AMLRDC

FINAL REPORT DAN 23S

1980 to 1986

A PROJECT TO DEVELOP A PERFORMANCE TESTING SCHEME FOR TERMINAL MEATSHEEP SIRES

Department of Agriculture New South Wales

AUSTRALIAN MEAT AND LIVESTOCK
RESEARCH AND DEVELOPMENT
CORPORATION

NEW SOUTH WALES DEPARTMENT
OF AGRICULTURE, AGRICULTURAL
RESEARCH STATION, COWRA

FINAL REPORT

PROJECT DAN 23S

EVALUATION OF THE USE OF GROWTH RATE AND FAT DEPTH MEASUREMENTS IN A PERFORMANCE TESTING SCHEME FOR TERMINAL MEATSHEEP SIRES

JULY 1980 to JUNE 1986

Cover: *Ten month old Dorset Horn rams - ideal age and weight for testing by the N.S.W. Meatsheep Testing Service - a service developed as a result of DAN 23S (photo J Herdegen).*

FORWARD

This report presents the aims, methods, results, industry impact and implications of DAN 23S - a co-operative project sponsored by the Australian Meat & Livestock Research & Development Corporation and conducted by the New South Wales Department of Agriculture with the aid of New South Wales Meatsheep stud breeders from 1980 to 1986. The project has successfully designed and developed a practical computerised production testing scheme for terminal ram breeders. This scheme has won such widespread industry support that almost half of all N.S.W.'s 5.5 million slaughter lambs per year are now being bred by rams officially tested for growth rate and fat depth. It has provided the basis for the design of 'LAMBPLAN' - a proposal for the first truly national performance scheme for Australia's lamb industry.

DAN 23S owes a great deal for its success to staff from the Agricultural Research Station Cowra and especially Alan Luff the Service's Officer-In-Charge since 1981, a number of key, very enthusiastic stud breeders plus some very able Departmental geneticists, sheep and wool advisers and biometricians. The contributions from Dr. Neal Fogarty and Dr. Kevin Atkins towards the preparation of this final document are gratefully acknowledged.

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December, 1987.

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ABSTRACT

DAN 23S – EVALUATION OF THE USE OF GROWTH RATE AND FAT DEPTH MEASUREMENTS IN A PERFORMANCE TESTING SCHEME FOR TERMINAL MEATSHEEP SIRES

The project was undertaken by the N.S.W. Department of Agriculture with the financial support of the AMLRDC to evaluate the development of a viable facility to enable meatsheep breeders to objectively test rams for growth rate and fat depth. This was achieved through:

* development and implementation of the N.S.W. Meatsheep Testing Service (MTS) to measure growth rate and fat depth;

* accumulation and analysis of a large industry data base to provide a sound technical basis for operational guidelines, adjustment procedures and parameter estimates to develop improved breeding programmes.

* use of the Service as a model for national genetic improvement programmes for meatsheep;

The MTS has been strongly supported by the industry and breed societies. Over 84,000 sheep on 196 different properties throughout N.S.W. have been tested by the MTS since its establishment in 1980. Its usage has now grown to the extent where 17,000 sheep are tested annually in N.S.W. from over 120 studs representing 13 breeds. Almost half the terminal meatsheep rams sold annually in N.S.W. are now tested for growth rate and fat depth. This objective information is being used increasingly in ram sales. The Service has now been put on a commercial basis in accord with the "user pay principle".

The large and unique data base has established heritability estimates of 0.30 for yearling growth rate (adjusted for differences in age, type of birth and rearing status and age of dam) and 0.35 for fat depth (adjusted for liveweight). These estimates are high compared to many other production traits and allow rapid genetic progress to be made. Analyses provided estimates of environmental effects and genetic parameters that previously did not exist for these Australian meatsheep breeds. This allows more efficient adjustments to be made and provides the parameters necessary for estimation of breeding values and the development of selection indexes.

The MTS has proved to be a successful model for development of similar services in other States. The development of the recommended national performance recording scheme for meatsheep (LAMBPLAN) has relied greatly on the experience gained from industry usage of the MTS.

DAN 23S has greatly assisted the adoption of objective measurement of growth and fat by meatsheep studs and its increasing use in selection and ram marketing activities. Continued long term genetic improvement in the lamb industry has been significantly enhanced.

SUMMARY

DAN 23S - EVALUATION OF THE USE OF GROWTH RATE AND FAT DEPTH MEASUREMENTS IN A PERFORMANCE TESTING SCHEME FOR TERMINAL MEATSHEEP SIRES

Development and implementation of performance recording schemes in the meatsheep industry have been strongly advocated to increase the rate of genetic improvement in economically important traits such as growth rate and leanness. This project was undertaken to evaluate the development of a viable facility to enable meatsheep stud breeders to objectively test rams for genetic differences in growth rate and fat depth. Within this broad objective the project aimed to:-

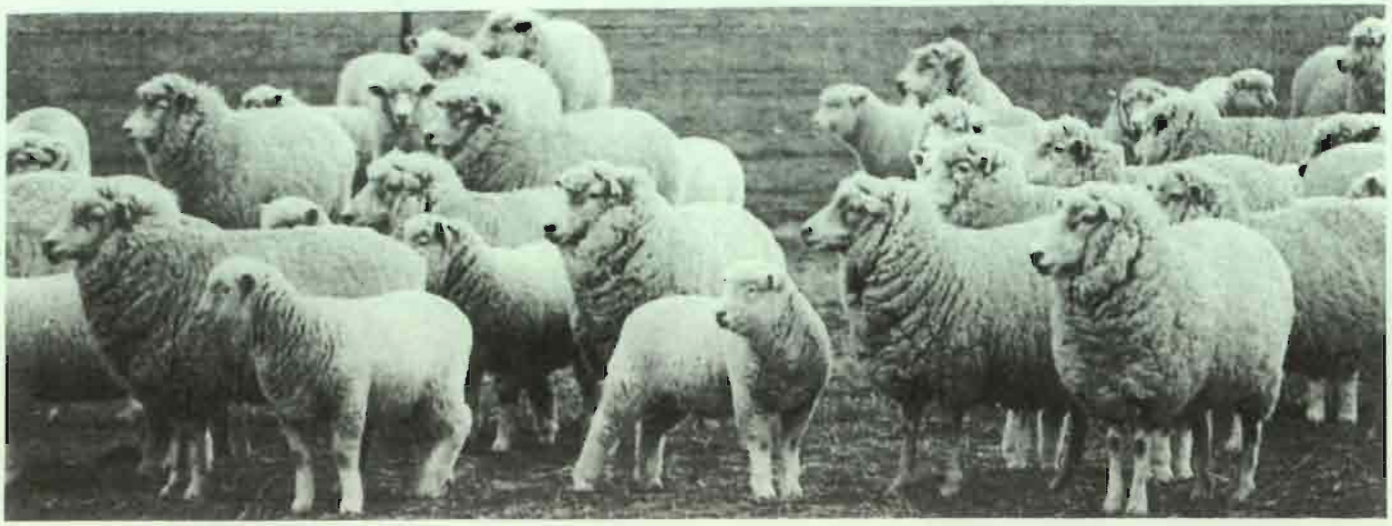
* develop recommendations and guidelines regarding the feasibility and practical design of a performance testing scheme for meatsheep;

* develop and implement, in conjunction with the N.S.W. meatsheep stud industry, the N.S.W. Meatsheep Testing Service, to provide a model scheme for other organisations;

* provide a large industry data base on Australian meatsheep breeds to give a sound technical basis for operational guidelines, adjustment procedures, parameter estimates and development of recommended breeding programmes.

To achieve these objectives the project involved four components which included; the development (through software and processing technology and advisory programmes) of the Meatsheep Testing Service and its implementation and promotion in N.S.W.; evaluation of devices for measuring fat depth in live animals; accumulation of a large industry based data set and its analysis to provide estimates of genetic parameters and environmental effects for Australian meatsheep flocks; and a model for development of performance recording nationally for the meatsheep industry.

The N.S.W. Meatsheep Testing Service (MTS) allows breeders to use objective measurement of growth rate and fat depth (adjusted for non-genetic effects) as an aid to their selections and sales. It has been strongly supported by the industry and breed societies since its commencement in 1980 with 17,000 sheep now tested annually from over 120 studs representing 13 breeds. *Almost 50% of the terminal meatsheep rams sold annually in N.S.W. are now tested for growth rate and fat depth. This means almost half of all N.S.W. lamb carcases are now sired by MTS tested rams.* The success of the service can be attributed to many factors including the co-operation and involvement of industry in design and implementation, simplicity of output reports, quality control and associated strong advisory support plus the high level of technical backup and monitoring provided.



Typical Australian Dorset lambs on Border Leicester cross Merino ewes. Almost half of the 5.5 million lambs slaughtered in N.S.W. each year are now sired by rams officially tested for growth rate and leanness as a result of this project (photo AMLC).

Liveweight and subcutaneous fat depth of animals, using an innovative ultrasonic backfat meter, are recorded by the MTS. Growth rate is adjusted by computer for the non-genetic effects of age, type of birth and rearing status and age of dam. The service provides the stud breeder with reports for individual rams showing individual growth % (adjusted growth rate expressed as a percentage of the group mean), fat class (seven classes in standard deviation units from the group mean liveweight adjusted fat depth) and growth order rank. In addition flock summary statistics and a sire summary are also reported. This information is used by stud breeders to provide more accurate objective measurements to aid selections within their breeding programme and it is being used increasingly in the sale of stud rams and flock rams to commercial lamb producers.

An important part of the project has been the evaluation of procedures and devices for measuring fat depth in live sheep. Initially the scanogram was used but an ultrasonic backfat meter, developed by DSIR in New Zealand and manufactured and marketed by Delphi Industries Ltd., was utilised from late 1981. The backfat meter is portable, fast and relatively easy to use and has a high level of accuracy when used by an experienced operator.

A large data set has been accumulated by the MTS from industry meatsheep flocks. Analyses have been undertaken on a subset comprising over 28,000 Poll Dorset records from 50 flocks representing 498 sires. This has provided unique parameter estimates for growth to various ages and fat depth as well as non-genetic effects and documentation of flock structure and the source of sires which previously did not exist. Restricted maximum likelihood (REML)

statistical procedures were used which have been specially developed to analyse this type of field data. REML takes proper account of the extreme variation that exists in the number of progeny per sire (mean 39, range 5 to 280), as well as allowing simultaneous analysis of management groups and sires.

The estimates of heritability for adjusted yearling liveweight are about 0.3 and are consistent across ages of measurement from less than seven months to 15 months of age. The estimate of heritability for fat depth varied from 0.3 to 0.4. These relatively high estimates for live animal fat depth measurement probably reflect the desirable conditions under which measurements are recorded and only one experienced and skilled operator being used. The genetic correlations between liveweight and fat depth are high (0.78 to 0.50) and decline with increasing age at measurement. The genetic correlations between liveweight and fat depth adjusted for liveweight are considerably lower (0.26 to 0.10), although they remain positive. This means that selection for increased liveweight alone will result in a small genetic increase in fat depth on a liveweight adjusted basis. The estimates for liveweight and fat depth obtained from these analyses, provide the parameters necessary for estimation of breeding values and the development of selection indexes for recommended breeding programmes.

Suffolks have been among thirteen different breeds tested by Dan 238 (photo AMLC).

The magnitude of non-genetic effects on liveweight were documented. These provided more appropriate standard adjustments for type of birth and rearing status and age of dam effects. The magnitude of these effects declined with increasing mean age of tested animals. Removal of liveweight effects on fat depth largely accounted for age of dam and type of birth and rearing effects on fat depth. Analysis of flock structure highlighted the high sire generation interval of 3.3 years, with a high proportion of older sires being used. This limits the rate of genetic progress that can be achieved and performance is further jeopardised by increasing levels of inbreeding. Almost all flocks (96%) used both homebred and imported sires with a very high level of migration between flocks. Less than 50% of tested animals were by homebred sires. Thus the genetic variation between flocks is probably very small.

Proposals and recommendations for the Animal Production Committee to implement a national performance recording scheme for meatsheep breeders have been developed largely from experience gained from the MTS in N.S.W. The proposed scheme (LAMBPLAN) has been designed for sire breeds in the initial phase. A more comprehensive scheme suitable for dual purpose breeds and including reproduction rate and wool production will be developed later as the second phase of LAMBPLAN. Appropriate breeding objectives for meatsheep sire breeds include growth and carcase leanness with the selection criteria of a body weight and a live animal fat measurement forming the basis of LAMBPLAN. There is strong support from breed societies and industry organisations for these proposals. LAMBPLAN will facilitate on a national basis:-

* promotion of performance recording for meatsheep

* uniform procedures for measurement, adjustment and output of results

* strong support from Department of Agriculture Advisory Services

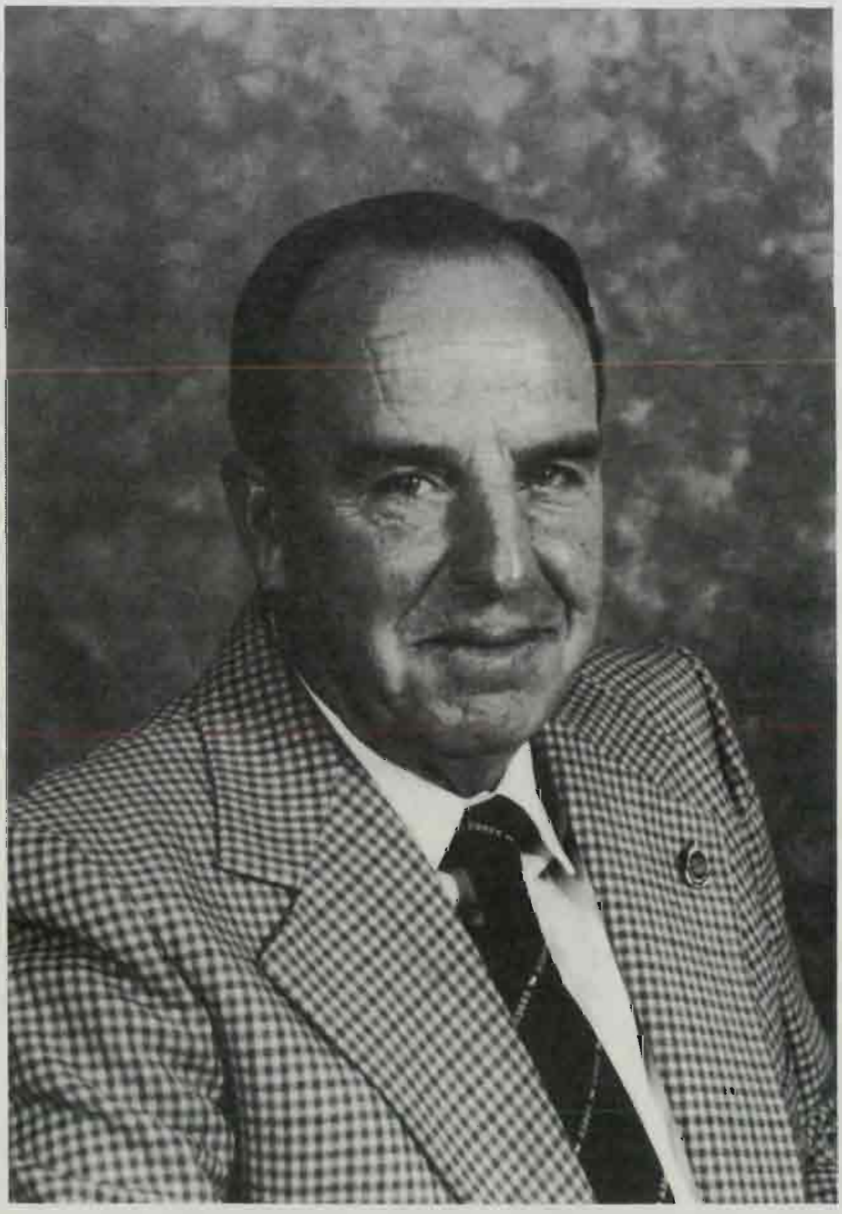
* industry participation in ongoing policy and developments

* uniform implementation of further technical developments.

The AMLRDC support for this project from 1980/81 to 1985/86 assisted the N.S.W. Department of Agriculture develop and implement the MTS and gain its wide acceptance amongst N.S.W. meatsheep stud breeders and the meatsheep industry. The service has now been put on a commercial basis under the "user pay" principle. Costs of providing the service are being contained by decentralisation of operations and greater use of the Department of Agriculture AGNET computer network and electronic data handling. Further technical and software developments are being undertaken to improve the service in line with LAMBPLAN guidelines.

The project has significantly contributed to the adoption of objective measurement of growth and fat in meatsheep studs. As well as providing the facility for carrying this out the MTS has been a very important focus for N.S.W. advisory programmes aimed at increasing the rate of genetic improvement in growth and leanness in the lamb industry. Measurements are being used increasingly by stud breeders in their selections and sales of rams. There is also a greater awareness of the importance of objective measurements in ram purchases by commercial lamb producers.

A moderate increase (10-20%) in usage of the MTS is projected in N.S.W. over the next three years. However, there will be an increasingly effective usage by stud breeders of the information provided by the service in their stud selection programmes as well as by commercial lamb producers. The MTS has been developed as a model for adoption by other states, some of which are initiating similar services in response to strong stud industry pressure. This project has provided significant experience in operation of a performance testing service as well as provided previously unavailable technical data necessary for the estimation of breeding values and development of appropriate selection indexes for the meatsheep industry. The adoption of LAMBPLAN nationally and its availability to all meatsheep stud breeders will greatly contribute to continued long-term genetic improvement in the lamb industry.



Mr Don Peden President of The Australian Society of British Breed Sheep has been a strong supporter of the project and the MTS since its inception (photo ASBBS).

RECOMMENDATIONS

For the increased genetic improvement of growth rate and leanness in the Australian meatsheep industry it is recommended that:

1 the N.S.W. Meatsheep Testing Service (MTS) be continued to provide a facility for meatsheep breeders to test animals for genetic differences in growth rate and fat depth within the same environment;

2 further research be undertaken to develop practical, cost efficient means of making genetic comparisons in growth rate and fat depth between sheep raised under different environmental conditions;

3 the MTS be further improved by incorporating estimated breeding values for growth rate and leanness and combining them in selection indexes;

4 breeders should be offered a choice of selection indexes in keeping with their differing breeding objectives;

5 further technical innovations regarding data collection, measurement, input and processing to improve efficiency of operations and reduce costs be pursued;

6 the promotion and adoption of the proposed national performance recording scheme - LAMBPLAN - be strongly supported in all States and the AMLRDC consider its possible contribution to national co-ordination;

7 government and industry organisations, in considering LAMBPLAN's implementation, take note of the advisory approach used to successfully market the MTS in N.S.W. and in particular the need for close and continuous industry consultation;

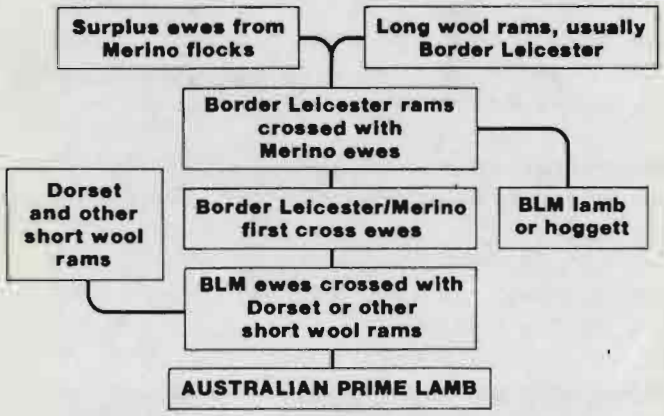
8 further research be undertaken into defining breeding objectives for various types of meatsheep flocks and development of appropriate selection indexes;

9 further research be undertaken to evaluate the correlated responses from continued selection for faster growth and leanness on other carcase and production characters;

10 further analysis of the MTS data base be undertaken to define gene flow in the ram breeding industry and estimate genetic parameters and environmental effects for other important breeds.

1. BACKGROUND AND INDUSTRY CONTEXT

The lamb industry has an organised structure with the majority of slaughter lambs being crossbred progeny of one of the terminal sire meat breeds and Border Leicester x Merino or other breed ewes. Genetic improvement in growth rate and carcase quality of slaughter lambs is primarily achieved through improvement in the meatsheep breeds.



The crossbreeding structure of the Australian lamb industry. Genetic improvement in growth rate and carcase quality is primarily achieved through the Dorset and other terminal sire breeds.

The meatsheep breeds (e.g., Poll Dorset, Suffolk) are each formed into a heirachy with a relatively small number of studs supplying the majority of the breeding stock and rams used in the industry. There are approximately 200 terminal meatsheep breed studs that provide over 60% of the flock rams sold in New South Wales and over 90% of replacement stud sires. These studs have a flock size of more than 150 ewes and turn off about 15,000 terminal sires per year to the prime lamb industry (Breed Society Statistics). Genetic improvement programs operating in these important studs determine the rate of genetic improvement in the lamb industry as a whole. Consequently it is important that the genetic improvement programs have sound objectives and be carried out efficiently to ensure optimum improvement in the industry as a whole.

Development and implementation of performance recording schemes in the meatsheep industry have been strongly advocated as a means of increasing the rate of genetic improvement in economically important traits by various expert panels and workshops (APC 1969, 1974, N.S.W. Deptartment of Agriculture 1972, Harris, *et al.* 1975; Thatcher and Harris 1983). Early attempts to establish performance recording schemes in the 1960's and 1970's failed to attract widespread breeder usage. However, in the late 1970's a number of developments occurred in the industry especially amongst Dorset breeders, that prompted a keen interest in adoption of production testing. These included:-

* the demonstration of extensive within flock variation in measured growth and fatness in Dorset Production competitions initiated at Cowra by the N.S.W. Department of Agriculture (Fogarty and Harris 1975, Clements and Fogarty 1976);

* the rapid increase in use of fleece measurement data in the sale of Merino rams (Tucker 1978);

* the increased attempts to develop and implement carcase classification in lamb marketing and its focus of attention on the economic importance of carcase weight and carcase fat (Moxham and Brownlie 1976);

* the development of technology to accurately measure fat depth in live animals to aid stud breeders in their selections (Thompson *et al.* 1977, Clements *et al.* 1981);

* experience gained in the co-operative Flock test performance recording scheme conducted by the Victorian Department of Agriculture in the late 1970's;

* the success of the national sheep performance recording scheme in New Zealand.

This project capitalised on these developments and the changing attitudes of meatsheep stud breeders. As a result the N.S.W. Meatsheep Testing Service was developed and implemented with widespread support from stud breeders in N.S.W., advisory and technical backup from the N.S.W. Department of Agriculture and financial support from the AMLRDC.

The "Scanogram" being tested to measure fat depth by Livestock Officer, John Butt on Graham Crane's Poll Dorset ram in 1980. The scanogram has now been replaced by a cheaper, more easily operated ultrasonic machine developed in New Zealand (photo P Austin, The Land).

Studies into the breeding objectives in genetic improvement programs for meatsheep breeds have shown the importance of weight (Stafford and Walkley 1979). More recently the inclusion of carcase fatness in the breeding objectives has been advocated (Fogarty 1984; Atkins 1987). This is because of its demonstrated economic importance in consumer acceptance of lamb cuts (Thatcher 1982), despite the seemingly low market price incentive for leanness currently received by lamb producers (Harris 1982). The introduction of a uniform language of carcase definition (AUSMEAT) and sale by description using computerised information systems (CAIM) will further enhance the demand for objective measurements on seed stock from both the commercial flock ram buyer and stud breeder.

The selection criteria most appropriate to these breeding objectives include weight (or growth rate) and fatness (Atkins 1987). The genetic and phenotypic parameter estimates for weight and fatness have been summarised by Bennett and Clarke (1984) and Simm (1986). These estimates indicate that the heritability for weight is in the range 0.2 to 0.3 and that for carcase fat 0.3 to 0.4. Estimates of the genetic correlation between these two traits are few and variable, and may depend on the enterprise objective (Atkins 1987). Evidence suggests the genetic correlation is probably slightly positive which means a genetic increase in slaughter weight of lambs will result in a slight increase in genetic fat levels. The use of a selection index with restriction on fatness can overcome this undesirable effect.

2. OBJECTIVES

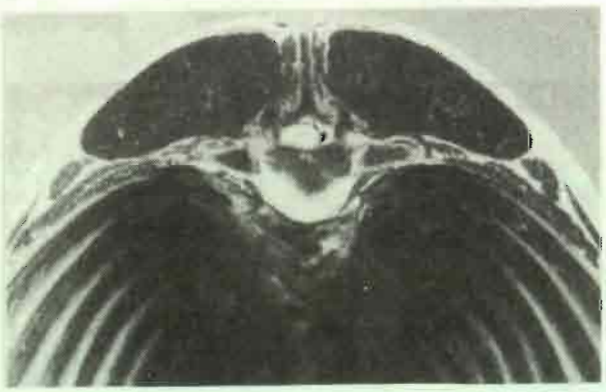
To evaluate the development of a viable facility enabling meatsheep stud breeders to objectively test rams for genetic differences in growth rate and fat depth.

Within this broad objective the project aimed to:-

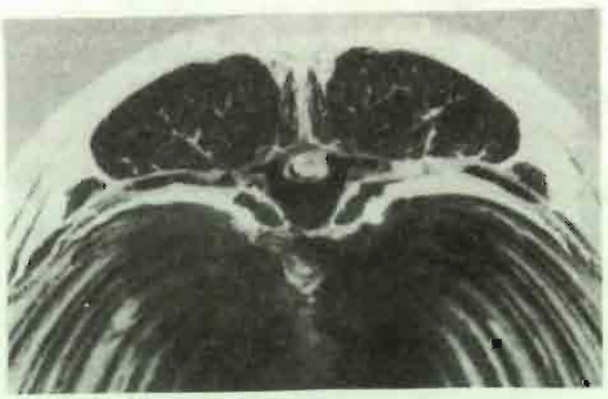
* develop recommendations and guidelines to government and industry regarding the feasibility and practical design of a performance testing scheme for the Australian meatsheep breeding industry;

* develop and implement, in conjunction with the N.S.W. meatsheep stud industry, the N.S.W. Meatsheep Testing Service, to provide a model scheme for other organisations and accumulate a large data base;

* provide a large industry data base on Australian meatsheep breeds to give a sound technical basis for operational guidelines, adjustment procedures, parameter estimates and development of recommended breeding programmes.



Crossection of a well muscled lean lamb carcase - the type DAN 23S aimed to breed.



Crossection of a poorly muscled, overfat lamb - DAN 23S aided the identification and culling of such animals.

(photos AMLC)

3. METHODOLOGY

The project involved four components which included:-

* the development, implementation and promotion of the Meatsheep Testing Service, through software and data processing technology and a co-ordinated advisory programme;

* the evaluation of devices for measuring fat depth in live animals;

* the accumulation of a large industry based data set and its analysis to provide estimates of genetic parameters and environmental effects for Australian meatsheep flocks for the development of appropriate and effective breeding programmes; and

* a model for development of performance recording nationally for the meatsheep industry.

3.1 THE N.S.W. MEATSHEEP TESTING SERVICE (MTS)

The Service enables stud breeders and producers of prime lambs to identify and select rams which will sire faster-growing, leaner lambs to provide the type of carcase that today's consumer demands - young, tender lamb with a minimum of wasteful and unhealthy fat. Innovations in ultrasonic fat-depth measuring equipment, weighing scales and the latest in computer programs make it possible to offer this service to New South Wales meatsheep breeders, through the Department of Agriculture's country-based sheep advisers.

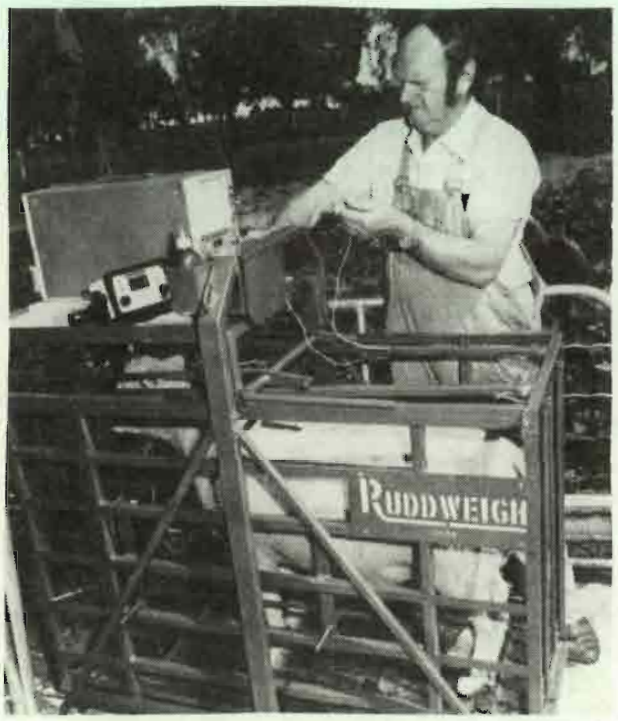
Growth rate and subcutaneous fat depth are genetically the most important carcase traits for the prime lamb industry. In studs the response to selection for growth rate and leanness accumulates with each generation of new animals. These accumulated benefits in the studs flow on to commercial lamb producers through the rams they purchase.

Users of the MTS have rams weighed usually between 8 and 12 months of age before they are classed or selected into their various sale categories. At the same time fat depth is measured using an ultrasound machine. Information is collected on the lamb's date of birth, whether it was born and also reared as a single or twin, the age of its dam (adult or maiden) and identification of its sire. The information is analysed by computer to calculate growth rate and adjust for known non-genetic effects such as age, type of birth/rearing and age of dam. This provides the stud breeder with a more accurate grading of rams on their genetic merit.

Animals must be run together from birth to testing if they are to be compared. It is not possible to compare gradings of rams from different studs, or even from different management groups within the one stud.

3.1.1 Operations

Stud breeders initially contact the MTS through their local N.S.W. Department of Agriculture Livestock Officer (Sheep and Wool). There are some 32 officers located in districts throughout the State. The Officer-in-Charge of the MTS, who is located at Cowra Agricultural Research Station, is contacted and a suitable day and time arranged for testing to be carried out. On the arranged day, the breeder yards the sheep to be tested and assists with identification, measurement and recording procedures.



Rams being weighed and fat scanned by Alan Luff.

DAN 23S has shown that over 90 yearling rams can be tested per hour under normal field conditions (photo J Gasparotto).

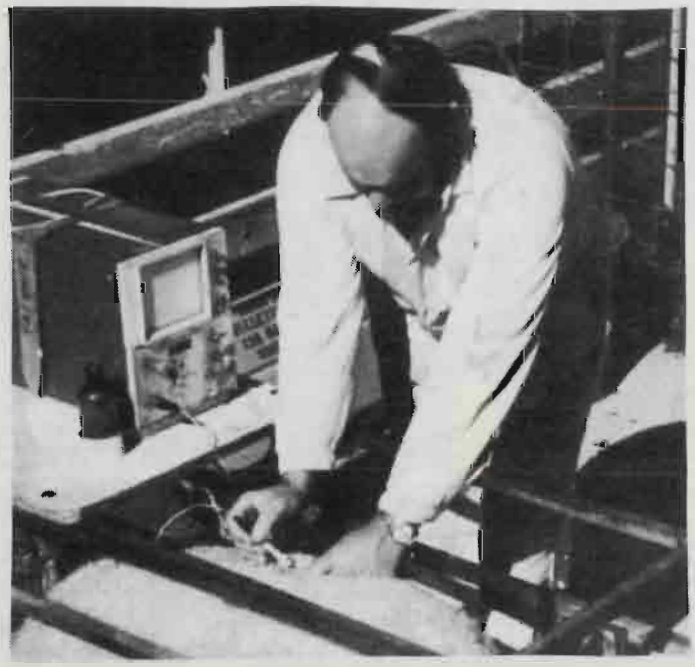
The ram ear tag is read, the ram is weighed, and the fat depth recorded. Fat depth is measured with an ultrasonic backfat meter at the 12/13th rib over the loin eye muscle. The ultrasonic backfat meter was developed by DSIR in New Zealand and is manufactured commercially by Delphi Industries Ltd., Auckland, N.Z. Lambing records give ram age (date of birth), dam age (maiden or adult), birth and rearing status (single, twin, etc.) and sire identification. These details are normally kept by stud breeders as part of their breed society requirements. This information is used to make adjustments to growth rate and provide sire summaries. Weighing and measuring can be done inside most shearing sheds, or outside in the sheep race, at a rate of around 90 rams per hour. No shearing or clipping is necessary with the modern equipment now in use.

3.1.2 Measurements and Computer Processing

Growth rate of a ram to hogget age is the most accurate guide to the growth rate to weaning of that ram's progeny. Measurements at this age shows the ram's genetic merit under feed and management conditions available after weaning, rather than earlier when the mothering ability of the ewe and competition from twins and triplets influence growth rate to a much greater degree. Individual ram 'growth percentage' is calculated as the ram's adjusted growth rate expressed as a percentage of the average growth rate of all rams in the group. Adjustments using the computer program are made for known environmental effects on growth rate, as follows:-

Dam age - adult 0%, maiden or old age 2%
Birth type - single 0%, twin 1%, triplet 2%, quad 3%
Rearing type - single 0%, twin 2%, triplet 4%, quad 6%

A crossbred slaughter lamb will be about 0.5 kg heavier than other lambs of the same age for every 10% its sire was superior in growth percentage. Thus, on average, 35 kg crossbred lambs sired by a ram with a growth percentage of 120% will be 1 kg heavier than lambs of the same age sired by rams with a growth percentage of 100%.



The ultrasonic fat probe developed by DSIR in New Zealand being used by Alan Luff. Measurements are taken over the eye muscle on the 12th rib. No clipping or shearing is required.

Fat depth on rams is measured using an ultrasonic sound backfat meter at the "C" site (over the loin 45 mm from the midline at the 12/13 rib). Measured fat depth is adjusted for liveweight differences by regression to reduce non genetic influences and the undesirable bias in favour of lighter, slower growing animals. Adjusted fat depth information is presented in classes to minimise the effect of minor errors that can occur in attempting to measure small differences between individual animals. It also prevents breeders misinterpreting small absolute differences between rams and highlights the importance of selecting rams from the extremes of the population distribution if significant genetic progress is to be achieved.

Because young rams are usually very lean, difficulties can be encountered in trying to measure fat at very young ages. For this reason it is better to delay measuring until rams have attained an average liveweight of 45 kg or more and average fat score 3 or higher, normally around 8 months of age. By delaying measuring until this age, advantage is also taken of differences in maturity. Fat depths and growth rates can be measured at older ages and heavier weights but the most useful information will be obtained in the 8 to 16 month range.

3.1.3 Reports

The Service provides the stud breeder with the following reports (see Appendix I):-

a) individual ram report;
b) flock summary;
c) sire summary.

Data being fed into the Cowra computer terminal. Special software programmes have been developed to analyse breeders information and present it in the clearest most useful way possible (photo J Gasparotto).

Results are mailed directly to the breeder in order to eliminate delays. A copy is supplied to the District Officer so that the important advisory link with the breeder can be maintained. Action has been taken to develop and evaluate the most suitable style of presentation of the results for breeders. The data is presented as simply and effectively as possible on an easily read and uncluttered report sheet. Experience has shown that the easier the measurements are to interpret and apply the more likely they will be used.

a) Individual Ram Report (see Fig. 3.1.1) Provides information for each ram on its:

Growth % - calculated from liveweight adjusted for non-genetic effects and expressed as a percentage of the average of his flock mates. Ram number 122 (Fig.3.1.1) with a Growth % of 112% grew 12% faster than the average of the flock. Ram number 117 with a Growth % of 96%, grew 4% slower than the average of the flock.

Fat Class- measured fat depth is adjusted for differences in liveweight and assigned to one of seven classes. The classes are in standard deviation units and indicate genetic merit for leanness. The classes, together with their standardised deviations and the approximate proportion of rams in each class for large management groups, are as follows:

Class	Merit	Range	Proportion
-3	leanest	< - 2.5 s.d.	1%
-2	next leanest	- 1.6 to - 2.5 s.d	6%
-1	next leanest	- 0.6 to - 1.5 s.d.	24%
0	average	+ 0.5 to - 0.5 s.d.	38%
+1	fat	+ 0.6 to + 1.5 s.d.	24%
+2	very fat	+ 1.6 to + 2.5 s.d.	6%
+3	fattest	> + 2.5 s.d.	1%

Growth order - ranks each ram in the group on its Growth %. Ram number 122 is ranked 9th.

Growth % Histogram - the distribution of rams according to Growth % is also presented graphically in the form of a histogram (Fig. 3.1.2). This illustrates effectively that growth rates are essentially normally distributed around the mean of the drop. It also shows the number of rams present in each 5 % "Growth %" group. This readily shows the number of rams available for any different growth rate grade that may be required.

Fig. 3.1.1 Sample Meatsheep Testing Service computer report for individual rams.

INDIVIDUAL RAM REPORT

RAM NUMBER	GROWTH %	FAT CLASS	GROWTH ORDER
105	73%	0	48
108	90%	0	41
117	96%	-1	34
122	112%	0	9
127	94%	+3	37
128	103%	-1	21
131	96%	0	33
133	118%	0	2
158	94%	-1	38
162	102%	0	24
174	103%	0	20
185	117%	+2	4
187	100%	-1	28
193	110%	-1	11
194	102%	-1	22
212	110%	0	10
213	121%	-1	1
231	113%	+1	7
232	85%	0	44
235	114%	+1	6
274	98%	0	31
278	108%	-1	15
284	96%	0	35
286	105%	0	17
302	101%	0	26
311	76%	+1	47
312	86%	0	43
314	84%	0	45
315	77%	+1	46
317	114%	+2	5
321	113%	+2	8
332	88%	0	42
339	98%	0	32
343	108%	-1	16
345	99%	-2	29
366	73%	+1	49
368	93%	0	40
373	99%	0	30
374	109%	+1	12
386	108%	0	14
390	117%	-1	3
416	100%	0	27
423	104%	-1	18
427	109%	0	13
454	102%	0	23
468	94%	0	39
478	103%	+1	19
479	101%	-1	25
499	95%	-1	36

Fig. 3.1.2 Sample Meatsheep Testing Service computer report for distribution of growth percentage

GROWTH RANGE	NO	HISTOGRAM
136-200 %	0	
131-135 %	0	
126-130 %	0	
121-125 %	1	**
116-120 %	3	******
111-115 %	5	**********
106-110 %	7	**********
101-105 %	10	**********
96-100 %	9	**********
91-95 %	5	**********
86-90 %	3	******
81-85 %	2	****
76-80%	2	****
71-75 %	2	****
66-70 %	0	
0-65 %	0	

Growth rate and fat depth information is only given on a comparative basis. No actual production figures are supplied, as these are often misleading and can encourage ram buyers to make invalid comparisons. This has the prime advantage of focusing on genetic differences rather than the phenotypic differences traditionally recognised by industry.

b) Flock summary (Fig. 3.1.3) This is a summary of all the rams tested in each management group, their age, their average growth rate in grams per day, their average fat depth in millimetres per 60 kilograms of liveweight and the number of rams in each fat class. Group average fat depth is expressed in millimetres per 60 kg to allow some progressive comparisons to be made between drops and between seasons.

c) Sire Summary (Fig. 3.1.4) The sire summary presents the average growth rate and fat depth of the progeny of each sire. Provided ewes have been allocated to sires randomly, and more than ten progeny from each sire are measured, this report can be used as a guide to the relative performance of each sire used within the stud.

Fig. 3.1.3. Sample Meatsheep Testing Service Computer Report

FLOCK SUMMARY

NUMBER TESTED	49
AVERAGE GROWTH RATE	198.6 G/DAY
AVERAGE FAT DEPTH	3.9 MM PER 60 KG

Fig. 3.1.4 Sample Meatsheep Testing Service Computer Report

SIRE SUMMARY

SIRE GROUP	NUMBER TESTED	AVERAGE GROWTH	AVERAGE FAT DEPTH
295.83	16	102.4%	3.8mm
315.83	16	96.2%	3.8mm
452.84	17	101.3%	4.1mm

FAT CLASS SUMMARY

FAT CLASS	NUMBER
-3	0
-2	1
-1	13
0	24
+1	7
+2	3
+3	1

3.1.4 Breeders Use of the Information

Information provided by the Service is used by breeders in:-

* Identification of reserve and replacement stud sires for use in stud improvement programs. This is particularly relevant to the breeding of faster growing, leaner rams in future generations.

* Progeny tests. Production information can be used in test matings of sires that have been bred under different conditions, provided they are mated to enough ewes of the same genetic merit.

* Ram selling systems for stud sires and flock rams. Information provided by the Service can be used when grading rams for sale. In auction selling, the information can be presented in sale catalogues to assist ram buyers. Simple colour codes can be used to identify superior ram grades for paddock buyers.

3.1.5. Breeders Use of the Service

There has been a rapid growth in breeder use of the Service since its instigation in 1980. Table 3.1.1 shows the number of sheep tested, number of studs, and average number of sheep tested per stud for the six years to 30 June 1986 and the subsequent year (1986/87) after funding from AMLRDC concluded. The slight decline in the number of studs and sheep being tested in 1986/87 was due to the necessity to charge a fee for the service after funding support ceased. However, it is thought this will only be a short-term reaction and indications are that the service is being very strongly supported by meatsheep breeders. Some 13 breeds utilise the service although 80% of sheep tested have been Dorset and Suffolk breeds (Table 3.1.2).

Table 3.1.1 **Annual usage of the Meatsheep Testing Service**

YEAR	SHEEP TESTED	STUDS	SHEEP/STUD
1980/81	1412	12	118
1981/82	7796	62	126
1982/83	9947	69	144
1983/84	13640	100	136
1984/85	17091	123	139
1985/86	17941	121	148
1986/87	16276	112	145

Some 18 studs now conduct annual on-property production sales of rams with growth rate and fat depth information displayed for prospective buyers. Australia's first group breeding scheme for meatsheep has been commenced by 19 stud breeders involved in the Australian Dorset Company (Pty). Measurements made by the Meatsheep Testing Service are used to aid selection of sheep for the elite control breeding nucleus and in the selection of their progeny.

Armdale Dorset stud is one of eighteen N.S.W. meatsheep studs now conducting annual production sales based on DAN 23S growth rate and leanness information.

Table 3.1.2 **Number of sheep tested and studs using the Meatsheep Testing Service by breed and year.**

	DORSET	SUFFOLK	OTHER SHORTWOOL	BORDER LEICESTER	OTHER
1980/81					
Sheep	794	99	241	-	278
Studs	8	2	1	-	1
1981/82					
Sheep	5538	569	362	672	655
Studs	34	8	2	9	9
1982/83					
Sheep	7272	383	327	1132	833
Studs	47	4	5	5	8
1983/84					
Sheep	9333	765	782	1312	1448
Studs	63	7	9	8	13
1984/85					
Sheep	12290	1426	1367	691	1317
Studs	77	11	14	6	15
1985/86					
Sheep	13577	1293	1270	509	1292
Studs	77	13	9	11	11
1986/87					
Sheep	12257	887	1506	589	1037
Studs	63	13	16	6	14
TOTAL					
Sheep	61061	5422	5855	4905	6860
Studs+	113	20	30	18	15

+ Total number of different studs

3.1.6 Advisory Services Support

The Meatsheep Testing Service has been strongly supported by the N.S.W. Department of Agriculture through an inter-regional advisory programme which commenced in 1982. The aim of the advisory programme is to:-

> ***"effectively utilise the NSW Meatsheep Testing Service to improve the genetic capacity of meatsheep flocks to more efficiently produce faster grown and leaner lamb carcases."***

Farmers participating in one of the many field days and demonstrations conducted throughout N.S.W. by the N.S.W. Department as part of the special advisory programme used to support DAN 23S.

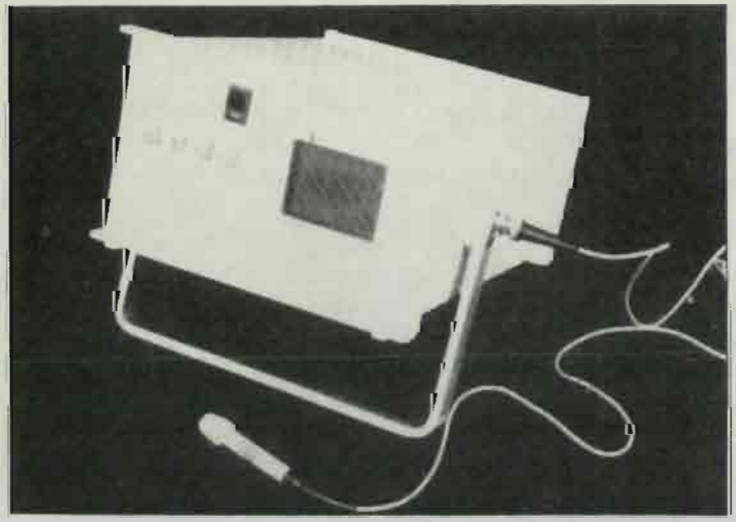
This programme has been co-ordinated by a working party under the chairmanship of the Prime Lamb Specialist and livestock officers representing four regions of the State and researchers. Activities have included field days, meetings, demonstrations, individual contact with breeders, assistance in correct use of measurements at sales, preparation of extension publications and other advisory aids.

A feature of these activities has been the close and continuing consultation between N.S.W. stud breeders and MTS staff. N.S.W. Breed Societies were closely involved in all stages of the project's original conception, submission and conduct. A special industry consultative committee (N.S.W. Meatsheep Scientific Liaison Committee) comprising representatives of the Australian Poll Dorset Association and all Australian Society of Breeders of British Sheep affiliated breeds was specificially created in 1981 to help in this project's implementation and other activities.

3.2 DEVELOPMENT AND ASSOCIATED ACTIVITIES

3.2.1 Measurement of Fat Depth

A series of steps have been taken to evaluate methods of measuring the fat depth of meatsheep rams. The Meatsheep Testing Service initially used the scanogram. This instrument was then compared with the scanoprobe and with condition scoring (Clements *et al.* 1981). The best available alternative ultrasound instrument was imported from New Zealand in September 1981. This instrument developed by D.S.I.R. is very portable, measures fat depth with an accuracy of + or - 1 mm and is cheaper than the scanogram. Its small transducer head enables measurements to be taken without clipping the wool regardless of the length of the fleece. Minimal interpretation of the measurement is required. Fat depth measurements with the New Zealand instrument are made at the "C" site rather than at the carcase classification "GR" site. Measurements at both sites are strongly related to commercial "yield", but are much easier to make at the "C" site on live animals. Attempts to use the currently available ultrasonic instruments at the "GR" site on live rams have given inconsistent results.



The ultrasonic backfat meter manufactured by Delphi Industries Ltd., Auckland.

DAN 238 has obtained heritabilities of 0.40 for fat depth with such machines and has been able to accurately identify differences between genetic yearling rams (photo MAF NZ).

The practical feasibility of measuring fat depth has been examined in situations such as sheep yards and shearing sheds. Factors considered have included sheep handling equipment, proximity to electric power, portable generators and fluctuating power supplies. Fat depth measurements have been made on rams and ewes varying from four months to two years of age.

Fat depth results provided to stud breeders are based on the millimetres of fat per 60 kg liveweight. This adjustment for liveweight overcomes the undesirable bias in favour of lighter, slower growing animals and reduces the effect of non-genetic, environmental influences affecting liveweight. The fat depth is presented in classes to focus on comparative differences and take account of the accuracy of measurement. Stud breeders commonly subject rams to differential treatment at a relatively young age. This project has provided a means for breeders to screen entire drops of young rams for fat depth before these treatments are applied.

3.2.2 Servicing other Research Projects

a) **Producing Larger Leaner Lambs, Vic. Dept. Agric. Rural Affairs, Rutherglen (L. Thatcher). Project DAV 25S**

Assistance was provided with training Victorian Department of Agriculture and Rural Affairs staff in use of the backfat testing meter. Studs with suitable performance testing records were nominated for purchase of animals for use in this project and extra testing carried out and objective measurement information was supplied prior to final selections. Earlier assistance was also provided in training workshops for the development of live lamb appraisal skills.

b) **White Suffolk Project, University of N.S.W., Hay (E. Roberts). Project UNSW 5S.**

Nucleus yearling ewes and rams at the Hay Field Station, have been screened for growth rate and fat depth to assist in selection programmes. Thirteen other flocks contributing ewes to the central nucleus have been screened over the last three years. Assistance has been given in the selection of contributor's stock to forward to the nucleus flock.

c) **Development of Meatsheep Sire, Armidale (T.S. Chang). Project CS 20S**

During 1983 and 1984, the yearling rams and ewes were measured for fat depth at the "C" site. All breeding ewes were also measured in order to correlate with observed responses in the carcases of their progeny.

d) **Synthetic Lamb Dam - Hyfer, N.S.W. Dept. Agriculture, Cowra and Leeton, (N. Fogarty)**

Growth rate and fat depth information has been provided throughout this project to assist in sire selections.

e) **Managerial considerations affecting lambing ewes for the prevention**

of excessive perinatal lamb loss, N.S.W. Dept. Agriculture, Cowra and Temora, (P.J. Holst)

Assistance was provided to this project in the measurement of skin thickness and subcutaneous fat depth at three stages of pregnancy by the use of ultrasound.

f) **Central Western Dorset Production Championship, N.S.W. Dept. Agriculture and Cowra Show Society, Cowra.**

Assistance was provided to this unique competition run on the Cowra Agricultural Research Station in conjunction with the Breed Societies and Cowra Show Society. Young ewe weaners were entered by Dorset stud breeders and run together for 12 months. Performance was assessed by growth over the period and measured fat depth. The competition attracted entries of 100 to 150 ewes from 16 to 25 studs annually over some 13 years. The competition demonstrated individual animal variation in performance and was an excellent forum for advisory programmes and promotion of the Meatsheep Testing Service.

g) **Co-operative Dorset Breeding Project, Cootamundra**

Assistance has been provided to the 16 contributors in this co-operative breeding scheme in the formation, setting up, selection and screening of sheep for selection into the nucleus flock as well as nucleus flock progeny. This has ensured that research results have been effectively applied in a worthwhile and practical breeding programme.

h) **Rabbit, Sheep and Pasture Interaction, N.S.W. Dept. Agriculture, Cowra, (J.D. Croft)**

Subcutaneous fat depth and liveweight of wethers grazing in this project was measured at 3 monthly intervals to assist in assessing sheep production losses through pasture degradation by rabbits.

3.2.3 Field Days, Demonstrations and Shows

The effective establishment and acceptance of the Meatsheep Testing Service has been dependent on an extensive advisory, promotion and demonstration programme amongst meatsheep breeders. Over the six year period of AMLRDC funding this was achieved by participation in:-

40 field days
27 demonstrations and meetings
21 shows and ram sales.

3.3 ANALYSIS OF DATA

The field data collected through the N.S.W. Meatsheep Testing Service provides a valuable and unique data set from current industry flocks. Analyses of these data provides information on the structure of industry flocks, breeding policies and estimates of environmental effects and genetic parameters.

As with any set of field data a considerable amount of editing was required prior to analysis. The editing is necessary to eliminate errors, remove animals with incomplete records, delete records of animals that are outside an acceptable age range for the group and delete groups that are too small to make a meaningful contribution.

3.3.1 Aim:

Analysis of the Meatsheep Testing Service data set was undertaken to:-

* document flock structure;
* estimate non-genetic effects and determine appropriate adjustment factors and procedures;
* estimate genetic parameters for use in calculation of estimated breeding values and selection indexes.

3.3.2 Description of the Data Set

Poll Dorset flocks represented the great majority of available data and these were edited as above to provide the data subset for analysis. Flocks tested in the years 1983 to 1986 were included if they had used at least five sires with at least five tested progeny records per sire. The age spread in management groups was restricted to 56 days by deleting animals outside this range.

The data subset included a liveweight at 5 to 15 months of age and a subcutaneous fat depth measurement over the loin (C site) taken at the same age and comprised the following:-

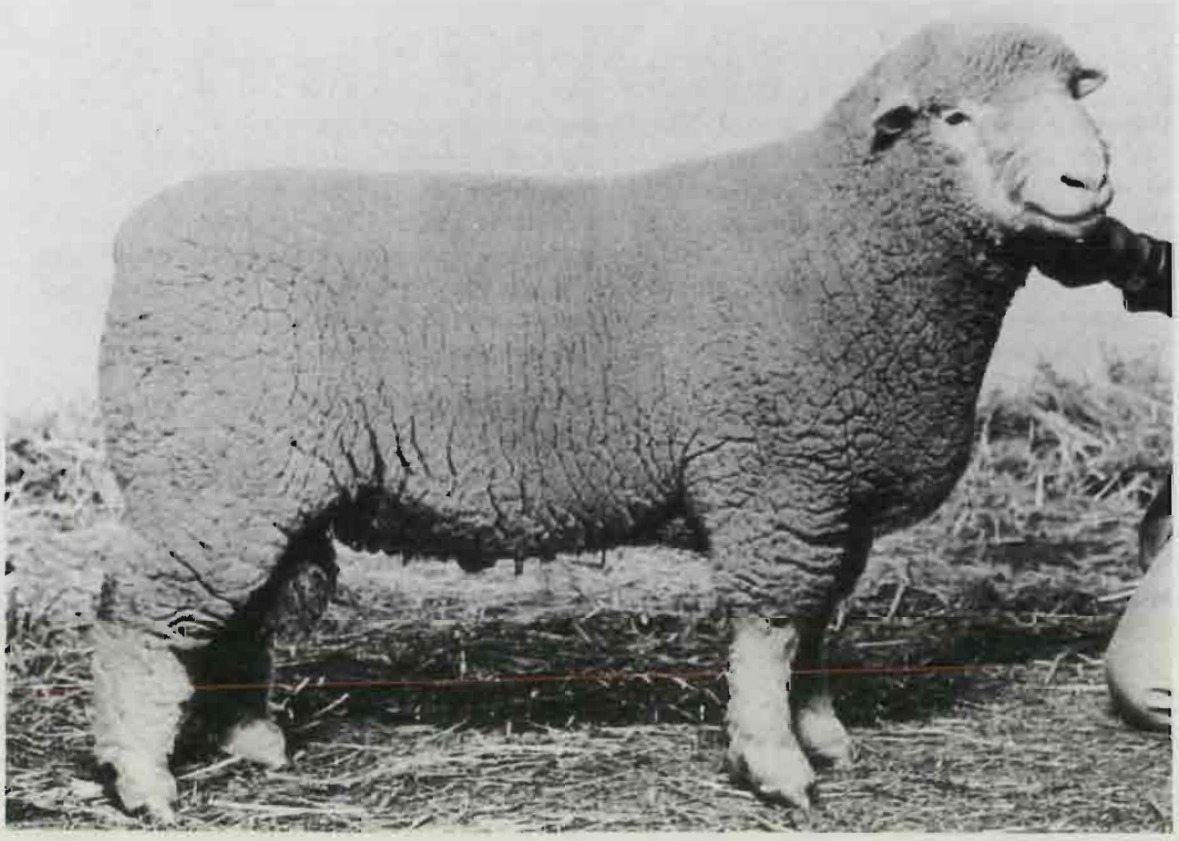
50 flocks
498 sires
28,160 individual records (70% rams)

3.3.3 Statistical Procedures

Management groups were arbitrarily divided into three groups according to the average age of animals being tested. This was done to examine the effect of average age on the magnitude of the non-genetic effects and need for different adjustment procedures. These groups were:-

a) Less than seven months
b) 7 to 11 months
c) 11 to 15 months.

The analysis used restricted maximum likelihood (REML) procedures (Meyer 1985). These procedures have been specially developed to analyse this type of field data to simultaneously take account of management groups and sires. In addition, the procedures take proper account of the extreme variation that exists in the number of progeny per sire. The overall mean number of progeny per sire was 39 but ranged from 5 to 280.



Poll Dorsets have been the most prominent breed among the 84,000 sheep tested by the Meatsheep Testing Service since 1980. This ram is typical of those bred as a result of the project - big, meaty and lean! (photo Stevens Livestock photography, Albury).

The data were analysed separately within the three groups above (mean age of management groups). The model fitted included flock, management group (absorbed), sires fitted as a random effect and fixed effects for age of dam (maiden < 2 and >7 years v adult 3 to 6 years), type of birth (1 v 2), type of rearing (1 v 2) and age (linear and quadratic). The data were analysed on the square root transformed scale to remove the dependence of the variance on the mean.

3.3.4 Results and Discussion

3.3.4.1 Flock Structure

The average age of sires when progeny were born, i.e., generation interval for the sire path, was 3.3 years. The proportion of animals with sires of various ages are shown in Table 3.3.1.

TABLE 3.3.1. PROPORTION OF TESTED ANIMALS WITH SIRES OF VARIOUS AGES

SIRE AGE (YRS)	ANIMALS TESTED (%)
1	4
2	36
3	26
4	15
5	9
6	5
7	3
8+	2

There was considerable variation in the average age of rams used between flocks. The average age of sires in flocks ranged from 2.3 to 5.7 years with 62% of flocks being greater than 3.0 years and 8% greater than 4.0 years. In contrast there were only 6% of flocks in which the average age of sires was 2.5 years or less.

High generation intervals reduce the rate of genetic change and response to selection as well as increase the level of inbreeding. A sire generation interval of between 2.0 and 2.5 years is regarded as optimal and can be achieved by using only two and three year old sires (when their progeny are born). The results point to the need for sire evaluation and culling decisions on old sires. Too many flocks are using too many old sires. This is severely limiting their possible genetic progress. Their performance is being further jeopardised by increasing inbreeding which has previously been highlighted as a problem in the Dorset Horn breed (Fogarty 1978), which showed a similar generation interval.

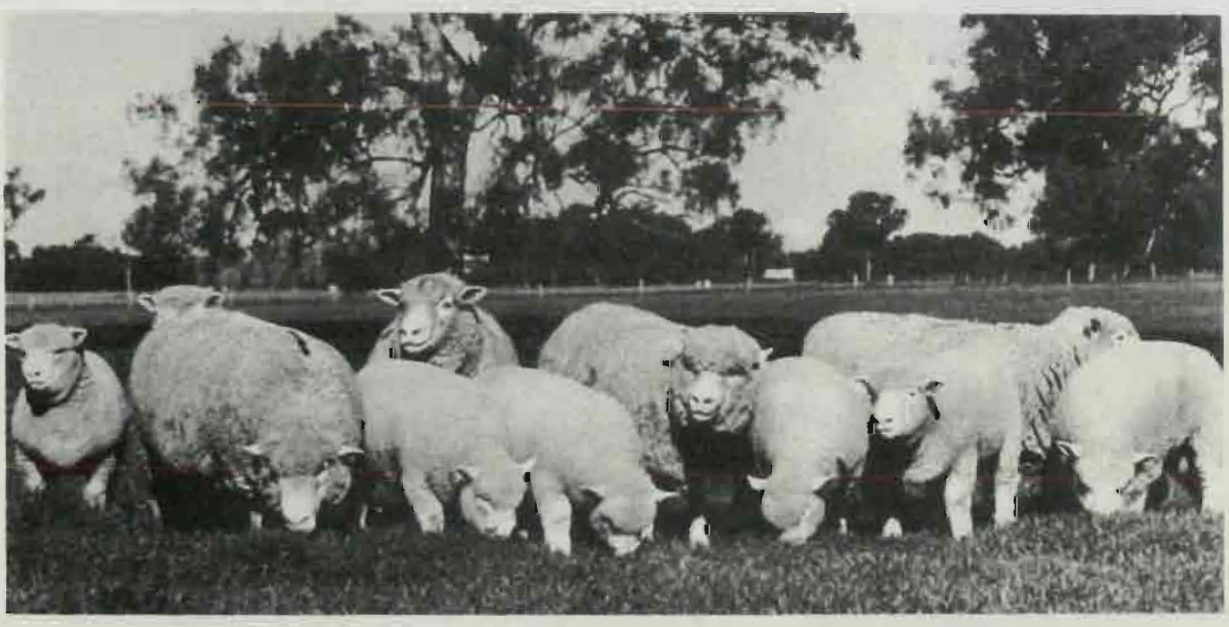
3.3.4.2 Source of sires

No flocks were closed i.e., used only homebred sires and only two flocks did not use any homebred sires. The great majority of flocks (96%) used both homebred and purchased sires. Less than 50% of tested animals were by homebred sires.

There is a very high migration of rams between flocks, with sons of previously bred and sold rams often being purchased and used. Thus it would seem that many breeders are using the Meatsheep Testing Service to evaluate sires, although as noted above, these sires are then being retained for too long. This would also indicate that variation between flocks is very small.

3.3.4.3 Environmental effects

The regression coefficients for age of dam and type of birth and rearing effects for square root transformed liveweight, fat depth and fat depth adjusted for liveweight for the three age groups of test animals are shown in Table 3.3.2. Mean liveweight for the age of dam and type of birth and rearing categories are shown in Table 3.3.3, together with the percentage deviations for the various categories from single born and reared rams from adult dams. As expected there is a decline in the magnitude of the deviations with increasing mean age of the tested animals from less than seven months to over 11 months. Group 1 (<7 months) animals were tested within a few months of weaning and maternal effects would be expected to be more important than the older and heavier animals in Group 2 and particularly Group 3.



Poll Dorset stud ewes and lambs on an excellent grazing oat crop in the Central West of N.S.W. The project has established the best way of making adjustments for different environmental effects, age of lamb, age of dam, type of birth and rearing status (photo Stevens photography, Albury).

Mean fat depths for animals in age groups 1, 2 and 3 were 2.8, 3.8 and 4.0 respectively. Removal of liveweight effects on fat depth largely accounted for age of dam and type of birth and rearing effects on fat depth.

TABLE 3.3.2 COEFFICIENTS FOR AGE OF DAM AND TYPE OF BIRTH AND REARING EFFECTS FOR SQUARE ROOT TRANSFORMED LIVEWEIGHT (WT), FAT DEPTH (FAT) AND FAT DEPTH ADJUSTED FOR LIVEWEIGHT (FAT.WT) FOR THREE AGE GROUPS OF TEST ANIMALS

EFFECT	GROUP 1 (<7 MTHS)			GROUP 2 (7-11 MTHS)			GROUP 3 (12-15 MTHS)		
	WT (/-kg)	FAT (/-mm)	FAT.WT (/-mm)	WT (/-kg)	FAT (/-mm)	FAT.WT (/-mm)	WT (/-kg)	FAT (/-mm)	FAT.WT (/-mm)
MEAN	6.18	1.69	1.70	6.96	1.94	1.95	7.54	2.01	2.01
ADULT DAM+									
S-S++	0	0	0	0	0	0	0	0	0
T-S	-.128	-.023	.016	-.156	-.049	.001	-.106	-.022	.007
T-T	-.367	-.123	.003	-.286	-.071	.019	-.198	-.047	.008
MAIDEN DAM									
S-S	-.082	-.038	-.013	-.100	-.031	.001	-.052	-.007	.007
T-S	-.195	-.055	.002	-.235	-.060	.009	-.165	-.033	.013
T-T	-.451	-.154	-.002	-.353	-.082	.028	-.297	-.066	.017
AGE REGRESSION (/day)									
Linear	.0115	.0039	.0003	.0099	.0037	.0006	.0065	.0023	.0004
Quadratic (x10^6)	-2	-3	7	-13	-3	-2	22	-11	-5
LIVEWEIGHT REGRESSION (//-kg)									
Linear			.325			.313			.279
Quadratic			-.0290			-.0183			-.0087

\+ Adult dam 3 to 6 years, Maiden dam <2 or >7 years.

++ S-S Single born and reared; T-S Twin born and reared as single; T-T Twin born and reared.

TABLE 3.3.3. LIVEWEIGHT FOR AGE OF DAM AND TYPE OF BIRTH AND REARING CATEGORIES AND FOR THREE AGE GROUPS OF TEST ANIMALS

	GROUP 1 (<7 MTHS)		GROUP 2 (7-11 MTHS)		GROUP 3 (12-15 MTHS)	
	WEIGHT (KG)	DEV.* (%)	WEIGHT (KG)	DEV. (%)	WEIGHT (KG)	DEV. (%)
ADULT DAM+						
S-S++	38.2		48.4		56.8	
T-S	36.7	- 4.3	46.3	- 4.6	55.2	-2.9
T-T	33.8	-13.0	44.4	- 9.1	53.8	-5.5
MAIDEN DAM						
S-S	37.2	- 2.7	47.0	- 2.9	56.0	-1.4
T-S	35.8	- 6.6	45.2	- 7.1	54.3	-4.5
T-T	32.8	-16.4	43.6	-11.0	52.4	-8.4

\+ Adult dam 3 to 6 years, Maiden Dam <2 or >7 years.
++ S-S Single born and reared; T-S twin born and reared as single; T-T twin born and reared.
* Deviation from S-S

These results indicate that the standard adjustments that have been used in the N.S.W. Meatsheep Testing Service have been slightly low for type of birth and rearing effects. There also needs to be different adjustments depending on the mean age of tested animals. More appropriate adjustment factors are shown in Table 3.3.4.

The magnitude of these environmental effects varies considerably between individual flocks and years. Despite this there is little loss of selection differential amongst replacement rams through use of standard adjustments in most flocks (Fogarty and Luff, 1985). However, the use of these improved standard adjustment factors will increase the overall efficiency of selection.

TABLE 3.3.4. STANDARD ADJUSTMENT FACTORS FOR ENVIRONMENTAL EFFECTS

EFFECT	AGE OF MEASUREMENT		
	4-6 MTHS	7-11 MTHS	12-15 MTHS
LIVEWEIGHT			
Age of dam - 1, 2, 7+ yrs (%)	+2	+2	+2
Birth type - twin (%)	+3	+3	+2
- triplet (%)	+5	+5	+3
Rearing type - twin (%)	+6	+3	+3
- triplet (%)	+9	+5	+4
Age (kg/day)	.15	.14	.10
FAT			
Weight (mm/kg)	.10	.09	.07

3.3.4.4 Genetic Parameters

Estimates of heritability, genetic and phenotypic correlations for liveweight fat depth and fat depth adjusted for liveweight for the three age groups are shown in Table 3.3.5.

The estimates of heritability for liveweight are about 0.3 and are consistent across the three age groups of animals tested. the estimates of heritability for fat depth vary from 0.3 to 0.4 which is relatively high for live animal measurement. This probably reflects the conditions under which measurements are recorded and operator accuracy and skills. Fat depth is measured at a relatively older age and when animals are in good condition to ensure reasonable fat levels especially on the rams. All fat measurements were undertaken by the one skilled and experienced operator. The heritability estimates for fat depth adjusted for liveweight were almost as high as those for unadjusted fat depth, except for the youngest age group.

The genetic correlation between liveweight and fat depth appears to decline with increasing age at measurement. The genetic correlations between liveweight and fat depth adjusted for liveweight are considerably lower although they remain positive. Thus selection for increased liveweight alone will result in a small genetic increase in fat depth on a liveweight adjusted basis.

The use of common sires in different groups allowed genetic correlations between the same measurements at different ages to be estimated. The genetic correlation between liveweight in Group 2 (7-11 months) and Group 3 (12-15months) was .72 (+.18). The corresponding genetic correlation for fat depth was 1.08 (+.07) and fat depth adjusted for liveweight was 1.01 (+.09). Selection based on fat depth at ages >7 months will lead to leaner animals at all ages. However, care is required in choosing an appropriate age for liveweight measurement since the genetic correlation between Group 2 and Group 3 was less than 1.0.

TABLE 3.3.5 ESTIMATES (+S.E.) OF HERITABILITY, GENETIC AND PHENOTYPIC CORRELATIONS FOR LIVEWEIGHT (WT), FAT DEPTH (FAT) AND FAT DEPTH ADJUSTED FOR LIVEWEIGHT (FAT.WT)

a) Group 1 <7 months

	WT	FAT	FAT.WT
WT	.31 + .06	.62 + .01	.01 + .02
FAT	.78 + .06	.30 + .06	.79 + .01
FAT.WT	.26 + .15	.81 + .06	.21 + .05

b) Group 2 7 to 11 months

	WT	FAT	FAT.WT
WT	.29 + .04	.59 + .01	.02 + .01
FAT	.67 + .06	.43 + .05	.82 + .00
FAT.WT	.25 + .10	.88 + .02	.39 + .05

c) Group 3 12 to 15 months

	WT	FAT	FAT.WT
WT	.24 + .04	.49 + .01	.01 + .01
FAT	.50 + .08	.33 + .04	.87 + .00
FAT.WT	.10 + .11	.91 + .02	.32 + .04

Heritability on the diagonal, phenotypic correlations above the diagonal and genetic correlations below the diagonal.

3.4 DEVELOPMENT OF A NATIONAL PERFORMANCE RECORDING SCHEME - LAMBPLAN

Animal Production Committee established a Working Party some years ago to co-ordinate the development of a national sheep performance recording scheme. A separate small sub-committee has developed proposals and technical guidelines for a national scheme for meatsheep to be called LAMBPLAN. These guidelines have been developed largely from experience gained from the N.S.W. Meatsheep Testing Service and have been accepted by Animal Production Committee pending approval by Standing Committee of Agriculture.

The initial phase of LAMBPLAN will be designed for sire breeds. The breeding objectives for meatsheep sire breeds in Australia have been detailed by Atkins (1987) who showed growth and carcase leanness to be appropriate. Selection criteria of a body weight and a live animal fat measure will be the basis of LAMBPLAN. Later development will include reproduction rate and wool production to provide a more comprehensive scheme suitable for dual purpose breeds.

LAMBPLAN will facilitate on a national basis:-

* promotion of performance recording for meat sheep
* uniform procedures for measurement, adjustment and output
* strong support from Department of Agriculture Advisory Services
* industry participation in ongoing policy and developments
* uniform implementation of further technical developments.

3.4.1 Aims of LAMPLAN

LAMBPLAN aims to:-

* provide breeding values for young rams (and ewes) using adjusted records of growth rate and fat depth (measured by ultrasonics)
* evaluate sires based on the performance of their progeny
* provide comparative performance information on sale rams.

These aims will be achieved by the following means:-

a) Provision of services to record body weights, to measure live animal fat depth and to estimate breeding values for growth and leanness. These records will be adjusted for known environmental effects to increase accuracy of estimation of breeding values. The breeding values will be combined into a selection index value based on user-supplied economic weights for growth and leanness and assumed genetic parameters. Three standard, or default, economic weights will be available for HIGH GROWTH, LEAN GROWTH and HIGH

LEAN objectives. This provides the breeder with an improved basis of selection among replacement animals.

b) Evaluation of the breeding value of sires based on progeny information. This evaluation will be provided by combining progeny data across management groups and years. In this context, the

relative genetic merit of sires will be assessed rather than just phenotypic performance. This will provide the breeder with an improved basis for culling old rams.

c) Development of an objective basis for the grading of stud and flock rams for sale. At the same time, this will allow commercial buyers to have access to objective measures of performance.

d) Amass a data base from industry sources from which genetic parameters appropriate to the target population can be estimated. These parameters will be used to support and improve the technical basis of the scheme.

3.4.2 Organisation of LAMBPLAN

LAMBPLAN will be developed as a National Scheme but operated separately by accredited suppliers. It is recommended that at least one operator be available within each State rather than a single centralised supplier. The specialised advisory support necessary for interpretation of results and promotion could not be adequately provided by a single centralised service. Potential suppliers will be accredited according to their compliance with the procedures listed in this report. The scheme will be user-pay although the schedule of charges will be decided upon by each supplier.

There are three components to LAMBPLAN that provide the uniformity necessary for a nationally co-ordinated scheme. These are:

a) Uniform measurement procedures, particularly for the measurement of fat depth by ultra-sound.

b) Uniform statistical procedures and data output. Uniformity in output of data, with commom terminology, is essential if the information is to be readily used and understood by both stud and commercial breeders. Selection criteria and statistical procedures used in adjustment of data and calculation of breeding values need to be uniform so the output can be used confidently on a national basis. While we strongly stress the importance of uniformity of methods, it is equally important that flexibility to accommodate the varying recording needs and breeding objectives of breeders is retained.

c) Advisory support through the distribution of specialised literature, promotion and, more importantly, a high degree of on-farm face-to-face consultations to assist the interpretation and practical use of results in breeding programmes.

An accredited service need not supply all three components provided that another accredited service agrees to provide the remaining inputs.

The potential for the future use of on-farm microcomputers for data processing needs to be constantly re-assessed. LAMBPLAN would be ideally suited to such development which is another argument against centralised processing of results.

3.4.3 Measurement Procedures

Fat depth on live animals is currently measured most accurately at the "C" site with ultrasonic devices by experienced operators. There is a need for operators using ultrasonic machines to be adequately trained

in order to obtain reliable measurements of fat. It is proposed that individual operators be accredited using a standard technique with a standard device. Currently, the New Zealand Delphi machine is the appropriate device. Operators should be assessed at regular intervals by the accrediting body.

The age at which body weight is recorded will vary with the type of flock, breeding objectives and management-marketing constraints. Since young ram lambs are very lean, the reliability of fat measurements improves at heavier weights. It is recommended that animals be a minimum of 35 kg (average for the group) and a fat score of at least 3 before being measured for fat depth. Under normal stud management, this weight would be achieved by 6 months of age.

The actual form in which data is collected and transmitted to LAMBPLAN will be left to each service supplier. The minimum information required is:-

management group
date of measurement
identity of animal
sire identity
body weight
fat depth
date of birth (to calculate age)
birth type (single, twin, triplet .....)
rearing type (single, twin, triplet .....)
age of dam (2 years, 3-6 years, 7+ years)

3.4.4 Data Processing

The following aspects of data processing are addressed:-

Adjustment of records for environmental effects
Breeding value estimation
Selection index procedures
Sire evaluation
Output formats

3.4.4.1 Adjustment procedures

a) Age variation. Extreme variation in age within a group can lean to inappropriate adjustments and incorrect selection decisions. When the range in age between animals is greater than 60 days, the group should be split into two management groups and processed separately.

b) Body weights will be adjusted for birth and rearing type, age of dam and age of the animal. Adjustments for birth/rearing type and age of dam will be by standard proportional methods. Where appropriate, these adjustment factors can be calculated from within the data set. However, with relatively small numbers of animals in each management group, this is rarely feasible. Default values for adjustments, as determined from an analysis of the NSW Meat Sheep Testing Service, should be used.

$$\text{Adj. Wt.1} = \text{Wt.1} \left(\frac{100 + \text{sum of adj. factors}}{100}\right)$$

Adjustment of body weight for age will be by regression from within the data. The regression of adjusted weight 1. on age is determined. Provided the regression coefficient is positive and the intercept estimate is also positive, the estimated regression is used for adjustment. If either or both of these conditions are not met, default regression values should be used.

$$\text{Adj. Wt.2} = \text{Adj. Wt.1} - (\text{Age deviation}) * bW$$

where bW = estimated or default regression (Wt.1/age)

c) Fat depth will be adjusted by regression on unadjusted bodyweight and predicted at 60 kg liveweight. The regression for adjustment will be that estimated from the data except where the estimated regression is negative and the default value can be used.

$$\text{Adj. Fat} = \text{Fat Depth} - (\text{Weight} - 60) * bF$$

where bF = estimated or default regression (fat/weight)

3.4.4.2 Breeding value estimation

Ideally, breeding values would be estimated for carcase weight and carcase fatness using the selection criteria on rams as indirect assessments of these objectives. Realistically, though, few genetic parameters for carcase traits are available and no reliable information is yet published on the genetic relationships between live animal measures on purebred rams and carcase traits on their crossbred progeny. Thus we have opted for breeding values for body weight and fat depth at 60 kg converted to a "GR" site equivalent. The assumed parameter matrix was taken from analyses of the NSW Meat Sheep Testing Service as 0.3 and 0.35 for the heritabilities of body weight and fat depth respectively, and 0.2 for the genetic correlation between them. The equations for estimated breeding values from these parameters are:

EBV (Weight) = 0.3 * WT' + 0.5 * FAT'
EBV (Fat) = 0.025 * WT' + 1.05 * FAT'

where WT' = deviation for adjusted weight (kg)

FAT'= deviation for adjusted fat (mm)

3.4.4.3 Selection index procedures

An index value can be estimated for each animal by combining the EBV's for weight and fatness according to their relative economic weights (V in $). Thus:

Index = V(WT) * EBV(WT) + V(FAT) * EBV(FAT)

The relative economic weights can be user specified, or one of three default values. These defaults are to be determined by the future LAMBPLAN committee but will be designed as follows:-

HIGH GROWTH - small negative economic value for fat reflecting current market value. Expected genetic trend will be near-maximum response in body weight and slight upward response in fatness.

LEAN GROWTH - index to restrict genetic change in fat to zero. The expected genetic response in body weight will be slightly lower than with the previous index.

HIGH LEAN - relatively large negative economic value for fat so that expected genetic responses will be positive in body weight (at a slower rate) and negative in fatness.

3.4.4.4 Sire Evaluation

Initially, the mean performance of progeny of sires will be reported for EBV (weight), EBV (Fat) and Index as a simple sire summary. A disclaimer that low numbers of progeny are a poor indicator of relative sire rankings will be produced on the output.

A more appropriate sire evaluation should be attempted as soon as possible by means of regressed contemporary comparisons. Information on common sires should be combined across management groups and years by retaining average EBV's and Index and effective progeny numbers for each data set. Sire solutions can then be obtained and regressed (or shrunk towards the mean) by the following formula:

Sire EBV = Mean EBV * n/(n + SF)

where n = number of progeny
SF = shrinkage factor
= $(4-h^2) / h^2$

3.4.4.5 Output formats

The three parts of the LAMBPLAN output are:

a) Cover page. Much of the design and information contained will be left to individual suppliers of LAMBPLAN. Obviously, there would be the LAMBPLAN logo, the supplying service, the breeder, average production levels and explanations of abbreviations. The details of the particular index used (one of the defaults or a user-specified) should also be listed.

b) Selection list

Tag number of individual
Sire identity
Dam identity (OPTIONAL)
Weight (or Growth) Percentage. The weight (or growth weight) of individuals, adjusted for environmental effects, expressed as a percentage (mean - 100). Absolute raw or adjusted values should not be presented.

Fat class. Fat depths will be expressed as standardised deviations from a mean of zero, having been adjusted to a 60 kg liveweight equivalent. The fat classes (where SD = standard deviation) are:

-3 fat depth is >2.5 SD's leaner than average
-2 fat depth is 1.6 to 2.5 SD's leaner than average
-1 fat depth is 0.6 to 1.5 SD's leaner than average
0 fat depth is within 0.5 SD's of flock average
+1 fat depth is 0.6 to 1.5 SD's fatter than average
+2 fat depth is 1.6 to 2.5 SD's fatter than average
+3 fat depth is >2.5 SD's fatter than average

EBV (Weight). The estimated breeding value for body weight as a deviation in kg.

EBV (Fat). The estimated breeding value for fat depth converted to a GR equivalent and expressed as a deviation in mm.

Index value. The index value will be expressed in $ and be calculated according to the chosen default economic values or the user-specified values. The column heading will indicate either the appropriate name of the default or a USER index.

Rank order. The variable on which the records are ranked can be chosen by the individual supplier, except that it will be specified in the column heading as, for example, WT% ORDER or INDEX ORDER etc.

Remarks. (optional).

This output format closely parallels that for fleece weight and fibre diameter in the WOOLPLAN selection list output and would assist in understanding by advisors and breeders.

c) Sire Summary

Sire identity
Number of progeny recorded
EBV (Weight)
EBV (Fat)
Index

3.4.5 Advisory Support

Specific advisory support will be required within each State for the promotion of LAMBPLAN and the use of adjusted records in selection programmes. Literature required for this support includes the following fact sheets that could be distributed through the States' Agfacts system:

Principals of LAMBPLAN
Breeding objectives for meat sheep
Data recording
Use of information in breeding
- selection
- marketing

Sire evaluation

It is also recommended that an Advisors' Manual be produced. Part of this Manual (general principles) could be shared with the proposed WOOLPLAN Advisors' Manual.

3.4.6 Further Development of LAMBPLAN

To this point we have considered terminal sire breeds only because of their numerical importance. The future development of recording services for meat breeds other than terminal sires (such as crossing sires and dual purpose breeds) should be seen as the provision of additional options within the basic LAMBPLAN service. Such as approach will achieve the flexibility of services required but not currently provided by existing services. Breeding objectives for these breeds have been considered by Fogarty (1987). The following options could be provided by an expanded LAMBPLAN service in the medium term:-

(a) Reproduction option. Maternal records of number of lambs weaned (or partitioned into litter size and lamb survival) could be used to estimate breeding values for reproduction rate.

(b) Maternal Growth option. Maternal records on weaning weight of progeny could be used to partition preweaning growth into direct and maternal genetic components for breeding value estimation.

(c) Wool option. Individual records on fleece weight (and fibre diameter) could be treated in an equivalent way to that used in WOOLPLAN.

The Wool option would be a technically simple innovation. The Reproduction and Maternal Growth options involve considerations of data capture by the recording service. Current services rely on whole-flock recording (that is, complete pedigree and lambing information) in order to store such data. It is important to note that the provision of such options will lead to increased complexity in data input, service operation and data output, and increased cost. There have been some recent developments in the area of whole flock recording systems (e.g., a new Tasmanian scheme) that may provide a more complete and readily accessible data handling package to assist with the implementation of a scheme with such expanded breeding objectives.

3.4.7 National Co-ordination

In order to preserve the national integrity of LAMBPLAN and to act as an accrediting body, there is a critical need to establish a LAMBPLAN Management Committee. It is suggested that this Committee be established for an initial period of three years. The size of the Committee should be small and contain industry representatives (breed societies and commercial producers), LAMBPLAN suppliers and research/advisory personnel. The committee will meet infrequently to determine policy, produce advisory and promotional literature, monitor progress, consider technical improvements in the scheme and deal with any problems or appeals from clients. Without such a committee the national scheme would quickly fractionate into separate State schemes with the attendant dangers of lack of uniformity, uneven advisory support and backup, and impeded rates of incorporation of future innovations.

3.4.8 Industry Reaction

Industry reaction to the projected development of LAMBPLAN was guaged from replies to an alerting letter sent to all breed societies and relevant industry bodies. The response rate was very high with almost all replies being very supportive and seeking involvement in the national development and co-ordination of the scheme. A small proportion of replies vigorously supported the need for an expanded LAMBPLAN for breed types other than terminal sires, particularly dual-purpose breeds.

4. ACHIEVEMENTS OF THE PROJECT

The major objective of the project was to evaluate the development of a viable facility to enable meatsheep stud breeders to objectively test rams for growth rate and fat depth, has been very successfully achieved. The project assisted the N.S.W. Department of Agriculture develop and implement the Meatsheep Testing Service which provides a practical and efficient testing service for stud breeders in N.S.W. The service has grown to the extent where some 17,000 sheep from over 120 studs are tested annually.

Development of the service involved evaluation of devices for measuring fat depth on live animals, developing appropriate software for adjusting data and preparation of reports, and industry promotion and provision of advisory support programmes. The successful operation and industry uptake of the service was achieved because emphasis was placed on all these aspects in a fully supported and co-ordinated programme. Some 20 publications have resulted from the project (see Appendix 2).

The Meatsheep Testing Service has proved to be a successful model on which to base proposed development of similar services in other States. Animal Production Committee recommendations for implementation of the national performance recording scheme for meatsheep (LAMBPLAN) have relied heavily on the experience gained from industry usage of the N.S.W. Meatsheep Testing Service.

An important achievement of the project has been the accumulation and analysis of a large data set on Australian meatsheep breeds. This data set is unique and provides a sound technical base for continued improvement and upgrading of methods and procedures. A large subset of the data base had been analysed to provide estimates of environmental effects and genetic parameters for liveweight and fat depth. these estimates have not previously been available for these traits on such an extensive range of Australian meatsheep flocks. The analyses provide more accurate estimates of adjustment factors for age of dam and type of birth and rearing effects. More importantly the accurate heritability and genetic correlation estimates for liveweight and fat depth provide the parameters necessary for estimation of breeding values and the development of selection indexes for improved breeding programmes.

The project through these achievements has contributed considerably to the adoption of objective measurement of growth and fat in meatsheep studs. Measurements are being used increasingly by stud breeders in their selections and sales of rams. Commercial lamb producers are more aware of the importance of objective measurements in ram purchases. The continued long-term genetic improvement of the lamb industry has been enhanced.

5. COMMERCIALISATION

This project supported the evaluation and development of the Meatsheep Testing Service by the N.S.W. Department of Agriculture in the N.S.W. meatsheep stud industry over six years. The service has expanded to the extent that some 17,000 animals are tested annually from over 120 studs. At the completion of AMLRDC support for the project in June 1986 the N.S.W. Department of Agriculture took over full responsibility for continuation of the service. A schedule of fees was introduced in January 1987 to put the operations of the service on a commercial basis in accord with the "user pay" principle. Currently the fee schedule is as follows:-

1-100 sheep tested $80 (minimum fee)
101-250 sheep tested $80 plus 50c/sheep >100
>250 sheep tested $155 plus 25c/sheep >250

The fee structure has been set to cover actual operating costs which are largely associated with travelling expenses to weigh and measure fat depth on test animals and computer processing. The projected income from fees is $12,000 p.a. at the current level of usage. Salaries of professional officers oversighting the operations and providing the advisory and research backup support are provided by the N.S.W. Department of Agriculture. It seems the introduction of fees has only had a minor impact on the usage of the service (less than 10% reduction) with the larger and genetically more important studs generally continuing to use the service. Costs of providing the service are being contained by the training of a small number of Sheep and Wool Officers in the use of the ultrasound fat measuring machine and the location of two additional machines and electronic weighing scales in the north and south of N.S.W. It is envisaged that this decentralisation of the service could result in an increased statewide usage of 10 to 20% over the next three years.

Use of the Department of Agriculture AGNET computer network means data an be input and reports printed locally while still maintaining centralised quality control of processing and accumulation of the data base. Software has recently been written for micro computer operation and further developments in improved electronic data input procedures are planned to increase the overall efficiency and reduce costs to the stud breeder.

The N.S.W. service has been developed as a model for adoption by other States. Some of these other Departments of Agriculture have initiated similar services in response to strong stud industry pressure. Information on N.S.W. operational experience and technical data has been readily provided to other government and private operators.

6. FUNDING

The AMLRDC provided financial support for the project for salaries for casual technical assistance, travelling expenses, operating expenses and purchase of capital items on a financial year basis as set out hereunder for two trienniums:-

July 1980 - June 1981	$15,750	
July 1981 - June 1982	$23,240	
July 1982 - June 1983	$23,710	$ 64,700
July 1983 - June 1984	$26,000	
July 1984 - June 1985	$20,865	
July 1985 - June 1986	$32,335	$ 79,200
	TOTAL	$143,900

The N.S.W. Department of Agriculture has made substantial contributions to support the project which has linked in with the Division of Animal Production statewide programme "Genetic Improvement in the Meatsheep Producing Industry". The Department of Agriculture has provided, through consolidated revenue grants, the salaries of the Officer-in-Charge of the Meatsheep Testing Service (full time) and salaries for other research, advisory and biometrical resource inputs (part time). In addition appropriate office and computer facilities have been developed and provided throughout the project. Research and biometrical back-up has assisted in the development and enhancement of suitable computer programs for processing and analysis of data. Travel and sustenance support of District Advisory Officers has been provided in activities associated with the Project. Advisory back-up from the Officer-in-Charge of the Meatsheep Testing Service and appropriate inputs from District Sheep and Wool Officers has ensured speedy acceptance within the N.S.W. meatsheep breeding industry.

It is estimated that 3.6 professional officer years per annum is used by the N.S.W. Department of Agriculture on the program "Genetic Improvement in the Meatsheep Producing Industry". Of this approximately 1.2 years is directly applicable to the continuation of the N.S.W. Meatsheep Testing Service at an annual cost of approximately $36,000 in salaries and associated expenses.

7. INDUSTRY IMPACT

There has been a rapid increase in the use of objective measurement of growth and fat depth in the N.S.W. meatsheep stud industry as a direct result of the availability of the Meatsheep Testing Service. Over the six years of the project the usage has increased from 1412 animals tested in 12 studs to 17941 animals tested in 121 studs, representing 13 breeds. There has also been an increase in the average number of animals tested per stud from 118 to 148.

The Australian Society of Breeders of British Sheep and the Australian Poll Dorset Association have shown considerable interest in supporting and contributing to the development of this production testing service. A total of 12,000 Poll Dorset and shortwool British Breed rams or 46% of the 26,000 sold annually in N.S.W. are now being measured for growth rate and fat depth. Of greater importance is that some 80% of the larger, genetically influential studs in the State are now utilizing the Meatsheep Testing Service. There is good acceptance of the use of objective measurements in sire selection in most major Poll Dorset, Dorset Horn and Suffolk studs.

Well known Dorset Breeders Bill Stewart and Noel Armstrong are two men who have strongly supported the project since it started.

Some 18 studs now conduct annual on-property production sales of rams with growth rate and fat depth information displayed for prospective buyers. Australia's first group breeding scheme for meatsheep has been commenced by 16 stud breeders involved in the Australian Dorset Company Measurements made by the Meatsheep Testing Service are used to aid selection of contributed sheep for the elite nucleus flock and in the nucleus flock selection programme.

The Meatsheep Testing Service has provided a very important focus for statewide advisory programmes aimed at increasing the rate of genetic improvement in growth and leanness in the lamb industry. These programmes have entailed some 40 field days, 27 demonstrations and meetings and 21 shows and ram sales as well as production of some 20 publications. A series of practical on-farm days have been held to educate breeders and promote demand for production tested rams by commercial lamb breeders. This exposure has created an awareness amongst breeders for the need to use objective measurement information in their breeding programmes and ram selections and purchases. Many ram breeders are now grading rams for sale on the basis of measured performance and pricing them accordingly.

The project has through analysis of the extensive and unique data base provided a sound technical basis for further improvements in the efficiency and accuracy of breeding value estimation and the development of realistic industry breeding objectives. It has been an integral part of the development of LAMBPLAN, the proposed national performance recording scheme for the meatsheep industry.

The industry impact of the project will continue to increase in the future. In N.S.W. there will be a moderate increase in usage of the Meatsheep Testing Service of some 10-20% over the next three years. However, there will be an increasingly effective usage of the information provided by the service by stud breeders in their stud selection programs and by commercial lamb producers in their ram purchases. This will occur through the further development of processing to include estimated breeding values for liveweight and leanness and their combination in selection indexes and the increasing use of objective information in sales.

As part of the ongoing appraisal and evaluation of the Meatsheep Testing Service an extensive survey of the service and its advisory programme is currently being undertaken in co-operation with Hawkesbury Agricultural College. Final year students are carrying out the survey to ascertain the knowledge of the service, its usage and effectiveness of promotion amongst meatsheep breeders. Separate surveys are being carried out for all users of the service and a large representative sample of non-users.

8. CONCLUSIONS

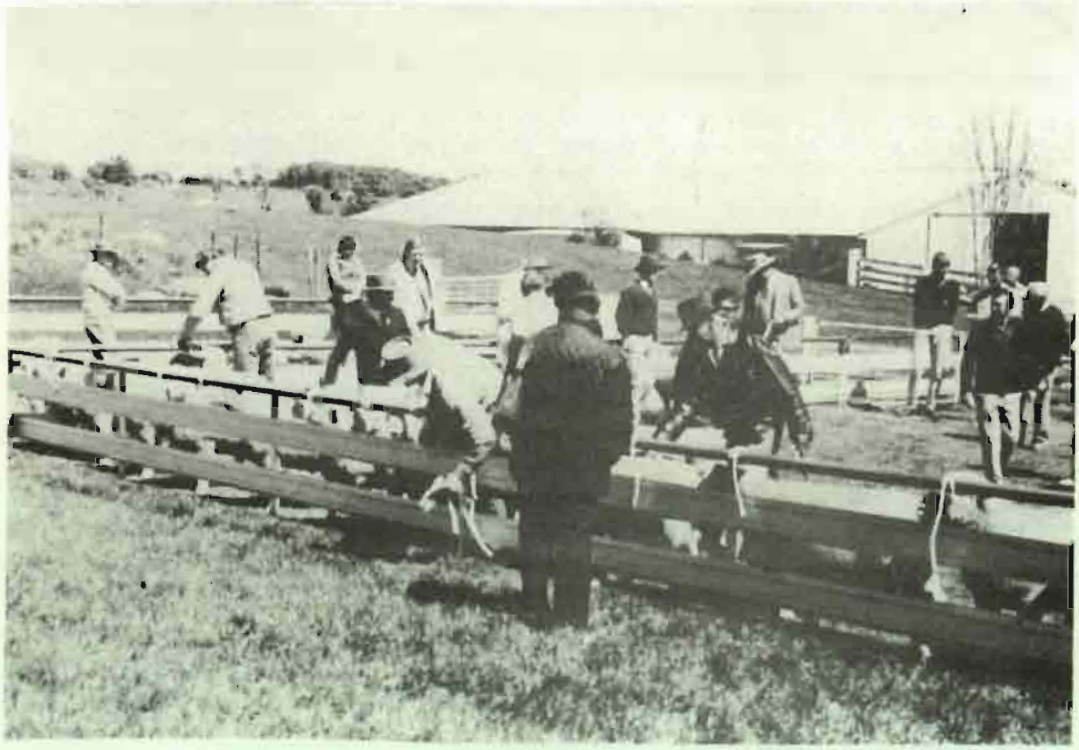
Increased genetic improvement in the meatsheep industry requires adoption of objective measurement and recording by stud breeders and the effective use of this information in soundly based breeding programmes. This project assisted in the successful implementation of the N.S.W. Meatsheep Testing Service (MTS) which provided a facility for breeders to measure growth rate and fat depth. This allows breeders to use objective information as an aid to their selections and sales. The MTS has been strongly supported by the industry and breed societies. Over 84,000 sheep on 196 different properties throughout N.S.W. have been tested by the MTS since its establishment in 1980. Its usage has now grown to the extent where 17,000 sheep are tested annually in N.S.W. from over 120 studs representing 13 breeds. This objective information is being used increasingly in rams sales.

Almost half of the terminal meatsheep rams sold annually in N.S.W. are now tested for growth rate and fat depth. This means almost 50% of N.S.W. lamb carcases are now sired by MTS tested rams.

The success of the MTS in N.S.W. can be attributed to a number of factors. Firstly, there was a recognition amongst influential stud breeders that genetic variation probably existed for growth rate and fat depth and that objective measurement of these traits could assist in their breeding programmes. These breeders and the Breed Societies gave strong support and were involved in the design of the service to accurately measure growth rate and fat depth and present the computer adjusted data in a simple and easily understood format. The service was operated and controlled on a full-time basis by a professional officer who was able to develop a rapport and confidence with stud breeders on a statewide basis and used the backfat meter with skilled consistency. The computing facilities permitted a rapid turn around of data and gave a professional image with the stamp of the Department of Agriculture as the independent testing authority. The concerted statewide advisory programme also contributed markedly to the success and acceptance of the MTS as did the strong technical research and biometrical support.

The MTS has also provided a large data set that has been accumulated from industry flocks. Analyses have been undertaken of a subset comprising over 28,000 Poll Dorset records representing 498 sires from 50 flocks. This has provided unique parameter estimates for growth to various ages and fat depth as well as more reliable estimates of non genetic effects and documentation of flock structure and source of sires which previously did not exist. The estimates of heritability are 0.30 for yearling growth rate (adjusted for differences in age, type of birth and rearing status and age of dam) and 0.35 for fat depth (adjusted for liveweight). These estimates are high compared to many other production traits and mean that rapid genetic progress can be achieved. The results of the analyses allow more efficient adjustments to be made and provide the parameters necessary for estimation of breeding values and the development of selection indexes. The flock structure analysis also highlighted the relatively high sire generation interval of 3.3 years, with a high proportion of older sires being used. This limits the possible rate of genetic progress and performance is being further jeopardised by increasing levels of inbreeding.

This project has been an effective model for further development of performance recording services in other states. Experience gained from the MTS in N.S.W. has been used to develop proposals for the Animal Production Committee to implement a national performance recording scheme for meatsheep breeders to be called LAMBPLAN. There is strong support from breed societies and industry organisations for these proposals. Accredited services within such a scheme would be organised on a State basis but would have uniform measurement and statistical procedures with common terminology and commitment to advisory support and promotion. These services would be provided on a user pay principle, which has now been successfully introduced in the N.S.W. Meatsheep Testing Service.



Another typical MTS field day

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APPENDIX 1

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APPENDIX 2

STAFF ASSOCIATED WITH THE PROJECT

1. **Project Supervisors**

Dr. R.L. Colman, Regional Director of Research, Orange
Mr. D.C. Harris, Special Livestock Officer (Prime Lamb Production), Orange

2. **Officer-in-Charge, Meatsheep Testing Service**

1/7/80 - 9/1/81 Mr. J. Butt, Livestock Officer, Agricultural Research Station, Cowra.

12/1/81 - 30/6/86 Mr. A.F. Luff, Livestock Officer, Agricultural Research Station, Cowra. (Mr. Luff has continued in this position following completion of the project).

3. **Resource Staff**

Dr. K.D. Atkins, Special Livestock Research Officer, Agricultural Research and Veterinary Centre, Orange.

Dr. N.M. Fogarty, Special Livestock Research Officer, Agricultural Research Station, Cowra.

Dr. A.R. Gilmour, Special Biometrician, Agricultural Research and Veterinary Centre, Orange.

Mr. W. Hill, Biometrician, Agricultural Research and Veterinary Centre, Orange.

Dr. B.J. McGuirk, Senior Livestock Research Officer, Sydney.

4. **Assistants**

A number of assistants were employed on a casual basis using funds provided by the AMLRDC. Those who had a major input to the project at Cowra Agricultural Research Station included Mr. G. Watt and Ms. L. McPhedran. In addition Dr. J. Murray was employed by the Department for a short period to assist with the analysis of the data set.

APPENDIX 3

SAMPLE MEATSHEEP TESTING SERVICE REPORT

NSW DEPARTMENT OF AGRICULTURE MEATSHEEP TESTING SERVICE
18/2/87 EXAMPLE POLL DORSET STUD
10 MONTH OLD POLL DORSET RAMS

NUMBER TESTED	100
AVERAGE GROWTH RATE	205.4 G/DAY
AVERAGE FAT DEPTH	4.6 MM PER 60 KG.

EXPLANATIONS OF ABBREVIATIONS

GROWTH % GROWTH RATE AS PERCENTAGE OF FLOCK AVERAGE
E.G. GROWTH % WOULD BE 105% IF GROWTH RATE WAS 105 GRAMS PER DAY AND FLOCK AVERAGE WAS 100 GRAMS PER DAY

FAT CLASS

-3	FAT DEPTH IS > 2.5 UNITS LEANER THAN AVERAGE
-2	FAT DEPTH IS 1.6 TO 2.5 UNITS LEANER THAN AVE.
-1	FAT DEPTH IS 0.6 TO 1.5 UNITS LEANER THAN AVE.
0	FAT DEPTH IS WITHIN 0.5 UNIT OF FLOCK AVERAGE
+1	FAT DEPTH IS 0.6 TO 1.5 UNITS FATTER THAN AVE.
+2	FAT DEPTH IS 1.6 TO 2.5 UNITS FATTER THAN AVE.
+3	FAT DEPTH IS > 2.5 UNITS FATTER THAN AVERAGE

UNITS ARE STANDARD DEVIATIONS

NOTE: IN CALCULATING GROWTH % ADJUSTMENTS ARE MADE FOR RAM AGE, BIRTH AND SURVIVAL STATUS AND DAM AGE.
IN CALCULATING FAT DEPTH AN ADJUSTMENT IS MADE TO 60 KG LIVEWEIGHT.

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SIRE SUMMARY

SIRE GROUP	NUMBER TESTED	AVERAGE GROWTH	AVERAGE FAT DEPTH
78.83	5	96.2 %	4.6 MM
93.84	7	100.0 %	4.6 MM
142.85	25	99.8 %	4.5 MM
154.82	25	98.6 %	4.6 MM
333.85	7	97.4 %	4.4 MM
444.80	31	102.5 %	4.7 MM

FAT CLASS SUMMARY

FAT CLASS	NUMBER
NO FAT	0
-3	0
-2	6
-1	24
0	40
+1	25
+2	4
+3	1

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AVERAGE FAT DEPTH 4.6 MM/60 KG.

RAM NUMBER	GROWTH	FAT CLASS	GROWTH ORDER	
1	100%	-1	44	SCURS
3	102%	0	39	
4	123%	+1	2	
8	103%	0	35	
12	92%	0	71	SCURS
15	92%	+1	78	SCURS
21	94%	+1	66	
24	89%	+1	85	
25	101%	-1	41	
40	97%	-1	57	
42	88%	0	92	
47	102%	0	38	
49	116%	-1	11	
50	113%	0	14	
51	107%	0	26	
59	85%	-1	98	
67	92%	-1	75	
69	94%	0	68	SCURS
73	92%	-1	70	
75	108%	0	23	
77	89%	+1	83	
78	104%	+2	32	
79	91%	+2	79	
83	89%	+1	82	
84	89%	0	87	
86	96%	-1	62	SCURS
87	92%	0	76	
91	112%	+2	16	
95	92%	+1	73	
96	93%	0	69	
97	124%	0	1	
98	89%	-1	84	
99	116%	+3	8	
100	95%	+1	65	SCURS
101	85%	+1	100	SCURS
104	98%	-1	54	
105	98%	0	49	
111	89%	+1	86	
116	98%	0	52	
117	114%	-1	12	
119	98%	-2	48	
123	116%	-1	9	
124	86%	0	97	
127	99%	-1	46	
128	119%	0	5	

NSW DEPARTMENT OF AGRICULTURE MEATSHEEP TESTING SERVICE
18/2/87 EXAMPLE POLL DORSET STUD
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AVERAGE GROWTH RATE 205.4 G/DAY
AVERAGE FAT DEPTH 4.6 MM/60 KG.

RAM NUMBER	GROWTH	FAT CLASS	GROWTH ORDER	
129	106%	+1	27	
135	112%	-1	17	
142	96%	+1	60	
146	92%	0	72	SCURS
153	98%	0	55	
156	105%	0	30	SCURS
157	96%	0	63	
163	108%	0	24	
164	88%	-1	91	SCURS
171	94%	+1	67	
172	90%	-2	81	
174	92%	0	77	SCURS
194	96%	+1	61	
197	98%	0	51	
213	95%	+1	64	SCURS
217	101%	+1	40	
218	97%	-2	59	
220	90%	-1	80	SCURS
224	111%	0	19	
225	121%	0	4	
228	87%	-1	95	
230	109%	+1	22	
237	99%	0	45	
244	107%	0	25	
246	97%	+2	58	
248	113%	+1	15	
249	103%	+1	37	
253	97%	-1	56	
258	103%	0	33	
260	105%	+1	29	
264	89%	0	90	
268	86%	-1	96	SCURS
272	98%	0	53	
274	98%	0	50	
277	89%	+1	88	SCURS
286	103%	-2	36	
287	118%	+1	7	
288	89%	-1	89	SCURS
296	121%	0	3	
297	114%	+1	13	
300	110%	-1	20	
302	118%	-2	6	
305	87%	+1	94	
307	85%	0	99	
319	111%	-1	18	

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18/2/87 EXAMPLE POLL DORSET STUD
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NUMBER TESTED	100
AVERAGE GROWTH RATE	205.4 G/DAY
AVERAGE FAT DEPTH	4.6 MM PER 60 KG.

GROWTH RANGE	NO	HISTOGRAM
121-125 %	4	+********
116-120 %	7	+***************
111-115 %	8	+*****************
106-110 %	9	+*******************
101-105 %	15	+********************************
96-100 %	20	+**
91 -95 %	16	+*********************************
86 -90 %	18	+*************************************
81 -85 %	3	+******
76 -80 %	0	+

N S W DEPARTMENT OF AGRICULTURE
MEATSHEEP TESTING SERVICE

INVOICE NO: E7050
25/02/87

Invoice to: A.BLACK
EXAMPLE
COWRA 2794

CHARGE FOR TESTING 100 SHEEP: $80.00

	CHARGES
1-100 sheep	$80 minimum charge
101-250 sheep	$80 plus 50c per head over 100
over 251 sheep	$155 plus 25c per head over 250

Please make cheques payable to
NSW DEPARTMENT OF AGRICULTURE

and send to NSW DEPT. OF AGRICULTURE
PO BOX 242
COWRA, NSW, 2794

quoting Invoice No E7050

Payment NET 30 days

FLETCHER INTERNATIONAL ABATTOIR

OFFICIAL OPENING DUBBO MONDAY JULY 31.1989

Good afternoon ladies and gentlemen.

We are here today witnessing one of the real success stories of an industry identity...Roger Fletcher...who has turned his dream of having an abattoir that is the best of its type in the world into a reality.

The AMLRDC is proud to have played a part in this project by providing the funds to assist in the integration of the equipment into an Australian working environment...and that pride should be shared by every sheep producer who through his levies has contributed to the result.

When the Research and Development Corporation was formed some four years ago, it set down as one of its priorities--after consultation with industry on the most cost effective areas to be tackled--the reduction of slaughtering costs by a minimum of 30 per cent by the year 1990.

I am pleased to be able to advise you that, with Roger Fletcher's help, that has been achieved for the sheepmeats industry.

But before going into that and other aspects of what has been achieved with this new plant, let me just cover some of the reasons why an operation of the type that we now have at Dubbo was so vitally important for the Australian meat industry.

I was reminded only last week of a speech that I gave to the Outlook Conference in the early 1970's in which I pointed out the rapidly rising costs in sheepmeats slaughtering and the need for the industry in Australia to develop automated processing techniques if we were to continue to compete on world markets.

It is a long time from ~~the~~ then till now.....some 15 years and costs have continued to rise steadily in that time. ...only in the last three years we have seen another $5 per head rise in slaughtering costs. And, with continually rising wages and inflation at 7 or 8 per cent, we could expect them to rise ~~again on a similar basis in the next two or three~~ years.

In the sheepmeats industry, we are dealing with two types of product...lamb, which is now a high quality product in many markets, and sheep which is a by-product of the wool producing area. In the consumers' minds, in Australia and overseas, we have seen the transition from the traditional acceptance of a lamb or mutton chop for breakfast and a roast leg of lamb or a shoulder of hogget for dinner to a sometimes brutally discriminating market which requires all types of specialised cuts provided in a sophisticated ready-to-eat form. We've moved out of the traditionally accepted approach of meat at least once a day to being just a part of the modern food market where in addition to having to compete with the food giants of the world in packaging and presentation, we have also had to counter the rapidly-increasing demands of the nutritionists, the medical profession and the fad merchants. We have, in short, seen sheepmeats competing in a vastly more sophisticated and demanding food market whilst our processing methods remained static and our costs of turning livestock to meat continued to rise.

The end result of that was obvious...and you have only to look at the concern many of us feel for the "mutton mountain" we will face in the first dry summer to fully understand that situation.

Within the industry there were people who recognised this problem and were prepared to do something about it. One of them was Roger Fletcher. What you are seeing here today is only part of the job Roger has done. I have been fortunate to see Roger's efforts in the marketing area over a number of years. He realised the need to change his boning, preparation and packaging methods to meet the new market demands in Australia and overseas and today his brand commands a premium in the top markets like Japan and Europe, particularly Germany, because he has given the market a new approach...in many cases new products.

But he also realised that he had to do something about his processing methods if he was to continue to survive the continually increasing cost areas.

The New Zealanders, perhaps because of the dependance of the meat industry on the sheepmeats section, have been working since the early 70's on developing new slaughtering techniques for mutton and lamb.In the mid 70's, I visited a plant set up north of Auckland to test out new slaughtering techniques... and I brought home a newly-developed knife with a guide attached that was the basis of their approach to opening the skin over the brisket by pulling off a strip of skin and freeing the forequarter for easier skinning operation. We put this system into operation at Wodonga works, but in New Zealand they continued to develop equipment to do the job still further till they were able to introduce what became known as the inverted dressing system.

In the case of the New Zealanders, however, whilst they made big steps forward in development of equipment , they made little improvement in costs of slaughtering...largely due to the domination of the unions in the operation.

It was very obvious to people like Roger Fletcher that the New Zealand system had much to offer but had to be changed to a large degree to allow for the vastly varied and different types of livestock, particularly mutton, that the system would have to handle in Australia. When Roger Fletcher made his approach to AMLRDC, we too saw that as a problem which should concern the whole industry. We were already at that time looking at a programme of alternative slaughtering techniques in the beef industry and we were happy to work with Roger and the New Zealand licensee to introduce the sheepmeats innovations in the slaughtering area.

What you have seen today is the result.

Now let's look at just what Roger has achieved.

Firstly, and most importantly, he has achieved cost reductions so important and so significant that the rest of the industry here and overseas will be forced to follow him.
He has achieved savings in manpower in at least six different and vital areas of the slaughtering operation, but also he has increased productivity per man. In addition,he is producing a vastly improved product in terms of cleanliness and hygiene to such a degree that he again has reduced his washing and trimming area very extensively.

The final situation with regard to labor savings is still not decided, but when it is completed I am sure this operation will have achieved significant labor savings ~~in the area of 25 percent plus~~.

But the benefits do not stop there....there are other perhaps intangible spin-offs.....a simplified system that allows unskilled people to be trained as operators in just 15 days. A significant cost area in this industry is workers'compensation and the elimination of heavy physical exertion on wet and slippery surfaces has already resulted in a big improvement in workers compensation experience.
Of very considerable significance is the fact that this system has "lightened the load for the worker" to the degree it will be possible for employees to work till normal retiring age rather than have to retire early as has been the norm in the industry for many years.

In the area of hygiene again there has been a vast step forward. The fact that human hands hardly touch the carcase and the skinning process is directed away from the carcase means that contamination is reduced to a minimum. No crutching is required and heads and hocks come out much cleaner....a point that has not been lost on overseas veterinarians visiting the plant.

The savings continue down the line....Roger Fletcher has long recognised the returns that are involved in skins...some years ago he achieved "by default" his own skin processing and marketing operation and he knows that flair marks or cut skins mean a loss in return to him.
For this reason, he has given a lot of attention to the skin area.....there are no flair marks on his skins and the new process is producing about 4 per cent of torn skins, but no other damaged skins. The overall saving is at least a 20 per cent increase in value of the skins.

Roger hasn't stopped at the slaughtering operation...if you go on through the plant you will find innovations throughout....his boning of carcases has again reduced labor, increased hygiene and made the working conditions such that inexperienced knife hands and women can be trained in a short time to carry out the process.
His carton storage, his freezing and even his loadout of containers is tackled with the same approach and the same results.

But dont get the idea that this was achieved easily. Remember here that you have here a family operation--not a large multinational company. And it wasn't just a matter of putting in the New Zealand system.Major problems were experienced to adapt the NZ system to Australian livestock which are bigger, tougher and more varied than the NZ stock. There was considerable trial and error--and a multiplicity of frustrations and costs before adjustments were made to achieve the smooth operation over the full range of Australian livestock.

It would be remiss of me to not mention also the importance of the attitude of the people who are now the staff and employees of Fletcher Dubbo to the new working conditions. Their approach is accepting the system and appreciating what it will mean to them in increased work opportunities in a much improved environment has been a vital ingredient in the establishment of the plant.

Where do we go from here.....

People like Roger Fletcher never stop still...and he will continue to improve his system...and as part of the agreement with the AMLRDC the developments that he has achieved here will be available to the rest of the industry.

The AMLRDC will spend $3million in direct sheep projects during 1989-90, and another $11 million will be spent on projects which have a direct benefit to sheepmeats and ~~the~~ cattle. This money will be spent on projects which cover pasture improvement, genetic improvement of livestock, new methods of increasing lambing percentages, increasing weaning percentages in Merino ewes and in crossbreds bearing high proportions of twins. It will cover also the need to control economically important diseases with the development of new vaccines and increasing the efficacy of vaccine protection. We will look further into the stress factors in sheep being exported and in this area as well we are looking at vaccines to prevent losses from salmonella, with this work at the stage of testing vaccines in a feedlot.

Lambplan was launched nationally in April and is expected to follow the pattern of its predecessor, the NSW Meatsheep Testing Service(also funded by AMLRDC). Two new projects in this area will evaluate the implications of using Lambplan in materal breeds of importance in the prime lamb industry and a more sophisticated analysis to determine EBVs in meat sheep.

In the marketing area, we will work on developments of such things as microwavable hamburger and in another innovative project the corporation is supporting work on the formulation of a range of co-extruded fresh and processed meat products suitable for the convenience food market.

We have work in progress also on enhancing the value of skins and hides. In fact this project has the potential to not only revolutionise the Australian tanning industry, but could also provide the methods to allow us to process hides and skins in Australia to the benefit of the industry and the economy.

We are continuing with funding of a West Australian project which utilises sheep skins and this has already resulted in a fashion house in WA exporting the single biggest shipment of merino leather clothing ever to be exported to the USA.

In the off-farm area, the work being undertaken on alternative slaughtering methods for cattle will provide some additional equipment for the sheep industry and I know that Roger is keen to look at this new equipment to further reduce his handling costs in certain areas.

The decision to set up a new and entirely separate research organisation in this industry just four years ago has changed the face of the industry. It has enabled a concentration of effort into those areas where the need is greatest.

It has enabled the AMLRDC, in close consultation with the peak industry councils, to pin point and attack the areas where the greatest cost benefit can be gained for the industry.

The AMLRDC has learned a great deal about not only what needs to be done, but also the resources available to get the job done.

This industry, as I have said, today is part of the overall food industry. We must continue to upgrade our ideas, to develop new products and new methods of processing, packaging and marketing. The rest of the food industry will continue to become more innovative, more competitive, more cost effective... to survive in such a climate the meat industry must do the same. A vital area will continue to be the conversion of livestock to meat. I foresee the time in the not distant future when meat workers will no longer be labelled as such, but will become specialised food technicians...where we will continue working in a much improved environment to change the preparation of product to break it down into components...where more and more work will be done in Australia providing more and more jobs. The need for this is obvious from our National viewpoint, necessary also on the basis of cost effectiveness and in some countries overseas-notably Japan- will be required rapidly because of their increasing shortage of labor in the "backroom" processing areas which already are suffering staff shortages.

The AMLRDC will play an increasinly important role..people like Roger Fletcher will also play their part.

Let me conclude by reading you a precis of the Summary of the report by the independent consultant the AMLRDC engaged to assess the work done by Roger Fletcher on this plant.-

"The decision of the Corporation," says the Consultant's report, "to support Fletcher in the installation and modification of this system has been fully vindicated.
Very substantial cost benefits can be identified, with the production of a much higher quality article for the consumer and greatly improved working conditions for the employees.

My own personal view is that the Fletcher Dubbo operation is a world leader of which the industry in Australia should be proud and I congratulate Roger Fletcher and his family and staff on their achievements.