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S. GRIFITH

**A PRELIMINARY ANALYSIS OF THE  
NEW SOUTH WALES  
PROTEIN FEEDS INDUSTRY**

DAVID GODDEN

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A PRELIMINARY ANALYSIS OF THE  
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PROTEIN FEEDS INDUSTRY

DAVID GODDEN

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CONTENTS

ACKNOWLEDGEMENTS	2
LIST OF TABLES	5
LIST OF FIGURES	5
1 INTRODUCTION	7
1.1 Background	7
1.2 Aim of the study	7
1.3 Problems expected	7
1.4 Outline of the study	10
2 THE PROTEIN FEEDS	11
2.1 Types of protein feeds	11
Animal	11, Fish 11, Vegetable 11,
Synthetics	12, Other 12
2.2 Statistical summary of protein feeds in N.S.W.	13
2.3 Nutritional aspects	13
Poultry	13, Pigs 14, Other livestock 14
3 COMPONENTS OF THE SUPPLY OF PROTEIN FEEDS	15
3.1 Modelling the protein feeds industry	15
3.2 Animal-derived meals	15
Nature of meat meal production functions	15
Estimated meat meal production functions	16
Lagged effects in meat meal production	18
Production interrelationships	18
Stocks	19
Exports of meat meals	19
Imports of meat meals	20
3.3 Oilseed meals	20
Cotton supply curve	20
Monthly availability of oilseed meals	21
Imports of oilseed meals	22
Exports of oilseeds and oilseed meals	23
Stocks of oilseed meals	23
3.4 Fishmeal	24
Imports	24, Stocks 25
4 SUMMARY	26
<u>Appendices</u>	
1 DATA	27
2 ESTIMATED MONTHLY AVAILABILITY OF PROTEIN FEEDS	29
3 PRICE SERIES	31
4 PRICE SERIES FOR LOW PROTEIN MEAT MEAL	33
REFERENCES	35

LIST OF TABLES

- 2.1 Oilseeds: conversion factors 11
- 2.2 Protein feeds in N.S.W. 13
- 2.3 Available amino acid: percentage composition of feed 14
- 3.1 Average carcass slaughter weights of stock (N.S.W.) 16
- 3.2 Correlation coefficients: slaughter numbers 17
- 3.3 Correlation coefficients: meat production 17
- 3.4 Correlation coefficients: production animal-derived meals 18
- 3.5 Yearly value of imports of animal-derived meals 20
- 3.6 N.S.W. monthly crushing rates: all oilseeds 21
- 3.7 N.S.W. monthly crushing rates: state-grown oilseeds 21
- 3.8 Regression equations: soyabean meal imports 22
- 3.9 Regression equations: fishmeal imports 24

LIST OF FIGURES

- 1 Product pathways in the protein feeds industry 8
- 2 Detailed structure of N.S.W. protein feeds industry 9

## 1 INTRODUCTION

### 1.1 BACKGROUND

The disruption to the world trade in protein feeds following the collapse of the Peruvian fishmeal industry in 1972 and the poor U.S. soyabean harvest of the same year, has led to an upsurge of worldwide interest in the role of protein feeds and their associated products. The search for alternatives to wheat following the imposition of wheat quotas (1969/70) and high prices for oilseed crops in the years after 1972 has accentuated, for Australia, interest in the protein feeds industry. Australian interest involves both the production of protein feed materials, and also the use of protein feeds as alternatives to the traditional protein sources used in intensive livestock production.

For brief introductions to the market situation for protein feeds see [2, 5, 7, 13].

### 1.2 AIM OF THE STUDY

This study was concerned initially with collecting basic data about protein feed production in New South Wales. A sequel to this data collection was an attempt to create a statistical picture of the protein feeds industry in New South Wales.

Of basic concern were the flows of protein feeds from producers to consumers - how much of each feed is produced and what major factors influence the 'how much'. This study was conceived of at an aggregate level on the premise that, since little was known about the industry at the outset of the study, a greater initial return could be expected from a broad approach.

The concentration on aggregated data is not to be taken as implying the unimportance of firm-level analysis. Indeed it was expected that the study would show that the aggregative approach still leaves much unexplained.

### 1.3 PROBLEMS EXPECTED

The study has attempted, where possible, to make use only of data which is publicly available. It was expected that this would limit the accuracy of the view of the industry gained but that two factors would outweigh this shortcoming. As an initial study in the field the project would be considerable even if it only involved the collection and collation of published data. Additionally, the discussion of the findings would be hampered where considerable use was made of confidential data. Statistics privately collected are indicated. All other data is available in the publications referenced.

As well as probable inaccuracies arising from the aggregate nature of the approach, and the almost exclusive use of published data, there is a third source of probable error. Since the study examined the New South Wales industry, it follows that it would be necessary to be able to trace flows into, and out of, the State. Data on international flows are available. However, data on interstate flows is not available. It was not possible within the scope of this study to examine interstate flows. It may be desirable to examine whether interstate trade is important, the magnitude of this trade, and how such trade affects the New South Wales industry.

The structure of the New South Wales protein feeds industry is quite complicated - see Figures 1 and 2. Because of limited resources, it was decided to restrict the study to strategic areas of the industry. For example, since most protein feeds processed into stock feeds pass through abattoirs, oilseed crushers, or are imported, it was decided to ignore the stockfeeds sector. This could be expected to introduce further error, and also limit the applicability of the results. It was felt that such limitations were nevertheless justified.

Figure 1 Product pathways in the protein feeds industry

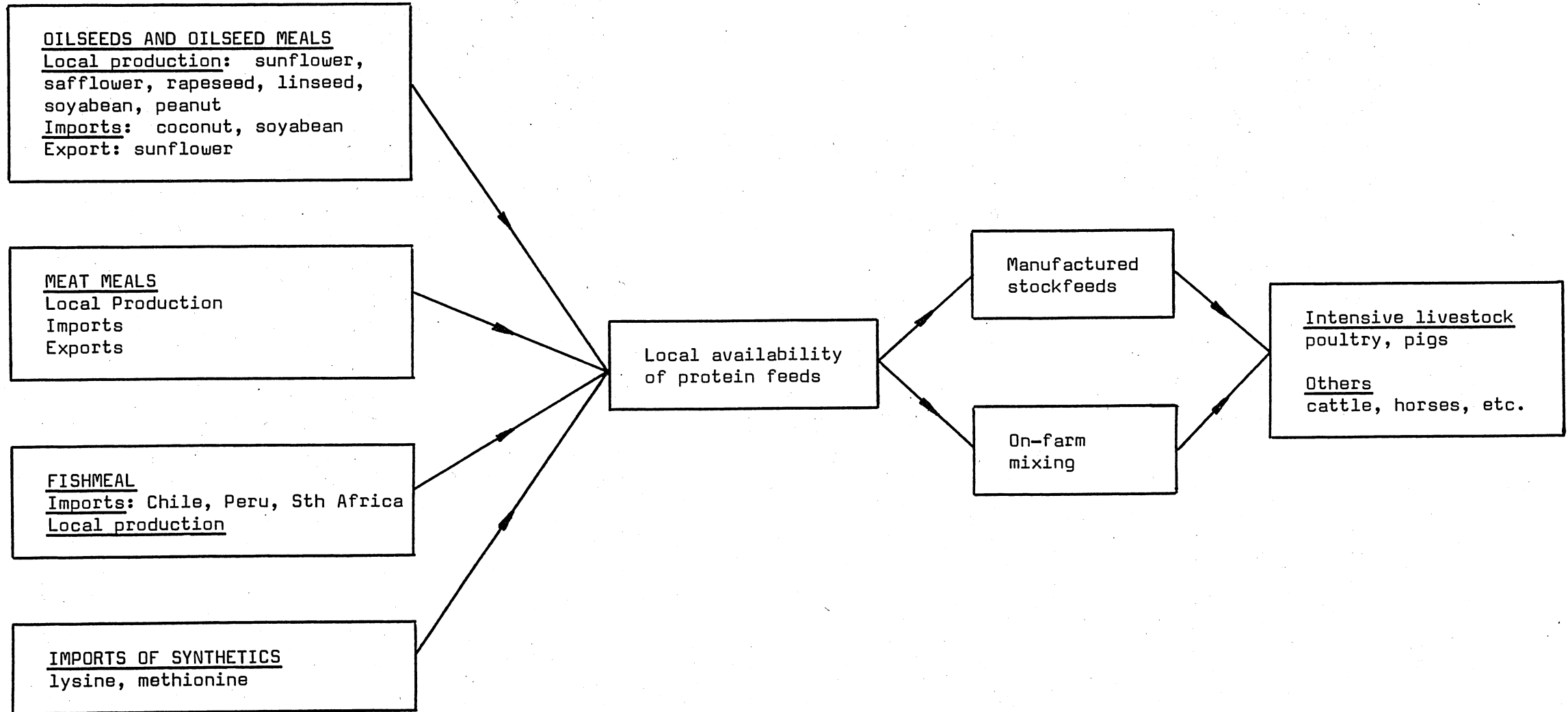
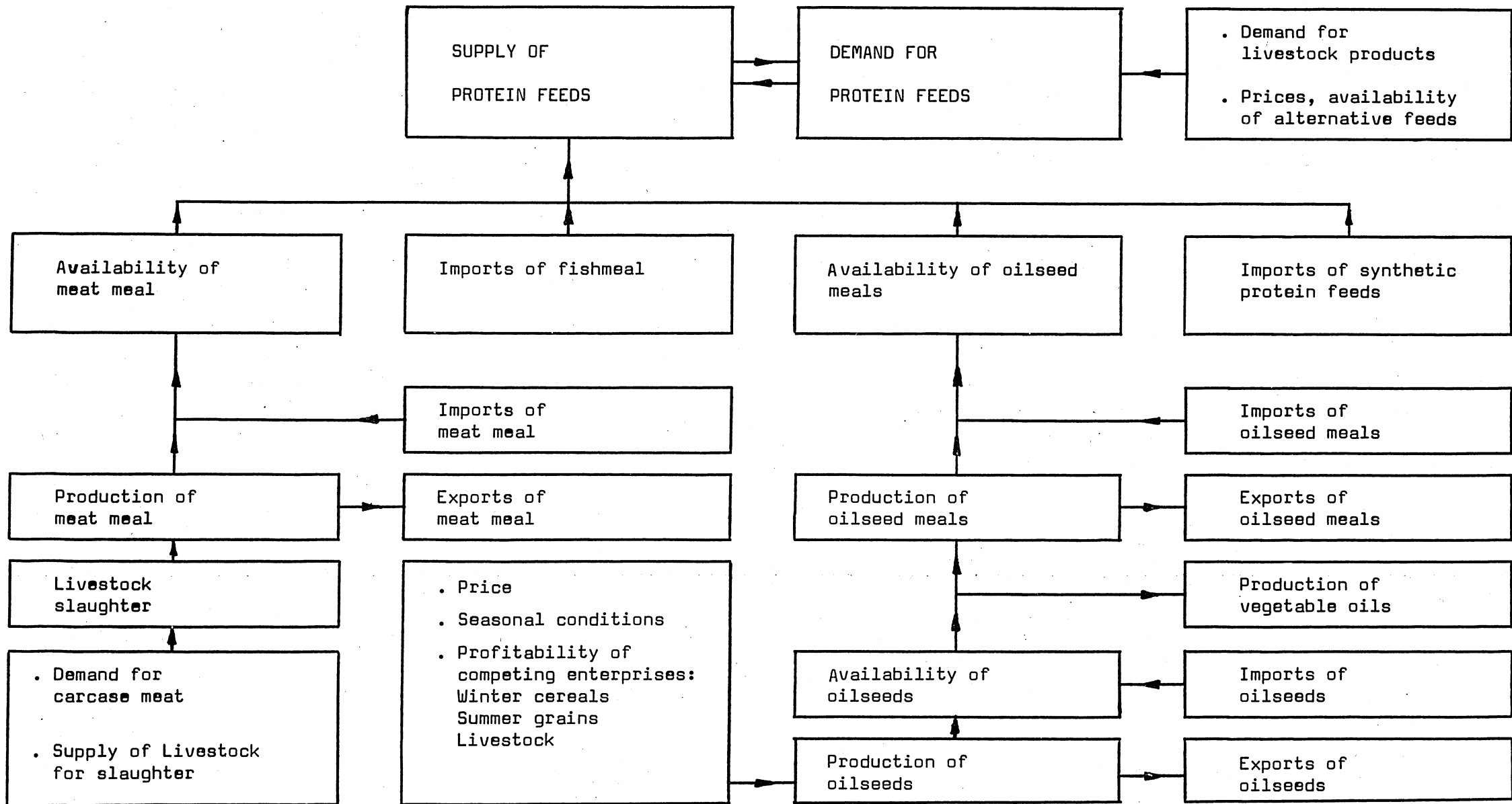




Figure 2 Detailed structure of New South Wales protein feeds industry



A further problem is encountered in the area of oilseed meals supply. Although three oilseed crops (linseed, safflower and cottonseed) have been grown in New South Wales for at least a decade, other oilseed crops are new - at least in a commercial sense. Thus it is impossible to estimate supply curves for these crops using historical data. Except in the case of cottonseed which is a joint product, no attempt has been made to estimate supply relations of New South Wales produced oilseeds.

#### 1.4 OUTLINE OF THE STUDY

The qualitative aspects of protein feeds are examined in Section 2 where the various protein feeds, their modes of production, and the particular feeds this study emphasises, are briefly discussed.

Section 3 examines the supply of protein feeds where the qualifications noted in Section 1.3 are important - in particular, it is essential to note that estimated curves refer to a particular point in the industry, usually the processing sector.

Linear regression using ordinary least squares has been used to estimate supply. The assumptions of classical least squares were considered applicable.

Section 4 discusses the implications of the study. Discussion centres on the use of results for policy making, lines of future research, and the likely benefits of future research.

## 2 THE PROTEIN FEEDS

### 2.1 TYPES OF PROTEIN FEEDS

#### 2.1.1 Animal Derived Meals

The traditional and most common forms of protein feed for livestock in Australia are meat meals. These meals are either by-products of the slaughter of meat for human consumption or are produced from animals not fit for human consumption. Meat meal forms part of the output of the rendering process which separates offals and condemned meat into fat and non-fat products. Tankage, the non-fat produce of the process is composed of fibre with a relatively high protein content. This material is dried and ground to produce meat meals. Where bone material is present in the ground meal, the resultant product is known as meat-and-bone meal. Meat meals vary in crude protein (CP) content. A frequently made distinction in data collection is between low protein meat meal (less than 50 per cent CP) and high protein meal (above 50 per cent CP).

Bloodmeal, with a crude protein level around 80 per cent, is manufactured from the blood of slaughtered animals.

#### 2.1.2 Fishmeal

The small amount of Australian-processed fishmeal consists of processed fish offal. Imported fishmeal, especially that from Chile and Peru, and to a lesser extent South and South-west Africa, is a high protein, high quality meal manufactured from whole fish. The Chilean and Peruvian production comes from anchovies taken from the Humboldt current off the west coast of South America.

#### 2.1.3 Vegetable oilseed meals

The crops soyabean, sunflowerseed, rapeseed, linseed, safflowerseed, peanut and cottonseed, all have fibres with a high protein level. Copra has a somewhat lower protein content. After the removal of oil by either mechanical or chemical processes, the resultant fibre or oilseed meal is palatable to most classes of livestock, although palatability varies among meals.

Average oilseed meal yield and raw protein (i.e., crude protein) levels for various oilseeds are shown in Table 2.1.

TABLE 2.1

#### OILSEEDS - CONVERSION FACTORS

Oilseed	Meal Yield %	Raw protein in oilseed meal %
Cottonseed	79	41
Safflower	70	41
Sunflower	65	43
Soyabean	83	46
Peanut (in shell)	50	52
Linseed	70	36
Rapeseed	61	36
Copra	35	22

Source: [5] No. 17 November 1972, p.96; the raw protein level for safflower (dehulled) is taken from [19, p.20].

#### 2.1.4 Synthetics

Some of the amino acids which are the constituents of 'protein' can be manufactured by industrial processes [15]. The two most important are lysine and methionine. Although prices are high<sup>1</sup> it is sometimes economic for a feedmixer to include these synthetics in feedmixes, when either the constituents of the mix are low in these amino acids, or when the prices of 'naturally occurring' meals containing these substances are relatively high.

#### 2.1.5 Other protein feeds

Most naturally occurring feeds, including the cereals, contain some protein - for example, wheat from northern New South Wales can have a protein content as high as 16 per cent. Pastures and forage crops also have highly variable protein levels, as do hay and silage. Furthermore, ruminants can manufacture their own amino acids from non-protein nitrogen sources such as urea. Other products such as skim milk, and feedstuffs manufactured as dairy factory by-products, also form sources of protein.

A 'new' source of protein material which is beginning to excite considerable interest is single cell protein (SCP). As the name suggests, SCP is protein material contained in single cell organisms. Such material is produced by industrial processes in organic material cultures [10].

For the purposes of this study, the feeds listed in sections 2.1.4 and 2.1.5, that is feeds other than meat meal, fishmeal and the oil-seed meals, have been ignored. This is more a matter of convenience than an indication that such feeds are unimportant. Cereals, forage crops and pastures have been ignored to limit the size of the project. A secondary reason is that they are used more as sources of energy (carbohydrate) than for protein, although of course the importance of the protein content cannot be discounted.

Nitrogenous materials such as urea have not been considered. The main use of protein feeds has been in the poultry and pig industries and pigs and poultry are monogastric and cannot make use of urea. Milk by-products have been ignored principally because the move towards more intensive pig production, coupled with the move towards wholemilk supply in New South Wales, has profoundly reduced the importance of milk protein in pig nutrition. Single cell protein is still in the developmental stage and is not commercially available in New South Wales.

In summary this study is concerned with protein feeds of the following origins:

Animal byproducts; meat meal, meat-and-bone meal, and bloodmeal

Fishmeal

Oilseeds; soyabean, sunflower, safflower, rapeseed, linseed, peanut, cottonseed, and copra

---

<sup>1</sup> 1974 prices of pure synthetic lysine were of the order of \$4 per kg. This compares with \$9.20/kg for available lysine in 50 per cent of CP meat meal (\$230/tonne with a 2.5 per cent lysine availability). It must be remembered that meat meal contains other essential amino acids not in synthetic lysine.

2.2 STATISTICAL SUMMARY OF PROTEIN FEEDS IN NEW SOUTH WALES

TABLE 2.2

PROTEIN FEEDS IN NEW SOUTH WALES (tonnes)

Year	Production <sup>1</sup>		Consumption			Net Imports		
	Meat Meals	Oilseed Meals	Meat Meals	Oilseed Meals	Fish-meal	Meat Meals	Oilseed Meals	Fish-meal
1965/66	65605	38669	51906	43422	4433	2010	10881	4401
1966/67	55141	36001	54372	41837	7120	-5763	16111	6926
1967/68	62840	44925	60077	52359	9105	-1259	25062	10283
1968/69	61077	40434	61187	44785	12725	-7212	16221	12921
1969/70	82971	56237	74479	61173	11559	-25092	16810	10235
1970/71	88792	31155	81372	75506	14428	-16545	18260	16159
1971/72	103565	37626	94492	68364	11570	-19053	10286	13175

Note: 1 New South Wales production of fishmeal is negligible.

Sources: Production Aggregated from [14].

Consumption Monthly consumption, estimated as the difference between monthly availability in a month (see Appendix 2) and stocks in the succeeding month [14], aggregated for each year.

Net Imports Estimated from [20, 21].

Table 2.2 suggests that the protein feeds are of considerable importance to New South Wales. At average prices for the period of \$60/tonne for the meat meals, \$100/tonne for the oilseed meals, and \$150/tonne for fishmeal the consumption of protein feeds is valued at some \$8 million in 1965/66 and some \$14 million in 1971/72. Since this value comprised either costs or returns for meat producers, abattoirs, cropping industries, importers, exporters, oilseed crushers, the stock feeds industry, and the intensive livestock industries, the flows of protein feeds are economically significant for many of the major agricultural industries of New South Wales. At March 1975 the price for high protein meat meal was about \$120/tonne, 50 per cent CP soyabean meal \$240/tonne, and 65 per cent CP fishmeal \$325/tonne, giving an estimated value of approximately \$20 million assuming protein feed consumption at the same level as for 1971/72.

2.3 NUTRITIONAL ASPECTS OF PROTEIN FEEDS2.3.1 Poultry

Although energy is the principal requirement of all poultry diets, the presence of protein material is important in determining growth performance. The ratio between energy content and the crude protein level of the ration influences feed intake, feed conversion, growth rate, body composition and feather condition of growing broilers [12, p.129]. Where protein levels are low, birds attempt to obtain more protein by a larger intake, which results in a high energy intake and a higher fat deposition [12, pp.132-134].

Protein per se is not the important factor however. Since protein is an inclusive name for many amino acids, what is important in selecting so-called protein feeds in rations are the relative levels of the various amino acids.

Table 2.3 indicates typical variations in levels among four of the more important amino acids in 'protein' feeds.

TABLE 2.3

AVAILABLE AMINO ACID - PERCENTAGE COMPOSITION OF FEED

Feed	Lysine	Methionine	Cystine	Tryptophan
Wheat	0.36	0.15	0.32	0.12
Fishmeal	5.74	1.70	0.84	0.70
Bloodmeal	4.62	0.59	0.67	0.65
Meat meal 54% CP	2.47	0.54	0.53	0.33
Soyabean (expelled)	2.65	0.51	1.00	0.48
Cottonseed meal	1.61	0.35	0.79	0.37
Sunflower	1.30	0.47	0.78	0.45
Linseed	1.34	0.40	0.70	0.55
Safflower	0.47	0.13	0.30	0.17

Source: [19]

Although poultry have specific requirements for particular amino acids, these levels can be achieved through many mixes of different protein feeds. The optimum feed mix is based not only on physical characteristics of energy, amino acid, vitamin and mineral levels, but also on price. Work at the Poultry Research Station, Seven Hills, New South Wales shows how feed mix composition of protein feeds changes with price [4].

### 2.3.2 Pigs

Like poultry, pigs require 'protein' (that is amino acids) in the diet for healthy growth. Since amino acids cannot be stored, protein feeds must be fed on a daily basis. Pig diets are generally formulated to a crude protein content of about 16-18 per cent. As with poultry, this requirement can be met from a variety of sources, including the basic source of dietary energy such as wheat [3, pp.1-2].

### 2.3.3 Other Livestock

Protein feeds are used in many livestock industries other than pigs and poultry. For example, the stockfeed industry formulates special feeds for animals ranging from horses to rabbits. Most of such feeds include some protein feeds. On the basis of livestock numbers, the only class of livestock, other than pigs and poultry, of probable economic importance to the protein feeds industry is dairy cattle.

The major types of supplements fed to lactating cows are rich in digestible energy. It has been shown that even in environments relatively unsuited to milk production, fertilized improved pastures are generally capable of supplying necessary protein material to dairy cows [17, p.295]. Where pastures have an insufficient protein content, forage crops such as lucerne are frequently the most efficient protein sources. Prepared stock-feeds constitute the other common source of protein material.

Although calves up to an age of about four weeks need protein material it is generally accepted that the best form is either whole or skim milk or milk-derived meals. However for calves in the age range 4 weeks to about 12 weeks meat meals and vegetable protein feeds can be satisfactorily used. This is the period after milk protein becomes non-essential and before rumen micro-organisms in the calf can supply the calf's protein needs from pasture [15].

### 3 COMPONENTS OF THE SUPPLY FOR PROTEIN FEEDS

#### 3.1 MODELLING THE PROTEIN FEEDS INDUSTRY

An ideal representation of the protein feeds industry would explain all the pathways illustrated in Figure 2. The model depicted describes a relatively open system, that is, there are a very large number of outside influences. Even with restrictions upon the number of protein feeds examined (see Section 2.1) there is still a vast complex of relationships to be investigated if the structure of Figure 2 is to be quantified. The approach taken below is to attempt to detail salient features of the industry, rather than examine the whole.

The following analytical steps were attempted: (a) an explanation of the determinants of meat meal production; (b) an explanation of the transition of annual oilseed crops into within-year availabilities of oilseed meals; (c) an explanation of other components of protein feed supply, namely imports, exports, and level of stocks. Even this simplistic approach encountered many difficulties the main one being data availability.

Until relatively recently, analytical interest in protein feeds appears to have been directly correlated with the price of meals. As prices rose, so did interest in how the prices of protein feeds were formed. As prices declined, so too did interest. Furthermore, as oilseeds have only been grown in large areas in the past few seasons, it is only recently that interest has arisen in the growing and use of such crops. Overall, these considerations have been reflected in a lack of sustained interest in protein feeds and adequate documentation of production, consumption, trade and prices. Much of the data is in the form of broad aggregates that make analysis practically impossible.

An additional difficulty for research in this area is that the Australian Bureau of Statistics (ABS) only publishes statistical information where there are more than three respondents in an industry group. In the oilseed crushing industry in New South Wales there are only three major crushers of oilseeds other than copra, and only two crushers of copra. Hence, despite any interest in analysing the production of oilseed meals in New South Wales, the only source of disaggregated data has been the crushers themselves.

Despite these difficulties, the following sections represent some progress in understanding the industry.

#### 3.2 ANIMAL-DERIVED MEALS

##### 3.2.1 Nature of Meat Meal Production Functions

Although the statistical evidence is scant, there seems good reason for considering the production of meat meals as independent of their market. That is, the level of production of these meals is independent of factors such as their price, and is related to economic variables outside the protein feeds industry.

The first evidence for this proposition is revealed through the role the meat meals play in the structure of the meat industry. Ownership of the offals from which a large proportion of the meat meals are produced is vested in the abattoirs, and proceeds from their sale are appropriated by them. Thus, the value of the meat meals to stock producers and stock sellers is the extent to which the sale of the meals reduces killing charges.

The second evidence for the assertion that the meat meals are substantially by-products of the slaughter of meat for human consumption comes from an analysis of the production of meat meal. Consider high protein (higher than 50 per cent CP) meat meal. For the period 1966/67 to 1971/72 the relationship between the production of this meal and the production of meat

for human consumption was<sup>2</sup>

$$PR_{MH} = -3.03 + .160PR_H \quad (3.1)$$

(.271)    (.006)     $R^2 = .91$

where  $PR_{MH}$  is the monthly production in thousands of tonnes of high protein meat meal, and  $PR_H$  is the monthly production in thousands of tonnes of meat for human consumption. Thus, for the period, for each tonne of high protein meat meal produced there were 6.25 tonnes of meat for human consumption produced.

The 1971 average monthly production of beef, mutton, lamb and pork were 22,718 tonnes, 12,558 tonnes, 10,514 tonnes and 4,010 tonnes, respectively [11], thus the weighted average wholesale value per tonne of total meat production, based on average wholesale values of these four classes of meat [6] was \$576. The unweighted average price per tonne of high protein meat meal for 1971 was \$92. Thus the value of \$92 from high protein meat meal is associated with a value of \$3600<sup>3</sup> from meat for human consumption. High protein meat meal therefore represents less than 3 per cent of the value of abattoir output.

### 3.2.2 Estimated Meat Meal Production Functions

If, as suggested above, meat meal production is a by-product of the livestock industry, the production functions of the three classes of meat meal will be most satisfactorily explained by slaughter statistics. The classes against which meat meal production figures were regressed were:

- (i) Numbers of livestock slaughtered in the following classes; adult cattle, calves, sheep, lambs, pigs.
- (ii) Meat production (in tonnes) of each class in (i).
- (iii) Average slaughter weights.

In regression analysis, the average slaughter weights of the five classes of slaughtered animals were never significant. This is not because these variables do not affect the production of animal meals, but for the statistical reason that the data used show only small variations in average slaughter weights over the period analysed (1966/67 to 1971/72). This can be seen in Table 3.1.

TABLE 3.1

#### AVERAGE CARCASE SLAUGHTER WEIGHTS (KG) OF STOCK (N.S.W.)

	Mean	Standard deviation
Adult cattle	199.5	5.5
Calves	48.6	11.3
Sheep	18.4	0.6
Lambs	16.7	0.3
Pigs	46.3	1.2

Source: [11].

<sup>2</sup> Numbers in brackets are the standard errors of the estimated co-efficients.

<sup>3</sup> The product of (value per tonne of meat) x (number of tonnes of meat produced per tonne of high protein meat meal). \$576 x 6.25 = \$3600.



Tables 3.2 and 3.3 show that high correlations exist among live-stock groups in the slaughter numbers and meat production groups, and for this reason, the best relationships between animal meal production and abattoir production are based on total meat production.

TABLE 3.2

## CORRELATION COEFFICIENTS - SLAUGHTER NUMBERS

	Adult cattle	Calves	Sheep	Lambs	Pigs
Adult cattle	1.0				
Calves	-0.50	1.0			
Sheep	0.77	-0.55	1.0		
Lambs	0.70	-0.53	0.65	1.0	
Pigs	0.62	-0.40	0.53	0.82	1.0

TABLE 3.3

## CORRELATION COEFFICIENTS - MEAT PRODUCTION

	Adult cattle	Calves	Sheep	Lambs	Pigs
Adult cattle	1.0				
Calves	-0.40	1.0			
Sheep	0.78	-0.32	1.0		
Lambs	0.74	-0.37	0.65	1.0	
Pigs	0.69	-0.29	0.54	0.82	1.0

The regressions below were based on monthly meat and meat meal production for the period 1966/67 to 1971/72. Figures in brackets beneath co-efficients are standard errors. Degrees of freedom in all cases is 70. All variables are in terms of thousands of tonnes.

$$PR_{BM} = -.135 + .008 PR_H \quad (3.2)$$

(.018) (.004)  $R^2 = .85$

$$PR_{ML} = .724 + .032 PR_H \quad (3.3)$$

(.167) (.003)  $R^2 = .52$

$$PR_{MH} = -3.03 + .160 PR_H \quad (3.4)$$

(.271) (.006)  $R^2 = .91$

$$PR_M = -2.31 + .192 PR_H \quad (3.5)$$

(.293) (.007)  $R^2 = .93$

In equations (3.2) - (3.5) the variables are

$PR_{BM}$  monthly production of bloodmeal

$PR_{ML}$  production of low protein (<50% CP) meat meal

$PR_{MH}$  production of high protein (>50% CP) meat meal

$PR_M$  production of all meat meal ( $PR_{ML} + PR_{MH}$ )

$PR_H$  production of meat for human consumption

All the coefficients in equations (3.2) - (3.5) are significant at

the 0.01 level. This, together with high  $R^2$  values, suggests that these equations represent good estimates of the relevant 'production' functions and that a high degree of confidence is justified in the predictive ability of these equations.

The relatively low  $R^2$  value in equation (3.3) is expected because although the production of most high protein meat meal is associated with the production of meat for human consumption, a significant amount of low protein meat meal is produced in manufacturing establishments which do not produce meat for human consumption. However, since the general level of livestock numbers, more or less reflected in meat production, can be expected to be reflected in livestock slaughtered in such establishments, equation (3.3) remains a reasonable predictor of such production.

### 3.2.3 Lagged effects in meat meal production

The regression of the production of meat meals on the previous month's production of meat for human consumption suggests that there is no significant lag in the production of meat meal. There appears to be no significant carry-over of offal from one month to the next, that is, meat meal is manufactured as the offal is produced.

For lags of one and two months, the coefficients remained substantially the same as in equations (3.2) - (3.5) but the  $R^2$  values declined.

### 3.2.4 Production interrelationships

Relationships among the meat meals are also of interest as is shown in the correlation matrix, Table 3.4.

TABLE 3.4

CORRELATION COEFFICIENTS FOR PRODUCTION OF ANIMAL-DERIVED MEALS

	$PR_{BM}$	$PR_{ML}$	$PR_{MH}$
$PR_{BM}$	1.0		
$PR_{ML}$	0.68	1.0	
$PR_{MH}$	0.88	0.65	1.0

$PR_{BM}$ ,  $PR_{ML}$ ,  $PR_{MH}$  and  $PR_M$  are as defined above.

Regression equations for the 'independent' factors are<sup>4</sup>

$$PR_{ML} = 1.45 + .173 PR_{MH} \quad (3.6)$$

(.103)    (.024)             $R^2 = .42$

$$PR_{BM} = .030 + .045 PR_{MH} \quad (3.7)$$

(.012)    (.003)             $R^2 = .78$

All variables except the constant term in equation (3.7) are significant at the 0.01 level of significance. The constant term is significant at 0.05.

<sup>4</sup> Equations (3.6) and (3.7) are not causal relationships, but merely illustrate the coefficients of the correlative relationships exhibited in Table 3.4.

These equations reflect the relatively constant proportions of meat offals produced which are used for the different types of meal.

The lower  $R^2$  value in equation (3.6) illustrates the substitutability in production between high and low protein meat meal and also that the production of a proportion of these meals is carried out in different types of establishments. The higher  $R^2$  in equation (3.7) shows that there is a strong constant relationship between the production of bloodmeal and high protein meat meal, which suggests that regardless of relative prices, the raw material of bloodmeal is not greatly directed towards the manufacture of high protein meat meal.

The foregoing analysis suggests that the production of the meat meals is largely a technical relationship dependent on livestock slaughterings which itself is independent of the market for protein feeds. Therefore, the production of the meat meals is an exogenous variable determined largely by the market for meat for human consumption.

### 3.2.5 Stocks

The stocks of protein meals of animal origin exhibit a cyclical pattern. Although this suggests that there could be a complex of factors determining the level of stocks, investigation suggests that stock levels can be estimated from previous stock levels. A simple explanation of this relationship is that processors and distributors attempt to maintain previous levels of stocks.

Simple autoregressive schemes of the form

$$S_t = a + b S_{t-1}$$

where  $S_t$  is the stocks of meal in month  $t$ , show the following results

$$\begin{array}{l} BM_t = 45.0 + .920 BM_{t-1} \\ (24.7) \quad (.052) \end{array} \quad R^2 = .79 \quad (3.8)$$

$$\begin{array}{l} ML_t = 274. + .816 ML_{t-1} \\ (97.1) \quad (.062) \end{array} \quad R^2 = .68 \quad (3.9)$$

$$\begin{array}{l} MH_t = 486. + .891 MH_{t-1} \\ (190.) \quad (.044) \end{array} \quad R^2 = .84 \quad (3.10)$$

where  $BM_t$ ,  $ML_t$ , and  $MH_t$  are the monthly stocks (in tonnes) of bloodmeal low protein meat meal and high protein meat meal respectively. These equations suggest a close correlation between the level of stocks in successive months.

### 3.2.6 Exports of meal meals

New South Wales has consistently exported protein meals of animal origin over the period 1965/66 to 1971/72, although in relation to consumption of meat meals these exports are relatively small. A problem in the analysis of these feeds is that the only quantity and value of export figures collected for meals of animal origin relate to "Flours and meals of meat, offals, fish, crustaceans or molluscs, unfit for human consumption".<sup>5</sup> Consequently any analysis of this data will at best be a crude interpretation of a series of relationships representing the component protein feeds.

Estimations of the export of meat meal in terms of the export price (f.o.b.) relative to the 'home' price of meals, proved non significant. In the absence of a general model of the protein feeds industry including both overseas and Australian demand, no other attempts were made to statistically explain meat meal exports.

<sup>5</sup> Two other minor classes are also collected, but exports classified in these classes are insignificant.

### 3.2.7 Imports of meat meals

In the period July 1965 to July 1969, New South Wales had sizeable imports of meals of animal origin (other than fishmeal). Table 3.5 indicates the size of this trade.

TABLE 3.5  
YEARLY VALUE OF IMPORTS OF ANIMAL-DERIVED MEALS

Year	\$
1965/66	244,000
1966/67	140,869
1967/68	213,190
1968/69	19,200
1969/70	0

Source: [21].

It would appear that these imports resulted from an inadequate supply of local meals as a result of reduced supply and increased demand stimulated by drought conditions in eastern Australia, especially in the years 1965/66 and 1967/68.

### 3.3 OILSEED MEALS

Of the oilseed crops, only cottonseed production can be predicted from other relatively independent variables, namely lint production. The other oilseeds - soya, rape, linseed, sunflower, safflower - are not joint products like cottonseed, but single products.

Estimation of supply curves for the oilseed meals other than cottonseed and coconut<sup>6</sup>, would require the estimation of supply curves of the oilseed crops. However, estimations of oilseed supply curves using historical data are difficult because these crops have been grown only for a small number of years.<sup>7</sup> The only alternative means of estimating oilseed crops is to simulate supply using programming techniques. It was felt that such a study was beyond the scope of a preliminary analysis.

#### 3.3.1 Cottonseed supply curve

It would be useful to predict the amount of cottonseed available for crushing from estimates of forthcoming crops. The relationships between annual cottonseed production and the crop of unginned cotton for New South Wales for the years 1965/66 to 1971/72 is

$$PR_{CS} = -0.583 + .524 PR_{UC} \quad (3.11)$$

(1.01)    (.015)

where  $PR_{CS}$  is the annual production of cottonseed in thousands of tonnes, and  $PR_{UC}$  is the annual production of unginned cotton in thousands of tonnes. For statistical purposes, 'lint' is now preferred to 'unginned'.<sup>8</sup> The relationship is taken as lint = 0.37 unginned.

<sup>6</sup> Coconut meal is a product of the extraction from copra of coconut oil used primarily in margarine manufacture. See below for analyses of copra imports.

<sup>7</sup> Some preliminary work likely to be of assistance in attempting to estimate these relations has recently been published regarding coarse grains [21].

<sup>8</sup> Quarterly Review of Agricultural Economics, Vol. 26, No. 3, July 1973, p.211 fn.6.

Hence equation (3.11) becomes

$$PR_{CS} = 0.583 + 1.42 PR_L \quad (3.12)$$

where  $PR_L$  is lint production in thousands of tonnes, and the statistical significance of relation is identical to that in (3.11) above.

Further, since cottonseed has a meal yield of 0.79<sup>9</sup> cottonseed meal production is related to lint production as follows

$$PR_{CM} = 0.460 + 1.12 PR_L \quad (3.13)$$

where  $PR_{CM}$  is cottonseed meal production in thousands of tonnes.

### 3.3.2 Monthly availability of oilseed meals

Even if models can be constructed to predict annual harvest of oilseeds, a substantial problem remains in converting annual harvests into monthly meal availability through the year. The most important component in predicting this availability is the rate at which an annual oilseed harvest is crushed. Tables 3.6 and 3.7 show oilseed crushing data for New South Wales.

TABLE 3.6

NEW SOUTH WALES AVERAGE MONTHLY CRUSHING RATES FOR ALL OILSEEDS  
1965/66 - 1971/71

Month	Rate (tonnes)	Standard Deviation (tonnes)
January	3510	1430
February	4040	930
March	4080	630
April	4090	820
May	4530	920
June	3910	1330
July	4470	1190
August	4240	1520
September	4140	1430
October	4300	1370
November	3950	1430
December	3850	1260

Source: [14].

TABLE 3.7

NEW SOUTH WALES AVERAGE MONTHLY CRUSHING RATE FOR STATE GROWN  
OILSEEDS 1965/66 - 1971/72

Month	Rate (tonnes)	Standard Deviation (tonnes)
January	2480	1690
February	3030	1230
March	2580	1330
April	2970	1140
May	3140	1580
June	2110	1760
July	3270	1440
August	3070	1650
September	1620	1560
October	2620	1030
November	2520	1230
December	2460	1400

Source: [14, 18, 20, 21].

<sup>9</sup> See Table 2.1

Because most oilseeds now crushed in New South Wales were not processed over the sample period 1965/66 to 1971/72, it is impossible to estimate the average amounts of the various crops which are crushed in different months of the year. Although data on the crushing of oilseeds is available from processors, it is not possible to model the rate at which oilseed is produced. This means that a major portion of the New South Wales protein feeds industry cannot be modelled and is a critical factor limiting the usefulness of analytic models of the New South Wales protein feeds industry.

### 3.3.3 Imports of oilseed meals

#### Soyabean meal

Consistently large amounts of soyabean meal entered New South Wales in the period 1965/66 to 1971/72 and the average monthly value of these imports for the period was \$140,000.

A simple linear regression of soyabean meal imports on the import price of soyabean was statistically unsatisfactory. Results of fitting soyabean meal imports in multiple regression models are shown in Table 3.8 where each row represents a regression equation and the included variables are indicated by a zero (0).

**TABLE 3.8**  
**REGRESSION EQUATIONS ESTIMATED WITH SOYABEAN**  
**MEAL IMPORTS INTO NEW SOUTH WALES AS DEPENDENT-VARIABLE**

Equation	Independent Variables														R <sup>2</sup>	
	a	b	c	d	e	f	g	h	i	j	k	l	m	n		
1	0	0*	0													.09
2		0*	0	0			0									.09
3		0*	0			0				0						.09
4		0							0	0						.07
5											0	0				.08
6		0*	0						0	0						.09
7		0*				0										.07
8		0*	0													.09
9		0							0*							.29
10			0								0	0				.10
11		0*				0*		0*								.39
12		0*							0*	0*	0					.32
13		0*	0*	0					0*							.33

#### Notes: Independent Variables

- a Price of fishmeal imports
- b Price of soyabean meal imports
- c Price of 50% CP meat meal
- d Stock of oilseed meals
- e Stock of animal-derived meals
- f Production of oilseed meals
- g Production of animal-derived meals
- h Stock of fishmeal
- i Availability of oilseed meals (see Appendix 2)
- j Availability of animal-derived meals (see Appendix 2)
- k Availability of fishmeal (see Appendix 2)
- l Fishmeal imports
- m Relative price of soyabean meal imports to fishmeal imports
- n Relative price of soyabean meal imports to meat meal 50% CP

#### Significance of Variables

Variables included in each equation are indicated by a zero (0). The variables marked with an asterisk were significant at the 5 per cent level.

Although equation 11 is the best estimator of soyabean meal imports both in terms of variation accounted for and number of significant variables, equation 9 indicates that by far the most important contribution to the explanation of variability is made by variable  $i$  (availability of oilseed meals). Since a correlation between soyabean meal imports and availability of all oilseed meals could be expected, little new knowledge is contributed by this analysis.

#### Coconut meal

Copra is imported into New South Wales primarily for the extraction of coconut oil, widely used as an edible oil. Simple linear regression between import quantities and import prices were not statistically significant. More complex import functions were not estimated because this would have required a study of the edible oils market.

#### Other oilseeds and oilseed meals

Soyabeans entered New South Wales in large quantities in only five separate months in the survey period. These months were July, September, October, and November of 1970, and March 1972. The total value of these five months of shipment was \$1.04 million.

Large imports of linseed entered New South Wales on six occasions in the survey period. These were February, March, and April of 1968, and May, July, and September of 1969. The value of these shipments was \$2.11 million. There were no other shipments in that period.

There have been continuing shipments of 'other', that is unspecified, oilseeds over the survey. Most shipments have been small, with seven exceptions. These months of large shipment were February, March, and May of 1968, May, September and November of 1969, and June 1972. The value of these shipments was \$3.82 million.

Oilseed meal imports other than soyabean meal were sporadic over the survey period with some moderately large shipments. There were nine months with significant imports, which had a combined value of \$155,000. No attempt was made to analyse statistically any of these infrequent importations of oilseeds or oilseed meals.

#### 3.3.4 Exports of oilseeds and oilseed meals

Exports of New South Wales produced oilseeds or oilseed meals in the survey period 1965/66 to 1971/72 were mainly either trifling or sporadic, for example 'other' oilseed exports were practically non-existent until May 1971. In the thirteen months May 1971 to June 1972 \$4.03 million of unspecified oilseeds were exported from New South Wales.

The aggregated export class 'oilseed meals other than soya' show a slightly different picture. Moderate amounts of these unspecified meals were exported from New South Wales from May 1967 to January 1972. A simple regression of export quantity  $X_{OM}$  on average export price  $P_X$  reveals the mildly significant relationship

$$X_{OM} = 1123. - 7.07 P_X \quad (3.14)$$

(185.)      (2.66)       $R^2 = .14$        $n = 45$

Both coefficients are significant at the .02 level of significance.

Two factors suggest that this result is not of great significance. The amount of these exported meals relative to New South Wales consumption is relatively small and the low  $R^2$  suggests that little of the variation has been accounted for.

#### 3.3.5 Stocks of oilseed meals

As with the meals of animal origin, a simple autoregressive scheme

is useful in explaining much of the variation in levels of stocks. A scheme of the form

$$S_t = a + b S_{t-1}$$

where  $S_t$  is the level of stocks in time  $t$  yields the following relation for total oilseed meal stocks

$$OM_t = 4453 + .504 OM_{t-1} \quad (3.15)$$

(.978)    (.098)                       $R^2 = .26 \quad n = 76$

where  $OM_t$  is the stock of oilseed meals in tonnes for month  $t$ .

Since the oilseed meal group contains the two basic sub-groups of 'coconut' and 'other' meals, it is desirable to disaggregate the oilseed meal variable, which is possible for the latter part of the survey period. Disaggregation yields the two equations

$$COC_t = 78.5 + .873 COC_{t-1} \quad (3.16)$$

(59.3)    (.080)                       $R^2 = .74 \quad n = 44$

$$OOM_t = 1183 + .895 OOM_{t-1} \quad (3.17)$$

(614.8)    (0.65)                       $R^2 = .84 \quad n = 37$

where  $COC_t$  is the stock in tonnes of coconut meal for month  $t$  and  $OOM_t$  is the monthly stock in tonnes of oilseed meals other than coconut.

As for the meat meals there is a strong suggestion that the level of monthly oilseed meal stocks is closely related to the level of stocks in the previous month and that stock holders attempt to maintain monthly stocks at previous levels. A comparison between equations (3.16), (3.17), and (3.15) suggests a marked independence between the market for coconut meals and other oilseed meals.

### 3.4 FISHMEAL

#### 3.4.1 Imports

Fishmeal imports have been consistently large over the period 1965/66 to 1971/72. A crude estimate of value of monthly import is \$120,000. As with soyabean meal and copra, an attempt was made to estimate a simple relationship between fishmeal imports and the price of that meal (f.o.b. port of shipment) but it was not statistically significant.

Multiple regression models with fishmeal imports as the dependent variable were estimated and the results are shown in Table 3.9 where each row represents a regression equation and the included variables are indicated by a zero (0).

TABLE 3.9

REGRESSION EQUATIONS ESTIMATED WITH FISHMEAL  
IMPORTS INTO NEW SOUTH WALES AS DEPENDENT VARIABLE

Equation	Independent Variables													$R^2$		
	a	b	c	d	e	f	g	h	i	j	k	l	m		n	
1	0	0	0													.03
2	0									0*						.40
3	0		0	0												.004
4	0				0	0										.04
5	0															.01
6	0	0	0	0					0*							.14
7	0								0*	0*						.51
8	0		0	0					0*							.14
9	0					0	0*	0*								.17
10	0								0*	0	0					.13
11									0*			0	0			.14
12										0*		0	0			.42
13												0	0			.01



TABLE 3.9 (Continued)

Notes: Independent Variables

- a Price of fishmeal imports
- b Price of soyabean meal imports
- c Price of meat meal 50% CP
- d Stock of oilseed meals
- e Stock of animal derived meals
- f Production of oilseed meals
- g Production of animal-derived meals
- h Stock of fishmeal
- i Availability of oilseed meals (see Appendix 2)
- j Availability of animal-derived meals (see Appendix 2)
- k Availability of fishmeal (see Appendix 2)
- l Imports of soyabean meal
- m Relative price of fishmeal imports to soyabean meal imports
- n Relative price of fishmeal imports to meat meal 50% CP

Significance of Variables

Variables included in each equation are indicated by a zero (0). The variables marked with an asterisk were significant at the 5 per cent level.

As Table 3.9 shows, no significant relation has been found between fishmeal imports and variables related to other protein feeds. The only significant relationships on the basis of  $R^2$  values, are 2, 7, and 12. The relatively higher  $R^2$  value in equation 7 is due to the high correlation between stocks of fishmeal and availability of fishmeal (the correlation between these variables being 0.85). In view of this, equation 7 does not provide a sound basis for understanding fishmeal imports. Since equations 2 and 12 have relationships between fishmeal imports and the independent variables that were expected,<sup>10</sup> no new insights are provided by the analysis.

Despite the wide range of estimations employed, no satisfactory statistical explanation for the level of fishmeal imports to New South Wales has been found.

3.4.2 Fishmeal stocks

A simple explanation of fishmeal stocks was estimated in terms of a simple first order autoregressive scheme as follows

$$FM_t = 637 + .725 FM_{t-1} \quad R^2 = .53 \quad n = 63 \quad (3.18)$$

(225)    (.087)

where  $FM_t$  is the monthly level of fishmeal stocks in tonnes.

While this estimator of fishmeal stocks is obviously inferior to the corresponding relations for the meat and oilseed meals, it still suggests a high correlation between fishmeal stocks in successive months.

<sup>10</sup> Since for fishmeals Availability = Stocks<sub>t-1</sub> + Import<sub>t</sub> (Appendix 2) there is an a priori relationship between fishmeal imports and stocks of fishmeal and availability of fishmeal.

#### 4 SUMMARY

The preceding analysis has achieved two results. Firstly, much uncollated data relating to the use of protein feeds in New South Wales has been collected and condensed. Secondly, the analyses of this data have added to understanding production and supply relationships for protein feeds in New South Wales.

Regarding the data, two important areas of deficiency still remain. The first, the absence of data relating to interstate trade, is not a new problem, but is one which is a source of continuing frustration to the analyst. Secondly, data relating to the production of particular oilseed meals is not publicly available.

The attempt to construct a model of the protein feeds industry successfully achieved estimations of production relationships for meat and blood meals and an understanding of movements in the stocks of protein feeds. The deficiencies of this part of the study include the inability to model production of oilseeds and oilseed meals and also the inability to explain trade in any protein feed.

The research reported here has been useful for providing a partial description of the protein feeds market in New South Wales.

## APPENDIX 1

DATA

As with most economic analyses, the scope of this study has been limited by the availability and quality of the data. This appendix sets out sources of, and reservations about, the data used in this study. Important sets of data used in the study are reproduced in appendices 2 and 3.

1 NEW SOUTH WALES PRODUCTION1.1 Meals of Animal OriginQuantities

Production and stocks of bloodmeal, meat meal, less than 50 per cent CP, and meat meal, more than 50 per cent CP, are available in [14]. Four individual months of production and stock figures were unavailable in this series and averages of previous and succeeding months were used to estimate the missing figures.

Prices

A sample of twenty-eight abattoirs were requested to provide monthly prices of meals which they produced. Of the replies, fourteen usable series of meat meal or meat-and-bone meal, 50 per cent CP, and six usable series of bloodmeal, 80 per cent CP, were obtained. From these series, arithmetic averages of monthly prices of 50 per cent CP meat meal and 80 per cent bloodmeal were generated. Prices of meat meal with less than 50 per cent CP were found to be correlated with those of 80 per cent CP meat meal (see Appendix 4).

1.2 Fishmeal

Production of fishmeal in New South Wales was obtained from [14]. Stocks of fishmeal were also established from this source. The import price series calculated from the import statistics [21] was used in analyses involving fishmeal prices, since no other price series was available.

1.3 Oilseed mealsQuantities

Annual productions of oilseeds in New South Wales were obtained from [18]. Crop statistics not covered in this publication were obtained from [1] and unpublished sources in the Division of Marketing and Economics, New South Wales Department of Agriculture.

Total monthly production of all oilseed meals, and total monthly stocks of all oilseed meals were obtained from [14].

Six months of data in 1969/70 and five months in 1970/71 were not recorded for reasons relating to confidentiality of data. An attempt to obtain production data from the firms involved proved impossible so production and stocks were estimated as the average of the recorded months on either side of the missing data.

Prices

Two series of oilseed meal prices were estimated. For the first, it was assumed that arbitrage amongst oilseed meals leads to fairly constant price relationships amongst these meals. An import price series for soyabean meal, calculated from import statistics [21] was used as an exogenous variable in analyses requiring the 'price' of oilseed meals.

For the second series of oilseed meal prices, price series of seven different oilseed meals (safflower, sunflower, soyabean, rapeseed, cottonseed, linseed and coconut) were weighted according to the estimated relative importance of these meals in New South Wales. The estimated relative importance was calculated from New South Wales production of oilseeds [18] and State imports [21] and exports [20].

## 2 TRADE

Monthly imports of meals and associated products for 1965/66 to 1971/72 were taken from [21]. Monthly exports of similar products for 1966/67 to 1971/72 were extracted from [20]. Export data was not available on a monthly basis for 1965/66. Both tables contain the quantity of the commodity traded and the value of this trade. These tables were used to construct time series of prices of imported and exported commodities associated with protein feeds (price = value of trade/quality traded).

## APPENDIX 2

ESTIMATED MONTHLY AVAILABILITY OF PROTEIN FEEDS, IN TONNES,  
FOR N.S.W.

(See explanatory notes following the data)

	Bloodmeal	Meat Meal (less than 50% CP)	Meat Meal (more than 50% CP)	Fishmeal	Oilseed Meals	
1965 July	317	2524	4693	1473	5730	
	290*	2305*	4022*	2853*	5601*	
	234	2221	3446	945	4908	
	264	2447	3760	1262	4925	
	380	3103	4479	1022	6564	
	448	2608	4942	1285	5845	
	477	2915	5098	1039	8532	
	569	3531	7284	920	12695	
	771	3799	8586	934	41438	
	811	3995	8792	1029	21397	
	915	5560	9546	920	14951	
	828	6387	9114	2117	10632	
	1966 July	734	5956	8842	1437	12940
		535	5005	7482	693	9916
495*		3583*	7570*	1400*	7842*	
465		3418	7191	2190	6637	
442		3567	6718	985	7830	
445		3381	6051	1779	8714	
406		2733	5548	1844	8043	
437		2584	6005	1353	10847	
586		2909	6379	1559	11617	
548		2569	6367	1350	14550	
581		3082	6545	1662	12462	
559		2877	6689	1323	10238	
1967 July		518	2747	7212	982	10673
		610	2836	6157	774	11664
	557*	3030*	6203*	2411*	19109*	
	517	3094	6011	1321	19569	
	514	3464	6879	2708	17706	
	577*	3519*	7112*	2954*	16405*	
	580	3566	7543	2356	14986	
	545	3407	8042	1023	13284	
	649	3723	8687	2100	12513	
	707	3598	8580	1494	11168	
	814	3937	9338	2232	11733	
	718	3248	9042	2265	9703	
	1968 July	782	3500	9118	2175	9894
		694	3589	8836	1513	9596
760		3016	8254	2833	9357	
646		3415	7845	1645	7589	
641		3205	7446	3371	6081	
673		3447	7011	2346	5774	
769		3463	7932	2120	6317	
803		2973	8005	2640	8877	
877		2907	8403	2313	9184	
854		3075	9245	5294	8993	
859		2910	8875	5346	10654	
823		3345	8916	3286	11612	

	Bloodmeal	Meat Meal (less than 50% CP)	Meat Meal (more than 50% CP)	Fishmeal	Oilseed Meals	
1969 July	747	3089	8166	2245	12949	
	639	2839	7862	1444	14851	
	572	2964	7510	854	15750	
	524	2646	7748	7111	15171	
	475	2254	6558	2941	15979	
	559	2745	7237	2461	17584	
	664	2206	6822	1419	16278	
	641	3658	6886	6353	17680	
	574	2886	6348	3062	17463	
	592	3127	8001	2284	17566	
	570	2885	7673	2515	17979	
	538	3324	7211	1969	17065	
	1970 July	617	3338	7343	894	18060
		536	2823	7122	5160	17560
601		2744	7231	7615	16419	
670		2639	6558	4319	16215	
647		2353	7042	3509	16080	
710		3031	8081	4157	16052	
670		2961	8145	3192	15981	
655		3418	8591	2284	17017	
852		3570	9519	10856	15936	
851		3555	9730	5360	16734	
1971 July	913	3767	10150	4821	17934	
	944	3511	10507	4522	15153	
	985	3886	10529	2614	15588	
	844	3390	8790	2306	15653	
	799	3235	8477	6854	17018	
	714	3617	7969	4677	17714	
	791	4106	9391	4465	15756	
	828	4634	10476	3899	18710	
	666	4272	9727	3037	17403	
	810	4423	10114	7920	17665	
1972 July	776	4572	11208	4609	16263	
	965	4431	10481	4568	16648	
	1151	4967	10291	3263	19688	
	1276	3787	10701	2811	19464	

**Notes:** 1 Several months of data were unobtainable. Average of observations immediately preceding and succeeding data gaps were used as estimates and are marked with an asterisk.

2 Export data was not available for 1965/66 (see Appendix 1) and exports have been taken as zero in the construction of this appendix.

3 For any month  $t$  :

$$\text{Availability}_t = \text{Stocks}_{t-1} + \text{Imports}_{t-1} + \text{Production}_t - \text{Exports}_t$$

## APPENDIX 3

PRICE SERIES (DOLLARS)

	Bloodmeal	Meat Meal (50% CP)	Soyabean Meal (Import)	All Oilseed Meals	Fishmeal (Import)	
July 1965	109.5	95.5	118	80.36	117	
	111.5	99.7	160	91.99	270	
	115.7	103.7	116	79.80	123	
	117.2	113.7	143	87.28	113	
	123.6	113.0	153	90.05	129	
	131.8	113.2	108	77.58	118	
	131.8	109.5	118	82.83	120	
	129.1	107.8	120	83.38	121	
	133.3	103.2	107	79.78	121	
	133.3	102.0	140	88.92	140	
	131.4	98.5	148	88.73	158	
	129.3	95.0	102	75.02	165	
	July 1966	130.0	94.3	138	75.25	125
		130.0	94.7	199	84.58	175
129.1		96.6	168	79.54	147	
128.8		100.0	168	79.84	125	
128.0		99.8	168	78.35	174	
129.7		97.4	137	71.71	166	
132.1		95.3	115	68.35	160	
132.1		94.8	127	70.48	160	
133.0		96.4	118	69.10	102	
132.5		98.3	141	72.62	164	
136.7		100.6	129	70.79	129	
137.2		100.6	121	69.56	139	
July 1967		137.3	99.5	112	72.09	109
		138.7	99.7	115	72.63	133
	137.4	100.7	113	72.27	146	
	135.8	100.1	119	73.36	115	
	135.8	99.8	125	74.44	122	
	136.5	98.1	111	71.91	124	
	134.7	96.0	119	73.26	122	
	133.7	96.7	146	78.14	119	
	129.1	95.1	114	72.35	122	
	125.7	94.5	110	71.96	108	
	127.5	93.2	125	74.68	114	
	127.3	93.7	127	75.21	128	
	July 1968	117.8	93.0	130	70.00	115
		118.5	91.6	125	69.43	102
119.1		91.4	119	68.73	114	
120.1		90.7	144	71.63	125	
118.1		90.0	132	70.24	117	
116.1		88.3	123	69.19	113	
119.7		87.9	109	67.50	114	
118.6		87.2	110	67.50	115	
118.1		85.6	110	67.61	98	
119.2		85.7	110	67.61	95	
120.2		84.5	108	67.38	89	
115.7		83.3	118	68.54	114	

	Bloodmeal	Meat Meal (50% CP)	Soyabean Meal (Import)	All Oilseed Meals	Fishmeal (Import)	
July 1969	116.7	84.4	114	72.56	95	
	118.3	85.1	112	71.65	113	
	118.1	85.1	228	74.47	99	
	118.5	85.8	142	77.45	113	
	118.0	86.8	113	71.72	141	
	120.2	87.4	124	74.94	123	
	121.1	88.5	110	73.30	98	
	121.1	89.1	121	76.30	99	
	122.1	90.1	125	76.76	118	
	122.1	91.3	120	77.66	137	
	124.1	92.3	127	76.65	143	
	127.5	94.0	126	76.71	164	
	July 1970	127.3	94.1	119	65.53	184
		128.2	97.1	119	65.37	139
129.4		98.3	115	65.63	158	
130.1		99.6	152	68.07	130	
130.3		101.2	155	68.42	154	
132.5		101.6	278	66.63	117	
135.0		102.5	108	63.77	192	
135.0		100.4	113	64.22	161	
133.4		95.0	112	63.98	163	
130.8		92.2	121	64.79	169	
134.4		89.2	165	68.95	207	
133.3		87.7	112	64.13	126	
July 1971		133.3	87.2	116	67.72	164
		133.3	88.1	119	68.09	133
	136.3	89.8	131	69.57	194	
	132.7	91.1	107	66.62	95	
	132.3	90.4	105	66.37	147	
	126.7	98.4	103	66.12	159	
	127.2	86.8	99	66.32	126	
	123.5	85.2	149	72.57	163	
	119.9	82.1	116	68.42	142	
	120.8	81.3	133	70.51	84	
	120.8	81.1	119	68.78	137	
126.6	80.6	102	66.69	161		

Source: For sources of price series see Appendix 1



## Appendix 4

Price series for low protein meat meal

Data was sought from meat processing organisations concerning monthly meat meal prices for the period 1965/66 to 1971/72 (see Appendix 1). However, no usable series were available relating to meat meals with a crude protein level below 50%. Since a significant proportion of meals of animal origin are meat meals with less than 50% CP (see Appendix 2), it is desirable to establish a price series for such products.

It would be convenient and interesting if the price of meat meals were related solely to CP levels. In order to test this hypothesis, prices of meat meals with 42% CP and 45% CP were regressed against prices of 50% CP meat meal.

The only series of prices for meat meals of less than 50% CP for the survey period were available from the files of the N.S.W. Department of Agriculture. These comprised two series for 45% CP meat meal and one series for 42% CP meat meal. Each of the series had some months data missing. For each series, the monthly prices which were available were regressed against the corresponding price of 50% CP meat meal produced by similar works.<sup>1</sup> Equations (1) and (2) below are the results for the two 45% CP series, and equation (3) is the result for the 42% CP series.

Results45% CP meat meals (two series)

$P_L$  = price of 45% CP meat meal

$P_H$  = price of 50% CP meat meal

$$P_L = -14.4 + 1.11 P_H \quad R^2 = .79 \quad (1)$$

(6.98) (.072)

$$P_L = 34.3 + .514 P_H \quad R^2 = .64 \quad (2)$$

(4.64) (.048)

The constant term of equation (1) is significant at 0.05; and the constant of equation (2) and both coefficients of  $P_H$  are significant at 0.01. At the mean of each series, the relative price of 45% CP meat meal is 0.96 and 0.87 respectively.

42% CP meat meals (one series)

$P_L$  = price of 42% CP meat meal

$P_H$  = price of 50% CP meat meal

$$P_L = 47.3 + 0.281 P_H \quad (3)$$

(3.49) (.037)

Both the constant term and coefficient of  $P_H$  are significant at 0.01. At the mean of the series, the relative price of 42% CP meat meal is 0.77.

<sup>1</sup> There is a noticeable difference in meat meal pricing policies between private and semi-government abattoirs. As data for prices of 45% CP and 42% CP meat meal was only available from private works close to Sydney, it seemed most reasonable to correlate these prices with prices for 50% CP meat meal produced in a private works close to Sydney.

If the relative prices of meat meals were solely governed by crude protein levels, 0.90 and 0.84 would be the prices of 45% CP and 42% CP meat meals relative to 50% CP meat meal. While the three relations estimated above do not exactly bear out this contention, they do lend some credence to the hypothesis.

The high correlations between low and high CP meat meal prices shown in this appendix were used in the estimation of protein feed supply relations. The series obtained by the arithmetic averaging of fourteen series of 50% CP meat meal prices (see Appendices 1, 3) was used as the price series for such meat meal. The same series was also used as the price series for meat meal less than 50% CP, and for all meat meal, because of the high correlations amongst all meat meal price series.

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