5	Total = 3600
August			90	12.0	88		3	8.5	Per cow = 36
									145

Each cow unit supplies 0.88 to the crossbred pool for sale as vealers or as fattened steers.
Replacements of 0.15 heifers are required from the heifer pool.

APPENDIX B (6)

SEASONAL LSM REQUIREMENTS FOR CATTLE FATTENING ACTIVITIES

Month	Angus Steers		Angus x Santa Steers		Purchased Steers	
	LSM per Head	Total	LSM per Head	Total	LSM per Head	Total
Holding Period		Summer		Summer		Summer
December	-	-	-	-	-	-
January	-	-	-	-	-	-
February	6.0	6.0	6.0	6.0	-	-
Holding Period		Autumn		Autumn		Autumn
March	6.3	-	6.4	-	-	-
April	6.4	12.6	6.6	13.0	7.0	7.0
Fattening Period		Winter		Winter		Winter
May	7.0	-	7.0	-	7.0	-
June	10.5	-	10.5	-	10.5	-
July	11.0	40.0	11.0	-	11.0	40.0
August	11.5	-	11.5	40.0	11.5	-
Finishing Period		Spring		Spring		Spring
September	11.6	-	12.5	-	12.0	-
October	-	11.6	-	12.0	-	12.0
November	-	-	-	-	-	-
TOTAL		69.6		71.0		59.0

APPENDIX B (7)

PASTURE PRODUCTION (LSMs)

		Arable Land		Non Arable
		Lucerne	Annual Pasture	Annual Pasture
A Land	Spring	30	30	22
	Summer	14	7	7
	Autumn	14	10	9
	Winter	14	16	11
		72	63	49
B Land	Spring	26	26	
	Summer	12	7	
	Autumn	12	10	
	Winter	12	12	
		62	55	
C Land	Spring	22	22	
	Summer	11	6	
	Autumn	11	10	
	Winter	11	11	
		55	49	

CROP PRODUCTION

Production	Wheat	Oats		Barley	
		Early	Late	Early	Late
Grain (a)	30	33	36	33	36
Forage (b)		45	20	40	25
Grain	30	33	36	33	36
Forage		45	20	40	25
Grain	27	33	36	33	36
Forage		45	20	40	25

Continued:

APPENDIX B (7) (Cont.)

		Arable Land		Non Arable Annual Pasture	Production	Wheat	Oats		Barley	
		Lucerne	Annual Pasture				Early	Late	Early	Late
D Land	Spring	20	20		Grain	27	33	33	33	33
	Summer	10	5							
	Autumn	10	9							
	Winter	10	10		Forage		40	20	35	25
		50	44							
E Land	Spring		19		Grain	24	30		30	
	Summer		6							
	Autumn		8							
	Winter		9		Forage		20		25	
			42							

(a) Grain yield in bushels

(b) Forage production in LSMs

APPENDIX C (1)

RESOURCES AND RESTRAINTS

Row	Name	Value	Description
1	ALANAR	2010 acres	Arable A class land
2	ELANAR	700 acres	Arable E class land
3	NONARR	810 acres	Non arable A, B, C and D class land
4	MAXACR	2300 acres	Autumn crop limit
5	MINACR	700 acres	Autumn crop limit
6	RAPMAX	300 acres	Oilseed rape limit
7	LUPMAX	100 acres	Lupin limit
8	PEAMAX	100 acres	Field pea limit
9	SUNMAX	300 acres	Sunflower limit
10	WHMAXQ	40000 bushels	Wheat quota limit
11	WHMXOQ	10000 bushels	Overquota wheat limit
12	MXCRAL	670 acres	A land crop limit
13	MXCREL	240 acres	E land crop limit
14	AROTAT		Rotation relationship arable A land
15	EROTAT		Rotation relationship arable E land
16	WHTPOL		Wheat grain pool
17	HAYMIN	25 tons	Hay production minimum
18	MINFCR	200 acres	Early sown grazing cereal limitation
19	MXGRST	50000 bushels	Grain storage limit
20	MXHYST	200 tons	Hay storage limit
21	MXHYAR	300 acres	Contract hay production area limit
22	MXSIAR	300 acres	Silage production area limit
23	MXSRPU	200 head	Steer purchase limit

APPENDIX C (1) (Cont.)

Row	Name	Value	Description
24	MXBRCW	600 head	Breeding cow limit
25	MXBREW	10000 head	Breeding ewe limit
26	MXBRBL	3000 head	Merino ewe x Border Leicester ram limit
27			
28	MAXSOW	44 head	Sow limit
29	SHPPOL		Cast for age ewe pool
30	WETPOL		Merino wether hogget pool
31	STRPOL		Purchased steer pool
32	SPRFED		Spring feed pool
33	SUMFED		Summer feed pool
34	AUTFED		Autumn feed pool
35	WINFED		Winter feed pool
36	ANFPOL		Angus steer pool
37	WIFRPL		Winter forage pool
38	PAHYPL		Paddock hay pool
39	EWEMIN	2000 head	Breeding ewe minimum
40	COWMIN	100 head	Breeding cow minimum
41	OAGRPL		Oat grain pool
42	BAGRPL		Barley grain pool
43	HAYPOL		Lucerne hay pool
44	SILPOL	200 tons	Silage pool with 200 tons reserved for drought
45	LIVCAP	$	Enterprise capital
46	MERPOL	Kilos	Merino wool pool
47	SUMLAB	3600 hours	Summer labour pool

APPENDIX C (1) (Cont.)

Row	Name	Value	Description
48	AUTLAB	3600 hours	Autumn labour pool
49	SPRLAB	3600 hours	Spring labour pool
50	MAXWHR	20000 head	Merino wether limit
51	MAXECP	300 acres	Early gra ing cereal limit
52	MXPDHY	300 acres	Paddock hay production limit
53	MXAWTR		Autumn winter feed transfer limit
54	MXSATR		Summer autumn feed transfer limit
55	MINWCP	500 acres	Wheat area minimum
56	MINXIL	100 acres	Minimum silage production area
57	BLANAR	2170 acres	Arable B class land
58	CLANAR	410 acres	Arable C class land
59	DLANAR	1400 acres	Arable D class land
60	ENONAR	965 acres	Non arable E class land
61	BROTAT		Rotation relationship arable B land
62	CROTAT		Rotation relationship arable C land
63	DROTAT		Rotation relationship arable D land
64	MXBCRP	730 acres	Crop limit B land
65	MXCCRP	140 acres	Crop limit C land
66	MXDCRP	470 acres	Crop limit D land
67	CFWTPL		Cast for age wether pool
68	XBSTPL		Angus x Santa cross steer pool
69	HEIFPL		Surplus Angus heifer pool
70	USWHTA		Relation total crop area to undersown crop on A land
71	USWHTB		Relation total crop area to undersown crop on B land

APPENDIX C (1) (Cont.)

Row	Name	Value	Description
72	USWHTC		Relation total crop area to undersown crop on C land
73	USWHTD		Relation total crop area to undersown crop on D land
74	MAXCAT		Limits cattle to 50% of sheep
75	MAXBAR		Malting barley area limit
76	CATREL		Limits Angus x Santa to 20% of Angus breeding
77	XBEREL		Limits Merino x Border Leicester to 20% of Merino breeding
78	MNGRST	10000 bushels	Grain reserve minimum
79	LUCMNA		Relationship lucerne extend activity to minimum phase lucerne on A land
80	LUCMNB		Relationship lucerne extend activity to minimum phase lucerne on B land
81	LUCMNC		Relationship lucerne extend activity to minimum phase lucerne on C land
82	LUCMND		Relationship lucerne extend activity to minimum phase lucerne on D land
83	MNHYST	25.0 tons	Hay reserve minimum
84	AHAYPL		Limits A paddock hay to A pasture
85	BHAYPL		Limits B paddock hay to B pasture
86	CHAYPL		Limits C paddock hay to C pasture
87	DHAYPL		Limits D paddock hay to D pasture

APPENDIX C (2)

Column	Name	Value $	Description
1	WHTGRH	-8.30	Wheat growing E land
2	WHTGRG	-7.60	Wheat growing A land
3	WHTSLQ	+1.05	Quota wheat selling activity
4	WHSLOQ	+0.85	Overquota wheat selling activity
5	OTGRGR	-7.65	Early oat grain and grazing
6	BAGRGR	-7.65	Early barley grain and grazing
7	BAGGRN	+16.65	Malting barley on D land
8	RAPCRP	+22.15	Oil seed rape on A land
9	LUPCRP	+17.15	Sweet lupin on A land
10	PEACRP	+16.25	Field peas on A land
11	SFLCRP	+21.20	Sunflowers on A land
12	SHWHGR	-3.60	Share wheat on D land
13	COWHGR	-12.60	Contract wheat on D land
14	SILPRO	-7.00	Silage production on A land
15	HAYPRO	-14.00	Contract hay production on A land
16	LUCCON	-1.10	Continuous lucerne on A land
17	LUCMIN	-1.25	Minimum phase lucerne on A land (6 years)
18	LUCMAX	-1.15	Maximum phase lucerne on A land (8 years)
19	ANAMIN	-0.90	Annual pasture on arable A land (4 years)
20	ANEMIN	-0.90	Annual pasture on arable E land
21	PERPAS	-0.80	Permanent phalaris pasture on A land
22	ANNPAS	-0.80	Annual pasture non arable A B C & D land
23	ANGBRD	+10.80	Angus breeding activity
24	BUYSTR	-100.00	Store steer purchase activity

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description
25	SELSTR	+75.00	Angus weaner selling activity
26	AASANT	+42.50	Beef crossbreeding activity
27	FATCAT	+120.00	Selling fat purchased steers
28	FATANG	+100.00	Selling fat Angus steers
29	MERBRD	-1.70	Merino breeding activity
30	MERXBL	+5.80	First cross breeding activity
31	MERWET	-0.90	Merino wether activity
32	SECXRS		Autumn winter feed transfer
33	SLSTWT	+4.00	Store wether selling activity
34	SLSTSP	+3.00	Store cast for age ewe selling activity
35	FATSHP	+4.00	Fat ewe selling activity
36			
37	AUFDPH	-4.00	Autumn fed paddock hay on A land
38	WTFDPH	-4.00	Winter fed paddock hay on A land
39	SUSEOT	+0.45	Summer oat selling
40	WISEOT	+0.55	Winter oat selling
41	SUSEBA	+0.60	Summer barley selling
42	WISEBA	+0.70	Winter barley selling
43	AUFDOA	-0.08	Autumn oat feeding
44	WIFDOA	-0.08	Winter oat feeding
45	AUFDBA	-0.08	Autumn barley feeding
46	WIFDBA	-0.08	Winter barley feeding
47	LOTFED	+100.00	Lot feeding of Angus steers
48	HASEWI	+20.00	Winter hay selling

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description
49	AUFDHY	-0.50	Autumn hay feeding
50	WIFDHI	-0.50	Winter hay feeding
51	WIFDSI	-0.50	Winter silage feeding
52	FOTRAS		Transfer of surplus feed from WIFRPL to WINFED pool
53	SPSUTR		Transfer surplus spring feed to summer with 35% wastage
54	SUAUTR		Transfer surplus summer feed to autumn with 25% wastage
55	BACPIG		Bacon pig enterprise
56	INTRST	-0.08	Interest charging activity
57	HISPLB	-2.00	Extra spring labour hiring activity
58	HISULB	-2.00	Summer labour hire
59	HIAULB	-2.00	Autumn labour hire
60	SEMRWL	+0.90	Merino wool selling activity
61	LATOAT	-7.65	Late sown oats on A land
62	LATBAR	-7.65	Late sown barley on A land
63	WHEATB	-8.10	Wheat on arable B class land
64	ELOATB	-7.65	Early sown grazing oats on arable B class land
65	LTOATB	-7.65	Late sown oats on arable B class land
66	ELBARB	-7.65	Early sown barley on arable B class land
67	LTBARB	-7.65	Late sown barley on arable B class land
68	RAPCPB	+20.00	Rape on arable B class land
69	LUMINB	+15.00	Lupins on arable B class land

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description
70	PEACPB	+14.00	Peas on arable B class land
71	SUNFLB	+20.00	Sunflowers on arable B class land
72	LUCCNB	-1.10	Continuous lucerne on arable B class land
73	LUCMNB	-1.25	Minimum phase lucerne on arable B class land
74	LUCMXB	-1.15	Maximum phase lucerne on arable B class land
75	ANPASB	-0.90	Annual pasture on arable B class land
76	PRPASB	-0.80	Permanent phalaris pasture on arable B class land
77			
78	WHTGRC	-8.10	Wheat growing on C class land
79	ELOATC	-7.65	Early oats on C class land
80	LTOATC	-7.65	Late oats on C class land
81	ELBARC	-7.65	Early barley on C class land
82	LTBARC	-7.65	Late barley on C class land
83	RAPCPC	+19.00	Oilseed rape on C class land
84	LUPINC	+14.00	Lupins on C class land
85	PEACPC	+13.00	Peas on C class land
86	SUNFLC	+19.00	Sunflowers on C class land
87	LUCCNC	-1.10	Continuous lucerne on C class land
88	LUCMNC	-1.25	Minumum phase lucerne on C class land
89	LUCMXC	-1.15	Maximum phase lucerne on C class land
90	ANPASC	-0.90	Annual pasture on C class land
91	PRPASC	-0.80	Permanent phalaris pasture on C class land
92			
93	WHTGRD	-8.10	Wheat growing on D class land

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description	
94	ELOATD	-7.65	Early oats	on D class land
95	LTOATD	-7.65	Late oats	on D class land
96	ELBARD	-7.65	Early barley	on D class land
97	LTBARD	-7.65	Late barley	on D class land
98	RAPCPD	+18.00	Rape	on D class land
99	LUPIND	+13.00	Lupins	on D class land
100	PEACPD	+12.00	Peas growing	on D class land
101	SUNFLD	+18.00	Sunflowers	on D class land
102	LUCCND	-1.10	Continuous lucerne	on D class land
103	LUCMND	-1.25	Minimum phase lucerne	on D class land
104	LUCMXD	-1.15	Maximum phase lucerne	on D class land
105	ANPASD	-0.90	Annual pasture	on D class land
106	PRPASD	-0.80	Permanent pasture	on D class land
107				
108	USWHTA	-7.60	Undersown wheat on A land	
109	USWHTB	-8.10	Undersown wheat on B land	
110	USWHTC	-8.10	Undersown wheat on C land	
111	USWHTD	-8.10	Undersown wheat on D land	
112	BARCPE	-7.65	Grain and grazing barley	on E class land
113	OATCPE	-7.65	Grain and grazing oats	on E class land
114	BARGNE	+14.00	Malting barley	on E class land
115	PRPASE	-0.80	Permanent pasture	on E class land
116	SHRHYA	0	Share hay making activity on B land	
117	FTSHWT	+4.50	Fat cast for age wether selling activity	

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description
118	OATBUY	-0.60	Autumn oat buying activity
119	BARBUY	-0.75	Autumn barley buying activity
120	HAYBUY	-20.00	Autumn hay buying activity
121	SUHYSL	+15.00	Summer hay selling activity
122	SLHEIF	+100.00	Heifers selling activity
123	SXVEAL	+85.00	Crossbred vealer selling activity
124	SLSTWT	+3.50	Store cast for age wethers selling activity
125	SLSXFT	+115.00	Fat crossbred steer selling activity
126	AFDPHB	-4.00	Autumn fed paddock hay B land
127	WFDPHB	-4.00	Winter fed paddock hay B land
128	AFDPHC	-4.00	Autumn fed paddock hay C land
129	WFDPHC	-4.00	Winter fed paddock hay C land
130	AFDPHD	-4.00	Autumn fed paddock hay D land
131	WFDPHD	-4.00	Winter fed paddock hay D land
132	APENAR	-0.80	Annual pasture on A B C D non arable land
133	AUFDSI	-0.50	Autumn silage feeding
134	LUEXIA	-1.15	Lucerne extend activity (7 year phase) on A land
135	LUEXIB	-1.15	Lucerne extend activity (7 year phase) on B land
136	LUEXIC	-1.15	Lucerne extend activity (7 year phase) on C land
137	LUEXID	-1.15	Lucerne extend activity (7 year phase) on D land
138	HYPROB	-14.00	Hay production on B land
139	BUYWET	-4.50	Wether hoggets purchase activity
140	AUFDWT	-0.08	Autumn wheat feeding activity
141	WIFDWT	-0.08	Winter wheat feeding activity

APPENDIX C (2) (Cont.)

Column	Name	Value $	Description
142	WIBYOT	-0.60	Winter oat purchase
143	WIBYBA	-0.75	Winter barley purchase
144	WIBYHY	-22.00	Winter hay purchase
145	SIPROB	-7.00	Silage production on B land

APPENDIX D (1)

SOLUTION OF THE BASIC MODEL - ACTIVITY LEVELS

Activity		Level
A land	Wheat	502 acres
	Undersown wheat	167 acres
	Minimum phase lucerne	1,226 acres
	Hay production + lucerne	14 acres
	Silage production + pasture	100 acres
	Autumn fed paddock hay	300 acres
B land	Wheat	396 acres
	Undersown wheat	181 acres
	Late sown barley	146 acres
	Minimum phase lucerne	1,240 acres
	Share hay production + lucerne	207 acres
C land	Undersown wheat	34 acres
	Late barley	102 acres
	Minimum phase lucerne	273 acres
E land	Barley	233 acres
	Annual pasture	466 acres
Non arable A-D land	Annual Pasture	610 acres
Non arable E land	Annual Pasture	965 acres
Pool disposals	Sale quota wheat	40,000 bus.
	Winter barley sale	20,890 bus.

APPENDIX D (1) (Cont.)

Activity		Level
Pool disposals (cont.)	Winter hay sale	200 tons
	Autumn feed silage	100 tons
Transfers	Winter forage transfer	8,153 acres
	Spring summer transfer	32,155 LSM
	Summer autumn transfer	8,805 LSM
Capital		$186,201
Autumn labour hire		307 hours
Merino wool sale		76,734 Kg
Angus breeding cows		500 head
Angus cows mated Santa bulls		100 head
Sell fat Angus steers		220 head
Sell fat crossbred steers		44 head
Sell surplus Agus heifers		100 head
Buy store steers		127 head
Sell fat purchased steers		127 head
Merino breeding ewes		8,333 head
CFA Merino exes x Border Leicester		1,666 head
Merino wethers		648 head
Sell store Merino wether hoggets		2,741 head
Sell store CFA wethers		149 head
Sows for bacon production		44 head
Total Gross Margin		$156,505

APPENDIX D (2)

THE SHADOW PRICES OF THE SUB OPTIMAL
ACTIVITIES IN THE BASIC SOLUTION

	Activity	Objective	Shadow Price
A land	Early Oats	-7.65	-1.68
	Late Oats	-7.65	-2.43
	Early barley	-7.65	-1.68
	Late barley	-7.65	-0.50
	Rape	+22.15	-3.19
	Lupins	+17.15	-4.41
	Peas	+16.25	-5.31
	Sunflowers	+21.20	-2.50
	Continuous lucerne	-1.62	-1.09
	Lucerne extend (7 years)	-1.15	0
	Maximum phase lucerne (8 years)	-1.15	-0.08
	Annual pasture	-0.90	-3.32
	Permanent pasture	-0.80	-3.94
	Winter fed paddock hay	-4.00	-7.37
B land	Early oats	-7.65	-1.18
	Late oats	-7.65	-1.93
	Early barley	-7.65	-1.18
	Rape	20.00	-5.08
	Lupins	15.00	-5.59
	Peas	14.00	-6.59
	Sunflower	20.00	-3.20
	Continuous lucerne	-1.62	-3.17

APPENDIX D (2) (Cont.)

	Activity	Objective	Shadow Price
B land	Lucerne extend	-1.15	-12.97
	Maximum phase lucerne	-1.15	-7.53
	Annual pasture	-0.90	-4.01
	Permanent pasture	-0.80	-4.86
	Hay production	-14.00	-1.06
	Silage production	-7.00	-1.86
	Autumn fed paddock hay	-4.00	-0.89
	Winter fed paddock hay	-4.00	-7.01
C land	Wheat	-8.10	-3.12
	Early oats	-7.65	-1.18
	Late oats	-7 65	-1.93
	Early barley	-7.65	-1.18
	Rape	+19.00	-7.04
	Lupins	+14.00	-4.67
	Peas	+13.00	-5.67
	Sunflowers	+19.00	-4.20
	Continuous lucerne	-1.62	-2.28
	Lucerne extend	-1.15	-0.17
	Maximum phase lucerne	-1.15	-0.38
	Annual pasture	-0.90	-1.73
	Permanent pasture	-0.80	-3.21
	Autumn fed paddock hay	-4.00	-18.84
	Winter fed paddock hay	-4.00	-13.42

APPENDIX D (2) (Cont.)

Activity		Objective	Shadow Price
D land	Wheat	-8.10	-1.02
	Share wheat	-3.60	-8.71
	Contract wheat	-12.60	-5.21
	Malting barley	+16.65	-3.41
	Early oats	-7.65	0
	Late oats	-7.65	-1.85
	Rape	18.00	-5.87
	Lupins	+13.00	-7.39
	Peas	+12.00	-8.39
	Sunflowers	+18.00	-3.10
	Continuous lucerne	-1.62	-2.21
	Lucerne extend	-1.15	-0.16
	Maximum phase lucerne	-1.25	-0.46
	Annual pasture	-0.90	-1.73
	Permanent pasture	-0.80	-3.47
	Autumn fed paddock hay	-4.00	-1.80
	Winter fed paddock hay	-4.00	-6.72
E land	Wheat	-8.30	-5.04
	Oats	-7.65	-1.76
	Malting barley	+14.00	-3.96
	Permanent pasture	-0.80	-1.13
Autumn winter feed transfer		0	-0.28
Pool disposal	Sell overquots wheat	0.85	-0.19
	Summer sell oats	0.45	-0.22

APPENDIX D (2) (Cont.)

	Activity	Objective	Shadow Price
Pool disposal	Winter sell oats	0.55	-0.12
	Summer sell barley	0.60	-0.12
	Autumn feed oats	-0.02	-0.37
	Winter feed oats	-0.02	-0.55
	Autumn feed barley	-0.02	-0.27
	Winter feed barley	-0.02	-0.53
	Autumn feed hay	-0.50	-9.38
	Winter feed hay	-0.50	-14.96
	Winter feed silage	-0.50	-1.53
	Autumn oat buy	-0.60	-0.27
	Autumn barley buy	-0.75	-0.30
	Autumn hay buy	-22.00	-8.88
	Summer hay sell	+15.00	-4.14
	Autumn feed wheat	-0.02	-0.52
	Winter feed wheat	-0.02	-0.83
	Winter buy oats	-0.60	-0.46
	Winter buy barley	-0.75	-0.56
	Winter buy hay	-22.00	-16.46
Livestock	Sell store Angus weaners	75.00	-5.67
	Sell store CFA ewes	3.00	-0.44
	Sell fat sheep	4.00	-0.81
	Lotfeed	100.00	-17.53
	Sell crossbred vealers	85.00	-5.41
	Buy wether hoggets	-4.50	-0.50

APPENDIX D (3)

SURPLUS RESOURCES OF THE BASIC MODEL SOLUTION

Resource	Surplus	RHS
Maximum autumn crop	70 acres	2,300
Minimum autumn crop	1,530 acres	700
Maximum rape	300 acres	300
Maximum lupin	100 acres	100
Maximum peas	100 acres	100
Maximum sunflower	300 acres	300
Maximum overquota wheat	10,000 bus.	10,000
Maximum crop E land	6 acres	240
Minimum hay production	195 tons	25
Minimum grazing cereal crops	398 acres	200
Maximum grain store	22,510 bus.	50,000 bus
Maximum hay area	286 acres	300
Maximum silage area	200 acres	300
Maximum steer purchase	73 head	200
Maximum ewes mated Border rams	1,333 head	3,000
Minimum breeding ewes	2,000 head	8,000
Minimum breeding cow numbers	500 head	100
Summer labour	18 hours	3,600
Spring labour	1,333 hours	3,600
Maximum wethers	19,351 head	20,000
Maximum autumn/winter transfer	64,441 LSM	0
Maximum summer autumn transfer	65,928 LSM	0
Maximum crop on B land	6 acres	730

APPENDIX D (3)(Cont.)

Resource	Surplus	RHS
Maximum crop on C land	3 acres	140
Maximum crop on D land	3 acres	470
Maximum breeding cattle/breeding sheep	11,470	0
Maximum malting barley area	300 acres	300
Minimum grain to be stored till winter	17,490 bus.	10,000
Minimum hay to be stored till winter	175 tons	25
Lucerne Minimum A	207 acres	
Lucerne Minimum C	45 acres	
B land paddock hay pool	2,166 LSMs	
C land paddock hay pool	273 LSMs	
D land paddock hay pool	933 LSMs	

APPENDIX D (4)

MARGINAL VALUE PRODUCTS OF THE SCARCE RESOURCES

Activity	RHS	MVP
Arable A land	2,010 acres	-19.15
Arable E land	700 acres	-12.67
Non arable A-D land	810 acres	-12.15
Wheat quota limit	40,000 bus.	-0.0084
Maximum crop on A land	670 acres	-0.31
A rotation relationship		-1.43
E rotation relationship		-4.79
Wheat pool		-1.04
Maximum haystore	200 tons	-0.86
Maximum breeding cow	600	-7.64
Maximum breeding ewes	10,000	-0.36
Maximum breeding sows	44	-161.00
Cast for age ewe pool		-3.44
Wether hogget pool		-4.00
Purchased steer pool		-100.00
Spring feed pool	LSMs	-0.21
Summer feed pool	LSMs	-0.33
Autumn feed pool	LSMs	-0.44
Winter feed pool	LSMs	-0.18
Angus steer pool		-80.67
Winter forage pool	LSMs	-0.18
Oat grain pool	bushels	-0.67
Barley grain pool	bushels	-0.70

APPENDIX D (4) (Cont.)

Activity	RHS	MVP
Hay pool	tons	-19.14
Silage pool	tons	+2.87
Livestock capital	$	-0.08
Merino wool pool	Kilos	-0.90
Summer labour	3,600 hours	-2.00
Autumn labour	3,600 hours	-2.00
Maximum early crop area	300 acres	-1.44
Maximum paddock hay area	300 acres	-1.41
Minimum silage area	100 acres	4.33
Arable B land	2,170 acres	-18.49
Arable C land	410 acres	-15.79
Arable D land	1,400 acres	-14.35
Non arable E land	965 acres	-9.93
B rotation relationship		-1.90
C rotation relationship		-3.82
D rotation relationship		-3.68
Cast for age wether pool		-3.50
Crossbred steer pool		-90.41
Angus heifer pool		-100.00
Undersown wheat relationship A land		-0.78
Undersown wheat relationship B land		-1.78
Undersown wheat relationship C land		-1.56
Undersown wheat relationship D land		-1.04
Limitation on beef cross breeding		-5.01

APPENDIX D (4) (Cont.)

Activity	RHS	MVP
Limitation on sheep crossbreeding		0
Minimum lucerne phase relationship		-11.09
B paddock hay pool		0

APPENDIX D (5)

OPTIMAL FARM PLANS FROM THE DIFFERENT RESOURCE AND PRICE MODELS

		Model 1	2	3	4
		Basic	Optimistic Prices	High Wool Price	Relax Cow Restraint
A land					
Wheat	acre	502	355		496
Undersown wheat	acre	167	118		165
Minimum phase lucerne	acre	1,226	1,023	1,282	1,056
Maximum phase lucerne	acre		341	427	
Lucerne extend	acre			39	178
Hay production + lucerne	acre	14			14
Silage prodn. + lucerne	acre	100	172	300	100
Autumn feed paddock hay	acre	300	300	300	300
B land					
Wheat	acre	396	542	225	283
Undersown wheat	acre	396	180	75	181
Late sown barley	acre	146			259
Minimum phase lucerne	acre	1,240	1,240	1,603	1,240
Share hay production + lucerne		207	207	267	207
C land					
Undersown wheat	acre	34	34	34	34
Late barley	acre	102	102	102	102
Minimum phase lucerne	acre	273	273	235	273
D land					
Wheat	acre		50	50	
Undersown wheat	acre	117	117	117	117
Early barley	acre	300	300	300	300
Late barley	acre	50			50
Minimum phase lucerne	acre	933	933	933	933
E land					
Barley	acre	233	233	68	233
Annual pasture	acre	466	466	137	466
Permanent pasture	acre			494	
Non arable A- D annual pasture	acre	610	630	719	611
E annual pasture	acre	965	965	965	965

Continued:

APPENDIX D (5) (Cont.)

		1 Basic	2 Optimistic Prices	3 High Wool Price	4 Relax Cow Restraint
		Dump 12	Dump 13	Dump 14	Dump 15
<u>Pool Disposal</u>					
Sale quota wheat	bus	40,000	40,000	13,723	36,361
Winter barley sale	bus	20,890	13,990	8,995	24,964
Winter hay sale		200	186	122	200
Summer hay sale				40	
Autumn feed silage	tons	100	315	700	100
Autumn feed hay				78	
<u>Transfers</u>					
Winter forage transfer	LSM	8,153	11,707	14,740	9,021
Spring summer transfer	LSM	32,155	29,302	35,903	32,990
Summer autumn transfer	LSM	8,805	5,848	0	9,590
Capital	$	186,201	142,581	151,607	228,383
Autumn labour hire	hours	307			213
Merino wool sale	Kg	76,734	130,585	161,353	52,639
Angus breeding cows		500	83	83	833
Angus cows x Santa		100	16	16	166
Sell Angus vealers				80	
Sell fat Angus steers		220	36		366
Sell XB vealers			17	7	
Sell fat XB steers		44			73
Sell surplus Angus heifers		100	16	16	167
Buy store steers		127	143		
Sell fat purchased steers		127	143		
Merino breeding ewes		8,333	8,835	10,000	5,995
CFA Merino ewes x Border Leic.		1,667			1,199
Merino wethers		648	11,453	15,427	
Sell store CFA ewes			1,767	2,000	
Sell store wether hoggets		2,741			2,098
Sell store CFA wethers		149	2,634	3,548	
Buy wethers				665	
Sows for bacon		44	44	44	44
Total Gross Margin	$	156,505	181,666	211,477	158,521

APPENDIX D (6)

SUMMARY OF PLANS FROM THE DIFFERENT RESOURCE AND PRICE MODELS

		Model 1	2	3	4
		Basic	Optimistic Prices	High Wool Price	Relax Cow Restraint
Wheat	acre	898	947	275	779
Wheat undersown	acre	497	449	226	497
Early barley	acre	300	300	300	300
Late barley	acre	298	102	102	411
Barley general	acre	233	233	233	233
Minimum phase lucerne	acre	3,672	3,469	4,053	3,502
Lucerne extend	acre			39	178
Maximum phase lucerne	acre		341	427	
Hay production	ton	221	207	207	221
Silage production	ton	100	172	300	100
Paddock hay production	acre	300	300	300	300
Annual pasture	acre	466	466	137	466
Permanent pasture	acre			494	

APPENDIX E

SOIL TYPES RELATED TO CURRENT CROP AND PASTURE ACTIVITIES

		Acres	Allawah & Wilgoma		Eulomo		
			A acres	B acres	C acres	D acres	E acres
Wheat	Allawah	240	112	128			
	Wilgoma	269	166	103			
	Eulomo	948			29	634	285
Oats	Allawah	218	164	54			
Barley 2 row	Allawah	51		51			
	Eulomo	67				67	
Barley 6 row							
grazing	Allawah	365	270	95			
grain	Allawah	26		26			
Rape	Allawah	194	82	112			
Lupins	Allawah	32	8	24			
Peas	Allawah	8	8				
Sunflowers	Allawah	36		36			
Lucerne	Allawah	2080	1190	890			
	Wilgoma	551		551			
	Eulomo	985			479	506	
Annual pasture	Allawah	115	19	96			
	Eulomo	1721				205	1516
Non arable	Allawah	141	65	76			
In crop	Wilgoma	28	24	4			
	Eulomo	429					429
		82			21	27	34
Non arable	Allawah	403	319	84			
In lucerne	Wilgoma	64		64			
	Eulomo	125			71	54	

Continued:

APPENDIX E (Cont.)

Soil Type Summary	Allawah	Wilgoma	Eulomo	Total
A type arable	1,820	190		2,010
B type arable	1,530	637		2,167
C type arable			408	408
D type arable			1,405	1,405
E type arable			700	700
A-D non arable	375	85	350	810
E non arable			965	965
				8,465

APPENDIX F

THE SOLUTIONS

BASIC MODEL

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/36/47 PAGE 0001

DUMP:DUMP 12 RIGHT HAND SIDE RHS1

OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	WHTGRH E	+ land	0	-8.3000	-5.0463
B	WHTGRG A	+	502.5000	-7.6300	0
B	WHTSLQ	+	40000.0000	1.0500	0
	WHSLOQ	+	0	0.8500	-0.1916
	OTGRGR A	+	0	-7.6500	-1.6773
	BAGRGR A	+	0	-7.6500	-1.6773
	BARGRN D	+	0	16.6300	-3.4136
	RAPCRP A	+	0	22.1500	-3.1954
	LUPCRP A	+	0	17.1500	-4.4130
	PEACRP A	+	0	16.2500	-5.3130
	SFLCRP A	+	0	21.2000	-2.5032
	SHWHGR D	+	0	-3.6000	-8.7068
	COWHGR D	+	0	-12.6000	-5.2079
B	SILPRO A	+	100.0000	-7.0000	0
B	HAYPRO A	+	13.9681	-14.0000	0
	LUCCON A	+	0	-1.6250	-1.0893
B	LUCMIN A	+	1226.0319	-1.2500	0
	LUCMAX A	+	0	-1.1500	-0.0786
	ANAMIN A	+	0	-0.9000	-3.3251
B	ANEMIN E	+	466.6667	-0.9000	0
	PERPAS A	+	0	-0.8000	-3.9394
NonArb B	ANNPAS A-D	+	610.3333	-0.8000	0
B	ANGBRD	+	500.0000	10.8000	0
B	BUYSTR	+	126.9438	-100.0000	0
	SELSTR	+	0	75.0000	-5.6694
B	AASANT	+	100.0000	42.5000	0
B	FATCAT	+	126.9438	115.0000	0
B	FATANG	+	220.0000	100.0000	0
B	MERBRD	+	8333.3333	-1.7000	0
B	MERXBL	+	1666.6667	5.8000	0
B	MERWET	+	648.6389	-0.7400	0
	SECXRS	+	0	0	-0.2803
B	SLSTWT	+	2741.5342	4.0000	0
	SLSTSP	+	0	3.0000	-0.4404
	FATSHP	+	0	4.0000	-0.8057
B	AUFDPH	+	300.0000	-4.0000	0
	WIFDPH	+	0	-4.0000	-7.3757
	SUSEOT	+	0	0.4500	-0.2220
	WISEOT	+	0	0.5500	-0.1220
	SUSEBA	+	0	0.6000	-0.1000
B	WISEBA	+	20890.0000	0.7000	0
	AUFDOA	+	0	-0.0200	-0.3685
	WIFDOA	+	0	-0.0200	-0.5555
	AUFDBA	+	0	-0.0200	-0.2740
	WIFDBA	+	0	-0.0200	-0.5318
	LOTFFD	+	0	100.0000	-17.5299
B	HASEWI	+	200.0000	20.0000	0

PROBLEM MACTIER LP　　SOLUTION　　DATE 07/12/72　　TIME 14/36/49　　PAGE 0002

DUMP:DUMP 12　　RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	AUFDHY	+	0	-0.5000	-9.3836
	WIFDHI	+	0	-0.5000	-14.9636
	WIFDSI	+	0	-0.5000	-1.5267
B	FOTRAS	+	8153.9167	0	0
B	SPSUTR	+	32155.4743	0	0
B	SUAUTR	+	8805.1417	0	0
B	BACPIG	+	44.0000	300.0000	0
B	INTRST	+	186201.4826	-0.0800	0
	HISPLB	+	0	-2.0000	-2.0000
	HISULB	+	0	-2.0000	-2.0000
B	HIAULB	+	307.1531	-2.0000	0
B	SEMRWL	+	76734.1805	0.9000	0
	LATOAT	+	0	-7.6500	-2.4293
	LATBAR	+	0	-7.6500	-0.5000
B	WHEATB	+	396.6667	-8.1000	0
	ELOATB	+	0	-7.6500	-1.1773
	LTOATB	+	0	-7.6500	-1.9293
	ELBARB	+	0	-7.6500	-1.1773
B	LTBARB	+	145.8333	-7.6500	0
	RAPCPB	+	0	20.0000	-5.0826
	LUPINB	+	0	15.0000	-5.5886
	PEACPB	+	0	14.0000	-6.5886
	SUNFLB	+	0	20.0000	-3.2032
	LUCCNB	+	0	-1.6250	-3.1751
B	LUCMNB	+	1239.9646	-1.2500	0
	LUCMXB	+	0	-1.1500	-7.5313
	ANPASB	+	0	-0.9000	-4.0126
	PRPASB	+	0	-0.8000	-4.8641
	WHTGRC	+	0	-8.1000	-3.1247
	ELOATC	+	0	-7.6500	-1.1773
	LTOATC	+	0	-7.6500	-1.9293
	ELBARC	+	0	-7.6500	-1.1773
B	LTBARC	+	102.5000	-7.6500	0
	RAPCPC	+	0	19.0000	-7.0391
	LUPINC	+	0	14.0000	-4.6754
	PEACPC	+	0	13.0000	-5.6754
	SUNFLC	+	0	19.0000	-4.2032
	LUCCNC	+	0	-1.6250	-2.2830
B	LUCMNC	+	273.3333	-1.2500	0
	LUCMXC	+	0	-1.1500	-0.3770
	ANPASC	+	0	-0.9000	-1.7268
	PRPASC	+	0	-0.8000	-3.2069
	WHTCRD	+	0	-8.1000	-1.0247
B	ELOATD	+	0	-7.6500	0
	LTOATD	+	0	-7.6500	-1.8455
B	ELBARD	+	300.0000	-7.6500	0
B	LTBARD	+	50.0000	-7.6500	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/36/50 PAGE 0003

DUMP:DUMP 12 RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	RAPCPD	+	0	18.0000	-5.8728
	LUPIND	+	0	13.0000	-7.3915
	PEACPD	+	0	12.0000	-8.3915
	SUNFLD	+	0	18.0000	-3.1032
	LUCCND	+	0	-1.6250	-2.2167
B	LUCMND	+	933.3333	-1.2500	0
	LUCMXD	+	0	-1.2500	-0.4604
	ANPASD	+	0	-0.9000	-1.7268
	PRPASD	+	0	-0.8000	-3.4685
B	USWHTA	+	167.5000	-7.6000	0
B	USWHTB	+	180.8333	-8.1000	0
B	USWHTC	+	34.1667	-8.1000	0
B	USWHTD	+	116.6667	-8.1000	0
B	BARCPE	+	233.3333	-7.6500	0
	OATCPE	+	0	-7.6500	-1.7616
	BARGNE	+	0	14.0000	-3.9636
	PRPASE	+	0	-0.8000	-1.1316
B	SHRHYA	+	206.7021	0	0
	FTSHUT	+	0	4.5000	-0.0637
	OATBUY	+	0	-0.6000	-0.2765
	BARBUY	+	0	-0.7500	-0.3040
	HAYBUY	+	0	-22.0000	-8.8836
	SUHYSL	+	0	15.0000	-4.1442
B	SLHEIF	+	100.0000	100.0000	0
	SXVEAL	+	0	85.0000	-5.4093
B	SLSTWT	+	149.1869	3.5000	0
B	SLSXFT	+	44.0000	110.0000	0
	AFDPHB	+	0	-4.0000	-0.8963
	WFDPHB	+	0	-4.0000	-7.0767
	AFDPHC	+	0	-4.0000	-18.8439
	WFDPHC	+	0	-4.0000	-13.4214
	AFDPHD	+	0	-4.0000	-1.8035
	WFDPHD	+	0	-4.0000	-6.7206
B	APENAR	+	965.0000	-0.8000	0
B	AUFDS1	+	100.0000	-0.5000	0
B	LUEX1A	+	0	-1.1500	0
	LUEX1B	+	0	-1.1500	-12.9713
	LUEX1C	+	0	-1.1500	-0.1671
	LUEX1D	+	0	-1.1500	-0.1578
	HYPROB	+	0	-14.0000	-1.0619
	BUYWET	+	0	-4.5000	-0.5000
	AUFDWT	+	0	-0.0200	-0.5194
	WIFDWT	+	0	-0.0200	-0.8327
	WIBYOT	+	0	-0.6000	-0.4634
	WIBYBA	+	0	-0.7500	-0.5618
	WIBYHY	+	0	-22.0000	-16.4636
	SIPROB	+	0	-7.0000	-1.8577

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/36/52 PAGE 0005

DUMP:DUMP 12 RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
#	GM	Z	156505.3930	0	
	ALANAR	+	0	2010.0000	-19.1539
	ELANAR	+	0	700.0000	-12.6702
	NONARR	+	0	810.0000	-12.1494
B	MAXACR	+	70.0000	2300.0000	0
B	MINACR	-	1530.0000	700.0000	0
B	RAPMAX	+	300.0000	300.0000	0
B	LUPMAX	+	100.0000	100.0000	0
B	PEAMAX	+	100.0000	100.0000	0
B	SUNMAX	+	300.0000	300.0000	0
	WHMAXQ	+	0	40000.0000	-0.0084
B	WHMXOQ	+	10000.0000	10000.0000	0
	MXCRAW	+	0	670.0000	-0.3083
B	MXCREW	+	6.6667	240.0000	0
	AROTAT	+	0	0	-1.4286
	EROTAT	+	0	0	-4.7888
	WHTPOW	+	0	0	-1.0416
B	HAYMIN	-	195.6702	25.0000	0
B	MINFCR	-	398.3333	200.0000	0
B	MXGRST	+	22510.0000	50000.0000	0
	MXHYST	+	0	200.0000	-0.8558
B	MXHYAR	+	286.0319	300.0000	0
B	MXSIAR	+	200.0000	300.0000	0
B	MXSRPU	+	73.0562	200.0000	0
	MXSRCW	+	0	600.0000	-7.6398
	MXBREW	+	0	10000.0000	-0.3588
B	MXBRBL	+	1333.3333	3000.0000	0
B	MXSEGR	+	3000.0000	3000.0000	0
	MAXSOW	+	0	44.0000	-161.0000
	SHPPOL	+	0	0	-3.4404
	WETPOL	+	0	0	-4.0000
	STRPOL	+	0	0	-100.0000
	SPRFED	+	0	0	-0.2131
	SUMFED	+	0	0	-0.3279
	AUTFED	+	0	0	-0.4372
	WINFED	+	0	0	-0.1845
	ANGPOL	+	0	0	-80.6694
	WIFRPL	+	0	0	-0.1845
B	EWEMIN	-	8000.0000	2000.0000	0
B	COWMIN	-	500.0000	100.0000	0
	OACRPL	+	0	0	-0.6720
	BAGRPL	+	0	0	-0.7000
	HAYPOL	+	0	0	-19.1442
	SILPOL	-	0	200.0000	2.8721
	LIVCAP	+	0	0	-0.0500
	MERPOL	+	0	0	-0.9000
B	SUMLAB	+	18.5136	3600.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/36/53 PAGE 0006

DUMP:DUMP 12 RIGHT HAND SIDE RHS1

OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
	AUTLAB	+	0	3600.0000	-2.0000
B	SPRLAB	+	1333.5136	3600.0000	0
B	MAXWHR	+	19351.3611	20000.0000	0
	MAXECP	+	0	300.0000	-1.4455
	MXPCHY	+	0	300.0000	-1.4105
B	MXSSTR	+	64441.3333	0	0
B	MXSATR	+	65928.8583	0	0
B	MINWCP	-	898.3333	500.0000	0
	MINSIW	-	0	100.0000	4.3278
	BLANAR	+	0	2170.0000	-18.4878
	CLANAR	+	0	410.0000	-15.7935
	DLANAR	+	0	1400.0000	-14.3512
	ENONAR	+	0	965.0000	-9.9385
	BROTAT	+	0	0	-1.9030
	CROTAT	+	0	0	-3.8161
	DROTAT	+	0	0	-3.6834
B	MXBCRP	+	6.6667	730.0000	0
B	MXCCRP	+	3.3333	140.0000	0
B	MXDCRP	+	3.3333	470.0000	0
	CFWTPL	+	0	0	-3.5000
	XBSTPL	+	0	0	-90.4093
	HEIFPL	+	0	0	-100.0000
	USWHTA	+	0	0	-0.7812
	USWHTB	+	0	0	-0.7812
	USWHTC	+	0	0	-1.5624
	USWHTD	+	0	0	-1.0374
B	MAXCAT	+	11470.6597	0	0
B	MAXBAR	+	300.0000	300.0000	0
	CATREL	+	0	0	-5.0087
B	XBEREL	+	0	0	0
B	MNGRST	-	17490.0000	10000.0000	0
B	MNHYST	-	175.0000	25.0000	0
B	LUCMNA	+	206.7080	0	0
	LUCMNB	+	0	0	-11.0895
B	LUCMNC	+	45.5647	0	0
B	LUCMND	+	155.5867	0	0
B	AHAYPL	+	2165.9965	0	0
B	BHAYPL	+	0	0	0
B	CHAYPL	+	273.3333	0	0
B	DHAYPL	+	933.3333	0	0

PROBLEM MACTIER LP   OBJECTIVE RANGING   DATE 02/12/72   TIME 14/37/04   PAGE 0009

DUMP;DUMP 12   RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

VARIABLE	TYPE	OBJECTIVE	LOWER LIMIT OF OBJECTIVE	INCOMING AT LOWER LIMIT	UPPER LIMIT OF OBJECTIVE	INCOMING AT UPPER LIMIT
WHTGRG	+	-7.6000	-8.0111	MXCRAW	+INF	
WHTSLQ	+	1.0500	1.0416	WHMAXQ	+INF	
SILPRO	+	-7.0000	-8.8577	SIPROB	-2.6722	MINSIW
HAYPRO	+	-14.0000	-14.8558	MXHYST	-9.8558	SUHYSL
LUCMIN	+	-1.2500	-1.2651	MXCRAW	-1.1500	LUCMAX
ANEMIN	+	-0.9000	-2.5974	PRPASE	6.2832	EROTAT
ANNPAS	+	-0.8000	-12.9494	NONARR	2.2833	MXCRAW
ANGBRD	+	10.8000	1.6323	MXBRCW	16.8104	CATREL
BUYSTR	+	-100.0000	-100.4308	MXCRAW	-99.6377	WHMAXQ
AASANT	+	42.5000	36.4896	CATREL	+INF	
FATCAT	+	115.0000	114.5692	MXCRAW	115.3623	WHMAXQ
FATANG	+	100.0000	94.3306	SELSTR	113.6601	CATREL
MERBRD	+	-1.7000	-2.1305	MXBREW	-1.1715	SLSTSP
MERXBL	+	5.8000	5.2715	SLSTSP	+INF	
MERWET	+	-0.7400	-0.9097	FTSHWT	-0.6922	MXCRAW
SLSTWT	+	4.0000	3.8230	MXCRAW	4.5000	BUYWET
AUFDPH	+	-4.0000	-4.8963	AFDPHB	+INF	
WISEBA	+	0.7000	0.6912	MXCRAW	0.7070	WHMAXQ
HASEWI	+	20.0000	19.1442	MXHYST	+INF	
FOTRAS	+		-0.05658	FTSHWT	0.07249	MXCRAW
SPSUTR	+		-0.05061	WHMAXQ	0.01693	MXCRAW
SUAUTR	+		-0.05143	FTSHWT	0.04833	MXPDHY
BACPIG	+	300.0000	139.0000	MAXSOW	+INF	
INTRST	+	-0.08000	-0.1612	MXBRCW	-0.06139	WHMAXQ
HIAULB	+	-2.0000	-2.4192	MXCRAW	0	AUTLAB
SEMRWL	+	0.9000	0.8691	FTSHWT	0.9087	MXCRAW
WHEATB	+	-8.1000	-8.3526	WHMAXQ	-7.7838	MXCRAW
LTBARB	+	-7.6500	-7.9662	MXCRAW	-7.3974	WHMAXQ
LUCMNB	+	-1.2500	-2.3119	HYPROB	2.0803	BROTAT
LTBARC	+	-7.6500	-8.8273	ELBARC	+INF	
LUCMNC	+	-1.2500	-1.4253	LUEX1C	4.4741	CROTAT
ELOATD	+	-7.6500	-8.8273	ELOATB	-3.6227	WISEOT
ELBARD	+	-7.6500	-8.8273	ELBARC	-5.8814	LTOATC
LTBARD	+	-7.6500	-8.6747	WHTCRD	-6.4727	ELBARC
LUCMND	+	-1.2500	-1.4156	LUEX1D	4.2751	DROTAT
USWHTA	+	-7.6000	-8.8333	MXCRAW	-4.4753	USWHTA
USWHTB	+	-8.1000	-19.5179	BROTAT	-4.9753	USWHTB
USWHTC	+	-8.1000	-22.4251	LUEX1C	-1.8505	USWHTC
USWHTD	+	-8.1000	-21.6289	LUEX1D	-3.9505	USWHTD
BARCPE	+	-7.6500	-9.4116	OATCPE	+INF	
SHRHYA	+		-12.9381	LUCMNB	19.9778	BROTAT
SLHFIF	+	100.0000	54.1614	MXBRCW	115.8169	CATREL
SLSTWT	+	3.5000	3.4413	FTSHWT	3.7078	MXCRAW
SLSXFT	+	110.0000	104.5907	SXVEAL	+INF	
APENAR	+	-0.8000	-10.7385	ENONAR	+INF	
AUFDS1	+	-0.5000	-2.0267	WIFDSI	0.9426	MINSIW
LUEX1A	+	-1.1500	-1.1940	LUCMAX	-1.1356	MXCRAW

PROBLEM MACTIER LP   OBJECTIVE RANGING   DATE 07/12/72   TIME 14/37/06   PAGE 0003

DUMP:DUMP 12   RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

VARIABLE	TYPE	OBJECTIVE	LOWER LIMIT OF OBJECTIVE	INCOMING AT LOWER LIMIT	UPPER LIMIT OF OBJECTIVE	INCOMING AT UPPER LIMIT
MAXACR	+		-7.0132	LUPINC	0.3083	MXCRAW
MINACR	-		-0.3083	MXCRAW	7.0132	LUPINC
RAPMAX	+		-3.1954	RAPCRP	+INF	
LUPMAX	+		-4.4130	LUPCRP	+INF	
PEAMAX	+		-5.3130	PEACRP	+INF	
SUNMAX	+		-2.5032	SFLCRP	+INF	
WHMXOQ	+		-0.1916	WHSLOQ	+INF	
MXCREW	+		-INF		3.3948	PRPASE
HAYMIN	-		-0.8558	MXHYST	4.1442	SUHYSL
MINFCR	-		-0.3162	MXCRAW	0.2526	WHMAXQ
MXGRST	+		-0.007018	WHMAXQ	0.008784	MXCRAW
MXHYAR	+		-4.1442	SUHYSL	0.8558	MXHYST
MXSTAR	+		-4.3278	MINSIW	+INF	
MXSRPU	+		-0.3623	WHMAXQ	0.4308	MXCRAW
MXBRBL	+		-INF		0.5285	SLSTSP
MXSFGR	+		-INF		+INF	
EWEMIN	-		-0.3588	MXBREW	+INF	
COWMIN	-		-7.6398	MXBRCW	+INF	
SUMLAB	+		-14.9977	LUPINC	0.7080	MXCRAW
SPRLAB	+		-1.2794	WHTCRD	2.0000	HISPLB
MAXWHR	+		-0.04779	MXCRAW	0.1697	FTSHWT
MXSSTR	+		-0.2803	SECXRS	0.02069	MXCRAW
MXSATR	+		-0.04833	MXPDHY	0.04102	MXCRAW
MINWCP	-		-0.2526	WHMAXQ	5.7474	WHSLOQ
MXBCRP	+		-8.3828	LUPINB	2.8545	BROTAT
MXCCRP	+		-7.0132	LUPINC	3.5813	LUEX1C
MXDCRP	+		-INF		3.3822	LUEX1D
MAXCAT	+		-0.02716	FTSHWT	0.007647	MXCRAW
MAXBAR	+		-3.4136	BARGRN	+INF	
XBEREL	+		-INF		0.4404	SLSTSP
MNGRST	-		-0.008784	MXCRAW	0.007018	WHMAXQ
MNHYST	-		-0.8558	MXHYST	+INF	
LUCMNA	+		-0.01242	MXCRAW	0.05546	LUCMAX
LUCMNC	+		-0.1442	LUEX1C	34.3380	CROTAT
LUCMND	+		-0.1362	LUEX1D	33.1439	DROTAT
AHAYPL	+		-0.01509	MXCRAW	0.04400	LUCMAX
BHAYPL	+		-0.8963	AFDPHB	3.1751	LUCCNB
CHAYPL	+		-0.1753	LUEX1C	4.5241	LUCMXC
DHAYPL	+		-0.1656	LUEX1D	5.5251	LUCMXD

MODEL 2

PROBLEM MACTIER LP   SOLUTION   DATE 07/12/72   TIME 14/38/39   PAGE 0001

DUMP:DUMP 13   RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	WHTGRH	+	0	-8.3000	-3.3592
B	WHTGRG	+	355.7051	-7.6000	0
B	WHTSLQ	+	40000.0000	1.1500	0
	WHSLOQ	+	0	0.9500	-0.1866
	OTGRGR	+	0	-7.6500	-3.2802
	BAGRGR	+	0	-7.6500	-3.2802
	BARGRN	+	0	16.6500	-4.5427
	RAPCRP	+	0	22.1500	-5.7414
	LUPCRP	+	0	17.1500	-8.4172
	PEACRP	+	0	16.2500	-9.3172
	SFLCRP	+	0	21.2000	-5.9357
	SHWHGR	+	0	-3.6000	-9.8363
	COWHGR	+	0	-12.6000	-5.1975
B	SILPRO	+	171.8880	-7.0000	0
	HAYPRO	+	0	-14.0000	-1.8144
	LUCCON	+	0	-1.6250	-0.4000
B	LUCMIN	+	1022.8277	-1.2500	0
B	LUCMAX	+	341.0108	-1.1500	0
	ANAMIN	+	0	-0.9000	-5.1562
B	ANEMIN	+	466.6667	-0.9000	0
	PERPAS	+	0	-0.8000	-5.0562
B	ANNPAS	+	629.9060	-0.8000	0
B	ANGBRD	+	83.3333	10.8000	0
B	BUYSTR	+	143.0583	-105.0000	0
	SELSTR	+	0	80.0000	-3.8610
B	AASANT	+	16.6667	42.5000	0
B	FATCAT	+	143.0583	120.0000	0
B	FATANG	+	36.6667	105.0000	0
B	MERBRD	+	8835.4844	-1.7000	0
	MERXBL	+	0	5.8000	-0.0654
B	MERWET	+	11453.4057	-0.7400	0
	SECXRS	+	0	0	-0.5128
	SLSTWT	+	0	4.0000	-0.0601
B	SLSTSP	+	1767.0969	3.0000	0
	FATSHP	+	0	4.0000	-0.5355
B	AUFDPH	+	300.0000	-4.0000	0
	WTFDPH	+	0	-4.0000	-13.7128
	SUSEOT	+	0	0.5000	-0.2309
	WISEOT	+	0	0.6000	-0.1309
	SUSEBA	+	0	0.6500	-0.1000
B	WISEBA	+	13090.0000	0.7500	0
	AUFDOA	+	0	-0.0200	-0.2923
	WIFDOA	+	0	-0.0200	-0.6578
	AUFDBA	+	0	-0.0200	-0.1378
	WIFDBA	+	0	-0.0200	-0.6416
	LOTFED	+	0	100.0000	-23.7995
B	HASEWI	+	186.0319	20.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/38/40 PAGE 0002

DUMP:DUMP 13 RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	AUFDHY	+	0	-0.5000	-2.8759
	WIFDHI	+	0	-0.5000	-16.7232
	WIFDSI	+	0	-0.5000	-4.4542
B	FOTRAS	+	11706.8358	0	0
B	SPSUTR	+	29301.7572	0	0
B	SUAUTR	+	5848.7110	0	0
B	BACPIG	+	44.0000	300.0000	0
B	INTRST	+	142581.2680	-0.0800	0
	HISPLB	+	0	-2.0000	-2.0000
	HISULB	+	0	-2.0000	-2.0000
	HIAULB	+	0	-2.0000	-1.0305
B	SEMRWL	+	130585.1871	1.1000	0
	LATOAT	+	0	-7.6500	-3.9212
	LATBAR	+	0	-7.6500	-2.6050
B	WHEATB	+	542.5000	-8.1000	0
	ELOATB	+	0	-7.6500	-2.7802
	LTOATB	+	0	-7.6500	-3.4212
	ELBARB	+	0	-7.6500	-2.7802
	LTBARB	+	0	-7.6500	-2.1050
	RAPCPB	+	0	20.0000	-7.9002
	LUPINB	+	0	15.0000	-9.0494
	PEACPB	+	0	14.0000	-10.0494
	SUNFLB	+	0	20.0000	-6.6357
	LUCCNB	+	0	-1.6250	-2.5119
B	LUCMNB	+	1239.9646	-1.2500	0
	LUCMXB	+	0	-1.1500	-6.5383
	ANPASB	+	0	-0.9000	-4.8418
	PRPASB	+	0	-0.8000	-5.2507
	WHTGRC	+	0	-8.1000	-1.3047
	ELOATC	+	0	-7.6500	-0.6752
	LTOATC	+	0	-7.6500	-1.3162
	ELBARC	+	0	-7.6500	-0.6752
B	LTBARC	+	102.5000	-7.6500	0
	RAPCPC	+	0	19.0000	-7.3339
	LUPINC	+	0	14.0000	-6.8671
	PEACPC	+	0	13.0000	-7.8671
	SUNFLC	+	0	19.0000	-5.5307
	LUCCNC	+	0	-1.6250	-1.4225
B	LUCMNC	+	273.3333	-1.2500	0
	LUCMXC	+	0	-1.1500	-0.1619
	ANPASC	+	0	-0.9000	-2.5940
	PRPASC	+	0	-0.8000	-3.0767
B	WHTCRD	+	50.0000	-8.1000	0
B	ELOATD	+	0	-7.6500	0
	LTOATD	+	0	-7.6500	-2.2042
B	ELBARD	+	300.0000	-7.6500	0
	LTBARD	+	0	-7.6500	-0.9453

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/38/41 PAGE 0003

DUMP:DUMP 13 RIGHT HAND SIDE RHS1

OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	RAPCPD	+	0	18.0000	-7.3080
	LUPIND	+	0	13.0000	-8.6575
	PEACPD	+	0	12.0000	-9.6575
	SUNFLD	+	0	18.0000	-5.2260
	LUCCND	+	0	-1.6250	-1.7013
B	LUCMND	+	933.3333	-1.2500	0
	LUCMXD	+	0	-1.2500	-0.3316
	ANPASD	+	0	-0.9000	-2.5940
	PRPASD	+	0	-0.8000	-3.8203
B	USWHTA	+	118.5684	-7.6000	0
B	USWHTB	+	180.8333	-8.1000	0
B	USWHTC	+	34.1667	-8.1000	0
B	USWHTD	+	116.6667	-8.1000	0
B	BARCPE	+	233.3333	-7.6500	0
	OATCPE	+	0	-7.6500	-1.2017
	BARGNE	+	0	14.0000	-3.9973
	PRPASE	+	0	-0.8000	-0.3075
B	SHRHYA	+	206.7021	0	0
	FTSHWT	+	0	4.5000	-0.4745
	OATBUY	+	0	-0.6000	-0.1414
	BARBUY	+	0	-0.7500	-0.1178
	HAYBUY	+	0	-22.0000	-3.4064
	SUHYSL	+	0	15.0000	-5.0000
B	SLHEIF	+	16.6667	100.0000	0
B	SXVEAL	+	7.3333	90.0000	0
B	SLSTWT	+	2634.2833	3.5000	0
	SLSXFT	+	0	110.0000	-1.5078
	AFDPHB	+	0	-4.0000	-1.2706
	WFDPHB	+	0	-4.0000	-12.8819
	AFDPHC	+	0	-4.0000	-26.7128
	WFDPHC	+	0	-4.0000	-16.5832
	AFDPHD	+	0	-4.0000	-2.5566
	WFDPHD	+	0	-4.0000	-11.6985
B	APENAR	+	965.0000	-0.8000	0
B	AUFDS1	+	315.6641	-0.5000	0
	LUEX1A	+	0	-1.1500	-0.0750
	LUEX1B	+	0	-1.1500	-11.3654
	LUEX1C	+	0	-1.1500	-0.0467
	LUEX1D	+	0	-1.1500	-0.0857
	HYPROB	+	0	-14.0000	-2.6058
	BUYWET	+	0	-4.5000	-0.4399
	AUFDWT	+	0	-0.0200	-0.3880
	WIFDWT	+	0	-0.0200	-1.0005
	WIBYOT	+	0	-0.6000	-0.5068
	WIBYBA	+	0	-0.7500	-0.6216
	WIBYHY	+	0	-22.0000	-18.2232
	SIPROB	+	0	-7.0000	-1.9584

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/38/43 PAGE 0005

DUMP:DUMP 13 RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
#	GM	Z	181666.3420	0	
	ALANAR	+	0	2010.0000	-24.7867
	ELANAR	+	0	700.0000	-15.6413
	NONARR	+	0	810.0000	-16.0640
B	MAXACR	+	265.7265	2300.0000	0
B	MINACR	-	1334.2735	700.0000	0
B	RAPMAX	+	300.0000	300.0000	0
B	LUPMAX	+	100.0000	100.0000	0
B	PEAMAX	+	100.0000	100.0000	0
B	SUNMAX	+	300.0000	300.0000	0
	WHMAXQ	+	0	40000.0000	-0.0134
B	WHMXOQ	+	10000.0000	10000.0000	0
B	MXCRAW	+	195.7265	670.0000	-0.00000077
B	MXCRFW	+	6.6667	240.0000	0
B	AROTAT	+	250.9634	0	0.000000070
	EROTAT	+	0	0	-3.8404
	WHTPOW	+	0	0	-1.1366
B	HAYMIN	-	181.7021	25.0000	0
B	MINFCR	-	202.5000	200.0000	0
B	MXGRST	+	29410.0000	50000.0000	0
B	MXHYST	+	13.9681	200.0000	0
B	MXHYAR	+	300.0000	300.0000	0
B	MXSIAR	+	128.1120	300.0000	0
B	MXSRPU	+	56.9417	200.0000	0
B	MXBRCW	+	500.0000	600.0000	0.000000017
B	MXBRFW	+	1164.5156	10000.0000	0
B	MXBRBL	+	3000.0000	3000.0000	0
B	MXSEGR	+	3000.0000	3000.0000	0
	MAXSOW	+	0	44.0000	-168.9579
	SHPPOL	+	0	0	-3.0000
	WETPOL	+	0	0	-4.0601
	STRPOL	+	0	0	-105.0000
	SPRFED	+	0	0	-0.3021
	SUMFED	+	0	0	-0.4648
	AUTFED	+	0	0	-0.6198
	WINFED	+	0	0	-0.1259
	ANGPOL	+	0	0	-83.8610
	WIFRPL	+	0	0	-0.1259
B	EWEMIN	-	6835.4844	2000.0000	0
	COWMIN	-	0	100.0000	5.2046
	OACRPL	+	0	0	-0.7309
	BAGRPL	+	0	0	-0.7500
	HAYPOL	+	0	0	-20.0000
	SILPOL	-	0	200.0000	5.2131
	LIVCAP	+	0	0	-0.0800
	MERPOL	+	0	0	-1.1000
B	SUMLAB	+	433.0065	3600.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/38/45 PAGE 0006

DUMP:DUMP 13 RIGHT HAND SIDE RHS1

OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
	AUTLAB	+	0	3600.0000	-0.9695
B	SPRLAB	+	1444.0855	3600.0000	0
B	MAXWHR	+	8546.5943	20000.0000	0
	MAXECP	+	0	300.0000	-0.1197
	MXPDHY	+	0	300.0000	-3.6699
B	MXSSTR	+	67357.6581	0	0
B	MXSATR	+	70196.3360	0	0
B	MINWCP	-	898.4402	500.0000	0
B	MINSIW	-	71.8880	100.0000	0.0000000082
	BLANAR	+	0	2170.0000	-23.2689
	CLANAR	+	0	410.0000	-19.7604
	DLANAR	+	0	1400.0000	-18.2244
	ENONAR	+	0	965.0000	-13.2014
	BROTAT	+	0	0	-1.0177
	CROTAT	+	0	0	-2.0950
	DROTAT	+	0	0	-2.6526
B	MXBCRP	+	6.6667	730.0000	0
B	MXCCRP	+	3.3333	140.0000	0
B	MXDCRP	+	3.3333	470.0000	0
	CFWTPL	+	0	0	-3.5000
	XBSTPL	+	0	0	-90.0000
	HEIFPL	+	0	0	-100.0000
	USWHTA	+	0	0	-0.8524
	USWHTB	+	0	0	-0.8524
	USWHTC	+	0	0	-1.1786
	USWHTD	+	0	0	-0.8524
B	MAXCAT	+	150615.4582	0	0
B	MAXBAR	+	300.0000	300.0000	0
	CATREL	+	0	0	-5.6893
B	XBEREL	+	1767.0969	0	0
B	MNGRST	-	10590.0000	10000.0000	0
B	MNHYST	-	161.0319	25.0000	0
	LUCMNA	+	0	0	-0.1500
	LUCMNB	+	0	0	-9.7662
B	LUCMNC	+	45.5647	0	0
B	LUCMND	+	155.5867	0	0
B	AHAYPL	+	2303.8030	0	0
B	BHAYPL	+	0	0	0
B	CHAYPL	+	273.3333	0	0
B	DHAYPL	+	933.3333	0	0

MODEL 3

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/40/07 PAGE 0001

DUMP:DUMP 14 RIGHT HAND SIDE RHS1

OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	WHTGRH	*	0	-8.3000	-3.7065
	WHTGRG	*	0	-7.6000	-2.3841
B	WHTSLQ	*	13723.0331	1.1500	0
	WHSLOQ	*	0	0.9500	-0.2000
	OTGRGR	*	0	-7.6500	-5.4172
	BAGRGR	*	0	-7.6500	-5.4172
	BARGRN	*	0	16.6500	-5.5937
	RAPCRP	*	0	22.1500	-9.9310
	LUPCRP	*	0	17.1500	-12.0116
	PEACRP	*	0	16.2500	-12.9116
	SFLCRP	*	0	21.2000	-10.2971
	SHWHGR	*	0	-3.6000	-11.8453
	COWHGR	*	0	-12.6000	-7.0453
B	SILPRO	*	300.0000	-7.0000	0
	HAYPRO	*	0	-14.0000	-9.1354
	LUCCON	*	0	-1.6250	-0.4000
B	LUCMIN	*	1282.4359	-1.2500	0
B	LUCMAX	*	427.5641	-1.1500	0
	ANAMIN	*	0	-0.9000	-6.1287
B	ANEMIN	*	136.9558	-0.9000	0
	PERPAS	*	0	-0.8000	-6.0287
B	ANNPAS	*	719.3876	-0.8000	0
B	ANGBRD	*	83.3333	10.8000	0
	BUYSTR	*	0	-105.0000	-3.6721
B	SELSTR	*	36.6667	80.0000	0
B	AASANT	*	16.6667	42.5000	0
B	FATCAT	*	0	120.0000	0
	FATANG	*	0	105.0000	-0.8501
B	MERBRD	*	10000.0000	-1.7000	0
	MERXRL	*	0	5.8000	-0.6202
B	MERWET	*	15427.8064	-0.7400	0
	SECXRS	*	0	0	-0.5275
	SLSTWT	*	0	4.0000	-0.5000
B	SLSTSP	*	2000.0000	3.0000	0
	FATSHP	*	0	4.0000	-0.8051
B	AUFDPH	*	300.0000	-4.0000	0
	WTFDPH	*	0	-4.0000	-14.0493
	SUSEOT	*	0	0.5000	-0.2222
	WISEOT	*	0	0.6000	-0.1222
	SUSEBA	*	0	0.6500	-0.1000
B	WISEBA	*	8994.7977	0.7500	0
	AUFDOA	*	0	-0.0200	-0.2366
	WIFDOA	*	0	-0.0200	-0.6065
	AUFDBA	*	0	-0.0200	-0.0730
	WIFDBA	*	0	-0.0200	-0.5830
	LOTFED	*	0	100.0000	-20.3833
B	HASEWI	*	121.9553	20.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/40/09 PAGE 0002

DUMP:DUMP 14 RIGHT HAND SIDE RHS1

OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
B	AUFDHY	+	78.0447	-0.5000	0
	WIFDHI	+	0	-0.5000	-14.9991
	WIFDSI	+	0	-0.5000	-4.9997
B	FOTRAS	+	14740.0452	0	0
B	SPSUTR	+	35903.8339	0	0
	SUAUTR	+	0	0	-0.0714
B	BACPIG	+	44.0000	300.0000	0
B	INTRST	+	151607.2435	-0.0800	0
	HISPLB	+	0	-2.0000	-2.0000
	HISULB	+	0	-2.0000	-2.0000
	HIAULB	+	0	-2.0000	-2.0000
B	SEMRWL	+	161352.9350	1.3000	0
	LATOAT	+	0	-7.6500	-6.5607
	LATBAR	+	0	-7.6500	-4.6437
B	WHEATB	+	224.7190	-8.1000	0
	ELOATB	+	0	-7.6500	-2.5332
	LTOATB	+	0	-7.6500	-3.6766
	ELBARB	+	0	-7.6500	-2.5332
	LTBARB	+	0	-7.6500	-1.7596
	RAPCPB	+	0	20.0000	-9.1969
	LUPINB	+	0	15.0000	-11.2776
	PEACPB	+	0	14.0000	-12.2776
	SUNFLB	+	0	20.0000	-8.6130
	LUCCNB	+	0	-1.6250	-1.0726
B	LUCMNB	+	1603.1325	-1.2500	0
	LUCMXB	+	0	-1.1500	-2.6901
	ANPASB	+	0	-0.9000	-4.6336
	PRPASB	+	0	-0.8000	-4.5336
	WHTGRC	+	0	-8.1000	-1.6904
	ELOATC	+	0	-7.6500	-0.7736
	LTOATC	+	0	-7.6500	-1.9170
	ELBARC	+	0	-7.6500	-0.7736
B	LTBARC	+	101.1239	-7.6500	0
	RAPCPC	+	0	19.0000	-8.9305
	LUPINC	+	0	14.0000	-9.5315
	PEACPC	+	0	13.0000	-10.5315
	SUNFLC	+	0	19.0000	-7.8534
	LUCCNC	+	0	-1.6250	-0.8726
B	LUCMNC	+	235.8516	-1.2500	0
	LUCMXC	+	0	-1.1500	-0.0410
	ANPASC	+	0	-0.9000	-3.2571
	PRPASC	+	0	-0.8000	-3.0664
B	WHTCRD	+	50.0000	-8.1000	0
B	ELOATD	+	0	-7.6500	0
	LTOATD	+	0	-7.6500	-2.3932
B	ELBARD	+	300.0000	-7.6500	0
	LTBARD	+	0	-7.6500	-0.5596

PROBLEM MACTIER LP   SOLUTION   DATE 07/12/72   TIME 14/40/10   PAGE 0003

DUMP:DUMP 14   RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	RAPCPD	+	0	18.0000	-8.5555
	LUPIND	+	0	13.0000	-9.8276
	PEACPD	+	0	12.0000	-10.8276
	SUNFLD	+	0	18.0000	-7.1630
	LUCCND	+	0	-1.6250	-1.1836
B	LUCMND	+	933.3333	-1.2500	0
	LUCMXD	+	0	-1.2500	-0.2022
	ANPASD	+	0	-0.9000	-3.2527
	PRPASD	+	0	-0.8000	-3.9613
	USWHTA	+	0	-7.6000	-5.8341
B	USWHTB	+	74.9063	-8.1000	0
B	USWHTC	+	33.7080	-8.1000	0
B	USWHTD	+	116.6667	-8.1000	0
B	BARCPE	+	68.4779	-7.6500	0
	OATCPE	+	0	-7.6500	-1.7503
	BARGNE	+	0	14.0000	-5.4341
B	PRPASE	+	494.5664	-0.8000	0
B	SHRHYA	+	267.2422	0	0
	FTSHWT	+	0	4.5000	-0.8316
	OATBUY	+	0	-0.6000	-0.0943
	BARBUY	+	0	-0.7500	-0.0530
	HAYBUY	+	0	-22.0000	-1.5000
B	SUHYSL	+	40.5180	15.0000	0
B	SLHEIF	+	16.6667	100.0000	0
B	SXVEAL	+	7.3333	90.0000	0
B	SLSTWT	+	3548.3955	3.5000	0
	SLSXFT	+	0	110.0000	-6.2753
	AFDPHB	+	0	-4.0000	-1.2153
	WFDPHB	+	0	-4.0000	-13.0813
	AFDPHC	+	0	-4.0000	-29.0805
	WFDPHC	+	0	-4.0000	-18.7144
	AFDPHD	+	0	-4.0000	-2.3549
	WFDPHD	+	0	-4.0000	-11.7210
B	APENAR	+	965.0000	-0.8000	0
B	AUFDS1	+	700.0000	-0.5000	0
	LUEX1A	+	0	-1.1500	-0.0750
	LUEX1B	+	0	-1.1500	-4.7826
B	LUEX1C	+	39.3165	-1.1500	0
	LUEX1D	+	0	-1.1500	-0.0132
	HYPROB	+	0	-14.0000	-9.1174
B	BUYWET	+	665.5077	-4.5000	0
	AUFDWT	+	0	-0.0200	-0.3227
	WIFDWT	+	0	-0.0200	-0.9426
	WIBYOT	+	0	-0.6000	-0.4643
	WIBYBA	+	0	-0.7500	-0.5630
	WIBYHY	+	0	-22.0000	-16.4991
	SIPROB	+	0	-7.0000	-1.0546

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/40/14 PAGE 0005

DUMP:DUMP 14 RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
#	GM	Z	211477.3990	0	
	ALANAR	+	0	2010.0000	-30.4684
	ELANAR	+	0	700.0000	-18.8610
	NONARR	+	0	810.0000	-19.8034
B	MAXACR	+	1330.3982	2300.0000	0
B	MINACR	-	269.6018	700.0000	0
B	RAPMAX	+	300.0000	300.0000	0
B	LUPMAX	+	100.0000	100.0000	0
B	PEAMAX	+	100.0000	100.0000	0
B	SUNMAX	+	300.0000	300.0000	0
B	WHMAXQ	+	26276.9669	40000.0000	0
B	WHMXOQ	+	10000.0000	10000.0000	0
B	MXCRAW	+	670.0000	670.0000	0
B	MXCREW	+	171.5221	240.0000	0
B	AROTAT	+	951.5545	0	0
	EROTAT	+	0	0	-3.8602
	WHIPOW	+	0	0	-1.1500
B	HAYMIN	-	242.2422	25.0000	0
B	MINFCR	-	201.1239	200.0000	0
B	MXGRST	+	34405.2023	50000.0000	0
	MXHYST	+	0	200.0000	-5.0000
B	MXHYAR	+	300.0000	300.0000	0
	MXSIAR	+	0	300.0000	-1.0396
B	MXSRPU	+	200.0000	200.0000	0
B	MXBRCW	+	500.0000	600.0000	0
	MXBREW	+	0	10000.0000	-0.0318
B	MXBRBL	+	3000.0000	3000.0000	0
B	MXSEGR	+	3000.0000	3000.0000	0
	MAXSOW	+	0	44.0000	-183.5000
	SHPPOL	+	0	0	-3.0000
	WETPOL	+	0	0	-4.5000
	STRPOL	+	0	0	-101.3279
	SPRFED	+	0	0	-0.3795
	SUMFED	+	0	0	-0.5839
	AUTFED	+	0	0	-0.6833
	WINFED	+	0	0	-0.1834
	ANGPOL	+	0	0	-80.0000
	WIFRPL	+	0	0	-0.1834
B	EWEMIN	-	8000.0000	2000.0000	0
	COWMIN	-	0	100.0000	19.5815
	OACRPL	+	0	0	-0.7222
	BAGRPL	+	0	0	-0.7500
	HAYPOL	+	0	0	-15.0000
	SILPOL	-	0	200.0000	6.3333
	LIVCAP	+	0	0	-0.0800
	MERPOL	+	0	0	-1.3000
B	SUMLAB	+	750.9210	3600.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/40/15 PAGE 0006

DUMP:DUMP 14 RIGHT HAND SIDE RHS1

OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
B	AUTLAB	+	458.3002	3600.0000	0
B	SPRLAB	+	1095.7219	3600.0000	0
B	MAXWHR	+	4572.1936	20000.0000	0
	MAXECP	+	0	300.0000	-1.2740
	MXPDHY	+	0	300.0000	-3.0646
B	MXSSTR	+	81725.4099	0	0
B	MXSATR	+	84245.9270	0	0
	MINWCP	-	0	500.0000	1.0453
B	MINSIW	-	200.0000	100.0000	0
	BLANAR	+	0	2170.0000	-26.7218
	CLANAR	+	0	410.0000	-23.5532
	DLANAR	+	0	1400.0000	-21.6546
	ENONAR	+	0	965.0000	-16.3476
B	BROTAT	+	635.5620	0	0
	CROTAT	+	0	0	-0.9864
	DROTAT	+	0	0	-1.6172
B	MXBCRP	+	430.3746	730.0000	0
B	MXCCRP	+	5.1681	140.0000	0
B	MXDCRP	+	3.3333	470.0000	0
	CFWTPL	+	0	0	-3.5000
	XBSTPL	+	0	0	-90.0000
	HEIFPL	+	0	0	-100.0000
B	USWHTA	+	0	0	0
	USWHTB	+	0	0	-0.8625
	USWHTC	+	0	0	-1.2851
	USWHTD	+	0	0	-0.8625
B	MAXCAT	+	188090.4564	0	0
B	MAXBAR	+	300.0000	300.0000	0
	CATREL	+	0	0	-8.9218
B	XBEREL	+	2000.0000	0	0
B	MNGRST	-	5594.7977	10000.0000	0
B	MNHYST	-	96.9553	25.0000	0
	LUCMNA	+	0	0	-0.1500
	LUCMNB	+	0	0	-4.1850
	LUCMNC	+	0	0	-0.0265
B	LUCMND	+	155.5867	0	0
B	AHAYPL	+	3013.1325	0	0
B	BHAYPL	+	0	0	0
B	CHAYPL	+	235.8516	0	0
B	DHAYPL	+	933.3333	0	0

MODEL 4

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/42/30 PAGE 0001

DUMP:DUMP 15 RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	WHTGRH	+	0	-8.3000	-5.1025
B	WHTGRG	+	496.2573	-7.6000	0
B	WHTSLQ	+	36360.9214	1.0500	0
	WHSLOQ	+	0	0.8500	-0.2000
	OTGRGR	+	0	-7.6500	-1.6385
	BAGRGR	+	0	-7.6500	-1.6385
	BARGRN	+	0	16.6500	-3.6075
	RAPCRP	+	0	22.1500	-3.3218
	LUPCRP	+	0	17.1500	-4.9965
	PEACRP	+	0	16.2500	-5.8965
	SFLCRP	+	0	21.2000	-2.7950
	SHWHGR	+	0	-3.6000	-8.8500
	COWHGR	+	0	-12.6000	-5.2500
B	SILPRO	+	100.0000	-7.0000	0
B	HAYPRO	+	13.9681	-14.0000	0
	LUCCON	+	0	-1.6250	-0.9080
B	LUCMIN	+	1055.9930	-1.2500	0
	LUCMAX	+	0	-1.1500	-0.0471
	ANAMIN	+	0	-0.9000	-3.5548
B	ANEMIN	+	466.6667	-0.9000	0
	PERPAS	+	0	-0.8000	-3.9841
B	ANNPAS	+	611.1657	-0.8000	0
B	ANGBRD	+	833.3333	10.8000	0
	BUYSTR	+	0	-100.0000	-0.6457
	SELSTR	+	0	75.0000	-4.7650
B	AASANT	+	166.6667	42.5000	0
B	FATCAT	+	0	115.0000	0
B	FATANG	+	366.6667	100.0000	0
B	MERBRD	+	5995.3160	-1.7000	0
B	MERXBL	+	1199.0632	5.8000	0
	MERWET	+	0	-0.7400	-0.2049
	SECXRS	+	0	0	-0.2999
B	SLSTWT	+	2098.3606	4.0000	0
	SLSTSP	+	0	3.0000	-0.4266
	FATSHP	+	0	4.0000	-0.8597
B	AUFDPH	+	300.0000	-4.0000	0
	WTFDPH	+	0	-4.0000	-7.8945
	SUSEOT	+	0	0.4500	-0.2209
	WISEOT	+	0	0.5500	-0.1209
	SUSEBA	+	0	0.6000	-0.1000
B	WISEBA	+	24064.7365	0.7000	0
	AUFDOA	+	0	-0.0200	-0.3480
	WIFDOA	+	0	-0.0200	-0.5486
	AUFDBA	+	0	-0.0200	-0.2474
	WIFDBA	+	0	-0.0200	-0.5239
	LOTFED	+	0	100.0000	-16.8083
B	HASEWI	+	200.0000	20.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/42/32 PAGE 0002

DUMP1DUMP 15 RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	AUFDHY	◆	0	-0.5000	-8.6003
	WIFDHI	◆	0	-0.5000	-14.7310
	WIFDRI	◆	0	-0.5000	-1.7102
B	FOTRAS	◆	9021.3448	0	0
B	SPSUTR	◆	32990.4988	0	0
B	SUAUTR	◆	9590.4441	0	0
B	BACPIG	◆	44.0000	300.0000	0
B	INTRST	◆	228383.9760	-0.0800	0
	HISPLB	◆	0	-2.0000	-2.0000
	HISULB	◆	0	-2.0000	-2.0000
B	HIAULB	◆	213.4457	-2.0000	0
B	SEMRUL	◆	52638.8743	0.9000	0
	LATOAT	◆	0	-7.6500	-2.5104
	LATBAR	◆	0	-7.6500	-0.5000
B	WHEATB	◆	283.4795	-8.1000	0
	ELOATB	◆	0	-7.6500	-1.1385
	LTOATB	◆	0	-7.6500	-2.0104
	ELBARB	◆	0	-7.6500	-1.1385
B	LTBARB	◆	259.0205	-7.6500	0
	RAPCPB	◆	0	20.0000	-5.1594
	LUPINB	◆	0	15.0000	-6.2711
	PEACPB	◆	0	14.0000	-7.2711
	SUNFLB	◆	0	20.0000	-3.4950
	LUCCNB	◆	0	-1.6250	-2.9424
B	LUCMNB	◆	1239.9646	-1.2500	0
	LUCMXB	◆	0	-1.1500	-7.4799
	ANPASB	◆	0	-0.9000	-4.1646
	PRPASB	◆	0	-0.8000	-4.7815
	WHTGRC	◆	0	-8.1000	-3.1500
	ELOATC	◆	0	-7.6500	-1.1385
	LTOATC	◆	0	-7.6500	-2.0104
	ELBARC	◆	0	-7.6500	-1.1385
B	LTBARC	◆	102.5000	-7.6500	0
	RAPCPC	◆	0	19.0000	-7.1493
	LUPINC	◆	0	14.0000	-5.2915
	PEACPC	◆	0	13.0000	-6.2915
	SUNFLC	◆	0	19.0000	-4.4950
	LUCCNC	◆	0	-1.6250	-2.0818
B	LUCMNC	◆	273.3333	-1.2500	0
	LUCMXC	◆	0	-1.1500	-0.3267
	ANPASC	◆	0	-0.9000	-1.8508
	PRPASC	◆	0	-0.8000	-3.1101
	WHTCRD	◆	0	-8.1000	-1.0500
B	ELOATD	◆	0	-7.6500	0
	LTOATD	◆	0	-7.6500	-1.9230
B	ELBARD	◆	300.0000	-7.6500	0
B	LTBARD	◆	50.0000	-7.6500	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/42/33 PAGE 0003

DUMP;DUMP 15 RIGHT HAND SIDE RHS1
OBJECTIVE GM

COLUMN INFORMATION

	NAME		VALUE	OBJECTIVE	SHADOW PRICE
	RAPCPD	♦	0	18.0000	-6.0092
	LUPIND	♦	0	13.0000	-7.6050
	PEACPD	♦	0	12.0000	-8.6050
	SUNFLD	♦	0	18.0000	-3.3950
	LUCCND	♦	0	-1.6250	-2.0417
B	LUCMND	♦	933.3333	-1.2500	0
	LUCMXD	♦	0	-1.2500	-0.4167
	ANPASD	♦	0	-0.9000	-1.8508
	PRPASD	♦	0	-0.8000	-3.4175
B	USWHTA	♦	165.4191	-7.6000	0
B	USWHTB	♦	180.8333	-8.1000	0
B	USWHTC	♦	34.1667	-8.1000	0
B	USWHTD	♦	116.6667	-8.1000	0
B	BARCPE	♦	233.3333	-7.6500	0
	OATCPE	♦	0	-7.6500	-1.8356
	BARGNE	♦	0	14.0000	-4.1575
	PRPASE	♦	0	-0.8000	-0.9631
B	SHRHYA	♦	206.7021	0	0
	FTSHWT	♦	0	4.5000	-0.1225
	OATBUY	♦	0	-0.6000	-0.2571
	BARBUY	♦	0	-0.7500	-0.2774
	HAYBUY	♦	0	-22.0000	-8.1003
	SUHYSL	♦	0	15.0000	-4.5261
B	SLHEIF	♦	166.6667	100.0000	0
	SXVEAL	♦	0	85.0000	-4.4894
B	SLSTWT	♦	0	3.5000	0
B	SLSXFT	♦	73.3333	110.0000	0
	AFDPHB	♦	0	-4.0000	-0.9498
	WFDPHB	♦	0	-4.0000	-7.5679
	AFDPHC	♦	0	-4.0000	-19.9693
	WFDPHC	♦	0	-4.0000	-14.1642
	AFDPHD	♦	0	-4.0000	-1.9112
	WFDPHD	♦	0	-4.0000	-7.1742
B	APENAR	♦	965.0000	-0.8000	0
B	AUFDS1	♦	100.0000	-0.5000	0
B	LUEX1A	♦	178.3625	-1.1500	0
	LUEX1B	♦	0	-1.1500	-12.9512
	LUEX1C	♦	0	-1.1500	-0.1389
	LUEX1D	♦	0	-1.1500	-0.1333
	HYPROB	♦	0	-14.0000	-1.0491
	BUYWET	♦	0	-4.5000	-0.5000
	AUFDWT	♦	0	-0.0200	-0.4955
	WIFDWT	♦	0	-0.0200	-0.8315
	WIBYOT	♦	0	-0.6000	-0.4577
	WIBYBA	♦	0	-0.7500	-0.5539
	WIBYHY	♦	0	-22.0000	-16.2310
	SIPROB	♦	0	-7.0000	-1.8832

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/42/35 PAGE 0005

DUMP;DUMP 15 RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
#	GM	Z	158521.5256	0	
	ALANAR	+	0	2010.0000	-20.1027
	ELANAR	+	0	700.0000	-13.2059
	NONARR	+	0	810.0000	-12.8868
B	MAXACR	+	78.3236	2300.0000	0
B	MINACR	-	1521.6764	700.0000	0
B	RAPMAX	+	300.0000	300.0000	0
B	LUPMAX	+	100.0000	100.0000	0
B	PEAMAX	+	100.0000	100.0000	0
B	SUNMAX	+	300.0000	300.0000	0
B	WHMAXQ	+	3639.0786	40000.0000	0
B	WHMXOQ	+	10000.0000	10000.0000	0
B	MXCRAW	+	8.3236	670.0000	0
B	MXCREW	+	6.6667	240.0000	0
	AROTAT	+	0	0	-1.0585
	EROTAT	+	0	0	-4.5841
	WHIPOW	+	0	0	-1.0500
B	HAYMIN	-	195.6702	25.0000	0
B	MINFCR	-	511.5205	200.0000	0
B	MXGRST	+	18435.2635	50000.0000	0
	MXHYST	+	0	200.0000	-0.4739
B	MXHYAR	+	286.0319	300.0000	0
B	MXSIAR	+	200.0000	300.0000	0
B	MXSRPU	+	200.0000	200.0000	0
	MXBRCW	+	0	1000.0000	-4.4917
B	MXBREW	+	2805.6208	10000.0000	0
B	MXBRBL	+	1800.9368	3000.0000	0
B	MXSEGR	+	3000.0000	3000.0000	0
	MAXSOW	+	0	44.0000	-161.0000
	SHPPOL	+	0	0	-3.4266
	WETPOL	+	0	0	-4.0000
	STRPOL	+	0	0	-99.3543
	SPRFED	+	0	0	-0.2259
	SUMFED	+	0	0	-0.3475
	AUTFED	+	0	0	-0.4633
	WINFED	+	0	0	-0.1923
	ANGPOL	+	0	0	-79.7650
	WIFRPL	+	0	0	-0.1923
B	EWEMIN	-	5194.3792	2000.0000	0
B	COWMIN	-	900.0000	100.0000	0
	OACRPL	+	0	0	-0.6709
	BAGRPL	+	0	0	-0.7000
	HAYPOL	+	0	0	-19.5261
	SILPOL	-	0	200.0000	3.1332
	LIVCAP	+	0	0	-0.0800
	MERPOL	+	0	0	-0.9000
B	SUMLAB	+	250.0049	3600.0000	0

PROBLEM MACTIER LP SOLUTION DATE 07/12/72 TIME 14/42/36 PAGE 0006

DUMP:DUMP 15 RIGHT HAND SIDE RHS1
OBJECTIVE GM

ROW INFORMATION

	NAME		SLACK	R.H.S.	PRICE
	AUTLAB	+	0	3600.0000	-2.0000
B	SPRLAB	+	1420.5621	3600.0000	0
B	MAXWHR	+	20000.0000	20000.0000	0
	MAXECP	+	0	300.0000	-1.5230
	MXPDHY	+	0	300.0000	-1.7336
B	MXSSTR	+	64565.3547	0	0
B	MXSATR	+	65563.8560	0	0
B	MINWCP	-	776.8226	500.0000	0
	MINSIW	-	0	100.0000	3.9301
	BLANAR	+	0	2170.0000	-19.2274
	CLANAR	+	0	410.0000	-16.4602
	DLANAR	+	0	1400.0000	-14.9653
	ENONAR	+	0	965.0000	-10.5505
	BROTAT	+	0	0	-1.4339
	CROTAT	+	0	0	-3.4136
	DROTAT	+	0	0	-3.3335
B	MXBCRP	+	6.6667	730.0000	0
B	MXCCRP	+	3.3333	140.0000	0
B	MXDCRP	+	3.3333	470.0000	0
	CFWTPL	+	0	0	-3.5000
	XBSTPL	+	0	0	-89.4894
	HEIFPL	+	0	0	-100.0000
	USWHTA	+	0	0	-0.7875
	USWHTB	+	0	0	-0.7875
	USWHTC	+	0	0	-1.5750
	USWHTD	+	0	0	-1.0500
B	MAXCAT	+	909664.7275	999999.0000	0
B	MAXBAR	+	300.0000	300.0000	0
	CATREL	+	0	0	-5.3833
B	XBEREL	+	0	0	0
B	MNGRST	-	21564.7365	10000.0000	0
B	MNHYST	-	175.0000	25.0000	0
	LUCMNA	+	0	0	-0.0222
	LUCMNB	+	0	0	-11.1004
B	LUCMNC	+	45.5647	0	0
B	LUCMND	+	155.5867	0	0
B	AHAYPL	+	1995.9575	0	0
B	BHAYPL	+	0	0	0
B	CHAYPL	+	273.3333	0	0
B	DHAYPL	+	933.3333	0	0

	RHS	1 WHTGRH	2 WHTGRG	3 WHTSLQ	4 WHSLOQ	5 OTGRGR	6 BAGRGR	7 BARGRN	8 RAPCRP	9 LUPCRP	10 PEACRP	11 SFLCRP	12 SHWHGR	13 COWHGR	14 SILPRO	15 HAYPRO	16 LUCCON	17 LUCMIN	18 LUCMAX	19 ANAMIN	20 ANEMIN	21 PERPAS	22 ANNPAS	23 ANGBRD
GM		-8.3	-7.6	+1.05	+0.85	-7.65	-7.65	+16.65	+22.15	+17.15	+16.25	+21.2	-3.6	-12.6	-7.0	-14.0	-1.625	-1.25	-1.15	-0.9	-0.9	-0.8	-0.8	+10.8
+ ALANAR 1	2010.		1.0			1.0	1.0		1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0		1.0		
+ ELANAR 2	700.	1.0																			1.0			
+ NONARR 3	810.		0.1			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1									1.0	
+ MAXACR 4	2300.	1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0													
- MINACR 5	700.	1.0	1.0			1.0	1.0	1.0	1.0	1.0	1.0													
+ RAPMAX 6	300.								1.0															
+ LUPMAX 7	100.									1.0														
+ PEAMAX 8	100.										1.0													
+ SUNMAX 9	300.											1.0												
+ WHMAXQ 10	40000.			1.0																				
+ WHMXOQ 11	10000.				1.0																			
+ MXCRAL 12	670.		1.0			1.0	1.0		1.0	1.0	1.0	1.0												
+ MXCREL 13	240.	1.0																						
+ AROTAT 14			1.0			1.0	1.0		1.5			1.0			-0.5	-0.5		-0.5	-0.375	-0.5				
+ EROTAT 15		1.0																			-0.5			
+ WHTPOL 16		-21.0	-30.0	1.0	1.0								-13.0	-25.0										
- HAYMIN 17	25.															1.0								
- MINFCR 18	200.					1.0	1.0																	
+ MXGRST 19	50000.																							
+ MXHYST 20	200.																							
+ MXHYAR 21	300.															1.0								
+ MXSTAR 22	300.														1.0									
+ MXSRPU 23	200.																							
+ MXBRCW 24	600.																							1.0
+ MXBREW 25	10000.																							
+ MXBRBL 26	3000.																							
+ MXSEGR 27	3000.																							
+ MAXSOW 28	44.																							
+ SHPPOL 29																								
+ WETPOL 30																								
+ STRPOL 31																								
+ SPRFED 32																	-30.0	-30.0	-30.0	-30.0	-19.0	-30.0	-22.0	46.0
+ SUMFED 33		-5.0	-5.0			-8.0	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0	-5.0	-5.0	-14.0	-14.0	-14.0	-14.0	-14.0	-7.0	-6.0	-7.0	-7.0	44.0
+ AUTFED 34															-14.0	-14.0	+14.0	-14.0	-14.0	-10.0	-8.0	-10.0	-9.0	40.0
+ WINFED 35															-14.0	-14.0	-14.0	-14.0	-14.0	-16.0	-9.0	-16.0	-11.0	43.0
+ ANGPOL 36																								-0.44
+ WIFRPL 37						-45.0	-40.0																	
38																								
- EWEMIN 39	2000.																							
- COWMIN 40	100.																							1.0
+ OACRPL 41						-33.0																		
+ BAGRPL 42							-33.0																	
+ HAYPOL 43																-1.0								
- SILPOL 44	200.														+3.0									
+ LIVCAP 45		10.0	10.0			10.0	10.0	10.0	10.0	10.0	10.0	10.0			10.0									150.0
+ MERPOL 46																								
+ SUMLAB 47	3600.	0.5	0.5			0.5	0.5	0.5	0.5	0.5	0.5													0.5
+ AUTLAB 48	3600.	1.0	0.8			1.0	1.0	0.8	0.8	0.8	0.8	0.5												0.5
+ SPRLAB 49	3600.											1.0			1.5									0.5
+ MAXWHR 50	20000.																							
+ MAXECP 51	300.					1.0	1.0																	
+ MXPDHY 52	300.																							
+ MXAWTR 53															-14.0	-14.0	-14.0	-14.0	-14.0	-10.0	-8.0	-10.0	-9.0	
+ MXSATR 54		-5.0	-5.0			-8.0	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0	-5.0	-5.0	-14.0	-14.0	-14.0	-14.0	-14.0	-7.0	-6.0	-7.0	-7.0	
- MINWCP 55	500.	1.0	1.0																					
- MINSIL 56	100.														1.0									
+ BLANAR 57	2170.																							
+ CLANAR 58	410.																							
+ DLANAR 59	1400.							1.0					1.0	1.0										
+ ENONAR 60	965.																							
+ BROTAT 61																								
+ CROTAT 62																								
+ DROTAT 63								1.0					1.0	1.0										
+ MXBCRP 64	730.																							
+ MXCCRP 65	140.																							
+ MXDCRP 66	470.							1.0					1.0	1.0										
+ CFWTPL 67																								
+ XBSTPL 68																								
+ HEIFPL 69																								-0.23
+ USWHTA 70			1.0			1.0	1.0		1.0	1.0	1.0	1.0												
+ USWHTB 71																								
+ USWHTC 72																								
+ USWHTD 73								1.0					1.0	1.0										
+ MAXCAT 74																								173.0
+ MAXBAR 75	300.							1.0																
CATREL 76																								-0.2
XBEREL 77																								
- MNGRST 78	10000.																							
LUCMNA 79																-0.1667		-0.1667	0.5					
LUCMNB 80																								
LUCMNC 81																								
LUCMND 82																								
- MNHYST 83	25.																							
+ AHAYPL 84																	-1.0	-1.0	-1.0	-1.0		-1.0		
+ BHAYPL 85																								
+ CHAYPL 86																								
+ DHAYPL 87																								

	24 BUYSTR	25 SELSTR	26 AASANT	27 FATCAT	28 FATANG	29 MERBRD	30 MERXBL	31 MERWET	32 SECXRS	33 SLSTWT	34 SLSTSP	35 FATSHP	36	37 AUFDPH	38 WTFDPH	39 SUSEOT	40 WISEOT	41 SUSEBA	42 WISEBA	43 AUFDOA	44 WIFDOA	45 AUFDBA	46 WIFDBA	47 LOTFCD
GM	-100.0	+75.0	42.5	120.0	100.0	-1.7	+5.8	-0.74		+4.0	+3.0	+4.0		-4.0	-4.0	0.45	0.55	0.6	0.7	-0.02	-0.02	-0.02	-0.02	+100.0
ALANAR 1																								
ELANAR 2																								
NONARR 3																								
MAXACR 4																								
MINACR 5																								
RAPMAX 6																								
LUPMAX 7																								
PEAMAX 8																								
SUNMAX 9																								
WIMAXQ 10																								
WHMXOQ 11																								
MXCRAL 12																								
MXCREL 13																								
AROTAT 14																								
EROTAT 15																								
WHTPOL 16																								
HAYMIN 17																								
MINFCR 18																								
MXGRST 19																	1.0		1.0	1.0	1.0	1.0	1.0	36.0
MXHYST 20																								0.33
MXHYAR 21																								
MXSIAR 22																								
MXSRPU 23	1.0																							
MXBNCW 24			1.0																					
MXBREW 25						1.0	1.0																	
MXBRBL 26							1.0																	
MXSEGR 27																								
MAXSOW 28																								
SHPPOL 29						-0.2	+1.0				1.0	1.0												
WETPOL 30						-0.35		+0.27		1.0														
STRPOL 31	-1.0			1.0																				
SPRFED 32			38.0	12.0	11.6	6.1	5.2	3.5						+30.0	+30.0									
SUMFED 33			38.0		6.0	5.7	6.0	3.0																
AUTFED 34			33.0	7.0	12.6	4.9	5.9	3.0	1.0			1.8		-27.0						-0.74		-1.02		7.0
WINFED 35			36.0			5.0	4.5	3.0	-0.85			2.7			-24.0						-0.74		-1.02	
ANGPOL 36		1.0			1.0																			1.0
WIFRPL 37				40.0	40.0																			
38																								
EWEMIN 39						1.0	1.0																	
COWMIN 40			1.0																					
OACRPL 41																1.0	1.0			1.0	1.0			
BAGRPL 42																		1.0	1.0			1.0	1.0	36.0
HAYPOL 43																								0.33
SILPOL 44																								
LIVCAP 45			150.0	25.0	25.0	6.0	5.0	4.0				1.0												25.0
MERPOL 46						-7.65	-5.65	-5.5																
SUMLAB 47			0.5			0.15	0.15	0.01																
AUTLAB 48			0.5			0.1	0.1	0.01																
SPRLAB 49			0.5			0.1	0.1	0.01						0.5	0.5									
MAXWHR 50								1.0																
MAXECP 51																								
MXPDHY 52														1.0	1.0									
MXSSTR 53									1.0															
MXSATR 54																								
MINWCP 55																								
MINSIL 56																								
BLANAR 57																								
CLANAR 58																								
DLANAR 59																								
ENONAR 60																								
BROTAT 61																								
CROTAT 62																								
DROTAT 63																								
MXBCRP 64																								
MXCCRP 65																								
MXDCRP 66																								
CFWTPL 67								-0.23																
XBSTPL 68			-0.44																					
HEIFPL 69			+0.15																					
USWHTA 70																								
USWHTB 71																								
USWHTC 72																								
USWHTD 73																								
MAXCAT 74			145.0			-10.85	-10.8	-6.25																
MAXBAR 75																								
CATREL 76			-1.0																					
XBEREL 77						-0.2	1.0																	
MNGRST 78																	1.0		1.0	1.0	1.0	1.0	1.0	36.0
LUCMNA 79																								
LUCMNB 80																								
LUCMNC 81																								
LUCMND 82																								
MNHYST 83																								0.33
AHAYPL 84														1.0	1.0									
BHAYPL 85																								
CHAYPL 86																								
DHAYPL 87																								

	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
	HASEWI	AUFDHY	WIFDHI	WIFDSI	FDTRAS	SPSUTR	SUAUTR	BACPIG	INTRST	HISPLB	HISULB	HIAULB	SEMRWL	LATOAT	LATBAR	WHEATB	ELOATB	LTOATB	ELBARD	LTBARB	RAPEPB	LUPINB	PEACPB	SUNFLB
GM	+20.0	-0.5	-0.5	-0.5	0.	0.	0.	300.0	-0.08	-2.0	-2.0	-2.0	+0.9	-7.65	-7.65	-8.1	-7.65	-7.65	-7.65	-7.65	+20.0	+15.0	+14.0	+20.0
ALANAR 1														1.0	1.0									
ELANAR 2																								
NONARR 3														0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MAXACR 4														1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
MINACR 5														1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
RAPMAX 6																					1.0			
LUPMAX 7																						1.0		
PEAMAX 8																							1.0	
SUNMAX 9																								1.0
WHMAXQ 10																								
WHMXOQ 11																								
MXCRAL 12														1.0	1.0									
MXCREL 13																								
AROTAT 14														1.0	1.0									
EROTAT 15																								
WHTPOL 16																-30.0								
HAYMIN 17																								
MINFCR 18														1.0	1.0		1.0	1.0	1.0	1.0				
MXGRST 19								150.0																
MXHYST 20	1.0	1.0	1.0																					
MXHYAR 21																								
MXSIAR 22																								
MXSRPU 23																								
MXBRCW 24																								
MXBREW 25																								
MXBRBL 26																								
MXSEGR 27																								
MAXSOW 28								1.0																
SHPPOL 29																								
WETPOL 30																								
STRPOL 31																								
SPRFED 32						1.0																		
SUMFED 33						-0.65	1.0							-8.0	-8.0	-5.0	-8.0	-8.0	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0
AUTFED 34		-30.0					-0.75																	
WINFED 35			-30.0	-10.0	-1.0																			
ANGPOL 36																								
WIFRPL 37					1.0									-20.0	-25.0		-45.0	-20.0	-40.0	-25.0				
38																								
EWEMIN 39																								
COWMIN 40																								
OACRPL 41														-36.0			-33.0	-36.0						
BAGRPL 42								150.0							-36.0				-33.0	-36.0				
HAYPOL 43	1.0	1.0	1.0																					
SILPOL 44				-1.0																				
LIVCAP 45								50.0	-1.0					10.0	10.0	10.0	10.0	10.0	10.0	10/0	10.0	10.0	10.0	10.0
MERPOL 46													1.0											
SUMLAB 47								15.0			-1.0			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
AUTLAB 48		1.0						15.0				-1.0		0.8	0.8	0.8	1.0	0.8	1.0	0.8	0.8	0.8	0.8	0.5
SPRLAB 49								15.0		-1.0														1.0
MAXWHR 50																								
MAXECP 51																	1.0		1.0					
MXPDHY 52																								
MXSSTR 53																								
MXSATR 54							1.0									-5.0	-8.0	-8.0	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0
MINWCP 55																1.0								
MINSIL 56																								
BLANAR 57																1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CLANAR 58																								
DLANAR 59																								
ENONAR 60																								
BROTAT 61																1.0	1.0	1.0	1.0	1.0	1.5			1.0
CROTAT 62																								
DROTAT 63																								
MXBCRP 64																1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MXCCRP 65																								
MXDCRP 66																								
CFWTPL 67																								
XBSTPL 68																								
HEIFPL 69																								
USWHTA 70														1.0	1.0									
USWHTB 71																1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
USWHTC 72																								
USWHTD 73																								
MAXCAT 74																								
MAXBAR 75																								
CATREL 76																								
XBEREL 77																								
MNGRST 78								150.0																
LUCMNA 79																								
LUCMNB 80																								
LUCMNC 81																								
LUCMND 82																								
MNHYST 83	1.0		1.0																					
AHAYPL 84																								
BHAYPL 85																								
CHAYPL 86																								
DHAYPL 87																								

	72 LUCCNB	73 LUCMNB	74 LUCMXB	75 ANPASB	76 PRPASB	77	78 WHTGRC	79 ELOATC	80 LTOATC	81 ELBARC	82 LTBARC	83 RAPCPC	84 LUPINC	85 PEACPC	86 SUNFLC	87 LUCCNC	88 LUCMNC	89 LUCMXC	90 ANPASC	91 PRPASC	92	93 WHTGRD	94 ELOATD	95 LTOATD
GM	-1.625	-1.25	-1.15	-0.9	-0.8		-8.1	-7.65	-7.65	-7.65	-7.65	+19.0	+14.0	+13.0	+19.0	-1.625	-1.25	-1.15	-0.90	-0.80		-8.10	-7.65	- 7.65
ALANAR 1																								
ELANAR 2																								
NONARR 3							0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1							0,1	0,1	0,1
MAXACR 4							1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0								1,0	1,0	1,0
MINACR 5							1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0								1,0	1,0	1,0
RAPMAX 6												1,0												
LUPMAX 7													1,0											
PEAMAX 8														1,0										
SUNMAX 9															1,0									
WHMAXQ 10																								
WHMXOQ 11																								
MXCRAL 12																								
MXCREL 13																								
AROTAT 14																								
EROTAT 15																								
WHTPOL 16							-27,0															-27,0		
HAYMIN 17																								
MINFCR 18								1,0	1,0	1,0	1,0												1,0	1,0
MXGRST 19																								
MXHYST 20																								
MXHYAR 21																								
MXSIAR 22																								
MXSRPU 23																								
MXBRCW 24																								
MXBREW 25																								
MXBRBL 26																								
MXSEGR 27																								
MAXSOW 28																								
SHPPOL 29																								
WETPOL 30																								
STRPOL 31																								
SPRFED 32	-26,0	-26,0	-26,0	-26,0	-26,0											-22,0	-22,0	-22,0	-22,0	-22,0				
SUMFED 33	-12,0	-12,0	-12,0	-7,0	-7,0		-5,0	-8,0	-8,0	-8,0	-8,0	-2,0	-7,0	-7,0	-3,0	-11,0	-11,0	-11,0	-6,0	-7,0		-5,0	-8,0	-8,0
AUTFED 34	-12,0	-12,0	-12,0	-10,0	-10,0											-11,0	-11,0	-11,0	-10,0	-10,0				
WINFED 35	-12,0	-12,0	-12,0	-12,0	-12,0											-11,0	-11,0	-11,0	-11,0	-11,0				
ANGPOL 36																								
WIFRPL 37								-45,0	-20,0	-40,0	-25,0												-40,0	-20,0
38																								
EWEMIN 39																								
COWMIN 40																								
OACRPL 41								-33,0	-36,0														-33,0	-33,0
BAGRPL 42										-33,0	-36,0													
HAYPOL 43																								
SILPOL 44																								
LIVCAP 45							10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0							10,0	10,0	10,0
MERPOL 46																								
SUMLAB 47							0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5								0,5	0,5	0,5
AUTLAB 48							0,8	1,0	0,8	1,0	0,8	0,8	0,8	0,8	0,5							0,8	1,0	0,8
SPRLAB 49															1,0									
MAXWHR 50																								
MAXECP 51								1,0		1,0													1,0	
MXPDHY 52																								
MXSSTR 53	-12,0	-12,0	-12,0	-10,0	-10,0											-11,0	-11,0	-11,0	-10,0	-10,0				
MXSATR 54	-12,0	-12,0	-12,0	-7,0	-7,0		-5,0	-8,0	-8,0	-8,0	-8,0	-2,0	-7,0	-7,0	-3,0	-11,0	-11,0	-11,0	-6,0	-7,0		-5,0	-8,0	-8,0
MINWCP 55							1,0															1,0		
MINSIL 56																								
BLANAR 57	1,0	1,0	1,0	1,0	1,0																			
CLANAR 58							1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0				
DLANAR 59																						1,0	1,0	1,0
ENDNAR 60																								
BROTAT 61		-0,5	-0,375	-0,5																				
CROTAT 62							1,0	1,0	1,0	1,0	1,0	1,5			1,0		-0,5	-0,375	-0,5					
DROTAT 63																						1,0	1,0	1,0
MXBCRP 64																								
MXCCRP 65							1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0									
MXDCRP 66																						1,0	1,0	1,0
CFWTPL 67																								
XBSTPL 68																								
HEIFPL 69																								
USWHTA 70																								
USWHTB 71																								
USWHTC 72							1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0									
USWHTD 73																						1,0	1,0	1,0
MAXCAT 74																								
MAXBAR 75																								
CATREL 76																								
XBEREL 77																								
MNGRST 78																								
LUCMNA 79																								
LUCMNB 80		-0,1667	0,5																					
LUCMNC 81																	0,1667	0,5						
LUCMND 82																								
MNHYST 83																								
AHAYPL 84																								
BHAYPL 85	-1,0	-1,0	-1,0	-1,0	-1,0																			
CHAYPL 86																-1,0	-1,0	1,0	-1,0	-1,0				
DHAYPL 87																								

	96 EILBARD	97 LTBARD	98 RAPCPD	99 LUPIND	100 PEACPD	101 SUNFLD	102 LUCCND	103 LUCMND	104 LUCMXD	105 ANPASD	106 PRPASD	107	108 USWHTA	109 USWHTB	110 USWHTC	111 USWHTD	112 BARCPE	113 OATCPE	114 BARGNE	115 PERPASE	116 GHRHYB	117 FTSHWT	118 OATBUY	119 BARBUY
GM	-7.65	-7.65	+18.0	+13.0	+12.0	+18.0	-1.628	-1.25	-1.25	-0.8	-0.8		-7.6	-8.1	-8.1	-8.1	-7.65	-7.65	+14.0	-0.80		+4.5	-0.6	-0.75
ALANAR 1													1.0											
ELANAR 2																	1.0	1.0	1.0	1.0				
NONARR 3	0.1	0.1	0.1	0.1	0.1	0.1							0.1	0.1	0.1	0.1								
MAXACR 4	1.0	1.0	1.0	1.0	1.0								1.0	1.0	1.0	1.0	1.0	1.0	1.0					
MINACR 5	1.0	1.0	1.0	1.0	1.0								1.0	1.0	1.0	1.0	1.0	1.0	1.0					
RAPMAX 6			1.0																					
LUPMAX 7				1.0																				
PEAMAX 8					1.0																			
SUNMAX 9						1.0																		
WHMAXQ 10																								
WHMXQQ 11																								
MXCRAL 12													1.0											
MXCREL 13																	1.0	1.0	1.0					
AROTAT 14													1.0											
EROTAT 15																	1.0	1.0	1.0					
WHTPOL 16													-27.0	-27.0	-24.0	-24.0								
HAYMIN 17																					1.0			
MINFCR 18	1.0	1.0																						
MXGRST 19																								
MXHYST 20																								
MXHYAR 21																								
MXSLAR 22																								
MXSRPU 23																								
MXBRCW 24																								
MXBREW 25																								
MXBRDL 26																								
MXSEGR 27																								
MAXSOW 28																								
SHPPOL 29																								
WETPOL 30																								
STRPOL 31																								
SPRFED 32							-20.0	-20.0	-20.0	-20.0	-20.0									-20.0				
SUMFED 33	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0	-10.0	-10.0	-10.0	-.50	-.50		+5.0	-5.0	-5.0	-5.0	-7.0	-7.0	-7.0	-7.0	-12.0	3.0		
AUTFED 34							-10.0	-10.0	-10.0	-9.0	-9.0									-9.0	-12.0		-0.74	-1.02
WINFED 35							-10.0	-10.0	-10.0	-10.0	-10.0									-10.0	-12.0			
ANGPOL 36																								
WIFRPL 37	-25.0	-25.0															-25.0	-20.0						
38																								
EWEMIN 39																								
COWMIN 40																								
OACHPL 41																		-30.0						
BACHPL 42	-33.0	-33.0															-30.0							
HAYPOL 43																					-0.9			
SILPOL 44																								
LIVCAP 45	10.0	10.0	10.0	10.0	10.0	10.0							10.0	10.0	10.0	10.0	10.0	10.0	10.0			1.0		
MERPOL 46																								
SUMLAB 47	0.5	0.5	0.5	0.5	0.5								0.5	0.5	0.5	0.5	0.5	0.5	0.5					
AUTLAB 48	1.0	0.8	0.8	0.8	0.8	0.5							0.8	0.8	0.8	0.8	1.0	1.0	1.0					
SPRLAB 49						1.0																		
MAXWIR 50																								
MAXECP 51	1.0																							
MXPDHY 52																								
MXSSTR 53							-10.0	-10.0	-10.0	-9.0	-9.0									-9.0	-12.0			
MXSATR 54	-8.0	-8.0	-2.0	-7.0	-7.0	-3.0	-10.0	-10.0	-10.0	-5.0	-5.0		-5.0	-5.0	-5.0	-5.0	+7.0	+7.0	-7.0	-7.0	-12.0			
MINWCP 55													1.0	1.0	1.0	1.0								
MINSIL 56																								
BLANAR 57														1.0							1.0			
CLANAR 58															1.0									
DLANAR 59	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0					1.0								
ENONAR 60																								
BROTAT 61														1.0							-0.5			
CROTAT 62															1.0									
DROTAT 63	1.0	1.0	1.5	1.0	1.0	1.0		-0.5	-0.375	-0.5						1.0								
MXBCRP 64														1.0										
MXCCRP 65															1.0									
MXDCRP 66	1.0	1.0	1.0	1.0	1.0	1.0										1.0								
CFWTPL 67																						1.0		
XBSTPL 68																								
HEIFPL 69																								
USWHTA 70													-3.0											
USWHTB 71														-3.0										
USWHTC 72															-3.0									
USWHTD 73	1.0	1.0	1.0	1.0	1.0	1.0										-3.0								
MAXCAT 74																								
MAXBAR 75																								
CATREL 76																								
XBEREL 77																								
MNGRST 78																								
LUCMNA 79																								
LUCMNB 80																					1.0			
LUCMNC 81																								
LUCMND 82								0.1667	0.5															
MNHYST 83																								
AHAYPL 84																								
BHAYPL 85																								
CHAYPL 86																								
DHAYPL 87							-1.0	-1.0	-1.0	-1.0	-1.0													

	120 HAYBUY	121 SUHYSL	122 SLHEIF	123 SXVEAL	124 SLSTWT	125 SLSXFT	126 AFDPHB	127 WFDPHB	128 AFDPHC	129 WFDPHC	130 AFDPHD	131 WFDPHD	132 APENAR	133 AUFDSI	134 LUEXIA	135 LUEXIB	136 LUEXIC	137 LUEXID	138 HYPROB	139 BUYWET	140 AUFDWT	141 WIFDWT	142 WIBYOT	143 WIBYBA	144 WIBYHY	145 SIPROB
M	-22,0	+15,0	+100,0	+85,5	+3,5	110,0	-4,0	-4,0	-4,0	-4,0	-4,0	-4,0	-0,8	-0,5	-1,15	-1,15	-1,15	-1,15	-14,00	-4,50	-0,02	-0,02	-0,6	-0,75	-22,0	-7,0
LANAR 1															1,0											
LANAR 2																										
ONARR 3																										
AXACR 4																										
INACR 5																										
APMAX 6																										
UPMAX 7																										
EAMAX 8																										
UNMAX 9																										
HMAXQ 10																										
HMXDQ 11																										
XCRAL 12																										
XCREL 13																										
ROTAT 14															-0,43											
ROTAT 15																										
HTPOL 16																					1,0	1,0				
AYMIN 17																			1,0							
INFCR 18																										
XGRST 19																					1,0	1,0				
XHYST 20																										
XHYAR 21																			1,0							
XSIAR 22																										1,0
XSRPU 23																										
XBRCW 24																										
XBREW 25																										
XBRBL 26																										
XSEGR 27																										
MAXSOW 28																										
SHPPOL 29																										
WETPOL 30																				-1,0						
STRPOL 31																										
SPRFED 32						12,0	26,0	26,0	22,0	22,0	20,0	20,0	-19,0		-30,0	-26,0	-22,0	-20,0								
SUMFED 33						6,0							-6,0		-14,0	-12,0	-11,0	-10,0	-12,0							-12,0
AUTFED 34	-30,0					13,0	-23,0		-20,0		-18,0		-7,0	-10,0	-14,0	-12,0	-11,0	-10,0	-12,0		-1,24					-12,0
WINFED 35								-21,0		-18,0		-16,0	-9,0		-14,0	-12,0	-11,0	-10,0	-12,0			-1,24	-0,74	-1,02	-30,0	-12,0
ANGPOL 36																										
WIFRPL 37						40,0																				
38																										
EWEMIN 39																										
COWMIN 40																										
DACRPL 41																										
BAGRPL 42																										
HAYPOL 43		1,0																	-0,9							
SILPOL 44														-1,0												+2,7
LIVCAP 45						25,0																				10,0
MERPOL 46																										
SUMLAB 47																										
AUTLAB 48														0,5												
SPRLAB 49							0,5	0,5	0,5	0,5	0,5	0,5														1,5
MAXWHR 50																										
MAXFCP 51																										
MXPDHY 52							1,0	1,0	1,0	1,0	1,0	1,0														
MXSSTR 53													-7,0		-14,0	-12,0	-11,0	-10,0	-12,0							-12,0
MXSATR 54													-6,0		-14,0	-12,0	-11,0	-10,0	-12,0							-12,0
MINWCP 55																										
MINSIL 56																										1,0
BLANAR 57																1,0			1,0							1,0
CLANAR 58																	1,0									
DLANAR 59																		1,0								
ENONAR 60													1,0													
BROTAT 61																-0,43			-0,5							-0,5
CROTAT 62																	-0,43									
DROTAT 63																		-0,43								
MXBCRP 64																										
MXCCRP 65																										
MXDCRP 66																										
CFWTPL 67					1,0																					
XBSTPL 68				+1,0		+1,0																				
HEIFPL 69			+1,0																							
USWHTA 70																										
USWHTB 71																										
USWHTC 72																										
USWHTD 73																										
MAXCAT 74																										
MAXBAR 75																										
CATREL 76																										
XBEREL 77																										
MNGRST 78																					1,0	1,0				
LUCMNA 79															1,0											
LUCMNB 80																1,0			-0,1667							
LUCMNC 81																	1,0									
LUCMND 82																		1,0								
MNHYST 83																										
AHAYPL 84																										
BHAYPL 85							1,0	1,0																		
CHAYPL 86									1,0	1,0																
DHAYPL 87											1,0	1,0														