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THE ECONOMICS OF THE  
ROMNEY N - TYPE 1963

by

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## INTRODUCTION

New Zealand is the world's major supplier of crossbred wool, and an increasing proportion of the New Zealand clip is being used in carpet manufacture. The production of true carpet wool in New Zealand however, is virtually nil.<sup>1/</sup>

As no true carpet wool is produced in New Zealand, carpet manufacturers in this country are obliged to import their carpet wool requirements. If it was considered desirable to replace these imports with locally-produced carpet wool, two solutions are available:

(i) A carpet wool breed such as the Scottish Blackface could be imported.

(ii) Carpet wool could be produced locally using stock already in New Zealand - the Romney N-type breed.<sup>2/</sup>

The likelihood of the importation of a carpet wool breed is small, due to quarantine regulations. Thus, the second alternative, the production of carpet wool in New Zealand through the Romney N-type or Drysdale breed, would seem to be the only feasible solution.

As well as providing carpet wool for the domestic market, the Drysdale breed could also supply carpet wool for export.

This thesis is an investigation of the potential profitability of the production of Drysdale wool in New Zealand, both for the domestic market, and for export.

In this introduction, the historical development of the Drysdale breed is briefly outlined, some of the technical terms frequently used with reference to the Drysdale breed are defined, a general discussion on Research concerned with farm technological change is given, and

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<sup>1/</sup> The characteristics of "true carpet" and "crossbred" wools are defined in Chapter 1.

<sup>2/</sup> A precise definition of terms such as "N-type" is given in Section 0.2 of this Introduction.

finally, the nature, scope and possible limitations of the study are outlined.

### 0.1 Historical Development of the Drysdale "Breed"

Wool research was initiated at Massey Agricultural College in 1928 in co-operation with the Department of Scientific and Industrial Research. In 1929, a study of hairiness or medullation as an undesirable fleece character began. This study was promoted as the results of complaints levelled by certain large buying concerns that New Zealand wool contained too large a proportion of hairy fibres. The results of this early work are reported by Dry.<sup>3/</sup> Hairiness was considered to be inherited in a multifactorial fashion, and selection, both for and against hairiness was shown to be effective.

As part of this initial work on hairiness, a search was made in 1931 on farms near Palmerston North for lambs with a high halo hair abundance.<sup>4/</sup> One of these lambs was found later to be the first Romney N-type sheep. The term "N-type" has its origin in the name of the stud breeder who supplied this lamb.

Some nine years later, the existence of a simple Mendelian situation in the inheritance of coarse hairiness in the Romney N-type sheep was first reported by Dry, Sutherland and MacMahon.<sup>5/</sup> Initially there was some controversy as to whether or not the genetic situation was in fact, a Mendelian one.<sup>6/</sup> However, further work clearly

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<sup>3/</sup> Dry F.W., "Hairy Fibres of the Romney Sheep". N.Z. Jnl. Agric. 48:331, 1934.

<sup>4/</sup> "Halo hairs" is the name given to very coarse hairy fibres in the lamb birthcoat. They are so called because a lamb with a large number on its head appears to be wearing a halo.

<sup>5/</sup> Dry F.W., Sutherland J.A., and MacMahon P.R., "A mendelian situation in the birthcoat of the New Zealand Romney lamb". Nature 145:390, 1940.

<sup>6/</sup> See Olbrycht F.M., "Pseudo-dominance in polygenic characters". Nature 147:57, 1941 and, Dry F.W. and Sutherland J.A., "A mendelian situation in the birthcoat of the New Zealand Romney lamb". Nature 148:563, 1941.

substantiated the existence of two genes, the dominant N gene, and the recessive, nr.

For the first ten years of experimental work with the Drysdales, attention was focussed on fundamental genetic and wool biology studies. The first intimation of the potential use of the Drysdale breed for carpet wool production was made by Professor A.F. Barker, who during a visit to New Zealand in 1946, commented on the suitability of the Drysdale fleece as a carpet fibre.<sup>7/</sup>

However, before the breed could be commercially exploited, more information on such economic characters as thrift, carcass quality, lambing percentage etc., was needed. This lead<sup>led</sup> to work by Cockrem<sup>8/</sup> on the pleiotrophic effects of the N gene, in particular, on carcass quality and growth rate. The only research with the Drysdales of immediate economic significance that has been carried out since Cockrem's study, is that concerning the quality of the Drysdale fleece as a carpet pile fibre.<sup>9/</sup>

The above historical introduction mentions only a few of the numerous papers and theses that have been published concerning various aspects of the N gene. For a more complete review of literature on this subject see Cockrem<sup>10/</sup> and Dry.<sup>11/</sup>

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<sup>7/</sup> Reported by Dry F.W., "Fundamental research gives a new carpet wool", Wool (M.C.W.A.) 1:No.5,p.13, 1952.

<sup>8/</sup> Cockrem F.R., "A study of the pleiotrophic effects of the dominant gene N in the New Zealand Romney sheep", Ph.D. Thesis, Massey Agricultural College, 1956.

<sup>9/</sup> Nash C.E., "The assessment of N-type fleeces", Ph.D. Thesis, University of Leeds, 1962.

<sup>10/</sup> Cockrem F.R., op cit.

<sup>11/</sup> Dry F.W., "The dominant N gene in the New Zealand Romney sheep", Aust. Jnl. Agric. Res. 6:725, 1955 and Dry F.W., "The recessive N gene in the New Zealand Romney sheep", ibid, p.833.

## 0.2 The Phenotypic Characterisation of the N Gene

The Drysdale phenotype at various ages has been described in detail by Dry.<sup>12/</sup> The objective of this section is to briefly describe the phenotypic characterisation of the N gene, and to define, for the purposes of this study, some of the technical terms frequently used with reference to the Drysdales. The recessive N gene (nr) will not be discussed here as this investigation is concerned only with the commercial utilisation of sheep which are either heterozygous or homozygous for the dominant N gene.

The system of grading lambs on halo hair abundance has been fully described by Dry.<sup>13/</sup> The maximum grade is called N Grade; lambs of this grade can almost invariably be considered to homozygous or heterozygous for the N gene.<sup>14/</sup>

The above grading however, does not distinguish between the heterozygote and the homozygote. Coverage gradings described by Stephenson <sup>15/</sup> allow this distinction to be made. The homozygous lamb invariably has N-grade halo hair coverage over the entire fleece bearing area. The heterozygote however, has a reduction of halo hair abundance in region immediately behind the shoulder (the "shoulder patch"). Again, there are occasional rare exceptions to this classification. The grading system is therefore based on reductions from the complete halo hair coverage of the N/N phenotype.

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<sup>12/</sup> Dry F.W., "The dominant N gene in the New Zealand Romney sheep", Aust. Jnl. Agric. Res. 6:725, 1955.

<sup>13/</sup> Dry F.W., "Multifactorial inheritance of halo hair abundance in the New Zealand Romney sheep", Aust. Jnl. Agric. Res. 6;608, 1955.

<sup>14/</sup> Exceptions to this classification do occasionally occur. However, other pleiotrophic characters such as horns enable the determination of genotype to be carried out with a high degree of accuracy. The methods of assessment are described in detail by Dry in his paper on the dominant N gene.

<sup>15/</sup> Stephenson K., "Some aspects of gene dosage in N-type sheep", Aust. Jnl. Agr. Res., 7:447, 1956.



In this thesis the term "N-type" is used to describe any animal, which on origin or breeding performance is believed to carry the gene N, and which possesses one or more of the characteristic features which distinguish sheep, either heterozygous or homozygous for the N gene, from the ordinary Romney. The term "Drysdale" is used interchangeably with "N-type". The Drydales are occasionally loosely described as a "breed", a term which is strictly not correct. The abbreviation "N/N" refers to animals which are homozygous for the N gene, and "N/+" refers to the heterozygote. "+/+" is used to indicate ordinary Romney stock with no evidence of the N gene in their genetic background.

### 0.3 Research on Farm Technological Change

The objective of this section is to briefly discuss the types of research that have been carried out on social and economic aspects of farm technological change. Section 0.4 "The nature, scope and limitations of the study" will be developed on the basis of this discussion.

Heady <sup>16/</sup> defines technological change as having two basic properties:

- (i) Technological change gives rise to a new production surface.
- (ii) Technological change increases output from given resources and/or decreases the input required for a given output and/or reduces risk and uncertainty.

Technological change is usually (though not necessarily) preceded by scientific innovation and accompanied by social innovation. The fact that technological change involves a movement away from the status quo necessarily implies a wide range of social and economic adjustments.

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<sup>16/</sup> Heady E.O., "Basic economic and welfare aspects of farm technological change", Jnl. Farm Eco., 31:293, 1949.

Obviously monetary factors will not be the only ones influencing any individual farmer's decision on the acceptance and adoption of a new technology.

Figure 0.1 gives a possible schematic outline for the development of a new technology.

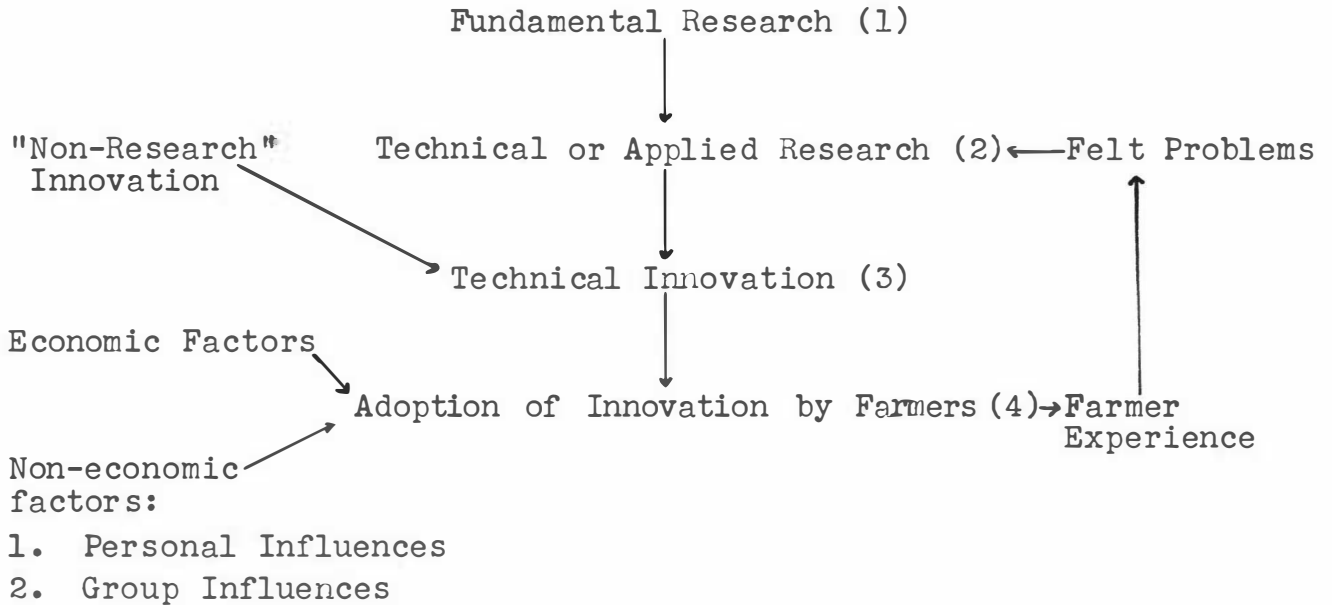


FIG 0.1: SCHEMATIC OUTLINE OF THE DEVELOPMENT OF A FARM INNOVATION

The present status of the Drysdale breed as a farm innovation can be considered to be at the third stage of the development plan shown in Fig 0.1. Deficiencies in technical knowledge on the breed still exist, and further research on these problems is required. Knowledge is at the stage however, where sufficient technical information is available to allow useful consideration of the factors involved in the commercial development of the breed.

As is discussed in Chapter V, "Further research on the Drysdale breed", consideration of the problems involved in the production of Drysdale wool at farm level can give a useful guide to further applied research, and to emphasise deficiencies in technical knowledge which

are of economic importance. Thus the research-extension-adoption relationship shown in Fig 0.1 is a continuous cyclic one. The key link in this communication chain is of course, the extension service.

From Fig 0.1, it can be seen that research on farm technological change falls into three classes:

(i) Technical research carried out in the development of the new technology.

(ii) Economic research to examine micro and macro-economic aspects of the change resulting from the adoption of the new technology. Micro-economic, or Farm Management research attempts to assess the profitability of the adoption of the innovation for any individual farmer.

(iii) Extension research to attempt to determine the most effective means of communicating the new technology from the research stage to the farm level.

Clearly then, the development of a new technology to a commercial level is a multi-stage process, and inadequate attention to any particular stage could delay the completion (in any desired sense of the word) of the process.

The investigation to be outlined in this thesis falls into the second class of research listed above. The Study is primarily a micro-economic one, although certain macro-economic aspects of the development of a carpet wool industry in New Zealand such as the effect of local carpet wool production on the level of overseas funds will be briefly discussed.

Heady <sup>17/</sup> distinguishes between different types of technological change according to; whether the demand for the product resulting

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<sup>17/</sup> Heady E.O., op.cit.

from the adoption of the new technology is elastic or inelastic, whether the output resulting increases or remains constant, and whether the innovation gives rise to an increase, decrease, or no change in costs. Various combinations of these three criteria can be made. Clearly, if the demand for a particular product is inelastic, an output-increasing innovation is undesirable. The distinction should also be made between innovations which are concerned with the product of the present farming system and those which produce a new product.<sup>18/</sup> If the innovation is simply an improvement in the efficiency of the production of a given commodity, then any estimate of the potential market for this increased output will depend primarily on the shape of the demand curve for that commodity. If however, the innovation involves a new product, the potential market will ceteris paribus depend on two factors:

(i) The shape of the aggregate demand curve for items that can be considered to be competitive with the new product.

(ii) The rate of substitution of the new product for the items with which it can be considered to be competitive.

The production of Drysdale wool clearly falls into the "new product" class of innovation, and thus any estimate of the potential demand for Drysdale wool should be concerned with both the market for carpet fibres in general, and the quality of Drysdale wool as a carpet fibre.

#### 0.4 Nature, Scope and Limitations of the Study

The frame of reference of this study is that of a commercial organisation with an interest in the development of Drysdale wool production and marketing in New Zealand. It is assumed that this

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<sup>18/</sup> Simon H.A., "Effects of technological change in a linear model" in "Activity analysis of production and allocation", E. Koopmans (Ed.) Wiley, New York 1951, p.260.

commercial body would be prepared to invest risk capital in the development, and would expect a profitable return on this capital. It is also assumed that the wool-producing farmers would have sufficient representation on this body to prevent the marketing section of the organisation from increasing marketing margins at the expense of producer returns. That is, the objective of the production-marketing organisation would be to develop a Drysdale wool production industry to such a level that the total return from the production and marketing of the wool would be maximised.

The object of the thesis is to put forward a tentative answer to the fundamental problem of the hypothetical commercial organisation described above: Is the production and marketing of Drysdale wool in New Zealand likely to be a profitable enterprise?

The investigation can be logically considered in five sections:

- (i) The potential market (both domestic and export) for carpet wool.
- (ii) The technical properties of Drysdale wool as a carpet fibre.
- (iii) The most efficient system for marketing a potential Drysdale wool clip.
- (iv) The profitability of Drysdale production at the farm level.
- (v) At all four levels listed above, knowledge at the present stage is incomplete. Further research into the various technical and economic problems would, to a certain extent, reduce the uncertainty resulting from this lack of knowledge. However, total resources available for research are likely to be limited, and it would seem likely that different research projects would contribute knowledge of varying economic significance. Thus, the final section of the investigation should be concerned with defining the financially important problem areas and suggesting research designed to overcome

these problems.

The above outline suggests five inter-related topics in the investigation of the commercial development of the Drysdale breed. This thesis is a preliminary investigation of all five topics. In that each topic could justifiably be developed as a full-scale research project in itself, any individual section cannot be treated in anything but a preliminary, and somewhat incomplete fashion. Because of the broad scope of the study, detailed conclusions on any particular aspect cannot be made. For example, in the section on the profitability of Drysdale production at the farm level, only three case farms are considered. To derive a normative supply function for Drysdale wool would require a detailed farm survey. However, to have made a more detailed study of any one aspect would necessarily have meant less emphasis on one or more of the remaining topics, and it is felt that the usefulness of the overall conclusions would have been reduced.

Within this frame of reference, and considering the five aspects of the problem listed above, an outline of the study by Chapter headings is as follows:

- Chapter I      The Potential Market for Drysdale Wool
  - II      The Quality of the Drysdale Wool as a Carpet Fibre
  - III     Marketing Schemes for Drysdale Wool
  - IV     Farm Management Aspects of Drysdale Wool Production
  - V      Further Research with the Drysdale Breed
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## C H A P T E R I

### THE POTENTIAL MARKET FOR DRYSDALE WOOL

Drysdale wool could be produced for domestic consumption in New Zealand or for sale on the world market. As it would probably take at least ten years to fulfil local carpet wool demand with the number of Drysdale sheep at present available,<sup>1/</sup> and because transport costs mean that the price paid for Drysdale wool on the domestic market would probably be higher than that which overseas manufacturers would be willing to pay, the local carpet wool market would seem to be of primary importance in the early stages of the development of the Drysdale breed. There is no reason however, why Drysdale wool should not eventually be sold on the world market, and world supply/demand trends for carpet fibres will be briefly outlined.

In this chapter, world trends in the production and consumption of carpet wools and other carpet fibres are examined, the domestic market for New Zealand-produced carpet wool briefly discussed, and finally, a tentative assessment of the potential market for Drysdale wool is made.

#### 1.1 Definition of Terms

Wools used in the manufacture of carpets are drawn from two main sources: the "unimproved" or true carpet breeds, and the lower cross-breeds. The word "unimproved" describing the first category, does not indicate that there has been no attempt at "improvement" by selection within the breed, but rather implies that there has been no crossing with English or Merino stock. Most all-wool carpets are made from a blend of true carpet types, and some finer wools from the lower crossbreeds.

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<sup>1/</sup> See Appendix A.

In this chapter, "carpet wool" is taken to mean "unimproved wool" of the type produced by the Scottish Blackface, Alleppo and Karakul breeds. The carpet fleece is characterized by a high dp/ds ratio,<sup>2/</sup> and an inner and outer coat of fine and coarse fibres respectively. The indigenous breeds of most Asiatic countries produce a fleece of this type. "Coarse crossbred" wool is taken in this chapter to mean any wool coarser than 46's - 48's, which does not fall into the "carpet wool" category.

It should be stressed however, that there is no clear distinction between "carpet wool" and "crossbred wool". As the average count of a wool sample falls, the dp/ds ratio tends to increase, and a very coarse pure Romney wool sample could have almost identical properties with those of a comparatively fine sample of a true carpet wool.

The N-type fleece falls into the "unimproved" category. As wools not of the true carpet type both complement and substitute for true carpet wools in carpet manufacture, trends in the production and consumption of both unimproved wool and the coarser crossbreds will be discussed.

## 1.2 Trends in Carpet Wool Production

Over the last ten years the proportion of the World Wool Clip made up of non-apparel types has steadily declined. This situation is illustrated in Table 1.1.

While average annual production of Merino wool increased by 34.26 per cent over the period 1951/52 - 1955/56 to 1961/62, "other" (of which over 90 per cent is used in carpets) had increased by only 11.53 per cent. The proportion of the world clip made up of

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<sup>2/</sup> The "dp/ds ratio" is the ratio of the diameter of the fibres produced by the primary follicles to the diameter of the fibres produced by the secondary follicles.



TABLE 1.1: ESTIMATED WORLD PRODUCTION OF RAW WOOL  
(Million lbs. greasy basis)

	Av 1951-52 to 1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62 <sup>a/</sup>
Merino	1,725	2,083	2,044	2,172	2,316	2,270	2,316
Crossbred	1,680	1,863	1,832	1,973	2,033	2,073	2,090
Other	1,136	1,159	1,174	1,210	1,264	1,269	1,267
Total	4,541	5,105	5,050	5,355	5,613	5,612	5,673

Source: Commonwealth Economic Committee and International Wool Textile Organisation, "Wool Statistics 1961".  
Supplement to "Wool Intelligence" May, 1962.

<sup>a/</sup> Provisional.

non-apparel types declined from an average of 25 per cent over the period 1951/52 - 1955/56 to 22 per cent in 1961/62. The objective of this section is to review production and trade trends in the major carpet wool producing countries of the world, and to make some assessment of possible future changes.

Table 1.2 gives total production and exports of carpet wool for the major producing countries in 1958.

Trends in production and exports for the major carpet wool producing countries will now be outlined.

#### 1.2.1 The Soviet Union

Trends in wool production and the planned future development of the sheep industry within the U.S.S.R. will be examined in some detail for two reasons:

TABLE 1.2: WORLD PRODUCTION AND EXPORTS OF UNIMPROVED WOOL  
(1958 Million lbs. clean basis)

Country	Production	Exports
Soviet Union	114.0	
China	80.0	
Outer Mongolia	24.0	
India	44.4	28.5
Turkey	38.6	
United Kingdom	28.3	10.8
Iran	22.1	11.2
Pakistan	24.0	18.9
Bulgaria	17.0	
Greece	15.0	
Iraq	15.0	7.2
Rumania	11.6	
Argentina	11.6	6.5
Yugoslavia	10.3	
Syria	10.3	12.3
Afghanistan	9.0	
South Africa	9.8	8.4
Spain	9.3	
Morocco	8.0	
Italy	4.2	
Others	38.5	
Total	545.0	173.0

Source: "The United States Carpet Industry and World Supplies of Carpet Wool", Wool Digest 11:96, 1960.

(i) The U.S.S.R. is the world's largest producer of carpet wools,<sup>3/</sup> and changes in the composition of the Soviet clip, consequently have a marked effect on world total production of this type of wool.

(ii) The planned changes that have taken in the composition of the Soviet flock, using controlled mating and artificial insemination are illustrative of the magnitude of the organisation required to develop a large scale carpet wool industry in New Zealand.

The Soviet Union is the second largest wool producing country after Australia.<sup>4/</sup> In 1960, the Soviet Union had 136.1 million sheep - an increase of 31.7 per cent since 1956. No other major wool producing country has shown a similar rate of expansion. Wool production per sheep of 5.6 lbs however, is still below the world average of 5.8 lbs.<sup>5/</sup>

The indigenous Russian breeds are, like those of all eastern European countries, semi-coarse, and coarse woolled. In 1928, more than 7,000 Merino rams were imported from Australia. This move constituted the beginnings of a flock "improvement" programme that built up the Merino flocks to 25 million in 1939, and 50 million in 1959. This increase in the numbers of fine woolled stock had been carried out partly at the expense of production of semi-fine, semi-coarse, and coarse woolled types and in 1959, a deficiency in these latter types became apparent. To quote from "Wool in Communist Countries":<sup>6/</sup>

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<sup>3/</sup> Estimated 20.9 per cent of world total in 1958, compared with China - 14.7 per cent and India - 8.1 per cent. See Table 1.2.

<sup>4/</sup> In 1960/61 U.S.S.R. produced 777 million lbs of wool, compared with Australia 1,627 million lbs and New Zealand 588 million lbs. Commonwealth Economic Committee and International Wool Textile Organisation "Wool Statistics 1961", 1962.

<sup>5/</sup> The description of the Sheep and Wool Industry in the Sino-Soviet Bloc is based primarily on: Australian Bureau of Agricultural Economics "Wool in communist countries", Economic research report Number 1. Canberra, Australia 1962.

<sup>6/</sup> Australian Bureau of Agricultural Economics, Op.cit. p.6.

"The drive for fine-woolled sheep was carried forward with such impetus that the aim was overshoot; in 1959 pure Merinos and crossbreds were so numerous that a deficiency in pure-bred semi-fine, semi-coarse and coarse woolled sheep became apparent".

This deficiency however, should be partly remedied if the objectives put forward in the Seven Year Plan 1959-65, are fulfilled. Table 1.3 shows changes in the absolute and relative composition of the Soviet clip for selected years from 1940 until 1958, and the target for 1965.

TABLE 1.3: TYPES OF WOOL PRODUCED IN THE U.S.S.R.  
AND TARGETS FOR 1965

Year	Fine Wool		Semi-fine Wool		Semi-coarse Wool		Coarse Wool		Total
	Mill.lb greasy	% of total	Mill.lb greasy	% of total	Mill.lb greasy	% of total	Mill.lb greasy	% of total	Mill.lb greasy
1940	42	12	18	5	101	30	183	53	344
1950	33	9	35	9	97	26	214	56	379
1955	95	17	114	21	130	23	214	39	553
1956	121	22	104	18	165	29	177	31	567
1957	171	27	115	19	165	26	179	28	630
1958	c	b27	c	b18	c	b24	c	b30	701
1965	d	b34	d	b25	d	20	d	21	1208

Source: "Wool in Communist Countries".

b. Percentages for 1958 and 1965 are on a clean basis, as the percentages of greasy wool are not known.

c. In 1958, the production of fine and semi-fine types amounted to about 335 million lbs greasy, coarse and semi-coarse to about 366 million lbs greasy.

d. The 1965 target for fine and semi-fine wool production is 805 million lbs greasy, coarse and semi-coarse 403 million lbs.

e. Classification of wool types is as follows:

Fine:	Bradford	60's - 80's
Semi-fine:	"	56's - 58's
Semi-coarse:	"	46's - 50's
Coarse:	"	44's and below.

From Table 1.3 it can be seen that, whereas in 1950 coarse and semi-coarse types made up 82 per cent by weight of the total clip, it is planned for 1965 that they should only make up 41 per cent. Although there is a planned increase (of 98 million lbs) in the production of coarse and semi-coarse types over the period 1955 to 1965, this is very small compared with that planned for fine and semi-fine types (596 million lbs). The Australian Bureau of Agricultural Economics has calculated that, even using overly-conservative figures, these production objectives are quite realistic, and have a high probability of achievement.

As the U.S.S.R. is capable of producing virtually all essential commodities, the Soviet economy can be considered to be largely self-sufficient. Also, in any communist country the emphasis in government planning tends to be on internal production rather than trade. The international trade of communist countries has been described as: "a by-product of their home investment and production plans" <sup>7/</sup> Hence, even major changes in the level of carpet wool production within the U.S.S.R. may not effect supplies of carpet wool on the World Market to any extent because development of the Soviet textile industry would be planned to just consume all the wool produced. In 1960, however, the U.S.S.R. imported a total of 135.6 million lbs (clean), ranking as the world's eighth largest wool importer. About

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<sup>7/</sup> "Wool in Communist Countries" quoted from "The Economist", May 14 1960.

two thirds of this was of coarse and semi-coarse types. Most of the Soviet trade in raw wool has been with other communist countries - in particular China and Outer Mongolia. U.S.S.R's trade in coarse and semi-coarse wools is given in Table 1.4.

TABLE 1.4: SOVIET TRADE IN SEMI-COARSE AND COARSE WOOLS  
(Clean basis)

Country of Origin	1956 mill.lbs	1957 mill.lbs	1958 mill.lbs	1959 mill.lbs	1960 mill.lbs
Afghanistan	8.2	8.8	5.1	11.0	11.2
China	28.7	30.2	27.6	28.7	24.5
India	3.5	6.8	10.1	7.5	7.7
Iran	7.7	8.2	10.4	7.1	5.7
Libanon	0.7	-	0.7	2.6	2.2
Mongolia	26.7	22.5	18.3	20.3	21.6
New Zealand	2.4	0.5	3.5	-	0.9
Syria	0.9	1.5	3.7	1.1	1.1
Others	-	0.2	1.9	2.4	12.8
Total imports	78.7	78.7	80.5	80.7	89.7
Total exports	26.6	29.3	36.4	25.8	26.7
Nett imports	52.1	49.4	44.1	54.9	63.0

Source: "Wool in Communist Countries", p.119.

Despite the fact that it is the world's largest producer of carpet wool, the Soviet Union is still a nett importer of carpet types. Most of these imports are from other countries in the Sino-Soviet bloc, and it seems likely that this situation will continue. Consequently, it is unlikely that changes in the Soviet production

of and/or trade in carpet wools will have any marked effect on the world carpet wool market.

### 1.2.2 China

In 1960/61 there were about 59 million sheep in China producing about 150 million lbs (greasy) of wool. China is the second largest carpet wool producer after U.S.S.R. (80 million lbs clean in 1958).

Since 1949, large scale cross-breeding programmes using artificial insemination and imported fine-wool sires have been carried out. In 1958, 12 million coarse woolled ewes were crossed with fine and semi-fine woolled rams, and about 80 per cent of these were artificially inseminated.

Despite these attempts at fleece improvement, it is believed that about four fifths of the wool produced is of coarse quality, suitable only for the manufacture of low quality cloth or carpets.<sup>8/</sup> However, it may be expected that a definite increase in the proportion of fine quality wools should result in the future. It has been estimated that wool production will rise to more than 200 million lbs in 1970. This allows for an increase in sheep numbers to 70 million and a slight increase in wool production per sheep (at present about 2.6 lbs per sheep).

Until 1960, China (excluding Outer Mongolia) was a nett exporter of raw wool. Table 1.5 indicates some of the changes that have occurred in China's wool production and trade since 1952.

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<sup>8/</sup> Lawrence M.J., "Wool in mainland China", *Quart. Rev. of Agr. Economics* 15:188, 1962.

TABLE 1.5: CHINA: WOOL PRODUCTION, EXPORTS AND CONSUMPTION  
(Million lbs. clean basis)

Year	Wool Production	Nett Exports of Raw Wool	Raw Wool Available	Imports of Tops	Wool Available for Manufacture
1952	50.46	26.78	23.68	6.40	30.08
1954	63.12	44.97	18.15	9.70	27.85
1955	65.46	30.96	34.50	15.70	50.20
1956	71.76	27.35	44.41	20.60	65.01
1957	75.30	26.61	48.69	18.90	67.59
1958	82.02	19.92	62.10	32.80	94.90
1959	89.88	17.68	72.20	24.10	96.30
1960	91.14	-4.48	95.62	23.10	118.72

Source: Lawrence M.J., "Wool in Mainland China", Quart. Rev. Agr. Eco. 15:188, 1962.

It is probably safe to assume that all wool exported is of carpet types, and all wool imported (either as tops or raw wool) is of apparel quality. From Table 1.5, it can be seen that the supply of carpet wool available for export has steadily declined from 44.97 million lbs in 1954 to zero in 1960. This trend is probably due to an expansion in domestic wool fabric manufacturing. Production of apparel and non-apparel fabrics (including blankets) increased from 8.2 million linear yards in 1947 to 30.7 million linear yards in 1960.

### 1.2.3 Outer Mongolia

Very few statistics on the sheep industry of Outer Mongolia are available. Nomadism is still the major form of land use, and in 1958 only 35 per cent of the nomadic livestock owners had joined the voluntary producer co-operatives. The most reliable information



available is that on wool exports to the Soviet Union which averaged 22.5 million lbs clean from 1956 to 1958. This indicates that at least 40 million lbs greasy were produced.

#### 1.2.4 Pakistan <sup>9/</sup>

Pakistan produces about 42 million lbs of raw wool, nearly all of which is carpet types. Of the non-communist countries, Pakistan is the second largest exporter of carpet wool after India (18.9 million lbs clean in 1958). America and the United Kingdom are the major importers. Recently plans have been stated for the improvement of wool handling procedures and an increase in the production of fine wool. Under the second five-year plan, fine woolled rams have been imported from Australia, and three fine-wool sheep breeding farms will be set up. Domestic consumption of carpet wool has been increasing, and now exceeds 10 million lbs.

#### 1.2.5 India <sup>10/</sup>

India's wool production for the years 1959-1961 was constant at 78.0 million lbs (greasy). Most of this is carpet wool and in 1960/61 India exported 44.0 million lbs mainly to the U.S.S.R., the U.K. and the U.S.A. India also has a significant domestic carpet industry with a total production of about 13 million lbs, 90 per cent of which is exported.

Under the two five-year plans, 1951-55 and 1956-61 substantial development of the Indian Wool Industry took place. Export markets have competed for raw materials with the expanding local textile

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<sup>9/</sup> Source: World Wool Digest 11:96, 1960., 13:66, 1962. Welton R.S., "The world carpet wool situation", U.S.D.A. Foreign Agricultural Service, Washington, 1959, p.10.

<sup>10/</sup> The discussion on India's sheep and textile industries is based on various issues of the World Wool Digest. See: World Wool Digest 8:30, 1957., 10:179, 1959., 11:168, 1960., 12:62, 1961., 12:151, 1961., 13:199, 1962. Also: Seeber G.E., "Wool in India", Quart. Rev. Agric. Eco. 15:122, 1962.

industry and export controls have been imposed since 1950. Also, due to chronic balance-of-payments difficulties, severe restrictions have been imposed on imported wools. This means that manufacturers, to keep their factories running, have to use locally produced carpet wool for apparel purposes. India's annual wool exports have declined from 70 million lbs in 1939 to about half this amount today.

Along with restrictions on the exports of coarse wool, attempts are being made to increase the local supplies of finer wool by fleece improvement programmes. Under the second five-year plan, about 460 sheep and wool research and extension centres have been established.

#### 1.2.6 Turkey 11/

Turkey produced 84 million lbs of wool in 1962, and a little less than half of this was of carpet types. Carpet wool exports total about 10 million lbs. Exports have been declining due to increased domestic consumption, and production of fine wool has been encouraged by the government in order to reduce import needs.

#### 1.2.7 United Kingdom 12/

Carpet wool in the United Kingdom is produced by the mountain breeds - Blackface, Swaledale, Herdwick etc. Output of carpet types has increased to a greater extent than apparel wools over recent years, and now totals over 40 million lbs (greasy) - about one third of the total United Kingdom clip. Hill wools are subsidized with the objective of increasing this production still further.

Exports of carpet wool from the United Kingdom exceed 15 million lbs (greasy).

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11/ Source: World Wool Digest 11:96, 1960., 13:217, 1962. Welton R.S., Op.cit., p.14.

12/ Source: Welton R.S., Op.cit., p.13.

1.2.8 Iran <sup>13/</sup>

Iran produces about 40 million lbs of wool annually, nearly all of which is carpet types. About half of this is exported, mainly to the U.S.S.R. and the U.S.A. The remainder is consumed locally in the production of Persian hand-woven rugs.

1.2.9 Iraq <sup>14/</sup>

Wool production in Iraq has declined steadily from 28 million lbs in 1956 to 24 million lbs in 1961. This decline has been due to a fall in sheep numbers caused primarily by repeated droughts, and disease. The entire wool output is of the native type.

Exports have also been declining, due to political events and an expansion of the local textile industry, as well as the fall in total wool production. Improvement of the Iraqi clip has been through the selection of better types of the indigenous breeds, rather than in crossing with English or Merino blood.

1.2.10 Syria <sup>15/</sup>

All wool produced in Syria is of carpet quality, the principle breeds being the Awassi, Karradi and Aleppo. In 1958, 20.7 million lbs (greasy) of carpet wool were produced, with an average yield of 43 per cent. Virtually all the Syrian clip is exported to the U.S.A. or the U.S.S.R. Syrian exports generally exceed production due to a proportion of re-exports from Iraq and Turkey.

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<sup>13/</sup> Source: World Wool Digest 12:76, 1961. Welton R.S., Op.cit., p.12.

<sup>14/</sup> Source: Welton R.S., Op.cit., p.11.

<sup>15/</sup> Source: Welton R.S., Op.cit., p.11.

### 1.3 Trends in Coarse Crossbred Wool Production

World production of coarse crossbred wool has shown a continued steady expansion over the last decade, this expansion being proportionately slightly less than the increase in Merino wool production over the same period. The estimated world production of coarse crossbred wool of types suitable for carpet manufacture (less than 48's American) was 518 million lbs (clean) in 1958.<sup>16/</sup>

The major producers of coarse crossbred wool suitable for carpet use are New Zealand and Argentina together accounting for about 87 per cent of the world total production of these types.

#### 1.3.1 New Zealand

New Zealand is the third wool producing country (after Russia and Australia) and the largest producer of crossbred wool. New Zealand wool production over the last 6 years has shown the largest proportionate increase of any country in the non-communist world (21 per cent from 1956/57 to 1961/62; compared with Russia 34 per cent, and Australia 8 per cent). The absolute expansion of New Zealand's wool production over the same time period was exceeded only by Russia and Australia. There is also evidence that the average count of the New Zealand clip is tending to fall. Table 1.6 shows the sales of New Zealand wool through the New Zealand Wool Commission by quality numbers over the last 6 years. The increase in the proportion of lower counts shown in Table 1.6 is probably due in part to pasture improvement with a resulting increase in nutritional standards, and in part to genetic factors such as the increased use of Border Leicester crosses, and possibly selection for a coarser fleece.

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<sup>16/</sup> U.S. Tariff Commission, quoted in World Wool Digest 11:96, 1960.

TABLE 1.6: WOOL SALES THROUGH THE NEW ZEALAND WOOL COMMISSION\*

Quality Group	1956/57 %	1957/58 %	1958/59 %	1959/60 %	1960/61 %	1961/62 %
52's and finer	32.00	28.50	23.25	24.75	20.50	22.50
50's	15.00	13.25	12.25	12.75	12.00	12.00
48's/50's	16.00	13.75	15.50	14.50	12.00	9.75
46/50's and 48's	27.50	29.75	13.50	31.75	36.00	36.75
46/48's	7.75	10.00	12.20	11.75	13.25	13.50
46's and lower	1.75	4.75	4.75	4.50	6.50	5.50

\* Returns exclude dag wool, re-offered wool and wool sold privately.

Source: N.Z. Wool Commission: "Statistical analysis of wool offered at auction sales", Wellington, 1962.

### 1.3.2 Argentina

Argentina produces about 400 million lbs (greasy) of wool. Of this, about 5 per cent is true carpet wool, and another 25 per cent is of coarse crossbred types. Most of the crossbred wool is produced from Lincoln stock. The U.S.A. imports all of the true carpet wool and about 60 per cent of the coarse crossbred types. Until recently replaced by New Zealand, Argentina was the leading supplier of carpet wools to the American market.

The exports of Argentine wool vary widely from year to year due to large stock accumulations and disposals. Apart from seasonal fluctuations, Argentine wool production had shown a continued increase over the last 5 years.

### 1.4 Trends in World Carpet Production and Consumption of Pile Fibres

From 1957 to 1960 production of machine-made wool or hair carpets by the major producing countries increased from 46,990 million lbs and 136,831 million square yards to

51,404 million lbs and 138,222 million square yards.<sup>17/</sup> The proportionate increase in carpet production of approximately 27 per cent is considerably greater than that recorded for the woven fabric sector, approximately 1 per cent. In absolute terms however, the woven fabric sector has shown a considerably greater rate of growth. Table 1.7 shows machine made carpet production for the world's major producing countries for the years 1957 to 1961. In 1961, the United States of America produced over 60 per cent of the total carpet production of the major producing countries. The United Kingdom produced 16 per cent. The increase in world carpet production over the period 1957-61 was due mainly to an expansion of the American carpet industry.

#### 1.4.1 United States of America <sup>18/</sup>

The United States of America is the world's largest carpet producer (159.8 million square yards in 1961). The industry increased production by about 150 per cent over the decade 1951-1961. Concurrently there has occurred a marked increase in the proportion of total carpet shipments represented by tufted carpets, and a corresponding decline in the proportion of woven carpets. The pattern of fibre consumption has also changed markedly, with an increase in the proportion of filament nylon and lower crossbred wools, and a decline in the consumption of true carpet wools.

This trend in the relative proportions of woven and tufted

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<sup>17/</sup> The factor for converting area to weight varies from 3 to 4. For an approximation to compare the rate of growth of the carpet industry with that of the woven fabric sector, a figure of 3.5 is taken here as a suitable conversion factor.

<sup>18/</sup> The description of the American carpet industry is based primarily on: American Carpet Institute Inc. "Basic facts about the carpet and rug industry", New York, 1962.

TABLE 1.7: PRODUCTION OF MACHINE-MADE CARPETS AND FLOOR RUGS OF  
WOOL AND HAIR FOR THE MAJOR PRODUCING COUNTRIES

	Unit	1957	1958	1959	1960	1961
United States <sup>a/</sup>	1000 sq.yd	56,357	49,181	58,500	48,900	..
United Kingdom	1000 sq.yd	47,580	47,180	45,880	45,580	42,460
Belgium	1000 lbs	30,144	27,185	34,465	32,620	37,415
France	1000 lbs	16,846	16,689	17,652	18,748	19,370
Western Germany	1000 sq.yd	17,507	16,798	17,715	20,134	20,705
Netherlands	1000 sq.yd	6,248	6,076	7,205	8,641	9,171
Japan	1000 sq.yd	3,796	3,540	4,493	6,201	..
Australia	1000 sq.yd	2,985	4,172	5,032	6,547	6,531
Canada	1000 sq.yd	2,358	2,607	2,662	2,219	..
Total	1000 sq.yd	136,831	129,554	141,487	138,222	..
Total	1000 lbs	46,990	43,874	52,117	51,404	56,785
Total woven tissues <sup>b/</sup>	million lbs	1,521.0	1,389.0	1,545.0	1,554.0	1,540.0

Source: Commonwealth Economic Committee "Wool Statistics", 1959 and 1962.  
American Carpet Institute Inc. "Basic facts about the carpet and rug industry", 1962.

<sup>a/</sup> This figure represents only about one third of total U.S. carpet production as it excludes tufted carpets and carpets containing synthetic fibres. In 1961, America produced 159,800 square yards of carpet in total. The figures for the other producing countries however, should give a reasonable indication of total carpet production.

<sup>b/</sup> For comparison. Includes apparel and non-apparel fabrics, and blankets.

carpets is clearly shown in Table 1.8.

TABLE 1.8: AMERICAN BROADLOOM CARPET SHIPMENTS BY TYPE

Year	Axminster	Wilton	Velvet <sup>a/</sup>	Tufted	Total
1951	39.4%	17.1%	34.1%	9.4%	100.0%
1952	36.4	19.8	29.5	14.3	100.0
1953	32.8	18.9	27.9	20.4	100.0
1954	26.3	16.5	24.6	32.6	100.0
1955	24.5	15.0	24.5	36.0	100.0
1956	20.2	14.3	23.4	42.1	100.0
1957	16.4	12.3	21.0	50.3	100.0
1958	12.6	11.1	18.2	58.1	100.0
1959	10.2	11.4	18.9	59.5	100.0
1960	8.5	9.0	15.5	67.0	100.0
1961	6.7	6.6	14.3	72.4	100.0

Source: American Carpet Institute Inc., "Basic facts about the carpet and rug industry", New York, 1962.

<sup>a/</sup> Includes chenille and knitted carpets.

The output of tufted carpets increased from 9.4 per cent to 72.4 per cent of the total carpet shipments over the ten year period 1951-1961. The decline in shipments of woven carpets is probably due primarily to competition from the lower cost tufted product, but apparently this section of the industry has also been suffering from the competition afforded by imported woven carpets - particularly Wilton.<sup>19/</sup>

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<sup>19/</sup> World Wool Digest 12:221, 1961.



TABLE 1.9: END USE OF FIBRES IN U.S.A.

	Non Cellulosic Fibres			Rayon and Acetate			Wool			Cotton			Total		
	Av 1952- 54	Av 1955- 57	Av 1958- 61	Av 1952- 54	Av 1955- 57	Av 1958- 61	Av 1952- 54	Av 1955- 57	Av 1958- 61	Av 1952- 54	Av 1955- 57	Av 1958- 61	Av 1952- 54	Av 1955- 57	Av 1958- 61
Total Apparel	m.lb 126.1	m.lb 202.6	m.lb 277.3	m.lb 410.8	m.lb 323.8	m.lb 303.7	m.lb 352.6	m.lb 348.7	m.lb 352.9	m.lb 1609.9	m.lb 1756.5	m.lb 1867.7	m.lb 2499.0	m.lb 2631.6	m.lb 2801.55
Carpets Woven	1.2	3.5	15.6	24.1	15.5	5.9	139.3	145.2	101.5	1.7	1.0	2.1	166.3	165.2	125.1
Tufted	0.5	7.4	47.6	15.0	96.7	80.1	0.6	8.5	47.8	66.0	48.1	54.3	82.1	160.7	229.8
<u>a/</u> Total Carpets	1.7	10.9	63.2	39.1	112.2	86.0	139.9	153.7	149.3	67.7	49.1	56.4	248.4	325.9	354.9

Source: Gulman G.O., and Fead M., "Competition Between Fibres", Australian Bureau of Agricultural Economics, 1959. "Textile Organon" Vol.33, No.11, 1962.

a/ Excluding backing yarn.

Table 1.9 shows the trends in fibre consumption by the American carpet industry over three three-year periods 1952-54, 1955-57 and 1958-61. Fibre consumption by the apparel sector is given for comparison.

Considering "total carpets" (that is woven and tufted carpets together) it can be seen from Table 1.8 that "synthetics" (non-celulosic fibres, rayon and acetate) use in carpet production rose steeply from approximately 16 per cent of total fibre use over the period 1952-54 to 42 per cent over the period 1958-61. This increase was entirely due to an increase in the proportion of synthetics used in tufted carpets coupled with an almost twelvefold expansion in total tufted carpet shipments. Synthetic use in woven carpet production stayed constant at approximately 15 per cent of total fibre consumption for this class of carpet. In the production of tufted carpet, synthetics use increased from 18.8 per cent of the total fibres used over 1952-54 to 55.5 per cent over 1958-61. Wool use also increased from less than 1 per cent in 1952-54 to 20.8 per cent over the period 1958-61. As shown in Table 1.10 New Zealand has been taking an increasing share of this increase in wool consumption. If the assumption is made that all wool from New Zealand and 50 per cent of imports from Argentina are of lower crossbred types, and all wool from Pakistan, Iraq, Syria, India and the United Kingdom plus the balance of imports from Argentina is carpet wool, then Table 1.10 allows an approximate estimate to be made of trends in the consumption of true carpet wool as distinguished from coarse lower crossbred types. Using this basis it can be seen that, while the consumption of unimproved carpet wool has declined from 55 per cent of the total wool consumption in 1956 to 39 per cent in 1961, the consumption of lower crossbred wool increased from 33 per cent of total wool consumption in 1956, to 48 per cent in 1961.

TABLE 1.10: UNITED STATES CARPET WOOL IMPORTS BY COUNTRY OF ORIGIN  
(Million lbs. clean basis)

	1956	1957	1958	1959	1960	1961
New Zealand	21.2	12.8	32.2	49.3	45.8	52.2
Argentina	52.5	46.6	45.2	60.5	45.8	47.6
Pakistan	13.8	14.2	10.8	14.8	11.6	14.9
Iraq	11.0	9.4	4.0	10.8	7.5	7.0
Syria	11.7	9.2	5.3	10.8	7.2	5.2
India	10.8	7.2	6.1	9.9	5.0	4.1
United Kingdom	4.4	2.2	5.0	7.7	4.6	6.9
Italy	1.2	1.8	0.6	2.5	1.6	1.5
Ireland	0.7	0.5	1.5	2.4	1.9	1.5
France	1.9	1.7	0.8	2.3	1.9	2.2
Other Countries	13.6	15.4	10.9	20.5	21.0	14.3
Total	142.8	121.0	122.4	191.5	153.9	157.4

Source: United States Department of Commerce,  
Report FT110, 1961.

New Zealand's exports to the United States of America of wool for carpet use in 1961 were 52.2 million lbs (clean). This is more than 70 per cent of our total wool exports to the United States of America, and approximately 10 per cent of our total wool exports.

Of the factors leading to these changes in fibre consumption by United States carpet manufacturers, the following are probably the most significant:

(i) Changes in carpet production technology, in particular, the rapid increase in the volume of tufted carpet shipments.

(ii) The development of new synthetic fibres at competitive and stable prices.

(iii) The suspension of tariff restrictions in 1958 to allow duty free entry of wools not finer than 46's with a 10 per cent tolerance of 48's. This suspension was reconsidered by the American Government in 1960 and will continue until 1963.<sup>20/</sup>

(iv) The decrease in exports of unimproved wool from the major producing countries discussed in the previous section.

The relative importance of these four factors is difficult to determine. It is however, of vital importance to New Zealand as a major supplier of crossbred wools, and a potential supplier of "unimproved" wool through the Drysdale breed.

#### 1.4.2 United Kingdom <sup>21/</sup>

In 1960 Britain produced 45.6 million square yards of carpet, making her the second largest carpet producer after America. Of this roughly 6 million square yards were tufted carpets and carpets faced with hair cotton, or jute. In comparison with the United States of America, Britain produces much less tufted carpet, and uses much more carpet wool as a raw material. All-wool carpets made up 69 per cent of total production in 1960, while those containing no wool constituted only 2 per cent. However, a marked trend towards synthetic fibre use took place from 1955 to 1960, and it is likely that this trend will continue. In contrast with the U.S.A., Axminster is the major carpet type in Britain, and the greatest increases in production have been shown for this type of carpet.

#### 1.4.3 Other Countries

Statistics on carpet production and fibre consumption for other carpet producing countries (of which Belgium, The Netherlands, Italy, Japan, France and Australia are the major suppliers) are not

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<sup>20/</sup> World Wool Digest 12:93, 1961.

<sup>21/</sup> Source: World Wool Digest 12:118, 1961., 13:101, 1962.

well documented. However, from the evidence available, there appears to have been a steady and continued expansion of the carpet industry in these countries, which equals or exceeds that of the apparel sector. In general, the marked trend towards tufted carpet production shown by the United States of America does not appear to have been exhibited by the other major carpet producers.

It seems likely that carpets would be a commodity with a high income elasticity of demand and this factor, combined with a probable increase in the volume of cheaper tufted carpets on the market suggests that the expansion in world carpet production over recent years will continue with rising standards of living.

#### 1.5 The Domestic Market for New Zealand-Produced Carpet Wool

At present, no true carpet wool is produced in New Zealand. Local carpet manufacturers have had to fulfil their carpet wool requirements through imports, either in the form of raw wool or yarn. In 1961, 1,214,220 lbs of carpet yarn and 693,453 lbs of raw carpet wool were imported. (Customs Department estimates for carpet yarn and raw wool imports from U.K.). The total (F.O.B.) cost was £611,701. The approximate (C.I.F. N.Z.) cost would be £660,000. There is a 15 per cent ad valorem tariff on carpet yarns imported into New Zealand.

Assuming a 20 per cent spinning wastage and a yield of 75 per cent, these imports are equivalent to approximately 3,000,000 lbs of raw wool. To produce this quantity of carpet wool in New Zealand through the Drysdale breed would require approximately 300,000 Drysdale sheep - assuming an average fleece weight of 10 lbs. This figure represents less than one per cent of the present New Zealand sheep population.

The approximate charges for a typical shipment of Scottish Blackface wool to New Zealand are as follows:

Raw wool price to farmer	46d
Marketing cost @ 5d per lb	51d
Yield @ 75 per cent	68d
Scouring charges @ 2.5d	70.5d
Freight, insurance, etc. @ 8d	78.5d

The available evidence suggests that Drysdale wool does not differ markedly in its technical properties from Scottish Blackface wool of this price (average quality wool suitable for carpet manufacture).<sup>22/</sup>

Thus, assuming Drysdale wool has a yield of 75 per cent, the Drysdale wool price (greasy) that would just "break even" with imported Scottish Blackface wool is 59d per lb. Allowing for brokerage, handling, and scouring charges totalling 6d, this price would allow a price of 53d per lb to be paid to the Drysdale wool producing farmers. This price is about 13d above average prices at present being received for crossbred wool.<sup>23/</sup>

At the least, Drysdale wool sold to New Zealand carpet manufacturers could expect a premium of 6d per lb over Romney wool.

If true carpet wool was produced in New Zealand in sufficient quantities to allow local demand for this type of carpet fibre to be fulfilled, it is likely that the importation of equivalent carpet fibres would be prohibited. Thus the New Zealand carpet wool market would be a "protected" one. However, the recent decision to commence the production of nylon in New Zealand could possibly reduce the price for carpet wool that could be demanded in a protected

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<sup>22/</sup> The quality of Drysdale wool as a carpet pile fibre is discussed in Section 2.6 of Chapter 2.

<sup>23/</sup> Average New Zealand wool price paid at auction in the 1962/63 season was 42.84d per lb. (N.Z. Wool Commission, "Statistical analysis of wool offered at auction sales 1962-63 season". Wellington, 1963). After allowing for brokerage and handling charges, this price would allow a farmer's price of approximately 40d per lb.

market - if the appropriate type of nylon is produced at competitive prices.

#### 1.6 Summary of Chapter I

(i) World production of carpet wools as a proportion of the total world wool clip has declined considerably over the last decade, and, from the evidence available, it can be expected to decline further in the future. This decline has been due mainly to fleece "improvement" programmes in the major carpet wool producing countries.

(ii) The supply of carpet wool on the world market has declined even further than total world production, due primarily to an expansion of the domestic textile industries of the major carpet wool producing countries. Political events, in particular the continued falling off in trade between the communist bloc and the western world, have also affected carpet wool supplies to non-communist countries.

(iii) World supplies of lower crossbred wools suitable for carpet use have shown a continued steady increase. New Zealand is the major supplier of this type of wool.

(iv) Over the same period that this decline in carpet wool production has occurred, world production of machine-made carpets has steadily increased, this increase being proportionately considerably greater than that recorded for woven fabrics. Most of this increase can be accounted for by a marked expansion of the American carpet industry.

(v) Considering trends in carpet production and pile fibre consumption for the American carpet industry, the following changes have occurred:

a. Over the decade 1951-1961, American total carpet production has increased by roughly 150 per cent.

b. This has been due to a marked increase in the volume of tufted carpet shipments. Production of woven carpets has declined.

c. Together with this change in the type of carpet produced, there has been a significant change in the nature of the raw materials used, viz: A decline in the consumption of true carpet wools, an increase in the consumption of synthetic fibres, and a lesser increase in the consumption of crossbred wool.

d. The proportionate increase in synthetic consumption by the carpet industry is considerably greater than that shown by the apparel sector.

(vi) In the other major carpet producing countries production has also in general (U.K. being the major exception) increased, but to a lesser extent than the U.S. The marked trend towards tufted carpet production and synthetic fibre use shown by American manufacturers does not seem to have been duplicated by other manufacturing countries.

(vii) The present domestic market for New Zealand produced carpet wool (on the basis of carpet wool imports) is approximately 3,000,000 lbs. Carpet wool produced locally could expect a premium of 6d to 1/6d per lb over crossbred types.

## 1.7 Conclusions from Chapter I: The Potential Market for Drysdale Wool in Carpet Manufacture

### 1.7.1 The World Market

From the available evidence it seems likely that world carpet production will continue to expand with rising standards of living. An expanding demand for carpets as a floor covering however, does not necessarily mean a similar expansion in the demand for carpet wools. There have been recent marked changes in pile fibre consumption patterns, and the trend has been in general towards synthetic fibre and coarse crossbred wool use, and away from the true carpet wools.



The basic question arising from an investigation of these trends in fibre consumption is: Are the changes that have taken place in fibre consumption for carpet manufacture due to changes in demand or to supply effects? For example, considering pile fibre consumption by American carpet manufacturers: the reduction in the use of unimproved wool could be due to a fall in world supplies of this class of wool, coupled with a rising supply of synthetics and coarse crossbred wools or, it may be primarily due to a reduction in demand for this class of wool brought about by changes in carpet production technology. To quote from "Basic facts about the carpet and rug industry", <sup>24/</sup>

"Viscose, acetate, nylon, and acrylic types represent the result of intensive research and the industry's answer to limited world wool supplies and an unstable wool market".

Whether or not synthetic fibres and crossbred wool do, in fact represent "the answer" should be indicated by the relative price trends for carpet and crossbred wools. If carpet wool prices have shown a greater increase (or a lesser decrease) in price over say, a five year period than crossbred wools, this trend would indicate that synthetic fibres and crossbred wools are, in fact, an imperfect substitute for true carpet wools.

The price changes for fine wool (64's), crossbred wool (48's), Blackface and Swaledale wools from 1956/57 to 1961/62 are given in Fig. 1.1. These prices are not comparable in an absolute sense, as the fine and crossbred quotations represent C.I.F. (U.K.) clean prices, while the carpet quotations represent the prices paid at auction. However, in the absence of differential changes in marketing costs, the trend of these prices should give an indication of

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<sup>24/</sup> American Carpet Institute, "Basic facts about the carpet and rug industry", New York, 1962.

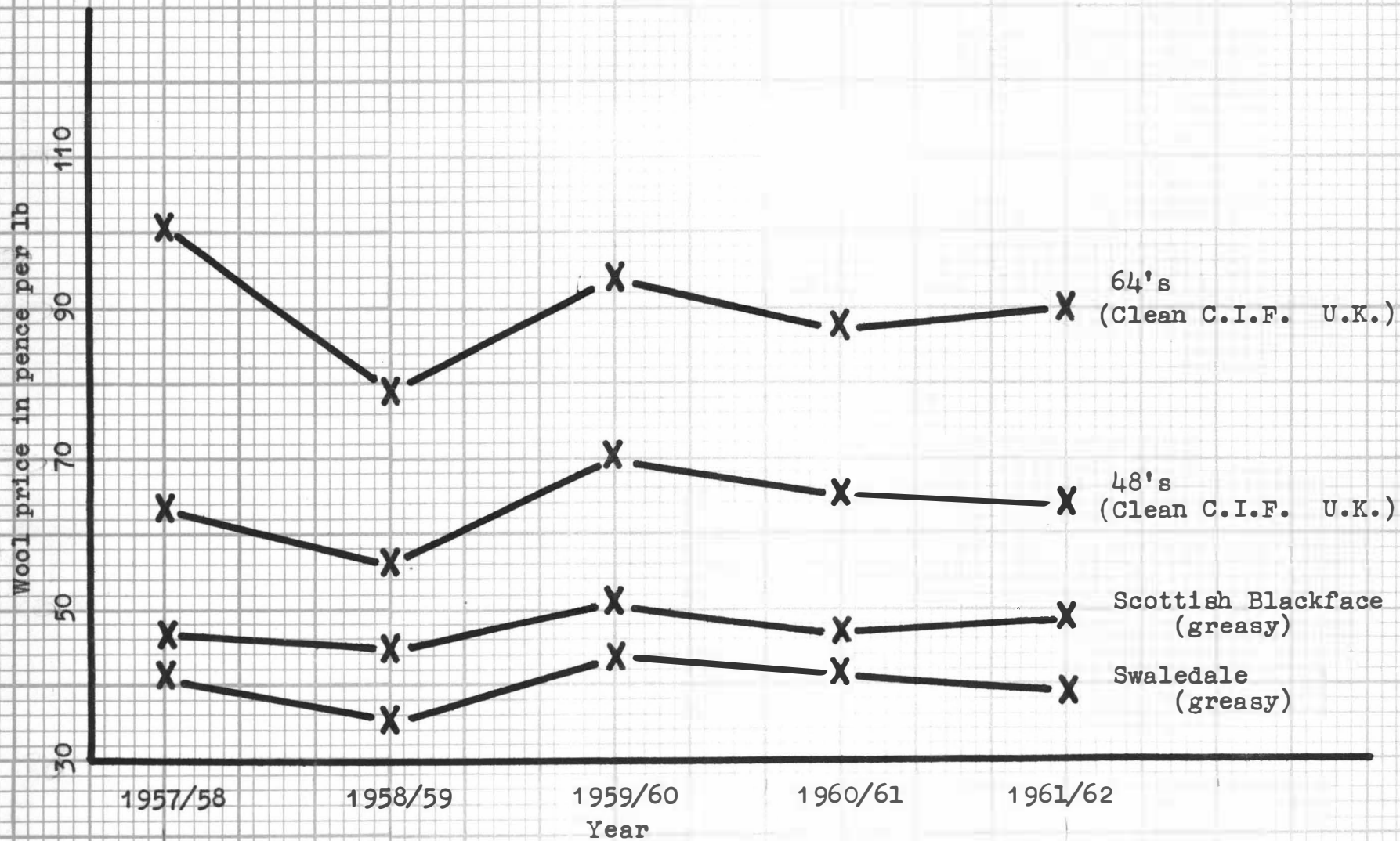


FIG 1.1: ANNUAL AVERAGE WOOL PRICES (U.K.)

the relative changes in demand for true carpet and crossbred wools.

Fig. 1.1 indicates that, if there is any trend in the relative prices of these four types of wool, such a trend is effectively masked by price fluctuations.

On the basis of this limited evidence on price trends (for the United Kingdom market only) it is not possible to draw any precise conclusion on whether or not the decrease in world supplies of carpet wool has been reflected in a rise in the price of carpet wool relative to crossbred wool.

On the other hand, as the same yarn is frequently used for both tufting and weaving, it would seem that the trend towards tufting shown by the United States of America has not been a major factor influencing carpet wool consumption in that country.

In view of this factor, trends in world carpet wool supplies, the probable expansion of the world carpet industry, and comments of experts in the carpet trade <sup>25/</sup> there would appear to the author to be no reason to think that the potential world market for New Zealand-produced carpet wool is any less favourable than that for New Zealand crossbred types.

#### 1.7.2 The Domestic Market

The important conclusion from the investigation of the local market for New Zealand-produced carpet wool is that Drysdale wool could expect a premium of up to 1/6d per lb over crossbred wool. This premium arises primarily from transport costs on imported carpet wool (mainly Scottish Blackface and Swaledale from the United Kingdom).

Thus, from the point of view of a production/marketing authority of the type described in Section 0.4, it seems likely that the pro-

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<sup>25/</sup> Ross D.A., Pers. Comm., 1962.

duction of Drysdale wool for the New Zealand market would be a profitable proposition provided that Drysdale wool was satisfactory as a carpet pile fibre, and that Drysdale wool production was profitable at the farm level. An investigation of these latter two factors forms the subject matter of Chapters II and IV respectively.

The production of Drysdale wool in New Zealand should also be to the benefit of the nation as a whole in that it would allow a saving of overseas funds. If the assumptions are made that there is no marked difference in the quality of the Drysdale and Romney carcass, and that Drysdales substitute for Romneys in a one to one stocking rate ratio, then the production of Drysdale wool in New Zealand simply to fulfil local carpet wool demand should allow a nett saving of overseas funds of approximately £123,000. This estimate is based on the figure for the C.I.F. (N.Z.) value of carpet wool imports in 1961 (yarn and raw wool) minus the F.O.B. (N.Z.) value of an equivalent amount of greasy New Zealand Romney wool.

## C H A P T E R   I I

### THE QUALITY OF THE DRYSDALE WOOL AS A CARPET PILE FIBRE

The "quality" of a carpet pile fibre is determined firstly by the processing properties of the raw fibre (that is, spinning, dyeing and weaving properties) and secondly by the contribution of the raw material to the quality of the manufactured carpet. The "ideal" carpet pile fibre would presumably be one that maximises the return to the carpet manufacturer - that is, a fibre which allows the production of the maximum amount of high quality carpet with the minimum of processing costs.

This Chapter outlines the factors influencing the quality of a carpet pile fibre according to the two criteria above, and assesses the suitability of Drysdale wool for carpet manufacture - as far as this is known at present.

#### 2.1 Types of Machine-Made Carpet and their Method of Manufacture

The major types of woven carpet are Axminster and Wilton. In recent years the world output of tufted carpet has increased considerably, and as tufting is a cheaper process than weaving, it seems likely that this trend will continue.

##### 2.1.1 Axminster Carpet

Axminster carpet is the main carpet type in every major machine-made carpet producing country except the United States of America. There are three important types of Axminster carpet - spool, gripper and chenille.

The first spool Axminster loom was developed in America about the middle of the nineteenth century. The major advantages of this type of carpet compared with the earlier-developed Wilton are that there is no necessity for "dead" yarn (that is, yarn of any

particular colour that does not show in the pile) and an unlimited range of colours can be produced. Production costs for spool Axminster are less than for Wilton provided reasonably long production runs are used. Setting-up costs comprise a large proportion of the total weaving costs.<sup>1/</sup>

Gripper Axminster carpet is a more recent development than spool, being first manufactured at the beginning of this century. As with spool Axminster there is no dead yarn, and gripper Axminster has the added advantages of allowing economical small orders, and a reduction in yarn wastage. The range of colour is restricted however, compared with spool. There are two main types of gripper weave - the Corinthian and the Kardax, the former being the cheapest and the most common. The pile tufts are inserted by means of a "gripper", a claw-like mechanism which selects individual tufts of yarn and places them in the backing threads. The design of the carpet is determined by a series of punched "jacquard" cards which allow the gripper to select yarns of the appropriate colour.

Chenille Axminster production has been falling due primarily to the high labour costs involved in the manufacture of this type of carpet. However, a very high quality carpet can be produced by this method.

### 2.1.2 Wilton Carpet

Wilton was the first machine-made carpet. The pile is in the form of a continuous length of warp. In patterned Wiltons the design is determined by a jacquard which causes yarn of the desired colour to be presented for tufting. The remaining colours lie

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<sup>1/</sup> Only important points of difference in the manufacturing process for different carpets are mentioned here. A much fuller description of the various aspects of carpet manufacture is given in Crossland A., "Modern carpet manufacture", Columbine Press, London, 1958.

"dead" in the body of the carpet. The dead yarn increases the bulk and "springiness" of the carpet, but in as far as this resilience can be achieved by cheaper backing materials, the Wilton carpet is unnecessarily wasteful of pile yarn.

### 2.1.3 Tufted Carpet

Tufted carpet production is, in general, cheaper than weaving, and the production cost economies are reflected in the retail price which is generally 10-20 per cent less than woven carpets of similar quality pile material. The rate of production of tufted carpet can be very high. The output from factory is usually limited by the speed of ancillary processes rather than the actual tufting operation. The yarn is fed into the tufting machine by sanded rollers and the rotation speed of these rollers determines the height of the pile; if this speed is high, more yarn is fed into the tufting needles with a corresponding increase in pile height. The backing material (usually jute fabric) is moved past the needles at a varying speed depending on the number of tufts per inch required. Tufted pile can either be cut or left in the looped form. A latex backing is applied to the completed pile fabric, and generally the carpet is dyed in the completed state.

### 2.1.4 Ancillary Processes

The manufacturing processes preparatory to weaving or tufting are in general, common to all methods of carpet manufacture. The carpet industry shows a higher degree of vertical integration compared with other textile industries, and frequently the whole manufacturing process - blending, carding, spinning, weaving, etc. - is carried out in the one factory.

The raw materials for carpet manufacture are true carpet wool, crossbred wool, synthetic fibres and backing materials.

The pile fibres are blended on a weight basis, oiled, and fed into a carding machine. The slubbings <sup>2/</sup> from carding are spun (with worsted yarns further combing takes place before spinning), and the hanks from the spinning machine are then scoured in preparation for dyeing. Today, woollen yarns are used to a much greater extent than worsted in carpet manufacture.

Dyeing is an extremely important process in carpet manufacture, and the ability of a carpet pile fibre to "take" different types of dye and to retain its colour in use is a major factor considered by buyers. Many carpet wools have the undesirable property of having discoloured fibres, or kemps, which will not "take dye". Some technical problems peculiar mainly to carpet fibre dyeing are: the large range of colours that it may be necessary to provide at short notice, the large weight of yarn that is required, problems arising from the use of blends of pile fibres, and the problem of accurately matching colours by subjective means. After dyeing, the hanks are dried and wound on to some type of bobbin in preparation for weaving. Following weaving, the carpet is "finished" - the major operations being; measuring, brushing and cleaning, back sizing, and steaming to "burst" the pile yarn.

There are, of course, variations on this procedure - for example; the pile fibre may be dyed before spinning, or in the case of tufted carpets, dyeing is generally carried out on the manufactured carpet. However, the above description very briefly outlines the general procedure most commonly used in the manufacture of machine-made carpets.

## 2.2 Criteria of Carpet Quality

To the carpet buyer, there would seem to be nine major criteria

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<sup>2/</sup> "Slubbing": A continuous strand of combed wool.



of carpet assessment:

(i) Pattern and colour. The colour and pattern of a carpet are not factors governing carpet quality per se. They are however, important factors in influencing a consumer's decision on whether or not to purchase any particular carpet. In that different fibres respond differently to various dyes, consumer preferences on colour are of importance in carpet manufacture. Apparent changes in pile colour over time may be due to light effects on the angle of the pile, or to photo-chemical changes in the dye. The former effect is due primarily to lack of resilience in the pile. "Red fade"<sup>3/</sup> is an example of the latter type of colour change.

(ii) Wear. Wear in carpets takes two forms - first, the disintegration of the pile fibre under abrasive pressure; and secondly, the loosening and pulling out of fibres or tufts from the backing material. Carpet wear is probably considered the most important criterion of carpet quality by carpet users. It is however, difficult for a carpet buyer at retail to assess the wearing qualities of any particular carpet.

(iii) Resilience. Resilience is a function of two factors; firstly, the work (foot pounds per square inch) required to compress the carpet pile, and secondly, the ability of the pile to retain its original form after the compressive pressure has been removed. Lack of resilience is manifested in tracking and shading. Resilience can be fairly easily assessed by the carpet purchaser.

(iv) Warmth. The apparent warmth of a carpet pile is governed mainly by the conductivity of the pile fibres. For example, wool has a low conductivity, and consequently feels warm to the touch. Warmth is easily assessed by the carpet purchaser.

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<sup>3/</sup> A colour change caused by dags in poorly skirted wool.

(v) Resistance to insect attack. The ability of a carpet pile to withstand moth and other insect attack was once of considerable importance. However, recently developed odourless insecticides have virtually eliminated this problem.

(vi) Dimensional stability. Rucking and folding were problems in the early development of the tufted carpet industry. Dimensional stability can easily be improved by increasing the strength and thickness of the backing material.

(vii) Resistance to dirt, and ease of cleaning. The ease with which a carpet soils depends primarily on the colour and pattern of the pile. Plain, light-coloured carpets show dirt more easily. The ease with which marks can be removed from the pile is also important.

(viii) Flamability - the propensity of the pile to scorch or burn.

(ix) Static electricity. Under conditions of low relative humidity, static electricity may be generated by the pile, causing a slight electrical shock to people walking on the carpet.

### 2.3 The Assessment of Carpet Quality

The material basis of carpet quality is, at present, not at all well understood. Research on carpet assessment is a comparatively recently developed field, and further investigation is needed, both on the method of assessment, and the relationship of the properties of the fibres used in carpet construction to the quality of the manufactured carpet.

The following brief review outlines the relevant literature on carpet assessment research.

#### 2.3.1 Wear

The factors governing wear in carpets have been listed by

Scheifer and Cleveland <sup>4/</sup> as follows:

- (i) The density, quality and height of the pile yarn.
- (ii) The type of pile anchorage.
- (iii) The type of carpet backing.

Because the compressive and abrasive action of a foot on a carpet is a complicated one, some workers have justifiably suggested that wear tests using machines do not give a very accurate indication of how a carpet will actually wear in commercial use.<sup>5/</sup>

Some of the machines that have been used for carpet wear testing are the Repenning impact tester, the Schlied wear tester, and the Martindale rubbing tester.<sup>6/</sup> A modification of the Scheifer testing machine has been designed at the Wool Industries Research Association.<sup>7/</sup> The W.I.R.A. machine is now available commercially and is used by carpet manufacturers.

Briefly, the machine consists of two revolving shafts with their centres slightly out of line. The specimen of the carpet to be tested is placed on the end of one shaft, and the abrading material on the other shaft. Abrasion is measured by pile weight loss per number of rubs, or the number of rubs to show the backing of the carpet. The major advantage of this machine is that it abrades the area of carpet being tested uniformly, and from every direction in its plane.<sup>8/</sup>

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<sup>4/</sup> Scheifer H.F. and Cleveland R.S., "Wear of carpets", Bureau of Standards Jnl. Res. 12:155, 1934.

<sup>5/</sup> Ross D.A., Pers. Comm., 1962.

<sup>6/</sup> Scheifer H.F., Fourt L. and Kropf R.T., "Textile testing in Germany. Part II. Serviceability evaluation of textiles", Text. Res. Jnl. 18:32, 1948.

<sup>7/</sup> Anderson S.L. and Dilworth S., "A comparison of the wear resistance of carpets 1. Methods of test", W.I.R.A. Bull. 18:55, 1956.

<sup>8/</sup> Scheifer H.F., "Solution to the problem of producing uniform abrasion, and its application to the testing of textiles", Text. Res. Jnl. 17:360, 1947.

The W.I.R.A. machine has been used to test carpet samples of different construction and pile material in comparison with commercial wear in an office corridor.<sup>9/</sup> It was suggested that the number of rubs to show the backing was a better measure of wear in practice than the rate of weight loss. However, the correlation coefficients are not given.

The effect of different abrasants on wear has been investigated by Clegg and Anderson.<sup>10/</sup> They found that the mean ranking of carpets of similar construction, but with different pile fibres, varied with the abrasant used.

Wear can also be caused by individual tufts pulling out of the carpet, and tests have been developed to measure tuft retention force.<sup>11/</sup>

From the above review, it would seem that, until a mechanical method of wear testing is developed which shows a high correlation with wear in practice, this aspect of carpet assessment will remain rather unsatisfactory.

### 2.3.2 Resilience

Carpet resilience has been studied by Beckwith and Barach using an instrument called a compressometer.<sup>12/</sup> Resilience was considered to be the ratio of the work returned on the release of the compressive load to the total work done in compression. It was suggested however, that the 'luxury feel' of a highly resilient carpet was indicated more clearly by a simple measure of the work of compression, rather than this ratio. The effects of compression (as

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<sup>9/</sup> Anderson S.L. and Clegg D., "The comparison of the wear resistance of carpets II. Laboratory tests and wearing trials in experimental carpets", W.I.R.A. Bull. 21:27, 1959.

<sup>10/</sup> Clegg D. and Anderson S.L., "Abrasion tests on carpets using different abrasants", Jnl. Text. Inst. 51:T385, 1960.

<sup>11/</sup> Snowden A.C., van Issum R. and Chamberlain N.H., Fed. Brit. Carpet Man. Bull No. 33, 1959.

<sup>12/</sup> Beckwith O.P. and Barach J.L., "Notes on the resilience of pile floor coverings" Text Res Inst 27:305, 1947

distinct from abrasion) have also been investigated at the W.I.R.A.<sup>13/</sup> As with wear testing the basic problem is to accurately simulate the complicated action of a foot on a carpet.

The cheapest and most easily used machine for the assessment of the general deterioration of a carpet in commercial use is the W.I.R.A. thickness tester.<sup>14/</sup> The thickness tester measures pile height under different pressures. Thus the test gives a combined measure of both resilience and wear at different times of the carpets use.

From the above brief discussion, it is apparent that further research is required on objective methods of carpet assessment. There are three fundamental problems: Firstly to devise a mechanical treatment which gives a high correlation with practical wearing, soiling, etc.; secondly to devise methods of accurately assessing carpet changes under treatment; and thirdly to relate the properties of yarn components, method of dyeing, method of weaving, etc., to the degree of deterioration of the carpet under treatment.

#### 2.4 Factors Influencing Carpet Quality

Clearly, the quality of a manufactured carpet is a function of both the material (pile and backing) used, and the method of manufacture. Two carpets of identical quality by one or more of the criteria listed in Section 4.2 may be produced from quite different pile fibres simply by using a different method of manufacture or different backing materials.

##### 2.4.1 Method of Manufacture

Probably the most important manufacturing influence on carpet

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<sup>13/</sup> Anderson S.L. and Dilworth S., Op.cit., p.57.

<sup>14/</sup> Anderson S.L. and Dilworth S., Op.cit., p.59.

quality, is the pile weight per unit area. For a given pile yarn, this ratio is a function of first; the tufts per unit area, and secondly the pile height. There is some evidence that, for a given pile weight, a shorter denser pile will wear better than a higher pile with fewer shots per inch.<sup>15/</sup>

Resilience in looped carpets is provided, to a certain extent, by the cantilever action of the loops. However, in general, the evidence suggests that for a given pile weight, the method of manufacture does not influence carpet quality to any extent. Beckwith and Barach <sup>16/</sup> found that after an initial wearing in period the form of a pile surface did not significantly effect the resilience of the pile, and other evidence corroborates this finding. The most important factors governing carpet quality would seem to be the weight and quality of the pile and backing materials used, rather than the method of manufacture.

#### 2.4.2 Materials Used

The basic problem in assessing pile fibres as far as their contribution to the quality of the final carpet is concerned, is that most carpet yarns are manufactured from blends of fibres, and an assessment of pile fibres individually is consequently somewhat unrealistic. The relationship of, say, wearing quality to the proportion of any particular fibre in the blend is likely to be non-linear. For example, if the wearing properties of filament nylon were known to be twice those of East Indian wool, a 50/50 blend of

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<sup>15/</sup> Anderson S.L. and Clegg D.C. "A comparison of the wear resistance of carpets III. Final report on the experimental carpet containing East Indian and New Zealand/British wools", W.I.R.A. Bull. 24:17, 1962.

<sup>16/</sup> Beckwith O.P. and Barach J.L., Op.cit., p.309.

filament nylon and East Indian wool could be expected to have wearing properties halfway between the individual components. However, in practice, the contribution of the filament nylon in the blend to the wearing properties of the manufactured carpet would probably be disproportionately large, and the blend would show wearing properties much nearer those of the unblended filament nylon.

Despite these limitations involved in examining pile fibres individually, some assessment of the different fibres commonly used in carpet manufacture can be made. Table 2.1 gives a cardinal ranking of the major pile fibres used in carpet manufacture according to their contribution to the quality of the completed carpet. Criteria of manufacturing quality are discussed in Section 2.5 below.

## 2.5 Manufacturing Properties of Carpet Pile Fibres

As outlined in Section 1 of this Chapter, the major operations involved in carpet manufacture are blending, oiling, carding, spinning, scouring, dyeing, weaving or tufting, and the "finishing" operations. The method by which these operations are carried out varies between manufacturers, and there is no such thing as an "ideal" pile fibre for every manufacturing purpose.

In comparing carpet pile fibres, the following manufacturing properties should be considered:

### 2.5.1 Carding and Combing Properties

The most important quality factor in the raw fibre as far as combing and carding properties are concerned, is the overall strength of the staple. If staple strength varies along its length, break can occur.<sup>17/</sup> The level of the break region in the staple is also important.

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<sup>17/</sup> Ross D.A., Bratt R.L. and Story L.F., "The effect of staple strength on carding and combing", Jnl. Text. Inst., T907:51, 1960.

TABLE 2.1: CARPET PROPERTIES OF VARIOUS PILE FIBRES

	Wearing quality	Resilience	Warmth	Resistance to Insect attack	Resistance to soiling	Resistance to heat and flame	Resistance to static electricity
True carpet wool	Fair	Good	Very good	Poor*	Good	Very good	Good
Crossbred wool	Good	Fair	Very good	Poor*	Good	Very good	Good
Nylon	Very good	Good	Fair	Very good	Fair	Fair	Fair
Rayon	Poor	Good	Fair	Very good	Fair	Poor	Fair

Sources: W.I.R.A. publications, various.

Lipson M., "Competition between fibres: Technological", Chapter 35 in "The simple fleece. Studies in the Australian wool industry", Alan Barnard (ED), Melbourne University Press, Melbourne, 1962.

Ross D.A., Pers. comm.

\* Research has overcome these disadvantages.



### 2.5.2 Spinning Properties

The desirable spinning properties for a pile fibre depend primarily on the degree of "twist" to which the yarn will be subjected. The major spinning characteristics of any fibre are the mean fibre length and diameter, and the frequency distribution of these parameters. The relative importance of each of these characters differs with different types of yarn. For example, the nature of the fibre length frequency distribution is less important with woollen than with worsted yarn as the former is subjected to less twist.

### 2.5.3 Dyeing Properties

The important dyeing characteristics in a pile fibre are firstly, the ease with which the fibre can be dyed to the desired shade, and secondly, the ability of the dyed fibre to maintain its colour in commercial use. The importance of dyeing properties depends on the colour required. For example, in a pastel carpet discoloured fibres in a carpet wool may be a major problem. In a dark shade carpet however, fibre colouration may be only of minor importance. Colour changes in use are generally caused by photo-chemical changes in the dye.

### 2.5.4 Weaving and Tufting Properties

The principal requirement of a yarn for both weaving and tufting is regularity. Again, the importance of various yarn characteristics depends on the method of manufacture. For example, in tufted carpet manufacture, small irregularities in the yarn can be of major importance. Similar irregularities would probably be of less importance in woven carpet manufacture.

## 2.6 Properties of Drysdale Wool as a Carpet Pile Fibre

There has been a considerable amount of speculation concerning the merits of Drysdale wool as a carpet fibre. Three attempts have been made to assess the quality of carpets made from Drysdale wool and only one of these has been satisfactorily completed.

Present knowledge on the carpet properties of Drysdale wool is due almost entirely to Nash,<sup>18/</sup> and unless specifically mentioned, the results given below are those obtained from his work. The results are given in some detail, as the carpet properties of Drysdale wool are a critical factor in deciding whether or not the production of Drysdale wool in New Zealand is to be commercially successful.

### 2.6.1 Method of Analysis Used

Wool from the following genotypes, N/N, N/+, nr/nr,  $\frac{1}{2}$  Cheviot-N/N,  $\frac{1}{2}$  Cheviot-N/+,  $\frac{1}{4}$  Cheviot-N/N,  $\frac{1}{4}$  Cheviot-N/+,  $\frac{1}{2}$  Lincoln-N/N,  $\frac{1}{2}$  Lincoln-N/+,  $\frac{1}{4}$  Lincoln-N/N and  $\frac{1}{4}$  Lincoln-N/+ - was spun into a woollen yarn, manufactured into a Gripper Axminster carpet, and tested in comparison with a control blend containing East Indian wools, Welsh wools, continental skin wools and New Zealand crossbred types. Dyed and undyed samples were tested.

The raw wool was assessed subjectively by experienced carpet wool buyers. Measurements were taken of staple length, fibre length and diameter, medullation and percentage composition of fibres in the staple. Measurements were also taken on the yarn after spinning.

The following assessments were made on the completed carpet:

- (i) Pile weight per square yard.
- (ii) Abrasion testing using the W.I.R.A. tester.

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<sup>18/</sup> Nash C.E., "The assessment of N-type fleeces", Ph.D. thesis. University of Leeds, 1962.

(iii) Tuft withdrawal force.

(iv) A practical wear test with various thickness and resilience measurements at various stages of wear.

(v) A subjective assessment of the newly-manufactured carpet.

### 2.6.2 Results and Conclusions

The staple length was, for manufacturing purposes, excessively long. The author suggests that the most suitable way of remedying this problem would be by shearing twice a year. Double shearing would also be beneficial in producing a more even diameter along the length of the fibre. The "weak base" of Drysdale wools was considered to be a most important defect by buyers. The decrease in average fibre diameter along the length of the staple was confirmed by microscopic tests.

The fibre length frequency distribution showed the expected bimodal distribution,<sup>19/</sup> and it was suggested that this may cause weakness in the yarn due to a comparative absence of fibres in the trough of the frequency distribution.

Medullation was higher with increasing levels of the N gene, and it was suggested that this was due to the medulla being sustained more completely down the staple.

The results from mechanical abrasion were not related directly to count, but there was a significant relationship between pile weight loss under abrasion, and medullation - the highly medullated wools abraded more rapidly. The part Lincoln wools with a low degree of medullation showed the least wear. However, the most highly medullated blend was the control blend and it ranked sixth (out of twelve samples) in the wear test. This suggested that

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<sup>19/</sup> Due to the high dp/ds ratio common to all true carpet wools.

other factors such as the "bursting" properties of the blend played a part in resisting abrasion. The practical wear test confirmed that the part Lincoln carpets were the most resistant to wear. However, the Cheviot cross and pure Drysdale carpets retained their thickness better under commercial use, and this was probably due to a higher degree of medullation of these wools. Although medullated wools in general wear more quickly, they are generally more resilient, and hence, carpets manufactured from medullated wools could possibly be expected to maintain their thickness more satisfactorily under commercial use.

The various factors which contributed to the quality of the manufactured carpets were aggregated for each blend, and a ranking was given. The conclusions from this ranking were that firstly, the homozygote wools were all more satisfactory than the heterozygote, and that secondly, the  $\frac{1}{4}$  Cheviot-N/N and N/N wools were most suitable for the type of carpet manufactured in this trial. This result was confirmed by the assessment of experts in the carpet trade. These wools have most of the properties necessary to make a good pile yarn. Their major limitation was the failure to sustain coarseness down the full length of the staple, but, as suggested earlier, this limitation could probably be reduced with double shearing. The addition of a small proportion of highly medullated wool would also probably eliminate this deficiency.

From this one study, and on the basis of the comments of a limited number of carpet manufacturers on the carpet properties of Drysdale wool,<sup>20/</sup> it can be concluded that Drysdale wool shows no major deficiencies as a carpet pile fibre. Further research should be designed to ascertain the properties of Drysdale wool in tufted carpet manufacture, and its performance in blends with synthetic fibres and other wools.

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<sup>20/</sup> Dry F.W., Pers. comm., 1962.

## C H A P T E R III

### MARKETING SCHEMES FOR DRYSDALE WOOL

#### 3.1 Introduction

The objective of this Chapter is to discuss the advantages and disadvantages of alternative schemes for marketing various quantities of Drysdale wool. The schemes are considered within the commercial frame of reference described in the introduction to the thesis.

The marketing system used for Drysdale wool could clearly influence both its competitive position vis a vis synthetics and other carpet fibres, and the profitability of Drysdale production at the farm level. For example, it has been claimed <sup>1/</sup> that fluctuating prices are an undesirable feature of the auction system of wool marketing. If this is true, and if Drysdale wool was sold at fixed prices, this would make it relatively attractive (to some carpet manufacturers at least) compared with other carpet wools sold through auction. At the farm level, if Drysdale wool was purchased from the farmer at fixed prices under some form of contract agreement, the risks involved in the adoption of the new technology would be less than if the wool was to be sold at unknown and varying prices through the auction system.

The long term trend in carpet fibre prices will, of course, depend on fundamental supply/demand forces. The supply/demand situation for carpet fibres has been discussed in detail in Chapter I, "The Potential Market for Drysdale Wool". The system of marketing used for Drysdale wool cannot effect these long-term trends. It can however, be an important factor in influencing the share of the

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<sup>1/</sup> Weisser M., "Stabilisation of wool prices" in "The simple fleece. Studies in the Australian wool industry", Melbourne University Press, Melbourne, 1962. p.511.

total carpet fibre market taken by Drysdale wool.

The most desirable system for marketing a Drysdale clip would depend, among other factors, on the amount of Drysdale wool available. For example, the sale of Drysdale wool at fixed prices through some form of central marketing organisation would not be profitable unless sufficient wool was handled to cover the costs of stock holding, classing, etc. On the other hand, marketing Drysdale wool directly from farmer to manufacturer would not require large quantities of wool. Thus, in the initial stages of the development of a Drysdale production/marketing programme, the sale of Drysdale wool directly from farmer to manufacturer could possibly be the most profitable marketing system. With greater quantities of wool available however, the development of a central marketing organisation handling wool both for the domestic and export markets might be a more efficient system.

It seems likely that it would take at least ten year's expansion of Drysdale sheep numbers to fulfil even present New Zealand domestic carpet wool requirements (See Appendix A.1). The conclusions from Chapter I suggest that Drysdale wool prices on the domestic market are likely to be higher than those received from exported wool. Thus, for the first ten years at least, primary consideration should be given to marketing Drysdale wool locally.

### 3.2 Problems in Evaluating Wool Marketing Systems

Briefly, an efficient marketing system can be considered to have two major characteristics: Firstly, the marketing system should channel supply to demand through an effective channel of communication; and secondly, the system should fulfill this operation at the lowest possible cost.<sup>2/</sup> The degree of effectiveness of any

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<sup>2/</sup> The criteria of efficiency for a marketing system will depend of course, on whether the system is being considered from the point of view of the producer, the consumer, or the marketing agent. An efficient marketing system from a wool producer's point of view is one that maximises his returns, while from the consumer's point of view, an efficient marketing is one that minimises his cost. In the long run, however, the producer and consumer views of efficiency reduce to the definition given above.

marketing system in channeling supply to demand should be reflected in the gross return received for the wool and the volume of wool sold.

It should be possible to evaluate the marketing cost for a marketing system with a high degree of accuracy. The expected consumer demand resulting from the adoption of any particular marketing system which has not been used for wool to date cannot be determined with any certainty. If a marketing system were to provide advantages which are not provided through the auction system however, it would be reasonable to expect manufacturers to pay some premium for wool marketed in this way, the comparison being, of course, with respect to wool of equal technical merit. For example, most of the criticism of the auction system of wool marketing through which nearly all the New Zealand clip is sold at present, has suggested some form of central marketing organisation as a suitable alternative.<sup>3/</sup> The costs of such a scheme can be evaluated with reasonable certainty.<sup>4/</sup> The change in total revenue from the sale of wool compared with that obtained if the same wool was sold through the auction system is extremely difficult to determine numerically. It is suggested however, that purchasing wool from such a central authority would provide advantages to manufacturers which are not available through the present (auction) system of wool marketing.<sup>5/</sup> Thus it seems likely that manufacturers could be expected to pay some premium for wool marketed in this way - although the magnitude of this premium would be difficult, if not impossible to determine ex ante.

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<sup>3/</sup> For example see: Boyer R., "Thoughts about a central marketing authority for wool" in "The simple fleece. Studies in the Australian wool industry", Melbourne University Press. Melbourne, 1962. p.520, and Philpott B.P., "Economic aspects of wool marketing", Wool (M.C.W.A.) 3: No. 4, p.19.

<sup>4/</sup> Boyer R., Op.cit., p.537 and "Report of the wool marketing committee of enquiry", Commonwealth of Australia Government printer. Canberra, 1962.

<sup>5/</sup> These possible advantages are discussed in Section 3.3 below.

### 3.3 Alternative Methods of Marketing Drysdale Wool

Three possible ways in which a Drysdale wool clip could be marketed would be:

(i) Through wool marketing channels at present available. That is, growers may forward their wool to brokers or dealers, who, after varying degrees of preparation, submit the wool for inspection by buyers. The wool may be sold through auction, or directly to buyers. Drysdale wool sold through auction would be eligible for the protection against price fluctuations afforded by the reserve price scheme operated by the New Zealand Wool Commission.

(ii) Through some form of central marketing organisation. The wool producers could be under some form of contract to this organisation, or they might be free to sell their clip through other channels.

(iii) Through a direct agreement between carpet manufacturers and farmers. This arrangement might involve some form of formal contract, or manufacturers may simply purchase their raw wool from farmers as required.

In this section, the advantages and disadvantages of these three marketing schemes at various levels of Drysdale wool production will be discussed.

#### 3.3.1 Marketing Drysdale Wool on the Domestic Market

All three of the possible schemes listed above could be used to market Drysdale wool from New Zealand farmers to New Zealand carpet manufacturers. Any form of central marketing organisation however, would have fixed costs, and the small amount of Drysdale wool that would be available initially could mean that insufficient wool would be handled to allow such an organisation to operate profitably.



A specialist central marketing organisation and direct sale from farmer to manufacturer are marketing schemes which have not been used to any extent for wool to date. An evaluation of any new marketing system necessarily involves some sort of comparison with the status quo, the status quo being in this case, the auction system.

The major disadvantage of the present system of wool marketing would seem to be the price instability produced. In that wool price fluctuations may not necessarily reflect true changes in demand, they lead to an inefficient marketing system because manufacturers' wants are not always accurately transmitted to the wool producers through price differentials. Price fluctuations are undesirable to manufacturers as they may suffer windfall loss on wool inventories held.<sup>6/</sup> Manufacturers can reduce the effect of price fluctuations by forward buying and hedging on the future's market. These operations however, involve commercial decisions which are not necessary when purchasing synthetic fibres. The available evidence indicates the future's trading is fairly effective in reducing risks incurred by manufacturers and other handlers of wool but of course, the commercial operations involved require time and capital.<sup>7/</sup>

A further possible disadvantage of the present wool marketing system is that the marketing cost may be, in some cases, unnecessarily high due to repetitive and (for some manufacturing purposes) unnecessary handling and classing.<sup>8/</sup>

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<sup>6/</sup> The causes and effects of wool price fluctuations are discussed in much more detail in the literature on economic aspects of wool marketing. See for example: Boyer R., Op.cit.; Weisser M., Op.cit.; Philpott B.P., Op.cit. and Chislett G.D., "An investigation into wool marketing", Australian Wool Growers' Council, Sydney, 1959.

<sup>7/</sup> Gruen F.H., "The case for the present marketing system" in "The simple fleece", p.500 and Weisser M., "Cost and benefit of hedging wool", Quart. Rev. Agric. Eco., 15:160, 1962.

<sup>8/</sup> Boyer R., Op.cit., p.529.

Thus, it can be argued that the auction system of wool marketing is not always an "efficient marketing system" by the criteria given in section 3.2 above as it may not provide an effective channel of communication between wool producers and wool users, and in some cases, the marketing cost may be unnecessarily high.

The sale of Drysdale wool directly from farm to manufacturer would seem to have two major advantages over sale through auction:

- (i) A reduction in brokerage and handling charges.
- (ii) Direct communication between farmer and manufacturer can take place.

The possible disadvantages of direct sale compared with auction sale are:

(i) The wool would be displayed to fewer potential buyers. As Drysdale wool would represent only a small part of total sales at any auction however, it is unlikely that it would attract the attention of many buyers, and thus this possible disadvantage would not seem to be of major importance. In any case, there are only 13 carpet-manufacturing firms in New Zealand and thus at the most only 13 potential buyers of carpet wool for New Zealand use.

(ii) If brokers could provide a cheaper and more efficient classing service for Drysdale wool than farmers or manufacturers then the lack of this service would be to the disadvantage of direct sale compared with auction. In that New Zealand wool classers will have had virtually no experience in handling true carpet wool, it seems likely that their contribution towards the useful grading of Drysdale wool would not be very great. As the wool would undoubtedly be used in different blends and for different manufacturing purposes, grading could probably be carried out most efficiently at individual factories. The saving in brokerage and handling charges an expected 2 to 3 pence per lb on the basis of similar charges for

crossbred wools) would mean that the price of the wool to the manufacturer could be correspondingly less.

On the basis of this assessment of the possible advantages and disadvantages of direct sale over sale through auction, the conclusion is made that marketing Drysdale wool directly from farmer to manufacturer would be the more efficient marketing system for the New Zealand market.

The further alternative listed above was marketing Drysdale wool through some form of specialist organisation. The minimum scale of such an organisation would be the employment of one specialist carpet wool classer. This classer's salary and travelling expenses would amount to at least £2,000. If a "reasonable" charge for this service was considered by the Drysdale producing farmers to be 2d per lb, then at least 240,000 lbs (approximately 650 bales) of Drysdale wool would be required. Although this amount of wool could be produced within the next five years given an intensive programme to expand present Drysdale numbers, it is clear that, in the immediate future, insufficient Drysdale wool will be available to make even a small-scale Drysdale marketing organisation practicable. Even at the stage in the expansion of Drysdale numbers where sufficient wool was available to allow a specialist Drysdale marketing organisation to operate profitably, there seems to be no apparent advantages of such an organisation as compared with direct sale in marketing Drysdale wool to local manufacturers.

A suggested plan for the organisation of a scheme involving sale of Drysdale wool directly from farmers to manufacturers will now be outlined.

### 3.3.2 The Organisation of Drysdale Wool Marketing for the New Zealand Market

At present Drysdale rams are loaned by Massey University College

under a written agreement with a carpet manufacturing firm. This firm in turn loans rams to selected farmers. This relatively rigid method of control is considered necessary because it would be undesirable to have untraced Drysdale stock in commercial Romney flocks. The farmers who have entered the scheme supply Drysdale wool at a known premium (over Romney wool produced off the same farm) under a written contract agreement.

In the author's opinion, this system would be in principle, a satisfactory way of fulfilling all local carpet wool demand. The administrative details of a suggested scheme are outlined in Sections 3.3.2.1 and 3.3.2.2 below.<sup>9/</sup>

#### 3.3.2.1 Agreement between Massey University College and Carpet Manufacturing Firms

Due to the possibilities of unknown genetic effects and the apparent attitude of the Romney Marsh breed society towards the Drysdales, it would seem to be desirable to maintain a fairly rigid level of control of any expansion of the Drysdale breed. Taking account of this factor, the research facilities available at Massey, and the fact that a Drysdale flock will probably be maintained at Massey for research purposes, it is felt that it would be desirable to retain Massey as a central stud. Drysdale rams could be selected by Massey staff according to the wool type required by each particular carpet firm.<sup>10/</sup> It is suggested that the carpet firms pay a levy to Massey for the loan of rams of £10 per ram per year. The balance of

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<sup>9/</sup> There are obviously numerous minor variations which could be made to any suggested scheme. It is beyond the scope of this study to discuss all these variations here.

<sup>10/</sup> It seems likely that most New Zealand carpet firms would seek the coarsest possible wool type which they would use to "toughen" blends with finer crossbred wools.

this levy after all costs had been paid could be used to finance further research into problems concerning the Drysdale breed.<sup>11/</sup> To maintain the desired level of control, manufacturers would be permitted to dispose of rams only to farmers under a formal contract with them. The rams would remain the property of Massey University College.

### 3.3.2.2 Agreement between Carpet Manufacturers and Farmers

It is suggested that the following be the general conditions of a formal contract between farmers and manufacturers:

- (i) N/N rams would be supplied to co-operating farmers free of charge.
- (ii) These rams would be mated according to the directions of the carpet firm. In this way, each firm could direct wool production according to their particular requirements.
- (iii) All wool would be supplied directly to the carpet firm. Probably, the most efficient pricing system would be a known payment based on a specialised carpet bareme. This bareme may differ between firms. A system in which payment is on the basis of fixed premiums for N/N and N/+ wools (over Romney wool produced off the same farm) would seem to be undesirable in that there is no real incentive to improve the carpet quality of Drysdale wool. If a farmer felt that the price he was receiving for Drysdale wool was unsatisfactory he could always terminate his contract with that particular firm and, if he wished to continue carpet wool production, form a contract with another firm.
- (iv) The contract could be terminated with one year's notice from either party. The carpet firm would be obliged to buy in all Drysdale stock at ruling Romney prices, thus allowing the

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<sup>11/</sup> This aspect is discussed more fully in Chapter V.

farmer to replace his depleted stock numbers at zero cost. This clause would be to the disadvantage of the carpet firm in that they could have a quite large potential liability. This liability would be equal, at the most, to the difference between Drysdale store stock prices and Romney store stock prices multiplied by the number of animals involved.

(v) All male progeny would be castrated and surplus stock would be sold under the direction of the carpet firm. Ewes may be sold fat or as fat lamb dams. If ewes were sold for further breeding, the carpet firm would formulate an agreement with the farmer to whom they were sold.

A contract agreement of the type described above is obviously subject to abuses. For example, there is no real way of ensuring that all male stock are castrated. However, any agreement could not be completely inviolate, and it is felt that a contract of the general form described above would provide the maximum possible level of control of the expansion of the Drysdale breed, and also allow maximum communication between farmer and manufacturer.

If the average Drysdale wool price paid to farmers by a particular carpet firm was 48d per lb, and this firm's annual carpet wool requirements were 100,000 lbs, then the cost of fulfilling these carpet wool requirements with Drysdale wool would be as follows:

Raw wool cost. 100,000 lbs @ 48d per lb	20,000
Levy on rams. 140 rams @ £10 per year	<u>1,400</u>
	<u><u>21,400</u></u>

That is, price per lb of Drysdale wool = 51.4d per lb.

The cost of imported Scottish Blackface wool would be approximately 55d per lb. The nett saving to the carpet firm is therefore approximately £1,500 in total, or about 3.5d per lb of wool.

This estimate is based on the price of Scottish Blackface wool being lower than average. It should not be necessary for the carpet firms to employ extra staff to administer the scheme. The allocation of rams and other details should be able to be handled by the firms' wool buyers or other members of the executive staff.

A Drysdale wool price of 48d per lb represents a premium of about 9d over present Romney prices. The nett gain to the Drysdale producing farmers depends, of course, not only on the Drysdale wool price, but also on the price of Drysdale cull stock and the production characters of fertility and thrift. The expected return to Drysdale farmers is discussed in Chapter IV.

### 3.3.3 Marketing Drysdale Wool for Export

It seems unlikely that a contract agreement between overseas carpet manufacturers and New Zealand farmers would be a feasible system of marketing Drysdale wool for export due to difficulties of communication and administration. Thus, the alternative channels available for marketing Drysdale wool for export would seem to be; either through marketing systems at present available, or through some form of specialist Drysdale wool marketing organisation.

It is worth reiterating that it is unlikely that there will be sufficient Drysdale wool available to allow more than negligible quantities for export within the next five to ten years.

Of the two alternatives above, it would seem that a specialist Drysdale wool marketing organisation would have the following advantages over sale through auction in marketing Drysdale wool for export:

(1) A specialist marketing organisation could achieve a similar level of control of the expansion of Drysdale numbers as the contract arrangement described in Section 3.3.2 above. At the stage when Drysdale stock numbers are at a level sufficient to provide wool for export however, the breed may be more acceptable to breed

societies and others who have objected to it to date, and consequently rigid control may not be necessary.

(ii) One of the criticisms of the auction system discussed in Section 3.3.1 above was that the system does not always accurately communicate manufacturers' wants to producers through price differentials. Because a specialist organisation would have specialist knowledge on carpet manufacturers' requirements, it is felt that such an organisation could transmit manufacturers' needs more accurately to growers.

(iii) Only grading that was considered necessary for any particular manufacturing purpose would be carried. Thus there would be possible cost savings compared with selling through brokers. On the basis of this assessment it is concluded that marketing through a specialist organisation would be a more efficient way of exporting Drysdale wool than through auction.

The organisation of a possible Drysdale marketing organisation will now be briefly discussed. Again, there are numerous possible minor variations to any suggested scheme, which are unnecessary to discuss here.

#### 3.3.3.1 Suggested Organisation of a Possible Small-Scale Marketing Organisation for Drysdale Wool

It is suggested that initially, the employment of one man, qualified in the assessment of wool for different types of carpet would be adequate to handle all the Drysdale wool likely to be available for export within the next 10 years (See Appendix A.1). This carpet wool classer would act as a specialist carpet wool dealer.

It is envisaged that this carpet wool dealer would spend at least three months per year in the major carpet manufacturing countries, talking with carpet manufacturers and providing technical advice on



the use of Drysdale wool in carpet manufacture. The balance of his time would be spent in administering the scheme, providing technical information on Drysdale wool and, during the shearing season, he would be engaged in shed classing. As far as possible, classing would be carried out to suit the requirements of particular manufacturers. He would also select rams for farmers in the scheme from a central stud run by Massey University College.

The scheme could be financed from the farmers involved, either in the form of a direct levy on wool sold, or in the form of a share contribution to a limited company. Probably a levy system would be simpler to administer and more acceptable to farmers. The approximate annual expenses of such a scheme would be as follows:

Salary of classer	1,500
Overseas travelling expenses	1,000
Car running	<u>500</u>
Total	<u>3,000</u>

If a "reasonable" levy was considered by farmers to be 2d per lb of wool, then at least 360,000 lbs of wool would be required (about 1,000 bales). The classing and other marketing arrangements for this quantity of wool should be able to be handled by one man as long as shearing dates are reasonably evenly spread. In some cases, it may not be necessary to class at the same time as shearing.

The wool price received by farmers would be simply that paid by manufacturers minus the handling and transport charges. A scheme such as this does not provide all the advantages of the type of marketing system used for synthetic fibres (fixed prices, immediate delivery, etc.). Its main advantage would be that it is a specialist organisation, specialising in handling Drysdale wool for particular end uses. Because of this, it seems likely that manufacturer demand for wool marketed in this way would be somewhat higher than if it was

marketed through auction.

A more extensive central marketing organisation for Drysdale wool that held stocks, and supplied wool at fixed prices for immediate delivery would require more Drysdale wool for its economic operation than is likely to be available within the next 15 years. Consequently the author feels that consideration of the details of the operation of such a scheme is beyond the scope of this study.

## C H A P T E R IV

### FARM MANAGEMENT ASPECTS OF DRYSDALE WOOL PRODUCTION

#### 4.1 Introduction

In any investigation of the desirability of the adoption of a given technological innovation by any individual farmer, there are four fundamental points to be considered:

- (i) The change in nett revenue resulting from the adoption of the innovation.
- (ii) The way in which the innovation "fits in" with the fixed resources of the present farming situation.
- (iii) Any changes in the variability of total nett revenue which result from the adoption of the innovation.
- (iv) The capital required to develop the innovation.

Formally, of course, capital does not differ from any other scarce resource. However, if the capital required can only be obtained by borrowing, and the possibility of borrowing depends on the nature of the innovation, the security available, and possibly other factors, these financial considerations should probably be evaluated separately.

The objectives of this chapter are to assess the profitability of Drysdale production over a range of production coefficients and prices, for two hypothetical "benchmark" farms, and an actual case farm. For the two hypothetical farms revenue per ewe-equivalent from a Drysdale flock is compared with that from the present farming system over a range of conditions. The case farm study involves a more detailed analysis and includes such factors as risk and uncertainty, and possible effects of genetic selection.

The commonest technique used in assessing the profitability of the adoption of a new technology by any individual farmer is, of course, the partial budget. The partial budget compares two

technological situations - with and without the innovation, at some static point in the future. If the change in nett revenue resulting from the adoption of the innovation is a positive figure, then the innovation is said to be "profitable". It is assumed that the judgment of the person formulating the plan allows only "feasible" (in terms of fixed resources and the input/output requirements of the innovation) plans to be compared.

The analytical technique of linear programming allows a more complete evaluation of the new technology in terms of the first two criteria above, in that the programme selects the most profitable combination of all farm activities (including the new technology) within the limitations of fixed resource availability. The partial budget compares two plans only; a linear programme compares a whole range of plans, and selects the optimal combination of activities.<sup>1/</sup>

Considering the nature and scope of this study and the limited resources available, it was decided that a detailed linear programming analysis in which Drysdale production was incorporated as an activity competing for scarce resources with the activities of the present farming situation on one or more case farms, was not required at this stage.

Linear programming is used however, to determine the most profitable combination of age classes in a Drysdale breeding flock. The revenue from the plan is determined over a range of production coefficients and prices, and compared with that from the present policy on two hypothetical case farms. A "break even" Drysdale wool price is derived for each farm.

The farmer adopting a new technology is in an uncertainty situation with respect to both expected future production and future

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<sup>1/</sup> These points of comparison between linear programming and budgeting are discussed more fully by: Candler W.V., "A new look at budgeting from the standpoint of linear programming", Aust. Jnl. Agric. Eco. 3:46, 1959.

prices. In a partial budget, only the production coefficients of the present farming system are known with any certainty. Future prices of both the products of the present farming system, and the products resulting from the adoption of the new technology are unknown. In the case of the Drysdales, the physical production coefficients of the breed are also not known with any certainty.

The effects of variability in price and input/output coefficients can be examined using a parametric budget or a parametric linear programme.<sup>2/</sup> In this study, there are two major benefits arising from the use of parametric programming:

(i) The effect on nett income of variations in price or technical coefficients can be observed over a range of interest. If, over quite a wide range in say, average wool weight, the nett income from the plan does not vary by more than a small amount (say 1 per cent) it can be concluded that variations in wool weight are not of major economic significance. The effect on nett income of any variation in any technical coefficient can be examined, and, from this assessment of relative economic importance, criteria for selection or future research with the breed can be developed.

(ii) Nett revenue at different Drysdale wool prices can be calculated, and the Drysdale wool price that just breaks even with the present farming system on any farm can be determined.

From Chapter III, it can be seen that, both the expected financial return from the Drysdales, and the variability of this return over time are intimately related to the system of marketing the products (wool, carcass, and possibly store stock) of the breed. Clearly, if the farmer is under a contract agreement of some type, and the future prices for one or more of the commercial products of the breed are therefore known, the uncertainty due to possible price

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<sup>2/</sup> Candler W.V., Op cit.

variation is eliminated. Uncertainty due to lack of knowledge on production characters however, still remains. If the Drysdale wool was sold through the auction system, it is quite possible that the price received by the farmer would be higher, in some cases, than under a contract agreement, but the potential variability of this price would also be higher. Which marketing system is desirable from any individual farmer's point of view depends primarily on the nature of his indifference system.<sup>3/</sup> The relationship of the marketing system to the profitability of carpet wool production and the variability of the expected returns is discussed with reference to a case farm in Section 4 of this Chapter.

#### 4.2 Technical Coefficients for Budgeting and Linear Programing Analysis of Drysdale Farming Plans

The input/output coefficients used in formulating a budget or a linear programme can be obtained from two sources:

(i) The results of controlled experiments conducted at research institutions or on farms, by research workers.

(ii) Empirical knowledge based on farmers' experience.

Farm management workers generally utilize both these sources of information. In the case of a newly developed technology however, which has yet to be exploited commercially, empirical knowledge from practical experience is not available. This situation applies, in part, to the commercial development of the Drysdale "breed". Although a small flock of Drysdales has been maintained by Massey College for over twenty years and records on various productive characters have been kept intermittently, it is likely that data obtained from these sources would not be very conclusive. The major

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<sup>3/</sup> See Heady E.O., "Economics of agricultural production and resource use", Prentice Hall. New York, 1952. Chapter 17.

reason for this conclusion is that, in general, the Drysdale's have not been run under husbandry conditions which are comparable to those maintained for the commercial Romney flock. This situation appears to be due primarily to the fact that when the Drysdale's were not being used experimentally they were, for various reasons, somewhat neglected. Neither experimental conditions (where the experiment is designed to determine fundamental wool biology or genetic characteristics of the breed) nor conditions under which the general standard of husbandry is lower than that for other flocks on the same farm, are suitable situations from which empirical knowledge can be derived.

In the following discussion, the limited empirical knowledge available from practical farming situations will be combined with experimental results to derive coefficients for use in a farm management analysis. Estimates will be derived for such productive coefficients as wool weights, lambing percentages, etc. The reliability of these estimates under farm conditions will be discussed.

There are four major characters of economic importance in a carpet wool producing breed. They are: Fleece production, carcass production, fertility and thrift. The relative importance of each of these characters is not constant, but will vary over time as the relative prices of meat, wool and surplus stock vary.<sup>4/</sup>

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<sup>4/</sup> This concept of "relative economic worth" has been discussed in relation to the construction of a selection index by Rae A., "Some suggested improvements for the present day Romney", M.A.C. Sheep farmers' annual p.155, 1954; and Dunlop A.A. and Young S.S.V., "Selection of Merino sheep on analysis of relative economic weights applicable to some wool traits", Empire Jnl. of Experimental Agriculture 28:201, 1960. It is discussed further in section 4.4 of this Chapter with reference to the formulation of criteria for technical research with the Drysdale's.

#### 4.2.1 Fleece Production

There are three broad components of "fleece production": Fleece weight and yield, processing qualities, and the contribution of the fleece to the quality of the resulting carpet. Of these, only the first will be discussed here. The remaining two have been examined in Chapter II.

Fraser <sup>5/</sup> reported that there were no consistent differences in the fleece weights of N/N, N/+, nr/nr, nr/n, and +/+ ewes. However, the plan of the experiment is not given, and there is no information on lambing status or body weight variations. Cockrem <sup>6/</sup> found that N/N and N/+ hoggets showed a greater greasy fleece weight at constant body weight. He suggests that real differences in clean wool weight were likely to have occurred. From this experimental evidence, and from records of fleece weights clipped at Massey and other farms, it can be concluded that the greasy fleece weights of both N/+ and N/N sheep under lowland conditions are likely to be equal to or greater than those of Romney stock of similar age.

#### 4.2.2 Carcass Production

Cockrem <sup>7/</sup> studied the effect of the gene N on live body weight, body size (as measured by; leg length, depth of thorax and heart girth), and the following carcass characteristics: live weight, carcass weight and length/weight, length/circumference ratios for the left, fore cannon bone.

Measurements were taken at birth, 30, 67, 100 and 144 days of age, and the experiment was repeated over two years. In both years

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<sup>5/</sup> Fraser A.S., "Growth of the N-type fleece", Aust. Jnl. Agr. Res. 3:435, 1952.

<sup>6/</sup> Cockrem F.R.M., Ph.D. thesis, Massey Agricultural College, 1956.

<sup>7/</sup> Cockrem F.R.M., Op.cit.



he found no differences in body weight at birth between N/N, N/+ and +/+ lambs. In the first year weight differences were recorded at 30, 67, 100 and 144 days of age, the N/+ lambs being lighter than the +/+, and the N/N lambs being lighter than the N/+. These results however, were not confirmed in the second year of the experiment where no differences in body weights between N/+ and +/+ lambs were obtained. This suggested a genotype-environment interaction possibly between climatic conditions and birthcoat type. There was also a negative association between body weight at thirty days and the percentage of coarse, medullated fibres in the fleece. It is pointed out that differences obtained may not have been entirely due to the N gene, as the Drysdale flock, prior to the experiment, had been selected solely for carpet wool production.

Using the body size and carcass criteria outlined above, it was found that there were no differences in the biological or economic characteristics of the carcass which were not attributable to growth rate differences.

The economic significance of Cockrem's results on growth and carcass composition applied to present-day commercial conditions is not very clear. Basically the conclusion from his work is, that under certain environmental conditions, it takes longer to produce a lamb of the conformation required to "grade fat". However, this difference is of economic importance only if the Drysdale lamb's requirements of scarce feed, labour, etc., over its fattening period are greater than that of the ordinary Romney. This, in turn, gives rise to complex problems of grass production, feed utilisation, ewe milk production etc. If the total feed requirements to fatten a Drysdale lamb is no greater than that required for a Romney lamb of the same birth date, this increased production period would seem not to be economically important.

Also, the criteria of carcass quality used in Cockrem's study may not be particularly applicable to present-day consumer preferences. With increasing consumer demand for a lighter lamb with a lower proportion of fat in the carcass, it may well be that cannon bone weight and dimensional inter-relationships are not a satisfactory measure of carcass quality.

#### 4.2.3 Fertility

Evidence on the fertility of the Drysdale ewe compared with the ordinary Romney is somewhat inconclusive. There have been no controlled experiments designed to measure lambing percentage, and, for reasons previously outlined, results from practical farm experience are not entirely satisfactory. In the first year of Cockrem's experiment the lambing percentage (as measured by the percentage of live lambs born) was considerably lower for the N-type ewes than for the ordinary Romneys. However, the Drysdale stock were in poor condition at tupping. In the second year, the Drysdale lambing percentage was lower than the ordinary Romney, but the difference was probably not significant. Limited farm experience indicates that the Drysdale lambing percentage is somewhat less than that of the ordinary Romney, but again, no definite conclusions can be drawn. Clearly from section 4.4 of this Chapter, fertility is of major economic importance, and further investigation on this aspect is needed.

#### 4.2.4 Thrift

The term "thrift" has no precise meaning, but when an animal is described as "unthrifty" it is generally meant that its rate of live-weight gain is low, and in the extreme case, the animal dies. Thrift is also used to describe the ability of the animal to withstand adverse environmental conditions.

Thrift, especially at the hogget stage, has long been considered

a problem in the commercial utilisation of the Drysdale breed.

Cockrem's work indicated that the N/N and N/+ hoggets had lower body weights under certain environmental conditions, but suggested that these differences were due to lower body weights at thirty days, rather than differences in live weight gains after thirty days. Experience with the Massey flock seems to indicate that thrift has not been a major problem in recent years. Further experience on a hill country property indicates that the thrift of the Cheviot-N type cross was more satisfactory than that of the N type. It should be stressed however, that this evidence is neither precise, nor extensive, and further trials along the lines of Cockrem are needed.

#### 4.3 Revenue from a Drysdale Policy

In this section, a parametric linear programme is used to determine the optimum (within the limitations of definition of the problem) culling policy for a Drysdale breeding flock.<sup>8/</sup> The revenue per Drysdale ewe-equivalent from this policy at different lambing percentages, wool weights, Drysdale fat lamb prices, and wool prices is derived. Lambing percentages and wool weights were varied because it was felt that these coefficients were likely to be of particular economic importance, and at present, little is known of their variability under commercial conditions. Wool price was varied so that the revenue resulting from the plan at different wool prices could be determined. In section 4.5, this revenue is equated with that from the present policy on two farms and a "break even" Drysdale wool price for these farms is determined.

##### 4.3.1 Method of Analysis

In deciding on the most profitable policy for a breeding flock,

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<sup>8/</sup> A "breeding flock" is defined as a flock in which ewes are the major stock class. Sufficient numbers of female progeny are retained to maintain ewe flock numbers. Thus, a breeding flock is "self-contained", and rams are the only stock purchased.

the farmer is required to make one fundamental decision for each age class of stock; to cull, or to retain for further breeding and/or wool production. As long as there are more stock coming forward each year than those required to maintain flock numbers, this decision must always arise. Whether or not it is profitable to retain an animal in the flock depends on three factors:

- (i) The price that can be obtained for the cull animal.
- (ii) The expected future production if the animal is not culled, and the prices that can be expected for the products.
- (iii) The animals expected resource requirements over the future production period.

Several simple models have been developed which relate the numbers of stock available for culling at different ages to the basic population parameters of reproduction and death rates.<sup>9/</sup> To the author's knowledge however, no work to date has attempted to study the profitability of different culling policies. The linear programming technique used here selects (within the limitations of definition and formulation of the problem) the most profitable culling policy.

The first tableaux of the linear programme is given in Appendix table B.1. The basic data on which the programme is based is also given in Appendix B.

In Appendix table B.1, the fundamental restriction is winter carrying capacity expressed in terms of one ewe equivalent. Thus, the revenue obtained from the final tableaux is given on a "per ewe equivalent" basis. The remaining coefficients in the B column are all zero.

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<sup>9/</sup> For example: Hickey F., "Death and reproductive rates of sheep in relation to flock culling and selection", N.Z. Jnl. Agr. Res., 3:332, 1960, and Grainger W. and Walsh J.D., "Equations relating the composition of beef cattle herds to certain basic data", Aust. Jnl. Agric. Eco. 3:58, 1959.

Activities  $P_2$  to  $P_{13}$  inclusive represent stock selling activities and replace conventional disposal activities. The positive coefficients in the selling activity columns represent the per unit requirements of each stock selling activity of the corresponding stock class in the B column. For example, activity  $P_2$  "wether lambs sell" requires 1.03093 wether lambs born for each wether lamb sold. The coefficient is greater than unity to allow for losses (3 per cent) from birth to sale in December.

Activities  $P_{17}$  to  $P_{25}$  inclusive are stock wintering activities. Each has a positive requirement of the winter carrying capacity restriction. The positive coefficients in the stock wintering activity columns give the requirements of the stock class (represented by the column) of the (immediately younger) stock class represented by the row. The coefficients are greater than unity to allow for losses. The negative coefficients indicate that each wintering activity supplies one unit of its particular stock class. Thus, the programme "ties together" the various age classes.

The Z-C values of the selling activities represent the prices that can be obtained from the sale of cull stock. The Z-C values of the wintering activities are all zero, as the only revenue obtained directly from these activities is that from wool, and wool prices are varied parametrically using price variable programming.<sup>10/</sup> Lambing percentages and wool weights are also varied, using input/output parametric programming.<sup>11/</sup> The "lambs" and "wool 2" rows, and columns  $P_{26}$  and  $P_{27}$  are set up to allow parametric variation of wool weight and lambing percentage.

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<sup>10/</sup> Candler W.V., "A modified simplex solution for linear programming with variable prices", Jnl. Farm Eco. 39:409, 1957.

<sup>11/</sup> Candler W.V. and Manning R., "A modified simplex procedure for problems with falling average cost", Jnl. Farm Eco. 43:859, 1961.

#### 4.3.2 Possible Limitations of the Method of Analysis

The major possible limitations of the analysis arise from:

(i) The accuracy and validity of the coefficients and prices used in the programme.

(ii) Incomplete formulation of the programme.

Concerning the first possible limitation it can be said that the coefficients used are the most accurate obtainable, considering the present inadequate state of knowledge on the Drysdale breed. All the information outlined in section 2 of this Chapter has been utilised in conjunction with present knowledge on the Romney breed. Conservative estimates based on this available information have been used, and in the case of coefficients for which the variability under commercial conditions was considered likely to be high, parametric programming has been used to examine the effect of this variability on nett income. The prices used are also uniformly conservative in view of the uncertainty concerning the quality of the Drysdale carcass.

Concerning the second possible limitation, it should be stressed that the programming analysis as formulated in Appendix Table B.1 does not produce an "optimum Drysdale policy". The final plan given in Table 4.1 indicates only the levels of culling at different ages which both maintains constant flock numbers, and maximises nett revenue. This plan is expressed in terms of only one limiting resource; winter carrying capacity. Although, for the two farms under consideration carrying capacity over the winter and early spring would probably be the major factor limiting the numbers of stock carried, it is unlikely to be the only factor. Other scarce resources such as labour, carrying capacity in other months, etc., could limit the expansion of any particular activity in the plan. The programme as formulated in Appendix Table B.1 does not allow investigation of the most profitable timing of stock operations such as culling and

shearing. This would require activities to be added to the plan such as "December shearing", "October culling", etc. Despite these limitations however, it seems likely that the revenue resulting from the programmed plan would be at least equal to that resulting from any arbitrarily chosen Drysdale plan.

#### 4.3.3 The Drysdale Plan

The programme was computed on a desk calculator. The results of the final plan (for minimum values of lambing percentage, wool weight, and wool price) are summarized in Table 4.1.

TABLE 4.1: THE DRYSDALE PLAN

Activity	Description	Level in final plan	Revenue per unit of activity	Revenue from activity
P2	wether lambs sell	0.37511	1.6	.60018
P3	ewe lambs sell	0.16847	1.6	.26955
P10	6 year ewes sell	0.13718	0.6	.08231
P14	wool sell	0.86867	1.25	1.08584
P17	ewe hoggets	0.19838	0	0
P18	ewe 2-tooth	0.19441	0	0
P19	ewe 4-tooth	0.18663	0	0
P20	ewe 6-tooth	0.17824	0	0
P21	ewe 4 year old	0.16754	0	0
P22	ewe 5 year old	0.15414	0	0
Total revenue (from table)				2.03788
Total revenue (from plan)				2.03788

From Table 4.1, it can be seen that, the revenue from the z-c row in the B column of the final iteration equals that obtained from Table 4.1. That is, the programme checks. Also the sum of

the real activities in the plan multiplied by their land requirements equals unity. That is, the winter carrying capacity restriction is exactly fulfilled.

#### 4.3.4 The Effect of Variation in Prices and Production Coefficients

The results of varying lambing percentages, wool weights and wool prices were studied using parametric programming. The results are as follows:

(i) Wool weight variable: The relationship of revenue to wool weight (expressed in units of 10 lbs) is given in equation 4.1.

$$R = 0.95204 + 1.25 (0.19838W_{17} + 0.19441W_{18} + 0.18663W_{19} + 0.17824W_{20} + 0.16754W_{21} + 0.15414W_{22}) \quad 4.1$$

$$\text{Subject to: } W_{17} \geq 0.60, \quad W_{18} \geq 0.80, \quad W_{19} \geq 0.90, \quad W_{20} \geq 0.90 \\ W_{21} \geq 0.85, \quad W_{22} \geq 0.80$$

Where: R = Nett revenue in £'s per ewe-equivalent,

$W_{17}$  = ewe hogget wool weight,

$W_{18}$  = 2-tooth ewe wool weight,

$W_{19}$  = 4-tooth ewe wool weight,

$W_{20}$  = 6-tooth ewe wool weight,

$W_{21}$  = 4 year old ewe wool weight,

$W_{22}$  = 5 year old ewe wool weight.

All wool weights are expressed in units of 10 lbs.

Equation 4.1, of course, holds only for the minimum value prices and production coefficients given in Appendix B.

(ii) Lambing percentages variable: The effect of an increase in lambing percentages throughout the breeding flock is simply to allow increased sales of fat lambs. Equation 4.2 shows the effect on nett revenue of changes in lambing percentages.



$$R = 1.16815 + 1.55200 (0.19441P_{18} + 0.18663P_{19} + 0.17824P_{20} + 0.16754P_{21} + 0.15414P_{22} - 0.21304) \quad 4.2$$

Subject to:  $P_{18} \geq 0.8$ ,  $P_{19} \geq 0.9$ ,  $P_{20} \geq 0.9$ ,  $P_{21} \geq 0.9$ ,  
 $P_{22} \geq 0.9$ .

Where: R = nett revenue,

$P_{18}$  = 2-tooth lambing percentage,

$P_{19}$  = 4-tooth lambing percentage,

$P_{20}$  = 6-tooth lambing percentage,

$P_{21}$  = 4 year old ewe lambing percentage,

and  $P_{22}$  = 5 year old ewe lambing percentage.

The constant term (1.16815) in equation 4.2 above represents the revenue from the sale of wool. As with equation 4.1, equation 4.2 holds only for the minimum value prices and production coefficients given in Appendix B.

(iii) Wool price variable: The plan did not alter until the wool price was raised to £2.92855 per 10 lb (70.28d per lb). At this price, activities  $P_{23}$ ,  $P_{24}$  and  $P_{25}$  (wether hoggets, 2-tooths, and 4-tooths respectively) came into the plan. However, as the price for Drysdale wool is unlikely to reach this level in practice, the effect of price increases above 70d per lb were not investigated. The relationship of revenue to wool price is given in equation 4.3.

$$R = 0.95204 + 0.86867P_{w(D)} \quad 4.3$$

Subject to:  $2.82557 > P_{w(D)} \geq 1.25$

Where: R = nett revenue,

$P_{w(D)}$  = Drysdale wool price in £'s per 10 lb.

For example, at a wool price of £1.25 per 10 lbs (30d per lb) the revenue from the Drysdale plan is £2.03788 per ewe-equivalent.

If the Drysdale wool price was raised to £1.66667 per 10 lb (40d per lb), the revenue from the plan would be £2.39983 per ewe-equivalent.

(iv) Cull stock prices variable: Although the effect of variation in cull stock prices was not studied directly using parametric programming, the effect of changes in the prices received for fat lambs and other cull stock can be determined from Table 4.1. For example, in Table 4.1, activities  $P_2$  and  $P_3$  (wether lambs sell and ewe lambs sell) are in the final plan at levels of 0.37511 and 0.16847 respectively. The sum of these two coefficients is 0.54358.

An equation evaluating the effect of changes in fat lamb price would therefore be of the form:

$$R = C + 0.54358PF_{(D)}$$

Where:  $R$  = nett revenue,

$C$  = a constant term giving return from activities other than the sale of fat lambs.

$PF_{(D)}$  = price for Drysdale fat lambs.

Equation 4.4 shows the relationship between revenue and Drysdale fat lamb price.

$$R = 1.16815 + 0.54358PF_{(D)}$$

Subject to:  $PF_{(D)} \geq 1.6$  4.4

The only other cull stock sold are 6 year old ewes. The effect on revenue of changes in the price received for 6 year old ewes is given in equation 4.5.

$$R = 1.95557 + 0.13718P_{6 \text{ yr}} \quad 4.5$$

Subject to:  $P_{6 \text{ yr}} \geq 0.6$

Where:  $R$  = nett revenue,

$P_{6 \text{ yr}}$  = cull 6 year-old Drysdale ewe price.

Equation 4.6 expresses revenue as a function of wool price, wool weights, lambing percentages, fat lamb prices, and cull ewe prices.

$$\begin{aligned}
 R = & 0.13718P_{6yr} + Pw_{(D)} (0.19838W_{17} + 0.19441W_{18} + 0.18663W_{19} \\
 & + 0.17824W_{20} + 0.16754W_{21} + 0.15414W_{22}) + 0.97PF_{(D)} (0.19441P_{18} \\
 & + 0.18663P_{19} + 0.17824P_{20} + 0.16754P_{21} + 0.15414P_{22} - 0.21304)
 \end{aligned}$$

4.6

The coefficients in equation 4.6 have the same meaning as in equations 4.1 to 4.5 inclusive, and are subject to the same restrictions.

Fig. 4.1 shows the relationship between wool price and nett revenue for two levels of wool weights, lambing percentages, etc.

In Fig. 4.1, the line a-b, gives the relationship between nett revenue and wool price where:

$$\begin{aligned}
 P_{6yr} &= 0.6, & W_{17} &= 0.6, & W_{18} &= 0.8, & W_{19} &= 0.9, & W_{20} &= 0.9, \\
 W_{21} &= 0.85, & W_{22} &= 0.8, & P_{18} &= 0.8, & P_{19} &= 0.9, & P_{20} &= 0.9, \\
 P_{21} &= 0.9, & P_{21} &= 0.9, & P_{22} &= 0.9, & PF_{(D)} &= 1.6.
 \end{aligned}$$

The line c-d in Fig. 4.1 shows the relationship between revenue and Drysdale wool price where lambing percentages throughout the breeding flock are raised by 10 per cent, and wool weights are raised by 1 lb. That is:

$$\begin{aligned}
 P_{6yr} &= 0.6, & W_{17} &= 0.7, & W_{18} &= 0.9, & W_{19} &= 1.0, & W_{20} &= 1.0, \\
 W_{21} &= 0.95, & W_{22} &= 0.9, & P_{18} &= 0.9, & P_{19} &= 1.0, & P_{20} &= 1.0, \\
 P_{21} &= 1.0, & P_{22} &= 1.0, & PF_{(D)} &= 1.6.
 \end{aligned}$$

#### 4.4 Criteria for Further Research

One of the criteria for further research with the Drysdales discussed more fully in Chapter V, is the relative economic importance of the character to be studied.

Equations 4.1 to 4.5 give an indication of the relative economic importance of wool weights, lambing percentages, wool quality, fat

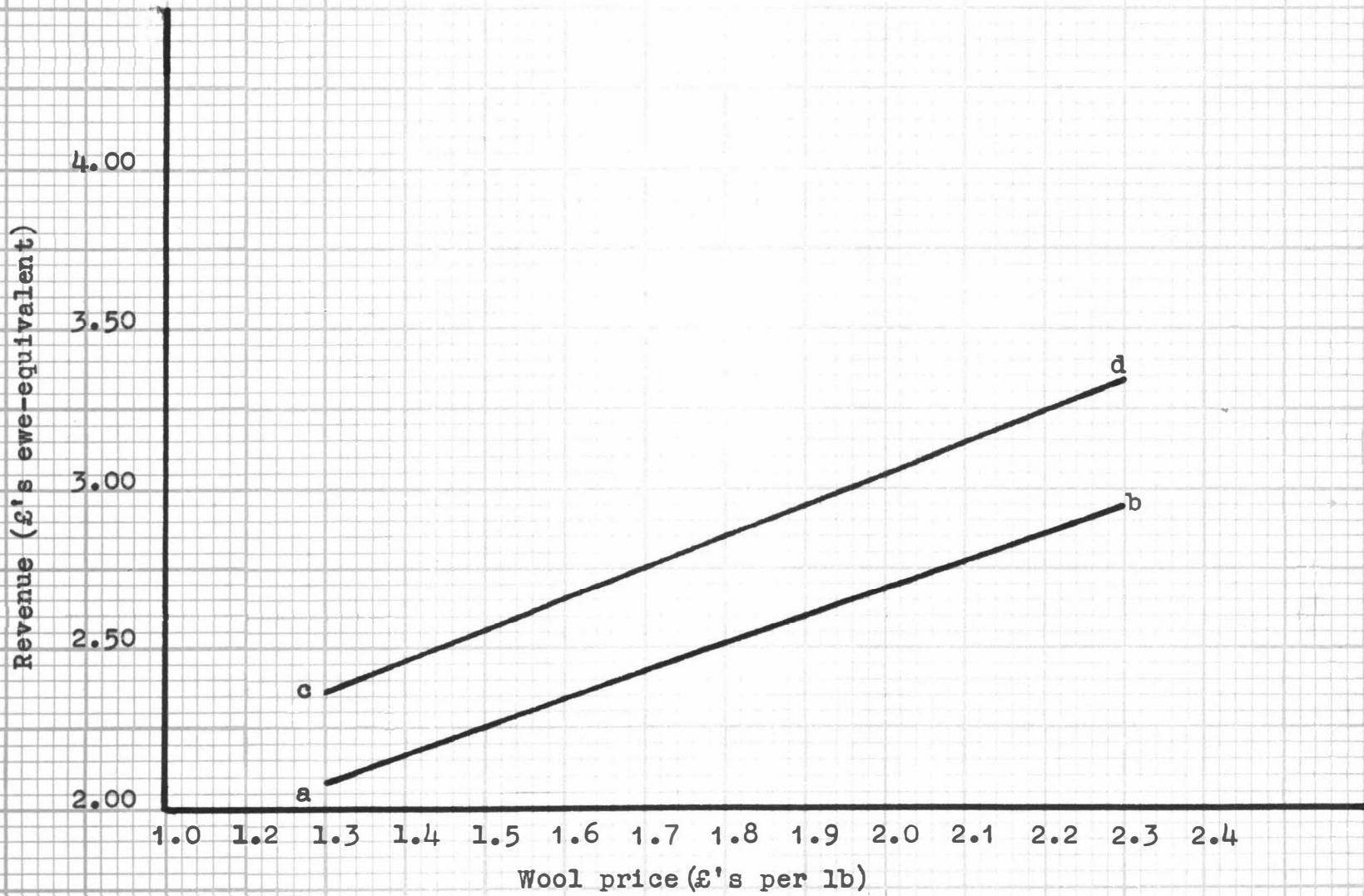


FIG 4.1: RELATIONSHIP BETWEEN REVENUE AND DRYSDALE WOOL PRICE

lamb quality, and cull ewe quality.

For example; from equation 4.1 it can be seen that an increase of 1 lb in wool weight for each stock class would increase revenue by £0.13492 per ewe-equivalent. On the other hand, an increase in average lambing percentage for each ewe stock class would increase revenue by £0.13672 per ewe-equivalent (equation 4.2). That is, for a farm with a carrying capacity of 1,000 ewe-equivalents, an increase of 10 per cent in average lambing percentage would add approximately £137 to the farmer's income. These weightings can of course, be applied only if the other production coefficients and prices are kept constant at the level given in Appendix B.

Equations 4.1 to 4.5 however, do not take into account the effect on nett revenue of possible variation in thrift - expressed in terms of death rate. The z-c values of the selling activities in the final iteration give an indication of the effect of marginal changes in death rate.

The z-c values of the selling activities in the final iteration are as follows:

$P_4$  (ewe hogget sell), 0.63741;  $P_5$  (ewe 2-tooth sell), 1.18305;  
 $P_6$  (ewe 4-tooth sell), 1.09474;  $P_7$  (ewe 6-tooth sell), 0.90224;  
 $P_8$  (4 year ewes sell), 0.49292;  $P_9$  (5 year ewes sell), 0.19292.  
The z-c values of the remaining selling activities are all zero.

These positive z-c values are the "shadow prices" the programme imputes to retaining these stock classes in the flock. For example, the z-c value of activity  $P_4$  (ewe hogget sell) is £0.63741. An increase of one per cent in losses at the hogget stage would therefore represent a 0.00637 per cent decrease in return per ewe-equivalent. This reasoning can, of course, be applied only to small marginal changes.

The positive z-c values of the selling activities also give

some indication of the relative economic importance of the quality of cull stock other than lambs and 6 year ewes. For example, the z-c value of activity  $P_4$  (ewe hogget sell) has a positive value of £0.63741. This means that the price of fat hoggets would have to be raised by an amount greater than £0.63741 before it would be profitable to sell this class of stock. This z-c value is the "shadow price" that the programme imputes to retaining these ewe hoggets in the flock for breeding and further wool production. Now the ewe hogget price given in Appendix table B.1 is £1.5. A price increase of £0.63741 represents a proportionate increase of 42.49 per cent. This increase is necessary before hogget selling will "break even" with the farming policy given by the programme. Thus, in comparison with productive characters such as wool weight and fertility, ewe hogget carcass quality is relatively unimportant.

#### 4.5 The "Break-Even" Drysdale Wool Price

In this section, the revenue from hypothetical fat lamb and hill sheep properties is determined using a partial parametric budget. This revenue is compared with that obtained from the Drysdale policy determined in section 4.3, and a "break-even" Drysdale wool price over a range of prices and productive coefficients is derived.

##### 4.5.1 Partial Budget for a Hypothetical Manawatu Fat Lamb

The sheep policy is one of buying in 6 year ewes in February, retaining them for one year's breeding and wool production, followed by sale fat in the following February-March period. This is a common policy on fat lamb farms in the Manawatu. Prices taken are for the 1962/63 season.

TABLE 4.2: PARTIAL BUDGET FOR A MANAWATU FAT LAMB FARM

Expenditure		Receipts	
1,000 ewes @ £1.5	1,500	950 fat ewes (Feb) @ 16/-	760
Shearing:		1,070 fat lambs (Jan) @ 35/-	1,870
970 ewes @ £11/100	106	Wool:	
1,070 lambs @ £11/100	118	Ewes: 10,670 lbs @ 38d	1,690
		Lambs: 2,600 lbs @ 38d	410
	<u>1,725</u>		<u>4,730</u>
	Nett Return		3,005
	Ewe-equivalents wintered		960
	Return per ewe-equivalent		3.13

The budget given in Table 4.3 can be generalised to cover a range of prices using parametric budgeting. Equation 4.6 expresses nett sheep revenue in terms of Romney wool price, and Southdown x Romney fat lamb price.

$$R = -1.01 + 13.82P_{w(R)} + 1.11P_{l(S)} \quad 4.7$$

Where:  $P_{w(R)}$  = Romney wool price in £ per lb.

$P_{l(S)}$  = Southdown cross fat lamb price in £.

#### 4.5.2 The Break-Even Drysdale Wool Price for a Hypothetical Manawatu Fat Lamb Farm

The break-even Drysdale wool price for the hypothetical fat lamb farm described in section 4.5.1 above can be determined by equating the revenue from equation 4.6 with that from equation 4.7, and allowing for a Drysdale shearing charge. That is:

$$\begin{aligned} &0.13718 P_{6yr} + P_{w(D)} (0.19838W_{17} + 0.19441W_{18} + 0.18663W_{19} \\ &+ 0.17824W_{20} + 0.16754W_{21} + 0.15414W_{22}) + 0.97DF_{l(D)} (0.19441P_{18} \\ &+ 0.18663P_{19} + 0.17824P_{20} + 0.16754P_{21} + 0.15414P_{22} - 0.21304) - 0.08 \\ &= -1.01 + 13.82P_{w(R)} + 1.11P_{l(S)} \quad 4.8 \end{aligned}$$

For example: Let  $Pw_{(R)} = 0.1625$ ,  $Pl_{(S)} = 1.75$ ,  $W_{17} = 0.8$ ,  
 $W_{18} = 0.9$ ,  $W_{19} = 1.0$ ,  $W_{20} = 1.0$ ,  $W_{21} = 0.95$ ,  $W_{22} = 0.9$ ,  
 $DFl_{(D)} = 1.6$ ,  $P_{18} = 0.9$ ,  $P_{19} = 1.0$ ,  $P_{20} = 1.0$ ,  $P_{21} = 1.0$ ,  
 $P_{22} = 1.0$ , and  $P_{6yr} = 0.6$ .

Inserting these values in equation 4.8, and solving for  $Pw_{(D)}$ , the break even Drysdale wool price is:

$$Pw_D = 1.99.$$

That is, the break even price for Drysdale wool under these conditions is 48d per lb. If the Romney wool price was raised to 45d per lb, the break even Drysdale wool price would then be 56d per lb.

There is assumed to be no correlation between the prices received for Drysdale and Southdown cross fat stock. This situation is unlikely to occur in practice. However, the magnitude of the correlation coefficient is not known, and consequently any selected value such as zero would be arbitrarily chosen. If the statistical relationship between any of the parameters in the budget was known, this relationship could be simply incorporated, and the budget correspondingly simplified. For example, if the relationship between Drysdale fat lamb price and Southdown cross fat lamb price was given by:  $P_{FL} = 0.9Pl_{(S)}$ , then equation 4.8 can be simplified to incorporate this relationship.

Table 4.4 shows the nett difference in return per ewe equivalent between the present policy and a Drysdale policy on the Manawatu fat lamb farm for various Drysdale production coefficients and prices.

From Table 4.4 it can be seen that, at ruling prices for Romney wool and Southdown cross lambs ( $Pw_{(R)} = 40d$  per lb,  $Pl_{(S)} = £1.75$ ) and using Drysdale prices and production coefficients that could reasonably be expected under these conditions ( $Pw = 45d$  per lb,



$P_{18} = 0.9$ ,  $W_{17} = 0.8$  lbs), the Drysdale policy returns slightly less than a fat lamb policy. At a Drysdale wool price of approximately 50d per lb, the two policies would just "break even".

TABLE 4.3: NETT GAIN FROM THE ADOPTION OF A DRYSDALE POLICY  
ON A MANAWATU FAT LAMB FARM  
(in £'s per ewe-equivalent)

	Drysdale wool price (Pence per lb)	Southdown cross fat lamb price = £1.75		Southdown cross fat lamb price = £2.25	
		Romney wool price		Romney wool price	
		30d	40d	30d	40d
$P_{18} = 0.8$ , $P_{19} = 0.9$ , $P_{20} = 0.9$ , $P_{21} = 0.9$ , $P_{22} = 0.9$ , $W_{17} = 0.7$ , $W_{18} = 0.8$ , $W_{19} = 0.9$ , $W_{20} = 0.9$ , $W_{21} = 0.85$ , $W_{22} = 0.8$ , $P_{6yr} = 0.6$ , $PF1(D) = 1.6$	30	-0.68	-1.25	-1.24	-1.81
	40	-0.30	-0.89	-0.86	-1.43
	45	-0.12	-0.69	-0.68	-1.25
	55	+0.25	-0.32	-0.31	-0.88
$P_{18} = 0.9$ , $P_{19} = 1.0$ , $P_{20} = 1.0$ , $P_{21} = 1.0$ , $P_{22} = 1.0$ , $W_{17} = 0.8$ , $W_{18} = 0.9$ , $W_{19} = 1.0$ , $W_{20} = 1.0$ , $W_{21} = 0.95$ , $W_{22} = 0.9$ , $P_{6yr} = 0.6$ , $PF1(D) = 1.6$	30	-0.40	-0.97	-0.96	-1.53
	40	-0.16	-0.57	-0.56	-1.13
	45	+0.21	-0.36	-0.35	-0.92
	55	+0.63	+0.06	+0.07	-0.50
$P_{18} = 1.0$ , $P_{19} = 1.1$ , $P_{20} = 1.1$ , $P_{21} = 1.1$ , $P_{22} = 1.1$ , $W_{17} = 0.8$ , $W_{18} = 0.9$ , $W_{19} = 1.0$ , $W_{20} = 1.0$ , $W_{21} = 0.95$ , $W_{22} = 0.9$ , $P_{6yr} = 0.6$ , $PF1(D) = 1.6$	30	-0.27	-0.84	-0.83	-1.40
	40	+0.15	-0.42	-0.41	-0.98
	45	+0.35	-0.22	-0.21	-0.78
	55	+0.77	+0.20	+0.21	-0.36

4.5.3 Partial Budget for a Hypothetical Good Quality Hill Property

The policy considered is a breeding one. That is, sufficient numbers of two-tooth ewes are retained to maintain breeding flock numbers. Female stock are sold as two-tooth (store) and culled as 5 year-olds (store). Wether lambs are sold either fat or in good store condition. Prices used are again based on the 1962/63 season.

TABLE 4.4: PARTIAL SHEEP POLICY BUDGET FOR A HILL COUNTRY BREEDING PROPERTY

Expenditure		Receipts	
Shearing:		Wool:	
920 ewes @ 11/100	101	15,700 lbs @ 38d per lb	2,490
430 hoggets @ 11/100	47	Surplus stock:	
890 lambs @ 11/100	98	220 fat lambs @ 35/-	385
		220 store lambs @ 34/-	374
		168 2-tooth ewes @ 60/-	504
		200 5-year ewes @ 35/-	350
Total Expenditure	246	Total Receipts	4,103
		Nett return	3,857
		Ewe-equivalents wintered	1,190
		Return per ewe-equivalent wintered	3.24

The budget in Table 4.4 can be expressed parametrically as follows:

If:  $P_{w(R)}$  = Romney wool price in £'s per lb,

and  $R$  = nett revenue per ewe-equivalent

then  $R = 1.15 + 13.19 P_{w(R)}$  4.9

#### 4.5.4 Break-Even Drysdale Wool Price for a Hypothetical Hill Country Farm

The break-even Drysdale wool price for the hypothetical hill country farm can be derived by equating the revenue obtained from equation 4.6 with that from equation 4.9, and solving for  $P_{w(D)}$ .

For example; if  $P_{w(R)} = 0.1625$ ,  $W_{17} = 0.8$ ,  $W_{18} = 0.9$ ,  $W_{19} = 1.0$ ,  $W_{20} = 1.0$ ,  $W_{21} = 0.95$ ,  $W_{22} = 0.9$ ,  $P_{18} = 0.9$ ,  $P_{19} = 1.0$ ,  $P_{20} = 1.0$ ,  $P_{21} = 1.0$ ,  $P_{22} = 1.0$ ,  $PFL_{(D)} = 1.6$ ,  $P_{6yr} = 0.6$ , and  $P_{w(R)} = 0.1625$ , the break-even Drysdale wool price is as follows:

$$P_{w(D)} = 0.22154$$

That is, for these production coefficients and prices, the break-even Drysdale wool price for this farm is 53d per lb.

The slightly higher break even price for the hill farm reflects in part the abnormally high store stock/fat stock price ratio that existed in the 1962/63 season. Of course the returns are expressed in terms of ewe-equivalents and the lowland farm would have a higher ewe-equivalent per acre ratio.

Ram costs and returns have not been included in the budgets as these would not differ markedly between policies and are only a small component of the total costs.

Table 4.5 shows the nett difference in return per ewe-equivalent between a Romney and Drysdale policy for the hill country farm.

#### 4.6 Farm Management Aspects of Drysdale Wool Production: A Case Study

The objective of this section is to examine various aspects of the management of a Drysdale flock on a case farm. Basic data on the farm will be briefly outlined and a partial budget is used to examine the effect of the adoption of a Drysdale policy on the

TABLE 4.5: NETT GAIN FROM THE ADOPTION OF A DRYSDALE POLICY  
ON A HILL COUNTRY PROPERTY  
(in £'s per ewe-equivalent)

	Drysdale wool price (pence per lb)	Romney wool price	
		30d/lb	40d/lb
$P_{18} = 0.8, P_{19} = 0.9,$	30	-0.82	-1.21
$P_{20} = 0.9, P_{21} = 0.9,$	40	-0.44	-0.99
$P_{22} = 0.9, W_{17} = 0.7,$	45	-0.06	-0.81
$W_{18} = 0.8, W_{19} = 0.9,$			
$W_{20} = 0.9, W_{21} = 0.85,$	55	+0.11	-0.44
$W_{22} = 0.8, P_{6yr} = 0.6,$			
PF1(D) = 1.6			
$P_{18} = 0.9, P_{19} = 1.0,$	30	-0.54	-1.09
$P_{20} = 1.0, P_{21} = 1.0,$	40	-0.14	-0.69
$P_{22} = 1.0, W_{17} = 0.8,$	45	+0.07	-0.48
$W_{18} = 0.9, W_{19} = 1.0,$			
$W_{20} = 1.0, W_{21} = 0.95$	55	+0.49	-0.06
$W_{22} = 0.9, P_{6yr} = 0.6,$			
PF1(D) = 1.6			
$P_{18} = 1.0, P_{19} = 1.1,$	30	-0.41	-0.96
$P_{20} = 1.1, P_{21} = 1.1,$	40	+0.01	-0.54
$P_{22} = 1.1, W_{17} = 0.8,$	45	+0.21	-0.34
$W_{18} = 0.9, W_{19} = 1.0,$			
$W_{20} = 1.0, W_{21} = 0.95,$	55	+0.63	+0.08
$W_{22} = 0.9, P_{6yr} = 0.6,$			
PF1(D) = 1.6			

TABLE 4.6: BUDGETED RETURN FROM A DRYSDALE WETHER POLICY

Wool:			
Breeding ewes	2,190 @ 10 lbs	21,900	
Ewe hoggets	510 @ 8 lbs	4,080	
Wether hoggets, 2-tooth, and 4-tooth.	2,670 @ 10 lbs	<u>26,700</u>	
		52,680 @ 46d per lb	10,100
Stock:			
Ewe lambs (fat)		415 @ 42/-	913
6 year ewes (fat)		372 @ 17/6	327
4-tooth wethers (fat)		802 @ 30/-	1,204
	Gross return		12,543
	Shearing cost 5,370 @ £6/100		325
	Return (after paying for shearing)		12,218

farmer's nett income. The role of carpet production as a possible means of diversification is discussed.

#### 4.6.1 The Case Farm: Basic Data

The property has a total area of 11,000 acres, and is situated 20 miles from Dunedin on rolling country above the Taeri Plain. The most recent valuations are: Unimproved value, £66,000. Capital Value, £65,000. The farm varies in altitude from 900 to 2,000 feet above sea level, and has an overall N.N.E. aspect.

The rainfall over the area is 25", well spread throughout the year. Winters are cold, with the likelihood of at least two snow falls per year. Climate is probably the major factor limiting further development of the higher tussock country.

Soils are mainly derived from mica schist. Varying levels of deficiency in lime, phosphate and molybdenum exist.

The general topography of the country is one of rolling tops dissected by steep gullies. About 80 per cent of the area is cultivable with a wheel tractor. The natural vegetation of the lower areas is grass and scrub; above 1,000 feet, snowgrass and tussock.

Of the 2,200 acres that would be suitable for re-grassing only about half of this has been sown in improved pasture to date.

The farm has been managed solely by the owner since 1959, when the original property was sub-divided. Prior to this, the owner was in partnership with his brother. The total labour force is five, including the manager. The property is run as a trust, the farmer having three sons - all possibly potential farmers.

Briefly, the farming policy (prior to the introduction of three Drysdale rams in 1962) was as follows: The property carried about 4,500 ewes plus replacements, and about 200 breeding cows. All two-tooth ewes (about 900) plus approximately 300 culled mixed aged ewes are put to the Southdown ram. The in-lamb 2-tooths are selected at shearing (September) on wool quality, and those with marked wool faults are put to the Southdown ram for the rest of their breeding life. This is an effective way of increasing the selection differential within the Romney flock while still maintaining flock numbers. The ewes mated with the Southdown ram are run on the developed country. The remainder of the ewes are mated to a Romney ram and wintered on the tussock. The breeding cows are also wintered on the tussock.

#### 4.6.2 The Place of the Drysdales on the Case Farm

As mentioned above, there are about 8,500 acres of tussock

country on the farm. The development potential of this tussock area is low, being limited by climatic factors. At present about 35 per cent of the ewe flock is wintered on the tussock country at the rate of one ewe per  $3\frac{1}{2}$  acres. Lambing percentages on the tussock are low (less than 80 per cent) and the extensive shepherding requires a high labour input.

The farmer envisages that the major role of the Drysdales on this farm will be as wethers on the tussock country. Wethers could be carried at a higher stocking rate (about 1 per 2 acres) and would require negligible shepherding. The reduced labour demands if wethers were run would allow more intensive shepherding on the lower country, and more labour for the development programme.

#### 4.6.2.1 The Role of the Drysdales in Diversification

The farmer considers that the opportunities for diversification through cropping on this farm are extremely limited. The present sheep policy allows opportunity for diversification and selection through mating ewes which are culled on wool quality to a Southdown ram. A Drysdale policy would allow even more intensive selection within the Romney flock, and provide a further opportunity for diversification. As some quality characteristics of carpet wool are exactly opposite to those of crossbred wools (for example, lustre), the culling of Romney ewes to mate with Drysdale rams can allow improvement in both Romney and Drysdale flocks.

#### 4.6.2.2 Drysdale Labour Requirements

A Drysdale policy on this farm would mean increased labour requirements in that there would be an extra mob of ewes to be handled for topping, shearing, etc. Wethers would however, replace ewes on the tussock country with a corresponding reduction in extensive shepherding, and the adoption of a part Drysdale - part Romney

policy could mean that more labour would be available at the critical lambing period.

#### 4.6.2.3 Financial Aspects

The financial aspects of the adoption of a possible Drysdale policy will now be discussed. The following assumptions are made:

- (i) The effective sheep carrying capacity of the property (assuming no change in cattle policy) is as follows:
  - Tussock, 1,600 ewe-equivalents.
  - Paddock, 4,000 ewe-equivalents.
- (ii) The substitution rate, ewes/wethers (or hoggets) 0.6.
- (iii) Only 4-tooth, 6-tooth, 4 year and 5 year ewes and wether hoggets, 2-tooth and 4-tooth can be wintered on the tussock.
- (iv) Basic production data is as follows:

	<u>Tussock</u>	<u>Paddock</u>
Lambing percentage:		
Drysdale	70%	90%
Romney	75%	95%
Wool weights hogget:		
Drysdale	-	8 lbs
Romney	-	8 lbs
Ewes:		
Drysdale	8 lbs	10 lbs
Romney	8 lbs	10 lbs
Wethers:		
Drysdale	10 lbs	11 lbs

#### (v) Prices:

Wool.	Romney 40d per lb.	Drysdale 46d per lb.
Lambs (Romney and Drysdale)	42/-	
2-tooth ewes (Romney store)	60/-	



5 year ewes (Romney store)	35/-
4-tooth wethers (Drysdale fat)	30/-
5 year ewes (Drysdale fat)	17/6

(vi) There is assumed to be no market for store Drysdale stock.

The Drysdale Policy: The policy consists of fully utilising the tussock carrying capacity with Drysdale wethers. The Drysdale breeding ewes, and ewe hoggets necessary to maintain this wether flock are run on the paddock country. The financial return from this policy is compared with that obtained from utilising the equivalent carrying capacity with a conventional Romney breeding policy.

TABLE 4.7: RETURN FROM ROMNEY BREEDING POLICY

Wool:		
Tussock ewes	1,600 @ 8 lbs	12,800
Paddock ewes	1,742 @ 10 lbs	17,420
Hoggets	1,257 @ 8 lbs	<u>10,056</u>
	40,276 lbs @ 40d per lb	6,710
Surplus Stock:		
1,330 wether lambs (fat)	@ 42/-	2,926
438 2-tooth (store)	@ 60/-	1,314
472 5-year (store)	@ 30/-	708
	Gross return	11,658
	Shearing cost	276
	Return (after paying for shearing)	11,382

The nett return from the Drysdale policy described above is higher by about £1,000. The main factors influencing the disparity

between the returns from the Drysdale and Romney policies are firstly, that the Drysdale wool price is 6d higher, and secondly, that the Romney lambing percentage on the tussock country is extremely low at 75 per cent. The premium of 6d per lb for Drysdale wool is precisely the premium that can be expected by the farmer, as he supplies Drysdale wool under a contract in which this premium is incorporated as a condition. The premium at which the Drysdale policy will just break even with the present policy is approximately 2d per lb.

#### 4.7 Conclusions from Chapter IV

The results of Tables 4.3 and 4.5 indicate that at present prices for Romney wool and cull stock, and using Drysdale prices and production coefficients that could reasonably be expected under these conditions, there is very little difference between the return from Drysdale production and the present policy. The use of parametric budgeting indicates how sensitive these returns are to variation in prices and production coefficients. For example, for the hypothetical fat lamb farm the Drysdale wool price that just breaks even with the present policy is approximately 48d per lb. If this price was raised to 60d per lb, however, the premium from a Drysdale policy would be approximately £0.34 per ewe equivalent (that is, about £350 for a 1,000 ewe-equivalent farm).

For the actual case farm described in section 4.6 however, the budgets in Tables 4.6 and 4.7 show that the adoption of a Drysdale wether policy would have a definite financial advantage over the present farming system. It would seem that, in general, the Drysdales would show a greater comparative advantage in farming systems (such as wether policy) in which a high proportion of the farm income was derived from wool.

The critical factor is the price that can be expected for

Drysdale wool. On the basis of imported Scottish Blackface wool prices, Drysdale production should show a small premium over the present system on the two hypothetical case farms, and a larger premium on the actual case farm. At lower Drysdale wool prices Drysdale production could clearly be less financially profitable than the present system. There may however, be other advantages such as the possible benefits from diversification in the adoption of a Drysdale policy.

## C H A P T E R V

### FURTHER RESEARCH WITH THE DRYSDALE BREED

#### 5.1 Introduction

Chapters I to IV inclusive have investigated four aspects, any one of which could be critical in deciding whether or not the commercial production of Drysdale wool in New Zealand is likely to be a profitable proposition. Uncertainty exists at each of these four levels. Further research into the production, marketing and manufacturing of Drysdale wool could, to a certain extent, reduce this existing level of uncertainty. Research could also contribute to increasing the technical quality of the Drysdale products, and the efficiency of their production. The objective of this chapter is to define criteria for research with the Drysdale breed, taking into account deficiencies in present knowledge, and the relative economic importance of the production characters on which research could be carried out. On the basis of this assessment, a possible research programme is outlined. The frame of reference of the discussion is the same as the general frame of reference for this thesis. That is, research planning is considered from the point of view of the Drysdale wool-producing farmers. Possible research fields are evaluated in terms of their potential contribution to the long-term financial return from Drysdale wool production.

Numerous studies have been carried out in the investigation of various aspects of the N gene. Most of this work however, has been concerned with fundamental wool biology and genetic considerations, rather than directly with the characteristics of the Drysdales as a carpet wool producing breed.<sup>1/</sup>

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<sup>1/</sup> The work of Cockrem and Nash being exceptions.

The mendelian situation in the Drysdale breed makes them particularly useful as experimental animals. The mating of a heterozygous N-type ram with Romney ewes allows two groups of offspring differing only in their dosage of the N gene. Maternal effects are automatically randomized.

No doubt the Drysdales will continue to be used as experimental animals in wool biology studies. However, considering the frame of reference of this study, only "applied" research with the objective of:

(i) Reducing the level of present uncertainty concerning aspects of the production and utilisation of the products of the Drysdale breed.

(ii) Increasing the technical quality of the Drysdale products and the efficiency of their production ...  
will be considered.

The first type of research simply allows farmers and carpet manufacturers increased knowledge of the expected results of the adoption of a Drysdale farming policy, and the use of Drysdale wool as a carpet fibre respectively. The second type of research should result in an increased nett return from the production and marketing of the wool. "Uncertainty decreasing" research is concerned simply with evaluating this new technology over a range of production and manufacturing conditions. While the objective of "efficiency increasing" technical research should be ultimately to give rise to a new production surface, the objective of "uncertainty decreasing" research would be simply to determine the form of the production surface given by the new technology.

Considering the frame of reference of this study, it is felt that first research priority should be given to reducing the present uncertainty concerning various aspects of the production and utilis-

tion of the products of the Drysdale breed. General problems involved in planning research will now be briefly discussed.

## 5.2 General Problems in Research Planning

The basic economic problem of the allocation of scarce resources to the most profitable alternative ends applies as much to research as it does to any other field of endeavour. The research planner however, is confronted with the major difficulty of numerically defining both the nature of the "production relationship" between research input and research result output, and criteria for "successful research".

If it is considered that it is possible to plan research at all, the assumption must be made that there is a criterion of "successful research" and this criterion can ultimately be expressed in financial terms.

The effective planning of research requires, as well as knowledge of the financial return expected if the research is successful, knowledge of the cost of any project (in terms of direct costs and the opportunity costs of research resources that could be used on other projects), knowledge of the expected time for the research project, and finally, knowledge of the probability of achieving the stated research objective.<sup>2/</sup>

These are the necessary conditions that must be fulfilled before an objective decision can be made in evaluating the expected nett gain from different research projects.

A detailed discussion of the cost and benefit of various research projects that could be carried out with the Drysdale breed is beyond the scope of this study. The objective here is simply to

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<sup>2/</sup> See: Mottley C.M. and Newton R.D., "Selection of projects for industrial research", Opns. Res. 7:760, 1959.

define areas in which further research with the Drysdale breed seems likely to be profitable, and to rank various possible projects according to their contribution to the nett return from the production and marketing of Drysdale wool.

### 5.3 Criteria for Research on the Drysdale Breed

There are four classes of research which could be expected to provide an increased financial return from the production and marketing of Drysdale wool.

(i) An improvement in the production characteristics of the breed. For example, increasing fertility, wool weight, etc.

(ii) An improvement in the system of management used - for a given technological and market situation. Farm management research such as farm surveys, linear programming and budgeting falls into this class.

(iii) An improvement in the price situation for Drysdale wool through marketing and market research.

(iv) An improvement in the technical quality of Drysdale wool as a carpet fibre through research on the manufacturing and carpet properties of the wool.

The expected financial gain arising from the adoption of the results of a particular research project can be evaluated using a parametric budget of the form:

$$Y = f (a_1 p_1 + a_2 p_2 + \dots + a_n p_n)$$

Where Y = nett return from the production and marketing of Drysdale wool

$P_j$  = nett return which can be attributed to the jth productive character

$a_j$  = level of the jth productive character.

Research on wool weight, fertility, etc., is concerned with increasing the value of the  $a_j$  coefficients; that is, increasing

the physical output from the fixed resources available to the Drysdale-producing farmer. Farm management research is concerned with choosing the Drysdale plan that maximizes  $Y$  - for given  $a_j$ s and  $p_j$ s. Market, marketing and technical research is concerned with increasing the level of the  $p_j$ s.

As long as the objective of each research project is clearly defined, its expected contribution to increasing profit should be able to be determined.

Equations 4.1 to 4.5 inclusive in Chapter IV can be used to evaluate the effect of unit change in prices and production coefficients. All these equations, of course, hold only for the minimum value prices and production coefficients given in Appendix B. For example, equation 4.1 expresses revenue in terms of wool weights:

$$R = 0.95204 + 1.25 (0.19838W_{17} + 0.19441W_{18} + 0.18663W_{19} + 0.17824W_{20} + 0.16754W_{21} + 0.15414W_{22}) \quad 4.1$$

Where  $R$  = nett revenue

and  $W_{17}$  .....  $W_{22}$  are the wool weights of the various stock classes.

At this wool price (30d per lb, or £1.25 per 10 lb) an increase in average ewe hogget wool weight ( $W_{17}$ ) of 1 lb would increase revenue by  $(£1.25 \times 0.1 \times 0.19838) = £0.02480$  per ewe-equivalent. At a wool price of 60d per lb however, an increase in average ewe hogget wool weight would increase revenue by  $£(2.5 \times 0.1 \times 0.19838) = £0.04959$  per ewe-equivalent.

Table 5.1 gives a ranking of production characteristics in terms of the change in the nett financial return resulting from a unit change in the value of the parameter. Table 5.1 is based on the following production coefficients and prices:

$$P_{6yr} \text{ (cull 6 year Drysdale ewe price)} = 0.6,$$

$$P_{w(D)} \text{ (Drysdale wool price)} = 2.08333,$$



$W_{17}$	(Drysdale ewe hogget wool weight)	=	0.8,
$W_{18}$	(2-tooth ewe wool weight)	=	0.9,
$W_{19}$	(4-tooth ewe wool weight)	=	1.0,
$W_{20}$	(6-tooth wool weight)	=	1.0,
$W_{21}$	(4 year ewe wool weight)	=	0.95,
$W_{22}$	(5 year ewe wool weight)	=	0.9,
$PF1_{(D)}$	(Drysdale fat lamb price)	=	1.6,
$P_{18}$	(2-tooth ewe lambing percentage)	=	0.9,
$P_{20}$	(4-tooth ewe lambing percentage)	=	1.0,
$P_{21}$	(6-tooth ewe lambing percentage)	=	1.0,
$P_{22}$	(4 year ewe lambing percentage)	=	1.0,
$P_{23}$	(5 year ewe lambing percentage)	=	1.0.

These prices and production coefficients are those which could justifiably be expected from the Drysdale breed under lowland commercial conditions. The ranking in Table 5.1 indicates the effect on nett revenue of a unit increase in these prices and production coefficients.

In Table 5.1, the ranking for fertility, wool weights, wool price, and cull stock quality is derived from equation 4.6. The ranking for thrift is derived from the z-c values of the selling activities given in section 4.4 Chapter IV.

The use of a ranking of relative economic importance of production characters such as given in Table 5.1 has the limitation that it applies to only one farming system and one particular set of production coefficients and prices. For example, the linear programming analysis in Chapter IV indicates that, for the farming situation given, it is not profitable to run wethers. On the actual case farm however, it seems likely that a wether policy would be more profitable than breeding stock. Consequently, while research on say wether wool weights

TABLE 5.1: RELATIVE ECONOMIC IMPORTANCE OF  
VARIOUS PRODUCTION CHARACTERS

Productive character	Unit charge	Effect on return per ewe-equivalent	Ranking
Lambing percentage: 2-tooth ewe	1%	0.0030	13
4-tooth ewe	1%	0.0029	14
6-tooth ewe	1%	0.0028	15
4 year ewe	1%	0.0026	16
5 year ewe	1%	0.0024	17
Wool weights: Ewe hogget	0.1 lbs	0.0041	6
2-tooth ewe	0.1 lbs	0.0040	7
4-tooth ewe	0.1 lbs	0.0039	8
6-tooth ewe	0.1 lbs	0.0037	9
4 year ewe	0.1 lbs	0.0035	10
5 year ewe	0.1 lbs	0.0032	12
Wool quality:	1d per lb	0.0034	11
Carcass quality:			
Ewe and wether lambs	£0.01	0.0060	4=
6 year ewes	£0.01	0.0010	20
Thrift:			
Ewe lamb (Dec - Aug)	1%	0.0060	4=
Ewe hogget (Aug - March)	1%	0.0120	1
2-tooth ewe (March - March)	1%	0.0110	2
4-tooth ewe (March - March)	1%	0.0090	3
6-tooth ewe (March - March)	1%	0.0050	5
4 year ewe (March - March)	1%	0.0020	18
5 year ewe (March - March)	1%	0.0010	19

would be of little value for the first two case farms in Chapter IV, it may be of considerable importance to the third case farm discussed in section 4.6. Clearly, research priorities would differ between farmers according to their farming system, resource framework, etc.<sup>3/</sup>

Also, genetic relationships, either for one character between years (for example, fertility at the 4-tooth and 6-tooth stage), or between different characters (for example, wool weight and fertility) mean that increases in any production coefficient through selection are likely to result in either increases or decreases in other production coefficients due to genetic correlation.

Although it may not be possible however, to make a precise distinction between the relative economic importance of say, thrift at the 2-tooth stage compared with thrift at the 4-tooth stage, the general order of importance of the various production characteristics can be evaluated. For example, research on fertility and wool weight should clearly have priority over research on the carcass quality of cull ewes.

Market and marketing research, and research on the manufacturing properties of Drysdale wool would effect the return from Drysdale production by increasing the price paid for Drysdale wool. Thus, an increase in the technical quality of Drysdale wool that raises the price that manufacturers are willing to pay by 1d per lb would increase the return obtained by the wool-producing farmers by £0.0034 per ewe-equivalent.

These weightings apply to both (that is "knowledge seeking" and "efficiency improving") classes of research discussed in section 5.1 above. If a parameter is of high relative economic importance,

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<sup>3/</sup> This point is made by Heady: Heady E.O., "Economic concepts in directing and designing research for programming use of range resources", *Jnl. Farm. Eco.* 38:1604, 1956.

then uncertainty concerning the value that it will take under commercial conditions is clearly undesirable. For example, there is little information available at present on the carcass quality of two-tooth ewes. However, as it is unlikely that two-tooth ewes would be sold fat under commercial conditions, uncertainty concerning their carcass quality is not of major commercial importance. On the other hand, fertility is of major importance in any breeding programme, and uncertainty concerning the expected lambing percentages of the Drysdale breed is correspondingly undesirable.

Finally, it should be stressed that these weightings of relative economic importance indicate only the change in financial return resulting from a small unit change in production coefficients and prices. They give no indication of the ease with which such a change can be made. A complete comparison between research projects requires the fulfilment of each one of the necessary conditions for research planning which are discussed in section 5.2 of this Chapter.

#### 5.4

As outlined in the introduction, the objective of this study was to determine whether or not the commercial production of Drysdale wool in New Zealand was likely to be a profitable proposition for the farmers involved. Basically, there are three possible conclusions which would be expected from the investigation:

(i) Drysdale production was, in fact, financially profitable and there were no excessive risks involved.

(ii) Drysdale production was not financially profitable.

(iii) Present knowledge of the technical quality of the wool, and production coefficients of the breed was inadequate to draw even a tentative conclusion.

Clearly, there are always risks involved in the adoption of a farm innovation. The critical question is: Is present knowledge

sufficient to allow the production of Drysdale wool on a small scale with no more than "normal business risks"? The evidence presented in the last four chapters suggests that Drysdale production is likely to at least break even with the present farming system over quite a wide range of conditions. It seems likely that Drysdales would show a premium over Romneys on country suitable only for running wethers.

On the basis of this evidence, it is felt that a pilot scale Drysdale production/marketing organisation supplying wool for the New Zealand market and of the form described in Chapter III could operate profitably for both the farmers and carpet manufacturers involved. The information obtained from experience of the Drysdales under farm conditions, and the performance of Drysdale wool in carpet manufacture should allow present uncertainties concerning these aspects to be reduced. A suggested plan for the organisation of such an evaluation programme will now be outlined.

#### 5.5 A suggested Drysdale Evaluation Programme

It is suggested that information on the performance of the Drysdale breed under farm conditions could be simply obtained from records kept by the Drysdale wool-producing farmers. Records of the production characteristics of the breed could be kept and compared with those of Romney sheep run on the same farm. This type of farm-scale trial would be similar to those carried out in the early development of the Perendale breed.<sup>4/</sup> The obvious disadvantage of this type of trial is that it is virtually impossible to keep environmental conditions constant between the experimental and the control breed. It is felt however, that if husbandry conditions

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<sup>4/</sup> See Peren G.S., Hewitt W.R.R., Ballard H.V., and Phillips T.O., "Trials with the Cheviot half-bred versus Romney sheep on poor hill country", Massey Agricultural College Sheepfarming Annual p.3, 1951.

are kept as similar as is practicably possible between the two breeds, useful results would be obtained. Certainly, this type of trial should show up any aspects in which the Drysdale differs markedly from the pure Romney breed.

It is suggested that the following records be kept.

- (i) Ewes: Lambing percentage (lambs docked) ewes tuppéd).  
Percentage dry ewes.  
Ewe death rate by age class.  
Ewe fleece weights by age class.  
Carcass quality of cull fat ewes.
- (ii) Lambs: Lamb wool weights (if shorn at this stage).  
Price received for fat lambs (as a function of carcass weight and quality).
- (iii) Hoggets: Death rate (docking to 2-tooth tuppéd).
- (iv) Wethers: Wool weights.  
Price received for cull stock.

All these records would be kept, as far as possible, for both Romney and Drysdale stock of similar age classes. Any farmers' comments concerning such aspects as lambing difficulties, ease of shepherding, etc., could be recorded.

The keeping of such records would involve the farmers concerned with work in excess of that normally required in the management of a Drysdale flock. Some compensation for this could be given in the form of a premium (over the "carpet bareme" price) paid for the wool. At present prices for imported carpet wool, such a premium could be paid without financial loss to the carpet manufacturing firm. The advantage to the carpet firms in having this information would be that they would be able to use it to persuade other farmers to grow Drysdale wool.

As far as the manufacturing and carpet properties of Drysdale

wool are concerned, information on these aspects would come from experience in using the wool in carpet manufacture. In particular, it would be of particular interest to ascertain the performance of Drysdale wool in the manufacture of tufted carpet, and in various blends with synthetic fibres and other wools. A research programme concerned with the assessment of carpets and carpet fibres is proposed by the Wool Research Organisation of New Zealand <sup>5/</sup>and carpet manufacturers could collaborate with this organisation.

It is felt that a research programme of this type would contribute considerably towards reducing present uncertainty concerning the performance of the Drysdale breed under commercial conditions, and the quality of Drysdale wool as a carpet fibre.

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<sup>5/</sup> Roberts N.F., "The research programme of the Wool Research Organisation of New Zealand"; Address given to the Massey Wool Conference. July, 1963.

## SUMMARY

1. The supplies of carpet wool available to carpet manufacturers have declined over the last decade due to firstly, an absolute decline in carpet wool production in some of the major carpet wool producing countries, and secondly, a decline in carpet wool exports from these countries due to increased domestic consumption. World carpet production has expanded at a rate which is proportionately considerably higher than that shown for woven fabrics. The major carpet producing country, the United States of America, has shown marked trends towards the production of tufted carpet and an increased consumption of synthetic fibres and crossbred wools in carpet manufacture. The fall in available supplies of carpet wools has not been reflected in a marked change in the relative prices of carpet compared with apparel wools. However, taking into account the general supply/demand situation for carpet fibres, the conclusion is made that, in the absence of a marked improvement in the technical quality of synthetic carpet pile fibres, the potential world market for carpet wools is at least as good as that for apparel wools.

The price that could be expected for Drysdale wool on the domestic market is likely to be somewhat higher than that received for exported wool. The cost of imported carpet wool in New Zealand is, in general, in excess of 55d per lb. Thus if wool of equivalent technical quality was produced in New Zealand for the local market, the producing farmers could expect a premium of between 9d and 1/6d per lb over crossbred wool. The extent of the domestic market (on the basis of present carpet wool imports) is approximately 3,000,000 lbs.

2. Different methods of carpet manufacture are outlined. Methods of testing carpets and carpet fibres are described, and their



limitations discussed. The quality of Drysdale wool as a carpet fibre appears to be satisfactory, at least for the manufacture of woven carpets. The major limitation of Drysdale wool as a carpet pile fibre is variation in fibre diameter along the length of the staple. The Drysdale fibre length was also excessive for manufacturing purposes. Both these limitations however, could be reduced with double shearing.

3. Drysdale wool could be sold directly from farmer to manufacturer, it may be marketed through auction, or it may be marketed through some form of specialist Drysdale marketing organisation. Because direct sale would allow effective communication between farmer and manufacturer, and also a reduction in brokerage and handling charges, it is concluded that a direct agreement between the Drysdale wool-producing farmers and carpet manufacturers would be the most efficient system for marketing Drysdale wool on the domestic market. The administrative details of a possible scheme are outlined. For the export market however, it is suggested that a specialist Drysdale marketing organisation would be the more efficient marketing system. A suggested small-scale scheme is briefly described.

4. Present knowledge on the four major productive characters of the Drysdale breed; thrift, fertility, carcass quality and weight, and wool weight is outlined. On the basis of this information a management plan for a Drysdale breeding flock is developed using linear programming. The financial return from the Drysdale sheep policy is compared with that from the present sheep policy on two hypothetical case farms using a "break-even" partial parametric budget. The expected revenue from a Drysdale policy on an actual case farm is determined and compared with the revenue from the farmer's present policy. It is concluded that, at the prices that could justifiably be expected for carpet wool for the New Zealand

domestic market, a Drysdale policy would be marginally profitable on the two hypothetical case farms, and would give a 7 per cent increased return on the actual case farm. It seems likely that Drysdale production would show a greater relative profitability on land suitable for running wethers.

Finally, the effect of variation in the productive characters of the Drysdale breed on revenue is evaluated and financial criteria for further research with the breed are developed.

5. Taking into account present knowledge on the Drysdale breed and the quality of Drysdale wool as a carpet pile fibre, and the research criteria developed in Chapter IV, a research plan that would reduce present uncertainties concerning the breed is outlined. Fertility is of major relative economic importance, and as uncertainty exists concerning the fertility of the Drysdale breed under commercial conditions, first research priority should be given to this aspect. On the other hand, the carcass quality of Drysdale cull stock is of less economic importance, and consequently research on the carcass quality of Drysdale cull stock should be of low priority compared with research on fertility.

## DISCUSSION AND CONCLUSIONS

The financial return to any farmer from Drysdale wool production would be determined by two classes of factors:

(i) External influences, which in the short term, cannot be controlled by the farmer. These would include such factors as lambing percentage, thrift, and wool weight and the quality of the Drysdale products. The farm's framework of fixed resources, in as far as it effects Drysdale production, is also a factor which the farmer is unable to change in the short term.

(ii) Factors which the farmer is able to control. Clearly, the management system used for the Drysdales can be controlled by the farmer. Knowing the farm's fixed resources, the production coefficients of the Drysdale breed, and the expected prices for the Drysdale products, the system of management which maximizes the financial return from Drysdale production can be formulated. The prices received can also be influenced, within limits, by the Drysdale-producing farmers in as far as they can select the most efficient system for marketing the Drysdale products.

As outlined in the introduction, the object of this study was to answer the question: Given optimum systems of management and marketing, is Drysdale production likely to be financially profitable for the farmers involved? To obtain an answer to this question requires an investigation of all four aspects (market for carpet fibres, the quality of Drysdale wool as a carpet fibre, the most efficient marketing system for Drysdale wool, the profitability of Drysdale production at the farm level) listed on page 9. At all levels uncertainty exists, and a research programme designed to reduce this uncertainty is given in Chapter V.

Summarizing the conclusions made from I, II, III and IV, we find:

(i) The potential world market for carpet wool seems likely to be at least as good as that for crossbred and fine wools. As far as the production of carpet wool for the domestic New Zealand market is concerned, the prices at present being paid for imported carpet wool should allow a premium of between 6d and 1/6d per lb to be paid for Drysdale wool compared with Romney wool.

(ii) As the result of one study carried out at the University of Leeds it is tentatively concluded that the Drysdale wool is satisfactory as a carpet pile fibre for woven carpets. The properties of Drysdale wool as a pile fibre for tufted carpets are unknown, and further research should be carried out to ascertain these properties. However, as the same yarns are frequently used in the manufacture of both woven and tufted carpets, it seems likely that Drysdale wool should have no major limitations as a pile fibre for tufted carpets.

(iii) Of the three marketing systems that were compared (auction, direct sale and central marketing authority) it is suggested that a direct agreement between Drysdale producing farmers and carpet manufacturers would be the most efficient marketing system for the domestic carpet wool market. However, a specialist Drysdale wool marketing organisation would probably be the most efficient marketing system for exporting Drysdale wool.

(iv) A linear programming analysis indicates that the most profitable flock management policy for two case farms is ewe policy where cull ewe stock are sold as lambs and ewes are cast for age at 6 years. All wethers are sold fat as lambs. At Drysdale wool prices in excess of 70d per lb a "wether policy" (wether hoggets, 2-tooths and 4-tooths kept) was the optimal policy. Comparing the revenue from this Drysdale plan with that from present policies on two case farms, it was found that, for prices that could reasonably

be expected for the Drysdale products and production coefficients that could be expected under these conditions, the Drysdale policy was only marginally more profitable than the present policy.

On the third case farm however, the Drysdale policy returned considerably more than the present policy. The Drysdale policy on this farm consisted of running wethers, and it seems likely that Drysdales would generally be relatively more profitable on country suitable particularly for this class of stock.

The most important factor influencing the profitability of Drysdale production is the price that can be expected for the wool. The price of imported carpet wool sets only an upper limit on the price likely to be paid for Drysdale wool. On the other hand, the price paid by New Zealand carpet manufacturers for Drysdale wool would have to be at a level such that the Drysdale producing farmers would not find it more profitable to sell their wool to overseas markets. The export price for Drysdale wool would set a lower limit on the price paid by New Zealand carpet manufacturers. As long as the Drysdale wool price was sufficient to encourage the production of some Drysdale wool (not necessarily all local carpet wool requirements) the development of a Drysdale industry in New Zealand would quite obviously be profitable for the farmers involved. The critical question is whether or not the wool price that would make Drysdale production profitable for some farmers is less than the price of imported carpet wool. On the basis of the evidence presented in this study, the conclusion is made that Drysdale production would, in fact, be profitable for some farmers at a Drysdale wool price level considerably below the cost of imported carpet wool. To determine the amount of Drysdale wool likely to be produced at any particular wool price from some form of supply function, would be the task of a considerably more detailed investigation. However,

considering the area of New Zealand which is suitable primarily for running wethers, it seems likely that at present prices for imported carpet wool, sufficient Drysdale wool would be produced to fulfil local demand. Such a conclusion can only be tentative in the absence of a detailed farm survey. Such a survey would logically follow this preliminary investigation.

Uncertainty exists on the productive ability of the breed under various environmental conditions and the quality of Drysdale wool as a carpet fibre. In the author's view however, this uncertainty is not sufficient to warrant further delay in the development of a Drysdale sheep industry in New Zealand.

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## APPENDIX A

The expansion of carpet wool production in New Zealand through the Drysdale breed would clearly be able to proceed only as rapidly as allowed by the reproduction and death rates of the breed.

Appendix Table A.1 shows the result of mating one Romney ewe to a Drysdale ram at the beginning of an expansion programme, and thereafter maximising the rate of expansion of Drysdale stock numbers.

The following assumptions are made:

1. Lambing percentage = 0.9.
2. Average annual death and culling rate = 0.06.
3. Ewes are cast for age at 6 years, wethers are culled as 4-tooths.
4. For the first four years (until Drysdales replace the Romney flock) ewe numbers are kept constant. After this, the maximum possible rate of increase in stock numbers is maintained.
5. Wool weights are as follows:
  - Hoggets 8.0 lbs.
  - Wethers and ewes 10.0 lbs.

From Table A.1, the expected production of Drysdale wool in any year can be estimated. For example, if 1,000 Romney ewes are mated to N/N rams in year 1, by year 10 (that is, nine years after the commencement of the breeding programme) the production of 63,180 lbs of Drysdale (N/N and N/+) wool could be expected.

The cumulative total in any year represents the result of mating one Romney ewe per year to a Drysdale ram. Fig A.1 gives the expected wool production in any year for various numbers of ewes mated each year.

From Fig A.1, it can be seen that, if a maximum rate of increase

TABLE A.1: RESULTS OF MATING PROGRAMMES TO INCREASE DRYSDALE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Drysdale ewes:															
N/+			0.398	0.772	1.041	1.204	1.338	1.497	1.399	1.339	1.332	1.349	1.389	1.407	1.414
N/N					0.079	0.230	0.454	0.758	1.157	1.685	2.268	2.959	3.784	4.773	5.958
Drysdale wethers 2-tooth and 4-tooth:															
N/+			0.398	0.772	0.690	0.523	0.436	0.435	0.449	0.548	0.577	0.526	0.514	0.516	0.527
N/N					0.079	0.230	0.385	0.555	0.520	1.018	1.301	1.629	2.045	2.540	3.137
Drysdale wool (lbs)															
N/N and N/+	0	6.77	14.73	24.66	25.71	29.44	35.84	44.58	50.51	63.18	75.23	88.98	106.46	127.35	152.20
Romney ewes mated per year						Drysdale (N/N and N/+ wool available (x 1,000 lbs))									
500		3.38	10.75	23.08	35.93	50.65	68.57	90.86	116.12	147.71	185.32	229.81	283.04	346.72	422.82
1,000		6.77	21.50	46.16	71.87	101.31	137.15	181.73	232.24	295.42	370.65	459.63	566.09	693.44	845.64
5,000		33.85	107.50	230.80	359.35	506.55	685.75	908.65	1,161.20	1,477.10	1,853.25	2,298.15	2,830.45	3,467.20	4,228.20
10,000		67.70	215.00	461.60	718.70	1,013.10	1,371.50	1,817.30	2,322.40	2,954.20	3,706.50	4,596.30	5,660.90	6,934.40	8,456.40

16	17	18	19	20
1.403	1.410	1.421	1.432	1.443
7.364	9.063	11.082	13.469	16.381
0.538	0.544	0.543	0.542	0.546
3.851	4.697	5.698	6.898	8.340
181.45	216.48	258.30	308.05	368.58
513.54	621.78	750.93	904.96	1,089.25
1,027.09	1,243.57	1,501.87	1,809.92	2,178.50
5,135.45	6,217.85	7,509.35	9,049.60	10,892.50
10,270.90	12,435.70	15,018.70	18,099.20	21,785.00

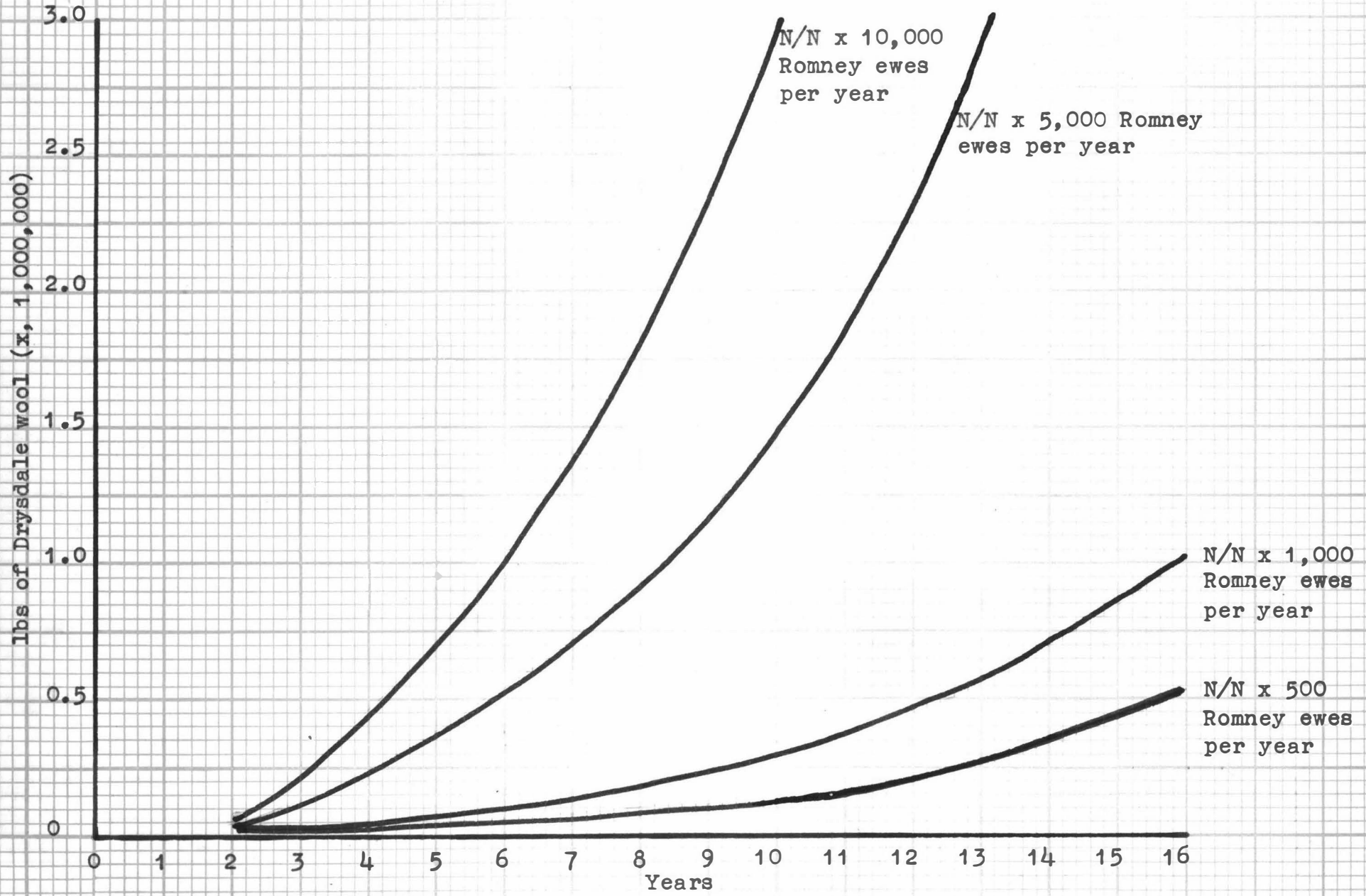


FIG A.1: EXPECTED DRYSDALE WOOL PRODUCTION

in Drysdale numbers is maintained, the mating of 500 Romney ewes to N/N rams annually will allow the production of approximately 150,000 lbs of Drysdale wool in 10 years.

Carpet wool imports into New Zealand in 1961 totalled approximately 2,900,000 lbs (raw wool equivalent). If 5,000 Romney ewes were mated annually to N/N rams this level of imports could be produced locally in about 12 years - allowing for the small numbers of Drysdale stock at present available. Of course, it is likely that the carpet industry in New Zealand will expand over this period with a corresponding increase in demand for carpet wool.

It seems likely that the critical factor governing the rate of expansion of Drysdale sheep numbers would be the number of Romney ewes available to mate to N/N rams. As the usual commercial mating ratio is one ram per 50 ewes (and this could be considerably lower with hand service or artificial insemination), it would seem that available numbers of Drysdale rams would be unlikely to limit the expansion of the breed.

The critical limiting factor controlling the rate of development of a Drysdale industry in New Zealand would seem to be then, the rate of acceptance and adoption by farmers of this new technology. The conclusions from Chapter IV indicate that Drysdale production would be quite profitable on one case farm and marginally profitable on two other case farms. It is, of course, not possible to make any precise inference from these case studies to other farms. In any case, financial profitability is undoubtedly not the only factor influencing the rate of farmer adoption of new technologies. Other factors such as the influence of neighbours, personal preferences, etc., probably also play a part to a greater or lesser degree.<sup>1/</sup>

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<sup>1/</sup> See: Griliches 2., "Hybrid corn: An exploration into the economics of technological change", *Econometrica* 25:501, 1957.

Consequently, it is virtually impossible to make any precise estimate of the potential rate of expansion of Drysdale sheep numbers. Any estimate can only be an opinion based on present experience of farmer acceptance and adoption of new technologies. In the author's view, it is likely that it will take at least ten years to produce enough Drysdale wool to fulfil local demand for carpet wool. This objective would be fulfilled if an average of approximately 6,000 Romney ewes were mated per year to Drysdale rams, and a maximum rate of increase of Drysdale numbers was maintained.

## APPENDIX B

The coefficients in the Drysdale linear programme, the first tableaux of which is given in Table B.1, are based on the following basic data:

(i) Lambing percentages: (minimum value)

2-tooth 80%

Mixed age 90%

(ii) Losses:

Ewe and wether lambs (Birth to December) 3%

Ewe and wether lambs (December to September) 4%

Hoggets, 2-tooth (September to February) 2%

Ewes: (February to February)

2-tooth - 4-tooth 4%

4-tooth - 6-tooth 4.5%

6-tooth - 4 year old 6%

4 year old - 5 year old 8%

5 year old - 6 year old 11%

Wether hoggets (September to February) 2%

Wether 2-tooth (February to September) 2%

Wether 2-tooth (February to February) 3%

Wether 4-tooth (February to September) 2%

(iii) Wool weights: (minimum value)

Ewe hoggets 6 lbs

2-tooth 8 lbs

4-tooth 9 lbs

6-tooth 9 lbs

4 year old 8.5 lbs

5 year old 8 lbs



Wether hoggets	6 lbs
2-tooth	9 lbs
4-tooth	9 lbs

The coefficients for the basic population parameters of lambing percentage and death rate are based on those derived by Hickey for the New Zealand Romney under commercial conditions.<sup>1/</sup>

(iv) The timing of stock sales and prices are as follows:

Lambs (December)	Price	£1.6
Hoggets (September)	"	£1.5
2-tooth ewe (February)	"	£1.0
4-tooth ewe (February)	"	£0.9
6-tooth, 4 year, 5 year and 6 year ewe (February)	"	£0.75
2-tooth wether (September)	"	£1.5
4-tooth wether (September)	"	£1.4

The minimum wool price is 30d per lb.

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<sup>1/</sup> Hickey F., "Death and reproductive rates of sheep in relation to flock culling and selection", N.Z. Jnl. Agr. Res., 3:332, 1960.

TABLE A.1: RESULTS OF MATING PROGRAMMES TO INCREASE DRYSDALE NUMBERS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Drysdale ewes:																					
N/+			0.398	0.772	1.041	1.204	1.338	1.497	1.399	1.339	1.332	1.349	1.389	1.407	1.414	1.403	1.410	1.421	1.432	1.443	
N/N					0.079	0.230	0.454	0.758	1.157	1.685	2.268	2.959	3.784	4.773	5.958	7.364	9.063	11.082	13.469	16.381	
Drysdale wethers 2-tooth and 4-tooth:																					
N/+			0.398	0.772	0.690	0.523	0.436	0.435	0.449	0.548	0.577	0.526	0.514	0.516	0.527	0.538	0.544	0.543	0.542	0.546	
N/N					0.079	0.230	0.385	0.555	0.520	1.018	1.301	1.629	2.045	2.540	3.137	3.851	4.697	5.698	6.898	8.340	
Drysdale wool (lbs)																					
N/N and N/+	0	6.77	14.73	24.66	25.71	29.44	35.84	44.58	50.51	63.18	75.23	88.98	106.46	127.35	152.20	181.45	216.48	258.30	308.05	368.58	
						Drysdale (N/N and N/+ wool available (x 1,000 lbs)															
Romney ewes mated per year																					
500		3.38	10.75	23.08	35.93	50.65	68.57	90.86	116.12	147.71	185.32	229.81	283.04	346.72	422.82	513.54	621.78	750.93	904.96	1,089.25	
1,000		6.77	21.50	46.16	71.87	101.31	137.15	181.73	232.24	295.42	370.65	459.63	566.09	693.44	845.64	1,027.09	1,243.57	1,501.87	1,809.92	2,178.50	
5,000		33.85	107.50	230.80	359.35	506.55	685.75	908.65	1,161.20	1,477.10	1,853.25	2,298.15	2,830.45	3,467.20	4,228.20	5,135.45	6,217.85	7,509.35	9,049.60	10,892.50	
10,000		67.70	215.00	461.60	718.70	1,013.10	1,371.50	1,817.30	2,322.40	2,954.20	3,706.50	4,596.30	5,660.90	6,934.40	8,456.40	10,270.90	12,435.70	15,018.70	18,099.20	21,785.00	

TABLE B.1: DRYSDALE LINEAR PROGRAMME. FIRST SIMPLEX TABLEAUX

Activity	B	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	
Description	Restriction or activity	Wether lambs sell	Ewe lambs sell	Ewe hogget sell	Ewe 2-tooth sell	Ewe 4-tooth sell	Ewe 6-tooth sell	Ewe 4 yr.old sell	Ewe 5 yr.old sell	Ewe 6 yr.old sell	Wether hogget sell	Wether 2-tooth sell	Wether 4-tooth sell	Wool sell			Ewe hogget winter	Ewe 2-tooth winter	Ewe 4-tooth winter	Ewe 6-tooth winter	Ewe 4 yr.old winter	Ewe 5 yr.old winter	Wether hogget winter	Wether 2-tooth winter	Wether 4-tooth winter			
Carrying capacity*	1																0.6	1.0	1.0	1.0	1.0	1.0	0.6	0.65	0.65			
Wether lambs		1.03093																-0.4	-0.45	-0.45	-0.45	-0.45	1.07388				-0.5	
Ewe lambs			1.03093														1.07388	-0.4	-0.45	-0.45	-0.45	-0.45					-0.5	
Ewe hoggett				1	1.02041												-1	1.02041										-0.5
Ewe 2-tooth						1.04167												-1	1.04167									
Ewe 4-tooth							1.04712												-1	1.04712								
Ewe 6-tooth								1.06383												-1	1.06383							
Ewe 4 year old									1.08696												-1	1.08696						
Ewe 5 year old										1.12359												-1						
Wether hogget											1												-1	1.02041				
Wether 2-tooth												1.02041												-1		1.03093		
Wether 4-tooth													1.02041												-1			
Wool 1														1			-0.6	-0.8	-0.9	-0.9	-0.85	-0.8	-0.6	-0.9	-0.9			-1
Lambs															1			-0.8	-0.9	-0.9	-0.9	-0.9						
Wool 2																1	-0.6	-0.8	-0.9	-0.9	-0.85	-0.8	-0.6	-0.9	-0.9			X1
z - c	0	-1.6	-1.6	-1.5	-1.0	-0.9	-0.75	-0.75	-0.7	-0.6	-1.5	-1.5	-1.4	-1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	X2

\* The inclusion of a carrying capacity disposal activity is unnecessary, as the optimum plan should just fulfil the carrying capacity restriction.