AN ECONOMIC ANALYSIS OF THE EFFECTS OF ALTERNATIVE SHEARING METHODS ON WOOL QUALITY IN EASTERN SOUTH DAKOTA

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CHAPTER I

INTRODUCTION

Characteristics of Wool Production in Eastern South Dakota

Sheep and wool production in the eastern one-half of South Dakota is essentially carried out under farm flock conditions. The farm flock acts as a partial supplement to other farm enterprises and provides a market for labor and feed, including weeds and unharvested crops. The flock size, management practices employed, and place of the sheep enterprise in the overall farm operation in eastern South Dakota are similar to those of midwestern states. In contrast, in the western one-half of the state sheep are produced under range flock conditions.

Flock Size

The size of the individual farm sheep enterprise in eastern South Dakota is indicated by the average number of sheep shorn per farm reporting in the 1954 Census of Agriculture. The average number of sheep shorn per farm ranged from 26 to 100 head in 39 eastern South Dakota counties.[1] With a few exceptions the average number of sheep shorn per farm was from 30 to 60 head in each county. Most of the

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[1] United States Census of Agriculture: 1954, United States Department of Commerce, Bureau of the Census, I, part 11, (Washington, D.C., 1956,) pp. 262-267.

exceptions were found in the more westerly counties where sheep production is carried on under more nearly range than farm conditions (Figure 1).

Sheep numbers have increased in these 39 counties from 550,100 on January 1, 1954 to 817,800 on January 1, 1960.[2] Data are not available to determine whether the increase was due primarily to larger flocks or to more farms having sheep. However, observation indicates that more of the increase is likely to be due to the latter and that the average number of sheep per farm may not have changed appreciably in the past five years.

Management Practices

The farm sheep flock is pastured on native or improved grasslands during the growing season. These are normally fenced so that herding is not necessary. Grass and weeds in farm lots, around outbuildings, and along roadsides are also grazed. After harvest and during the autumn months small grain stubble fields and corn fields provide roughage for the farm flock.

The winter ration includes grass and legume hay. When snow cover does not interfere fields and pastures may provide much of the roughage needs throughout most of the winter. Grain or commercial concentrates are typically added to the ewe ration prior to lambing and while the lambs are small, especially if legume hay is not fed.

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[2] South Dakota Agriculture, 1955 and South Dakota Agriculture, 1959, South Dakota Crop and Livestock Reporting Service, (Sioux Falls, South Dakota), pp. 32 and 32, respectively.

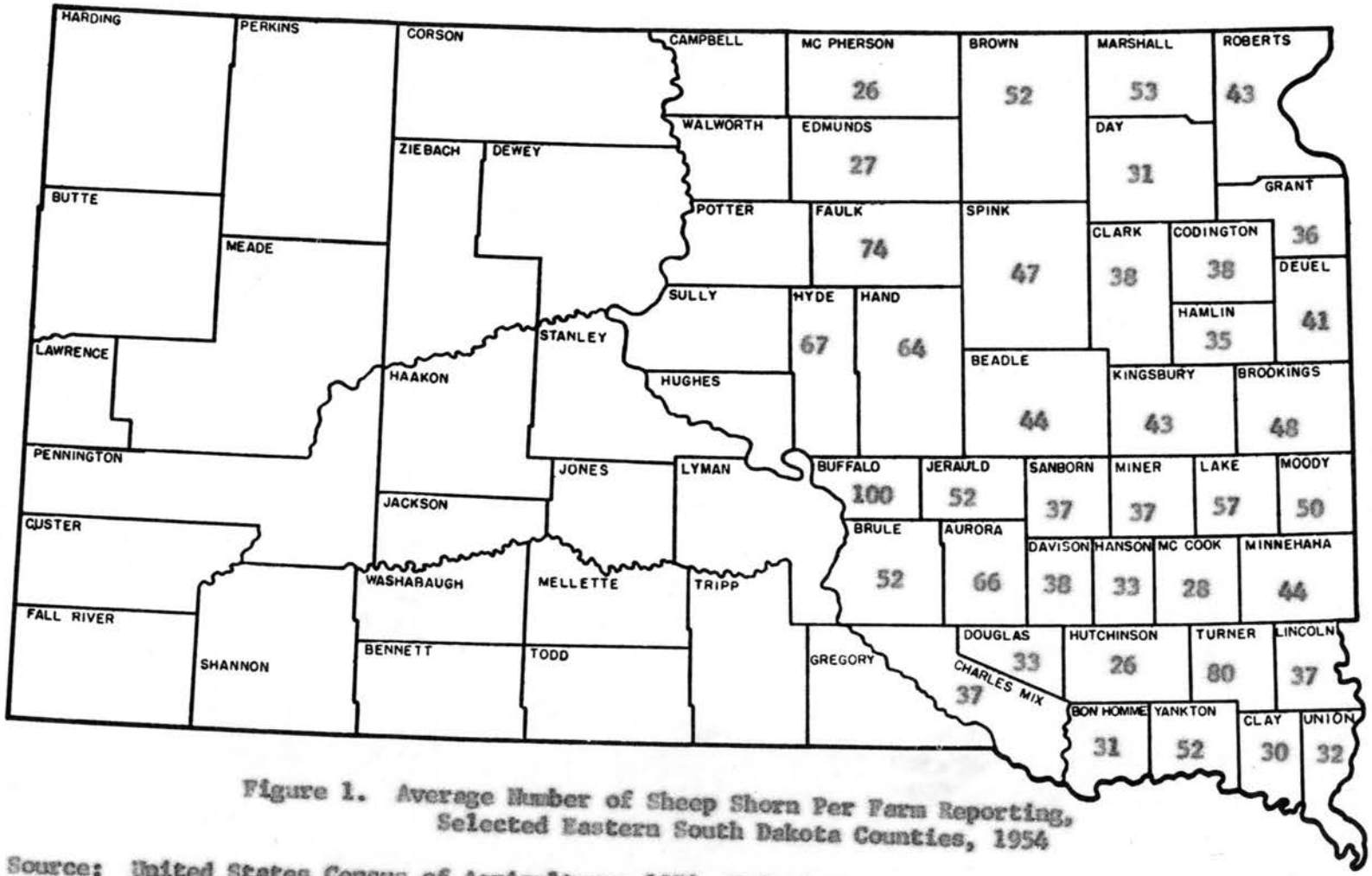

Figure 1. Average Number of Sheep Shorn Per Farm Reporting, Selected Eastern South Dakota Counties, 1954

Source: United States Census of Agriculture: 1954, United States Department of Commerce, Bureau of the Census, I, part 11, Washington, D.C., 1956, pp. 262-267.

Housing the farm flock is not a critical factor except at lambing time. Mature sheep can withstand low temperatures but need protection against storms and wet weather. Pole type sheds, often with straw or hay roofs, hog houses, and similar facilities are commonly used to house breeding ewes. At lambing time individual pens or portable panels are employed to separate the ewe from the flock for 24 to 72 hours, or until the ewe accepts the lamb and the lamb gains strength.

The time of lambing varies, by farm, from January to April. The tendency seems to be for more early lambing (January and February) and less March and April lambing, although the latter is still the more prevalent practice.

The labor requirement for the typical flock is relatively small. Lambing time is the exception. During this period of approximately two to four weeks the farmer must spend a considerable amount of time with the flock, especially if the weather is severe. Shearing, worming, docking and castrating lambs, and marketing lambs and wool require only a few hours each for the farm flock owner.

Shearing Practices

Sheep in eastern South Dakota are sheared between March 1 and July 1. One of the principal factors determining the time of shearing is the farmer's decision on whether to shear before or after lambing. Shearing prior to lambing has the advantages of making the ewe easier to handle at lambing time, requiring less penning area, and making it easier for the new-born lamb to suckle. It also means shearing earlier

in the season, however, and this has the disadvantages of making housing a more critical factor and resulting in a lighter clip (due to less grease in the wool).

Most farmers employ custom operators to shear their flocks. These custom shearers work singly, in couples, or occasionally in crews of three or four. The current charge is 50 cents per head. The shearers furnish paper twine for tying the individual fleeces.

The farmer is expected to have his sheep penned when the shearers arrive, although the shearers sometimes must help with this chore. The shearing is done on a tarpaulin placed on the floor of a barn or shed. The shearer catches the individual sheep prior to shearing. After the fleece is sheared it is pushed aside by the shearer. The farmer is expected to tie the fleece and bag or otherwise remove it from the shearing area. Shearing time is five to ten minutes per sheep, depending on the shearer's skill, size of the sheep, and condition of the wool.

The most acceptable method of handling wool on the farm is to tie the individual fleece with paper twine and place it in a burlap bag. Wool bags, when fleeces are properly packed by tramping, hold from 250 to 300 pounds of wool. Farm flock producers do not always use wool bags for packaging their wool. Often the tied fleeces are placed in a farm wagon or truck preparatory to hauling to market. Sometimes the wool is piled or stacked in a barn or shed until marketed. The wool may be marketed immediately upon shearing or it may be stored as long as several months on the farm before being marketed.

Place of Sheep Enterprise in the Total Farm Operation

There are several reasons why livestock enterprises are carried on by eastern South Dakota farmers. Among the more important reasons are:

1. The labor on many farms is more fully utilized throughout the year.
2. Important products on many farms are native hay and pasture. These have little or no value except as livestock feed.
3. The volume of business can be increased by the use of livestock, thereby spreading overhead and equipment charges.
4. Livestock farming tends to reduce fertility losses as compared with selling grain.
5. The production of livestock generally increases returns as compared with selling feed grains on the market.
6. Livestock enterprises provide for more flexibility of operations and tend to provide more income stability.
7. The livestock enterprises reduce labor, power, and machinery requirements by pasturing and feeding off some crops.[3]

There are some disadvantages associated with carrying on several enterprises on the same farm. One is that only an unusual farmer is likely to be skilled in the physical operations and management decisions of several enterprises. Another is that the small volumes of products grown on diversified farms may not be marketed to greatest advantage.

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[3]Lyle M. Bender, The Rural Economy of South Dakota, South Dakota Extension Service, Special Report No. 1, (Brookings, South Dakota, September 1956), pp. 310-311.

The sheep enterprise on eastern South Dakota farms acts partially as a supplemental operation. That is, some labor and feed (roughage), and perhaps housing requirements for the farm flock can be provided without greatly reducing the amounts of these factors needed for other farm enterprises. The typical sheep enterprise is not a large enough user of some resources to appreciably affect, by the use of these inputs, the level of output of other products on the farm. This is because the labor requirements for the sheep enterprise are low, with lambing season the only critical and important labor requirement. Sheep utilize crop by-products such as grain stubble, picked cornfields and roadside and field weed growth which are largely non-utilizable by other species of livestock. Again, except at lambing time, housing requirements are non-critical and flexible.

However, for other important resources the sheep enterprise bears a competitive relationship to other farm enterprises. Such resources include capital, feed concentrates, labor at times such as planting, harvesting, and animal reproducing seasons, and housing at critical times. For these resources the farm flock, of whatever size, will be in competition with other farm enterprises.

The joint product relationship of the sheep enterprise is important in determining the place of sheep production on eastern South Dakota farms. It refers to an enterprise that produces two products simultaneously, in this case lamb and wool. Joint production enterprises offer flexibility for changing physical and economic conditions and may help stabilize income. For instance, a farmer with sheep can sell his lambs as feeders in the fall if fat lamb prices are not

favorable or if feed is short. If feed supplies are adequate and prices favorable, he might feed his lambs. Also, the farmer has income from the enterprise twice during the year, from wool in the spring and from lambs in the fall or winter. The income in the spring provides farm operating capital. In several instances in the study herein reported farmers depended upon wool income to pay the first half of their real estate taxes, due prior to May 1.

Marketing Wool in Eastern South Dakota

Size of Farm Wool Clip

The average weight per fleece shorn in 1959 in the area east of the Missouri River in South Dakota was nine pounds.[4] Multiplying this figure by the average flock size (25 to 100 head) gives a farm wool clip of from 200 to 900 pounds. The South Dakota Wool Growers' Association recorded an average wool clip weight per grower in eastern South Dakota of 461, 420, 430, and 470 pounds for the years 1955 through 1958, respectively.[5]

Method of Sale

The usual method of marketing wool in the United States is explained in the following quotation:

> Raw wool may be segregated into two broad categories--apparel wool and carpet wool. This paper is primarily concerned with apparel wool from which most worsted and

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[4] South Dakota Agriculture, 1959, p. 36.

[5] Lloyd Eilum, Treasurer, South Dakota Wool Growers' Association, Minneapolis, Minnesota, Letter to the Author, January 21, 1960.

> woolen clothing is made. Marketing of apparel wool begins with sale by growers to local dealers, buyers for large central markets, merchants or cooperative organizations. Raw wool at all stages is generally sold on a grease basis, as it comes off the sheep. Such wool contains animal grease, dirt, briars and other foreign matter which comprises on the average about 55 percent of the gross weight. Removal of these foreign materials results in considerable shrinkage and gives a product known as "scoured" wool. Prices for wool still "in the grease" are quoted on a scoured basis and involve an estimate of the quantity of shrinkage which will develop in the scouring process. Sales are made for cash when the wool is sold at shearing time, or on consignment to a central market agency, or by contract made prior to the shearing season. Most wool eventually arrives at one of the four large central markets - Boston, Chicago, St. Louis, or Philadelphia - where it passes into the hands of the large wool merchants who grade, store, and finally sell it. Boston is the most important of these markets.[6]

Wool producers in eastern South Dakota sell their wool clip outright (cash basis) or pool it with the cooperative South Dakota Wool Growers' Association. When selling on the cash basis they may sell to an independent buyer or to the South Dakota Wool Growers' Association, which also buys wool. There are several buyers in the eastern one-half of the state, some of whom appear to be quite competitive in their local communities. The South Dakota Wool Growers' Association handled from 69 percent to 83 percent of the total volume of wool produced in South Dakota east of the Missouri River for each of the years 1953 through 1958. This is an average of more than 78 percent for the six-year period for which data are available (Table I). However, in a given community the independent buyer may be the price setter, with the Cooperative matching his price, rather

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[6]Charles D. Hyson, "Maladjustments in the Wool Industry and Need For A New Policy," Journal of Farm Economics, 29, No. 2, (May 1947), p. 426 fn.

TABLE I

WOOL PRODUCTION, WOOL MARKETED BY SOUTH DAKOTA WOOL GROWERS' ASSOCIATION, AND PERCENTAGE OF PRODUCTION MARKETED BY WOOL GROWERS', SOUTH DAKOTA EAST OF MISSOURI RIVER, 1953-1958

Year	Wool Production East of Missouri River[1]	Wool Marketed by S.D. Wool Growers' East of Missouri River[2]	Percent of Production Marketed by S.D. Wool Growers'
	(pounds)	(pounds)	(percent)
1953	3,870,000	3,229,998	83.46
1954	4,115,000	3,443,543	83.68
1955	4,590,000	3,652,243	79.57
1956	5,022,000	3,776,005	75.19
1957	5,293,000	3,676,116	69.45
1958	5,596,000	4,494,169	80.31

[1] South Dakota Agriculture, 1953-1958, South Dakota Crop and Livestock Reporting Service, Sioux Falls, South Dakota.

[2] Lloyd Rikum, Treasurer, South Dakota Wool Growers' Association, Minneapolis, Minnesota, Letter to the Author, January 21, 1960.

than vice versa. This may be especially true at certain times of the year and for a certain quality of wool. Some independent buyers, for instance, may be more discriminatory in buying than is the Association's buyer. In such a case the independent buyer might pay a higher price for a bright clean clip. At the same time the independent buyer might refuse to buy a poor quality clip at all. Other buyers might offer an "average" price for both clips. In neither case is the price based on a visual grade. Rather it is the result of a cursory overall examination of the clip.

Farmers may pool their wool clip with the Association. When a clip is pooled the grower receives an advance payment if desired, usually approximately two-thirds of the amount for which the wool is expected to sell. The wool then moves from the local buying station (operated on a part time basis by a storekeeper, shearer, etc.) to the area warehouse. The wool is moved later in the season to the Minneapolis central warehouse where the individual fleeces are graded and sorted. Wool of a given grade is packaged into larger lots. A written description of each lot is circulated among buyers and sealed bids are invited. When final sale is made the value of each grade of wool in the individual producer's clip is calculated and final payment is made after transportation and other marketing charges are deducted. The major proportion of the Wool Growers' volume is now sold in Minneapolis on a sealed bid basis. The remainder is shipped to the Boston market.

The prevalence or popularity of pooling as compared with cash sale by eastern South Dakota wool producers depends somewhat on how final returns from pooled clips compared with those from cash sales the previous year. Thus, in years following those in which prices advanced after the shearing season more wool is likely to be pooled. In years following those in which prices dropped after the shearing season cash sales will probably increase. Some producers regularly pool their clips. However, others sell for cash every year.

Regardless of whether the wool clip is sold for cash or pooled the grower is eligible to receive a wool incentive payment as authorized by the National Wool Act of 1954 and subsequent legislation

extending through 1961. As announced by the United States Department of Agriculture, the incentive payment for wool marketed during the 1958 marketing year (April 1, 1958 through March 31, 1959) was 70.3 percent of the dollar returns each producer received from the sale of shorn wool during the year. Thus the producer received a payment of $70.30 for every $100.00 received from the sale of shorn wool in 1958.

> The shorn wool payment rate for the 1958 marketing year was determined on the basis of the difference between the average price received by growers for shorn wool during the 1958 marketing year and the 62 cent per pound incentive level announced for the 1958 marketing year in October 1957. The average price received by growers was 36.4 cents per pound as determined by the Agricultural Marketing Service of the USDA on the basis of prices reported by growers in their applications for payment. The wool incentive rate of 70.3 percent is the amount needed to bring the average return for wool up to the incentive level of 62 cents. To determine the wool incentive payment for individual producers, the rate of 70.3 percent is applied to the dollar return each producer received for wool after paying marketing charges.
>
> The percentage method of payment is designed to encourage producers to do a good job of marketing their wool. Under this method, the producer who gets the best possible price for his wool also gets a higher incentive payment.[7]

Quality of Wool Marketed

More than one-half of the wool marketed by the South Dakota Wool Growers' Association in 1956 from east of the Missouri River in South Dakota was of three-eighths and one-fourth blood grades. Less than 16 percent graded as high as one-half blood. Only six and

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[7] The Wool Sack, published by the South Dakota, Minnesota, Iowa and Nebraska Wool Growers' Associations, 28, No. 7, (Brookings, South Dakota, July 1959), p. 1.

one-half percent graded Fine. Nearly 12 percent of the total Wool Growers' marketings from eastern South Dakota was graded as Clothing, indicating wool of short staple length relative to the fineness or fiber diameter. Burry and seedy wool comprised nearly nine percent of the total. This indicates a lack of management practices which help keep the fleece free from vegetable matter (Table II).

These data can be considered as quite a reliable indicator of the quality of wool produced in eastern South Dakota inasmuch as the Wool Growers' Association marketed 75 percent of the wool produced in the area in 1956 and the official providing the data pointed out that the percentages would vary only slightly from year to year. A variation in the amount of Clothing grade wool could occur. Wool of Clothing grade comes mainly from ewes with less than 12 months' growth of fleece and from aged ewes. Another year's data could show a smaller percentage of Clothing grade wool and a larger percentage of wool of three-eighths blood and one-fourth blood grades. The percentages of burry and seedy wool might also vary slightly from year to year.[8]

Feasibility of Grading at Farm or First Receiver

Because of the small size of the individual farm wool clip it is not feasible to grade wool on the farm at the time of shearing. Local buyers, either independent buyers or buyers for the cooperative Association, do not generally have the training and experience necessary

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[8]Lloyd Elkum, Treasurer, South Dakota Wool Growers' Association, Minneapolis, Minnesota, Letter to the Author, January 21, 1960.

TABLE II

GRADES OF WOOL MARKETED BY SOUTH DAKOTA WOOL GROWERS' ASSOCIATION, BY PERCENTAGE DISTRIBUTION, SOUTH DAKOTA EAST OF MISSOURI RIVER, 1956

Grade	Percent Received
Fine	6.57 %
One-half blood	9.17
Three-eighths blood	24.93
One-fourth blood	28.07
Low one-fourth blood	7.52
Clothing	11.53
Dead	.25
Black	.50
Burry and Seedy	8.76
Lamb	.54
Rejects	.71
Tags	1.45
Total	100.00

Source: Lloyd Eikum, Treasurer, South Dakota Wool Growers' Association, Minneapolis, Minnesota, Letter to the Author, January 21, 1960.

to place an objective grade on the wool they purchase. These buyers are likely to buy either on an "average" price or on the basis of the reputation of the seller's wool or the overall appearance of the clip.

The South Dakota Wool Growers' Association does not grade wool at its area warehouses. Most of the purchased wool has already been

paid for before it reaches the area warehouse. The pooled wool is graded at the central warehouse in Minneapolis.

Thus, under the present marketing system there is no opportunity for the producer who sells on a cash basis to have his wool graded before or at the time of sale. Pooled wool is graded prior to final payment. However, even when pooling his wool the producer does not have the opportunity to see his wool graded and thus observe at first hand how he might improve the product.

CHAPTER II

PROBLEM AREA

Statement of the Problem

The pricing system in an uncontrolled economy provides a means of allocating productive resources, promoting efficient use of resources, and providing an incentive to improve product quality. However, one of the prerequisites necessary for the pricing system to perform these functions is that there be knowledge of the information necessary for making economic decisions. When knowledge of the value of a production or marketing practice in terms of product quality or marketing efficiencies is lacking the pricing system cannot perform its role. Inability of the pricing system to reflect differences in quality or marketing costs may, in the case of wool, cause a misallocation of resources among enterprises on the farm and between the farm and non-farm segments of the wool industry. Resources may not be employed in the most efficient manner and the economic incentive to adopt the practice may be lacking. Inasmuch as marketing agencies have no criteria for ascertaining the value of the prepared wool, eastern South Dakota wool growers who offer tagged or sorted wool for sale must accept the same price as that paid for unprepared wool. A knowledge of the value of wool handled by alternative methods of farm preparation

is necessary to determine the economic feasibility of preparing wool for market at the farm.

Importance of the Problem

The lack of information relating the quality of the wool clip at the farm to its value to the manufacturer has been recognized for several years. Some of the information cited as being needed includes: (1) feasibility to growers and others of selling wool clips or lots on the basis of description, (2) development of methods of improved preparation and packaging, (3) feasibility and practicability of separating tags and off-sorts prior to sale and determination of best method of marketing these portions, and (4) discounts and premiums paid in relation to actual quality factors and value.[9]

The general manager of the South Dakota Wool Growers' Association, a recognized leader in the wool marketing area, expressed his views on eastern South Dakota wool preparation as follows:

> In our opinion our greatest problem in South Dakota is the poor preparation of our wool in the farming sections of the eastern part of the state. It takes us 12 months to produce a fleece or clip of wool and then we just do not spend the time or put forth the effort that is necessary to properly prepare the wool.
>
> In Australia, shearers will not work on a band or flock of sheep unless they have been tagged or crutched. When they find a problem of this kind they insist on first going through and doing this crutching job - then when that is finished they do the actual shearing. Through such a procedure the fleeces are not contaminated with tags, manure locks, stain and other foreign matter.

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[9] P. L. Slagsvold, "Problems in Wool Marketing Research," Journal of Farm Economics, 33, No. 4, Part 1, (November, 1951), pp. 534-537.

> We would not want to be quite that severe here but considerable work could be done in an effort to get this stuff removed at shearing time rather then tying it on the inside of the fleeces where it affects all of the fibers with which it comes in contact. Then we are penalized for our eastern South Dakota wool clip as a whole in the form of a lower price paid by the manufacturer.
>
> We believe there is a tremendous field here and would appreciate any study that might be given to it. Our organization would be willing to work along on any effort that might be put forth toward correcting this problem.
>
> There are a number of other matters that could be revieved but we believe this is so extremely important that at present we would prefer to rest our case on this one matter.[10]

Wool contributed $4,147,000, $4,490,000 and $5,387,000 to South Dakota cash farm income in 1956, 1957, and 1958, respectively. The total cash farm income from livestock and livestock products was from $363,000,000 to $479,000,000 annually for the same years. Approximately one-half of the South Dakota wool crop is grown east of the Missouri River.[11] Therefore, increasing net returns from wool cannot be expected to substantially increase aggregate farm income in eastern South Dakota. However, the implications of the results of improved farm flock wool production are greater.

The fleece wool producing area of the United States includes the eastern one-half of North Dakota and South Dakota, Nebraska, Kansas, Oklahoma, eastern Texas, and all of the states to the east thereof. In much of this area wool is produced by farm flocks under conditions similar to those of eastern South Dakota. This is especially

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[10]Carl J. Nadasdy, General Manager, South Dakota Wool Growers' Association, Minneapolis, Minnesota, Letter to the Author, November 19, 1956.

[11]South Dakota Agriculture, 1959, pp. 36 and 45.

true of the western corn belt area. The implications of wool quality improvement in eastern South Dakota will be applicable to a wide area beyond the state's boundaries.

The United States is a net importer of wool. Imports of apparel wool for consumption have been greater than United States production of apparel wool for most of the years since 1945. In some years imports have equalled more than twice the domestic production. Only since 1954 has United States production of apparel wool exceeded imports. In these years imports have been equal to 60 to 84 percent of domestic production (Table III).

The mill consumption of wool of spinning count grade 50's up to 60's is also shown in Table III. These grades correspond to one-fourth through three-eighths blood grades on the blood grading system. These generally correspond to the grades of wool produced in eastern South Dakota and similar fleece wool producing areas. Grade 50's up to 60's has comprised from 25 to 42 percent of total mill consumption each year since 1945. In four of these years the mill consumption of these grades alone has been greater than total United States wool production; in four other years the two have been nearly equal. Mill consumption of these grades has never been less than two-thirds of total domestic production during the 1945-1957 period. Since total production of wool in the fleece wool producing states has comprised from one-fourth to one-third of total United States wool production since 1945, and considering that not all wool produced in these states is of grade 50's to 60's, it is apparent

TABLE III

PRODUCTION, IMPORTS FOR CONSUMPTION AND MILL CONSUMPTION OF APPAREL WOOL, SCOURED BASIS, UNITED STATES, 1945-1958

Year	Production	Imports for Consumption	Total Mill Consumption	Mill Consumption of Grade 50's up to 60's
		(million pounds)		
1945	188.4	418.0	589.2	247.1
1946	169.6	473.0	609.6	190.5
1947	153.1	259.3	525.9	134.6
1948	136.9	246.2	485.2	130.7
1949	120.4	154.9	339.0	120.1
1950	119.8	250.1	436.9	150.9
1951	119.8	272.0	382.1	125.2
1952	127.9	243.4	346.8	124.2
1953	133.8	165.7	358.0	128.6
1954	130.4	104.0	269.6	92.7
1955	134.2	112.8	291.2	101.3
1956	135.3	103.8	296.7	107.2
1957	128.8	78.2	240.9	97.2
1958[1]	128.8	67.1	217.4	86.7

[1]Preliminary

Source: Wool Statistics and Related Data Through 1957, Statistical Bulletin No. 250, United States Department of Agriculture, Agricultural Marketing Service, (Washington, D.C., May 1959), pp. 76 and 77, and Supplement For 1959 to Statistical Bulletin No. 250, (December 1959), p. 62.

that the wool production of the fleece wool states is necessary for supplying mill requirements for these grades.[12]

Animal and vegetable fibers have been subjected to severe competition from manmade fibers over the past few years. However, new wool comprised from 85 to 89 percent of the apparel fiber consumed on the worsted system in the United States during the 1951-1958 period. From 34 to 44 percent of yarn spun on the woolen system during the same period was new wool. Reprocessed and reused wool contributed an additional 41 to 43 percent (Table IV). Approximately equal amounts of wool have been consumed on the worsted and woolen systems in the United States over the past five years.[13]

Total and per capita mill consumption of apparel wool have decreased from previous years but appear to have leveled off somewhat since 1954. Mill consumption of apparel wool on the scoured basis has ranged from 217 to 296 million pounds annually since 1954. Per capita consumption has been from 1.25 to 1.76 pounds annually during the same period (Table V).

Objectives of the Study

The following objectives were set out as a means of guiding the study of wool quality improvement in eastern South Dakota.

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[12] Wool Statistics and Related Data Through 1957, United States Department of Agriculture, Agricultural Marketing Service, Statistical Bulletin No. 250, (Washington, D. C., May 1959), p. 17.

[13] The Wool Situation, United States Department of Agriculture, Agricultural Marketing Service, (Washington, D. C., March 1959), p. 27.

TABLE IV

PERCENTAGE DISTRIBUTION OF APPAREL WOOL AND OTHER FIBER UTILIZED BY THE WORSTED AND WOOLEN SYSTEMS, UNITED STATES, FOR THE PERIOD 1951-1958

Fiber	Worsted System	Spinning of Yarn on Woolen System (except carpet)
	(percent of total consumption)	
Shorn and Pulled Wool of the Sheep	85.6 - 89.0	34.5 - 44.7
Other Wool, Reprocessed Wool and Reused Wool		41.2 - 43.2
Manmade Fiber	2.9 - 8.4	5.1 - 20.0
Other Fiber	4.9 - 11.0	3.8 - 9.0

Source: The Wool Situation, United States Department of Agriculture, Agricultural Marketing Service, (Washington, D. C., May 1959), pp. 22 and 23.

1. To determine the theoretical effects of improved methods of shearing and handling wool on quantities produced, prices received, apportionment of benefits between producers and consumers, farm resource allocation, producers' bargaining power, and marketing costs.
2. To develop and test practical methods of farm preparation of fleeces which could be expected to improve the quality of the wool.
3. To determine the effects of the preparation treatments on the quality and value of farm flock wool.
4. To determine the additional costs to producers of alternative methods of wool preparation.

TABLE V

ESTIMATED TOTAL AND PER CAPITA MILL CONSUMPTION OF APPAREL WOOL IN THE UNITED STATES, 1950-1958

Year	Total Consumption	Per Capita Consumption
	(million pounds)[1]	(pounds)[1]
1950	436.9	2.88
1951	382.1	2.47
1952	346.8	2.21
1953	358.0	2.24
1954	269.6	1.66
1955	281.2	1.70
1956	296.7	1.76
1957	241.4	1.41
1958	217.3[2]	1.25[2]

[1]Scoured basis

[2]Preliminary

Source: The Wool Situation, United States Department of Agriculture, Agricultural Marketing Service, (Washington, D. C., May 1959), p. 25; Wool Statistics and Related Data Through 1957, Statistical Bulletin No. 250, United States Department of Agriculture, Agricultural Marketing Service, (Washington, D.C., May 1959), p. 75; and Supplement For 1959 to Statistical Bulletin No. 250, (December 1959), p. 61.

5. To ascertain the net value, under given market conditions, of wool prepared for market by alternative methods.

Hypotheses to be Tested

Several hypotheses are suggested by the objectives set out for the study. One hypothesis is that tagging farm flock sheep will result in fleeces of increased quality relative to fleeces from untagged sheep and that this increase in quality will be reflected in an increased market value of the wool. Another hypothesis is that the additional cost of quality improving methods of wool preparation incurred by the producer will be at least offset by the higher gross return which he receives from the sale of improved wool. It is further hypothesized that the laboratory tests employed to determine the quality effects of the treatments used will yield results comparable to the visual grading employed by the wool industry. The study was carried out in such a manner as to verify or reject these hypotheses.

CHAPTER III

THE ECONOMIC BASIS FOR QUALITY IMPROVEMENT

Farmers can generally be expected to adopt practices that reduce production or marketing costs. But the use of techniques which improve quality without affecting physical input-output ratios is likely to have little appeal to producers unless they receive a higher price for superior products. The consumer may desire the improved quality of a product but the pricing system must reflect this preference to the producer if he is to be encouraged to produce the improved quality.

At the present time wool sold on the cash basis in eastern South Dakota is priced on an "average" value. The buyer need not know the actual value of the wool clip since he buys many clips. His uncertainty as to the true value becomes calculated as a probability distribution and is reduced to a calculated risk when purchasing any given farm clip. This is illustrated in Figure 2 where DD represents the wool buyer's derived demand for a given grade of wool. The buyer will pay up to price OP for quantity OQ of wool but he does not expect to get all of OQ quantity of wool of a grade with a value of OP. Therefore he will buy some fleeces which will grade higher (D'D') and be worth price OP' and others that will grade lower (D"D") and be worth price OP". For many purchases, however, the average grade will be defined by the derived demand function DD and the average price

will be OP. This indicates that the total amount that is paid for wool is approximately correct. But the distribution of the proceeds may not be correct for the sellers of the wool. Wool of an actual grade above that defined by DD is underpriced and wool of an actual grade below that defined by DD is overpriced. The farmer who produces only a small volume of wool and does not know the grade of the fleeces is faced with uncertainty because he cannot compute the probability distribution of his error in estimating the value of his wool. This puts the buyer in a more favorable position when bargaining power is considered. Consumer preferences for different grades of wool fiber, as represented by the actual value of wool of a given grade, are not reflected to the producer. Thus he has little or no economic incentive to produce the quality of product in the quantities which consumers want.

The same analysis holds for foreign matter and other contamination in the fleece. The buyer does not know the exact amount of loss from this source when buying the wool but from experience he knows the probability distribution of their occurrences. Thus he discounts all purchases by the amount of risk involved.

Given the derived demand curve for a given quality of wool at the first receiver (DD) and the risk discount for foreign matter, etc., the curve D'D' can be derived (Figure 3). For any given quantity Q, the value of the wool is price OP; but the buyer knows that some or all of the fleeces will have various degrees of foreign matter. Therefore, he discounts the value of all wool by a given amount and pays price OP' for all fleeces and clips.

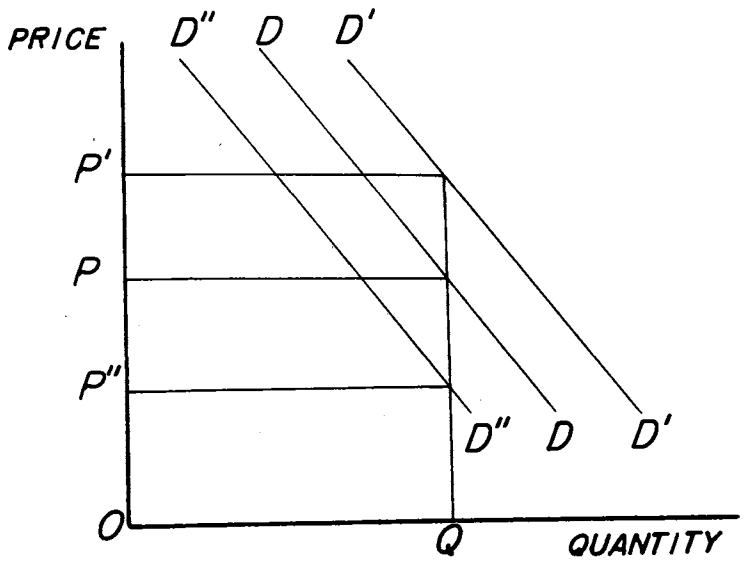

Figure 2. Demand Curves for Wool of Various Grades

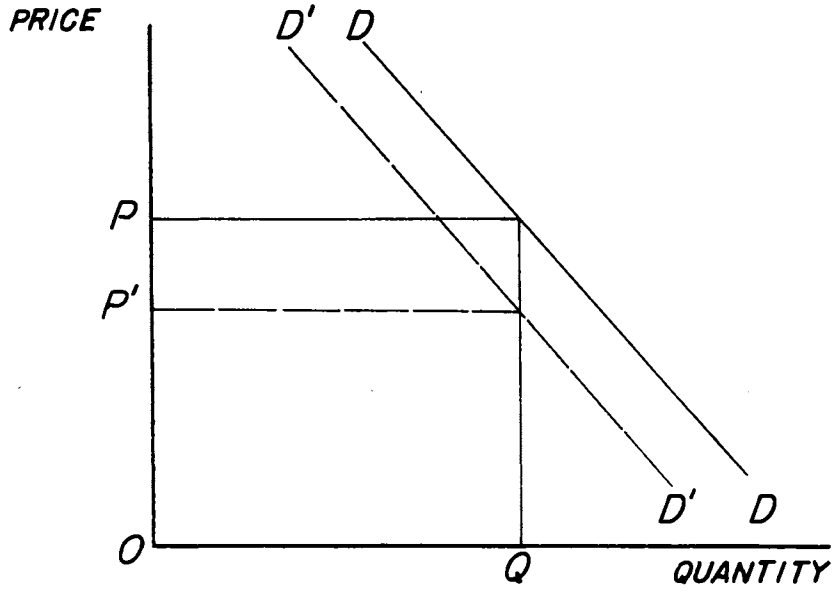

Figure 3. Demand Curves for Wool, Showing Risk Discount

If the buyer has calculated his average discount correctly, the total amount paid for all wool is equal to the total value of the wool at the producer level. The producer, however, does not necessarily receive the true value of his fleece or clip. He has no incentive to keep foreign matter and contamination out of his wool.

Some of the imperfections of the present method of pricing wool in eastern South Dakota can be summarized. First, local wool buyers do not have the ability to grade accurately the wool as they receive it from the producer. Therefore, wool from a given area is sold at approximately the average price resulting in technical uncertainty to the producer. This may prevent optimum adjustment of production to consumers' demand for given qualities of wool. The pricing mechanism does not function efficiently. Second, productive resources at the farm level are wasted. All wool is discounted the average amount of loss due to contamination. There is no incentive to reduce the amount of foreign matter and other contamination in the wool. Buyers do not determine accurately the extent of this contamination when buying the wool. Third, the producer does not know accurately the quality of wool he is producing. Therefore, he does not know his exact bargaining position. He may not be receiving the full value of the wool he is producing.

This chapter presents a theoretical analysis of the economic effects of an improvement in wool quality with respect to prices, quantities produced, farm resource allocation, producers' bargaining power, reduction of marketing costs, and accrual of benefits. The purpose of this analysis is to give an insight regarding the expected

impact on producers, marketing agencies, and consumers resulting from an improved method of handling wool on the farm. The analysis gives a hypothetical picture of the immediate and longer term effects of a practice which improves wool quality and reduces marketing costs.

In the following analysis the joint product nature of the sheep enterprise is not mentioned. It can be logically assumed that the quality and quantity of lamb or mutton will not be altered by the treatments applied in the experiment. Therefore the iso-resource and iso-revenue curves relative to wool can be assumed to include the cost and return, respectively, of the quantity of wool under consideration plus a given quantity of lamb or mutton.

The Effects of Greater Accuracy in Price Determination

In the following analysis it is assumed that the production and consumption functions are fixed, that all producers and consumers make rational decisions, and that the distribution of income is fixed.

When a commodity is sold on an average price basis, with no regard for quality differences, the price ratio or iso-revenue line between a high and low quality product is shown as AA' in Figure 4. The marginal rate of substitution of high quality for low quality for the producer is constant and equal to one. That is, the reciprocal of the slope of the revenue line AA' is unity. The revenue line to the producer is the iso-cost line to the purchaser.

The curve TT' is a long run iso-cost curve and represents a given cost to the producer of different quantities of a high and low quality product. The slope of this curve is not constant and

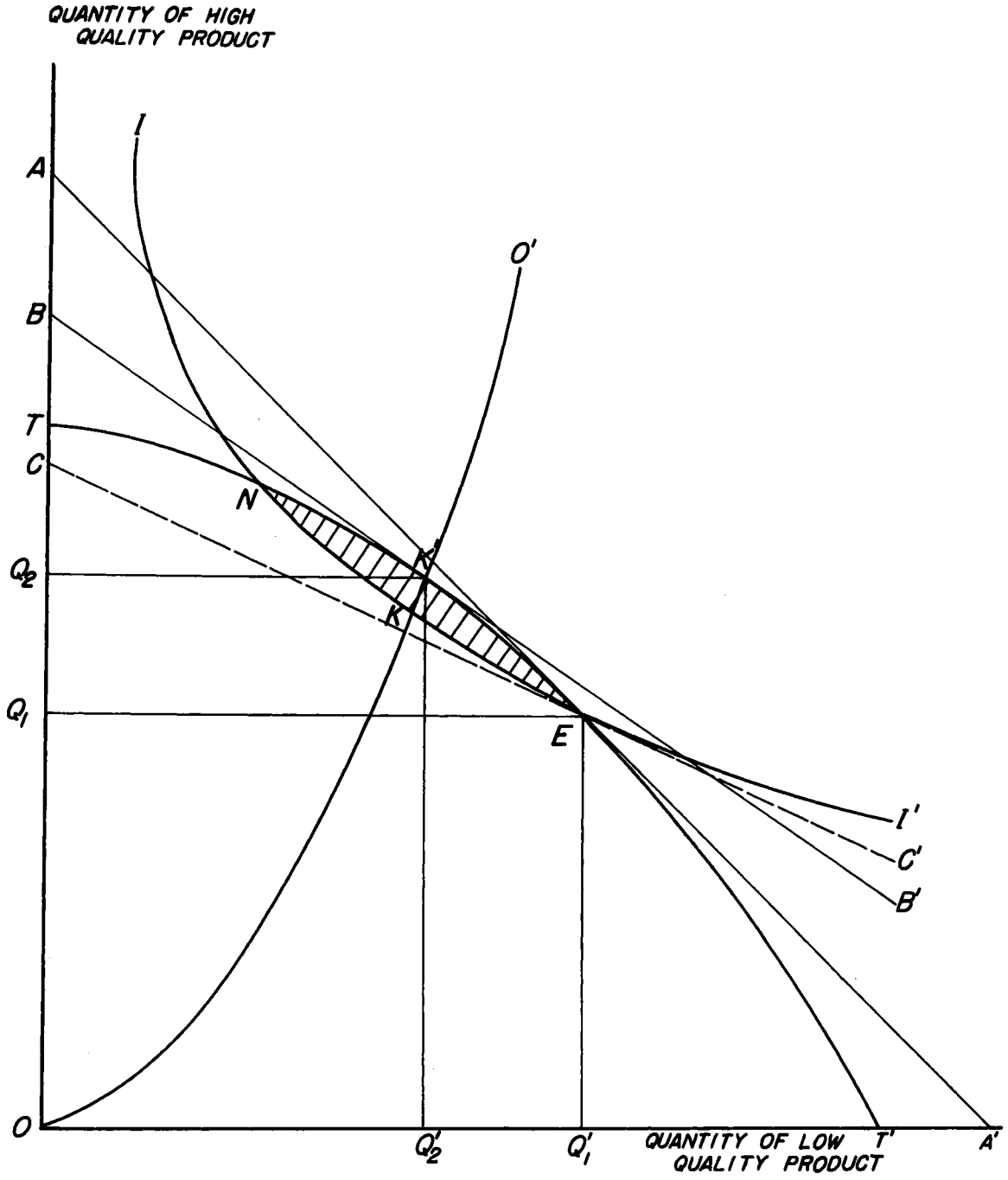

Figure 4. Substitution Rates Between A High and Low Quality Product

represents the rate of cost substitution for one unit of low quality product to that of high quality product without changing total cost. The slope of the iso-cost curve is equal to the ratio of the marginal cost of low quality product to the marginal cost of high quality product. The iso-cost curve is concave to the origin because of the competitive relationship between the high and low quality product. The marginal rate of substitution of high quality product for low quality product or low quality product for high quality product is negative. That is, with a given set of resources the output of one product cannot be increased without a reduction in the output of the other product.

When the product is bought on an average price basis low quality and high quality will bring the same price, so that OA is equal to OA'. The quantity of each quality produced is determined where the iso-price line AA' is tangent to the iso-cost curve TT', or point E. Here the ratio of the marginal cost of low quality product to the marginal cost of high quality product is equal to the ratio of the price of high quality product to the price of low quality product. The producer is in equilibrium when he produces OQ_1 of high quality product and OQ_1' of low quality product.

Assuming that all consumers have the same indifference map (identical marginal rates of substitution of high quality product for low quality product) and that each quality of product has a scale factor (an implied numerical scale, not necessarily the same on both axes), then the consumer indifference curve can be represented by II'. This curve represents the amount of high quality product which can be

substituted for one unit of low quality product without changing the total satisfaction of the consumer. This indifference curve intersects the iso-price line AA' at point E and shows that for this price ratio the consumer is willing to consume quantity OQ_1 of high quality product and quantity OQ_1' of low quality product. This is the quantity of each quality produced under an average price basis of purchasing with no price differential for the quality of product.

The optimum direction of production is not reached at point E because the producer can produce more of the high quality product and less of the low quality product at a lower total cost and the consumer will receive the same satisfaction. Line OO' represents the scale line where the ratio of the marginal rates of cost substitution is equal to the ratio of the marginal rates of satisfaction substitution. The locus of points which determines line OO' defines the points of tangency of all possible iso-cost curves and indifference curves. At any given point of tangency the iso-cost curve and the indifference curve have the same slope.

If the consumers' desires were expressed back through the marketing channel as a ratio of the prices of the two levels of quality of the product, the long run optimum points of tangency between the price lines and the indifference curves would all fall on the scale line OO'. This line would represent all possible points of long run equilibrium.

The ratio of prices that would give optimum production and consumption for any given outlay by the producer is equal to line BB', which is tangent to the iso-cost curve TT' at the point of its

intersection with the scale line OO'. When quantities OQ_1 and OQ_1' of the two levels of quality of product are produced, the consumer would be willing to pay the relative prices represented by line CC'. Line CC' is the price ratio line tangent to the consumers' indifference curve at point E.

The adoption of production and marketing practices which would enable producers to sell their product on a pricing basis reflecting quality differences as indicated by consumers' desires would result in a shift in the price ratio to that represented by line BB'. This is the price ratio line tangent to the iso-cost curve TT' and an indifference curve higher than II' at point K'. In order to reach equilibrium, producers would change their production of the relative quantities of the two levels of quality in favor of a greater output of high quality product. At equilibrium, OQ_2 of high quality and OQ_2' of low quality product would be produced. The indicated area between points E and N would be the area in which there would be a gain by pricing on a quality determined basis. Any shift of production in favor of the high quality product from point E to point N would enable the consumer to attain a higher indifference curve. The area of gain would be at a maximum anywhere on the scale line OO' between points K and K'.

The gain might accrue to the producer, manufacturer, or consumer, depending upon the relative elasticities of supply and demand. At point K' the consumer would get the full benefit. He has attained his highest possible indifference curve. At point K the producer would get the full benefit. The consumer would make the same

total expenditure for smaller quantities of product and would remain on his original indifference curve. If, through monopoly power, the manufacturer or marketing agency could keep the gain then the full benefit would accrue to him.

As producers move to the equilibrium position the ratio of prices paid by consumers for the two quality levels of the product changes from the slope of line CC' to that of line BB'. The price of the high quality product would decrease relative to the price of the low quality product. This would tend to stimulate the shift toward greater consumption of the high quality product.

Effect of Quality Improvement on Resource Allocation

To the extent that the sheep enterprise is supplementary to other farm enterprises on eastern South Dakota farms an increase in wool quality resulting in a price differential between high and low quality would not be expected to result in any change in farm resource allocation. However, to the extent that the sheep enterprise competes with other farm enterprises a change in the price of wool would be expected to cause a shift in the allocation of resources. For farms where the sheep enterprise requires a substantial proportion of the total capital, labor, housing, feed and pasture resources available, there would be competition for such resources between the sheep enterprise and other enterprises. A flock of 30 to 60 ewes would compete for some resources with dairy, beef or hog enterprises. A flock of 100 ewes would be in competition with other enterprises for many types of resources on a typical eastern South Dakota farm.

The optimum allocation of resources exists when the marginal value product of each factor is equal in each of the various lines of investment. If each dollar invested is yielding equal returns in every enterprise an optimum allocation of farm resources exists.

Figure 5 illustrates the relationship of two farm firms where firm A is producing a relatively high quality product (wool) and some other product competing for available resources. Firm B is producing the competing product and a relatively low quality product (wool). On both farms the two enterprises are competitive and inputs are substitutable at a diminishing marginal rate. As the output of wool is decreased to produce more of the competing enterprise product, increasing increments of wool must be sacrificed to produce each successive increment of the other product. The curve TT' shows the various possible long run combinations of output of the two products from a given input of resources. Lines AA' are iso-revenue lines which represent all of the various quantity combinations of the two products which can be marketed to bring a given revenue. The maximum revenue for a given price relationship can be denoted by the iso-revenue line which is tangent to the long run iso-resource curve. Thus the equilibrium point E_1 occurs where the ratios of the marginal rates of product substitution and the inverse ratio of prices are equal. At point E_1 each firm will produce quantity OQ_1' of the product under consideration (wool) and quantity OQ_1 of the competing enterprise product. Both firms receive the same price for the wool produced.

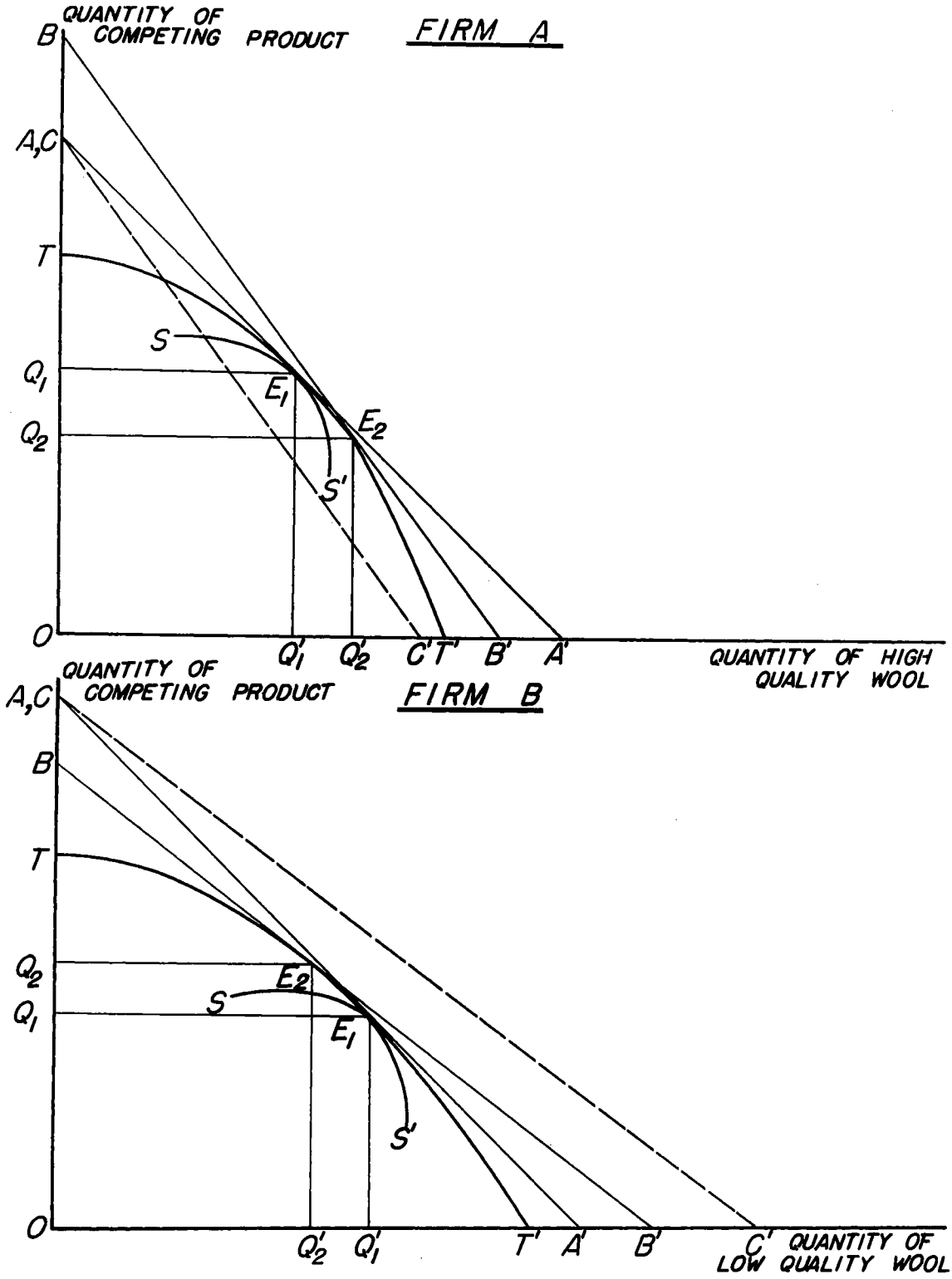

Figure 5. Substitution Rates Between Wool of High and Low Quality and a Competing Enterprise Product

If a method of purchasing wool is introduced whereby the producer is paid on the basis of the value of the quality of product he markets, then the price of the high quality product would increase and that of the low quality product would decrease. This would change the slope of the iso-revenue line from AA' to BB'. The slope of the iso-revenue line would become more nearly horizontal for firm B because of the increased quantity of wool which would be required to bring in the same revenue as was forthcoming prior to pricing on the basis of quality. Conversely the slope of the iso-revenue line for firm A would become steeper.

The new equilibrium for firm A will be at point E_2 where iso-revenue line BB' is tangent to iso-resource curve TT'. At this point firm A will produce quantities OQ_2' of wool and OQ_2 of the other product. There will be a reallocation of resources away from the production of the competing enterprise product and toward the production of wool. By constructing a new iso-revenue line CC', parallel to line BB' with OC equal to OA, it can be seen that the position of firm A is enhanced. Firm A, under the new price relationship, has attained a higher revenue line with the same outlay of resources. The quantity OC' of high quality wool could now be marketed for the same revenue that quantity OA' previously brought. The given resources will produce more income or a given income can be produced with fewer resources.

For firm B the new equilibrium will also be at point E_2, where quantities OQ_2' of wool and OQ_2 of the other product will be produced. Resources will be shifted away from wool production and into the

production of the competing enterprise product. Again constructing a new iso-revenue line CC', parallel to BB' and with OC equal to OA, it is seen that firm B is worse off with the new price ratio. A lower iso-revenue line is tangent to the iso-resource curve at E_2. Quantity OC' of low quality wool is now needed to produce the same revenue as quantity OA' brought before wool was purchased on a quality basis.

For the same amounts of resources, the net income to firm A will increase and that to firm B will decrease. There will tend to be a redistribution of income among wool producers. The result will be an incentive for low quality producers to improve their product.

The short run iso-resource curves would be more concave to the origin, as represented by SS'. A shift in the price ratio line as represented by BB' would cause only a small shift toward wool production for firm A and a small shift away from wool production for firm B. This follows when one recognizes the fixity of resources in their present uses in the short run. The longer the time period considered, the more resources become variable and the greater the degree of substitution between the two competing enterprises.

It is not possible to determine the aggregative income effects on wool producers. Some producers will gain and others will lose. If, because of the incentive of low quality producers to improve quality, a given aggregate outlay of resources results in a larger total production then aggregate consumer satisfaction will be increased. An increase in the supply of wool would result in a decrease in the price. The price of the high quality product would

decrease relative to that of the low quality product. Thus the aggregative long run effects of the reallocation of resources might result in prices for both high and low quality wool near or below the initial average price.

Influence on Producers' Bargaining Power

Eastern South Dakota wool when sold for cash is valued on the basis of superficial inspection which generally results in an average or near-average price being paid to all producers. The information and bargaining power upon which the price is based is largely on the side of the buyer. Not only do buyers start with somewhat more knowledge of wool quality, but after a clip has been processed, information becomes available to them as to shrinkage and the various quality factors, for use in another year. The producers generally do not have the advantage of this same background and knowledge of wool to permit bargaining equality. They may have some ideas of relative values based upon experience in previous years, but at best these largely form the basis for guesses only.

Because the buyer is only estimating the value of the clip he must allow for the probability distribution of his error in quoting a price. Because he has no basis for asserting otherwise, the seller must accept the buyer's judgment as to the value of his clip. He is powerless to bargain on the contention that his clip is above average quality and therefore merits a higher price.

Techniques for measuring wool quality and the setting of quality standards are not likely to benefit the producer until growers

take steps to assure better preparation of the clip.

> Bags of fleeces that are neither assorted nor skirted vary too widely in quality for a standard description, even if an adequate sampling technique could be devised. Much domestic wool is marketed in this condition. As it comes on the market at present, a large part would not fit into any feasible system of specifications....Unless the domestic grower can see the advantage of improving the preparation of his wool, and adopts it, there will be little gain to the grower in having standards or techniques for measuring.[14]

Thus benefits, and increased bargaining power, are likely to accrue to the producer only when improvement in preparation is carried out while the wool is still in the grower's control. Otherwise quality standards and measurement techniques will tend to benefit the wool trade, further decreasing the producer's bargaining power relative to that of the buyer. This indicates that improvement in the bargaining power of the producer is mainly contingent upon (1) developing farm methods of preparation which will improve wool quality and uniformity, (2) convincing the producer of the potential benefits of such preparation, so that he will adopt the improved practices, and (3) the structure of the market being such that the grower will benefit from the increased value added by such preparation, that is, the existence of a market structure in which the producer sells under less than a perfectly elastic demand.

Although the farm flock wool producer operates in a national market approaching pure competition there are two means whereby he can assert his bargaining power. One is in the local market where

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[14]D. W. Carr, "Comment on Problems in Wool Marketing Research by Siggsvold," Journal of Farm Economics, 34, No. 3, August 1952, p. 408.

the producer, because of personal acquaintance with the buyer and because the buyer can have first hand knowledge of the practices being carried on by the grower, need not sell under conditions of pure competition. The other is through cooperative marketing, whereby members of a large marketing organization can collectively assert bargaining power in a regional or even national market.

An increase in the producer's knowledge of the quality and market value of his wool would tend to accompany the adoption of better preparation methods. Even with a modified grading or quality selling basis the seller would have a bargaining point in the local market. Cooperative association members could assert similar bargaining power collectively. Higher final prices could be expected to result from a higher quality product and from a stronger competitive position. The bargaining power of even small producers who pool their wool and sell on the basis of quality would be enhanced. Buyers would be influenced by the sellers' increased bargaining strength because they could make price bids with the assurance that they were getting a product of higher and more uniform quality. Their probability distribution of error would be narrowed.

Effects on Marketing Costs

The possibilities for more thorough preparation of wool in producing areas to strengthen its competitive position and to increase incomes to producers, from the viewpoint of growers, would depend upon whether the additional costs of improved preparation would be at least offset by higher prices received as a result of such

improvements. The feasibility of such improvements would depend to a large degree upon the influence of particular kinds of preparation in producing areas, instead of at manufacturing centers, on the quality and costs of preparation, on costs of marketing and processing, and on the acceptability of the product to handlers and manufacturers.

This study was designed to determine the quality effects and costs of tagging farm flock sheep in eastern South Dakota. Other studies have indicated that manufacturers and topmakers are interested in obtaining better prepared clips.[15] It was beyond the scope of this study to determine the effects of tagging on total marketing and processing costs. However, some of the results of other research in this area can be used in conjunction with a logical analysis to determine the probable effects on marketing costs.

"The cost of fitting poorly prepared wools at the mill for manufacture appears, to mill operators, to be so high that discrimination against such wools is warranted."[16] A possible means of avoiding such discrimination and obtaining a higher price for the grower would be better preparation of wool in the producing area. Several factors affect the quality and cost of preparation in the producing area. Among these factors are: size of clip, availability

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[15]D. W. Carr and L. D. Howell, Economics of Preparing Wool for Market and Manufacture, United States Department of Agriculture, Technical Bulletin No. 1078, (Washington, D.C., November 1953), pp. 74-81; and Walter L. Hoddle, Manufacturers' and Topmakers' Views on Some Wool Marketing Problems, Farmers Cooperative Service, United States Department of Agriculture, General Report 34, (Washington, D.C., June 1957), pp. 8-11, 28.

[16]Carr and Howell, p. 47.

of facilities and personnel, and knowledge of mill requirements. In eastern South Dakota each of these factors limits a wool preparation program to less than a complete grading and sorting operation. A modified preparation program, consisting of tagging the sheep and keeping tags separate from the fleece, preventing the flock from collecting burs, straw and other foreign matter in the wool, and keeping the shearing floor clean, can be carried out in farm flock areas.

The possibility of increasing growers' returns by improved preparation of wool in producing areas is likely to depend to a considerable extent upon the effect of such preparation on subsequent costs of marketing and processing. If improved preparation in producing areas reduces the costs of marketing and processing wool, returns to growers may be increased by this means, provided costs of this preparation are as low as, or lower than, those for comparable services in central markets and provided further that the benefits of such preparation are reflected in prices to growers.

Marketing and processing costs may be lowered by reducing the cost of one or more of the following functions: buying and selling, transportation, handling and storage, grading, sorting.

The minimum charge for buying and selling services alone on the central market is the broker's levy. But this minimum service can be used only when the quality and uniformity of preparation is so dependable that assorting and display of the wool is not required and inspection can be reduced to a minimum. Wool not so dependably prepared in the producing area is more often sold through commission agents

who can prepare, combine, and display it to buyers who come to inspect it in the warehouse. Thus the costs of selling such wool are usually higher. Costs of buying follow a similar pattern. If the quality and uniformity of preparation is assured, a buyer can limit his inspection to a sample of the lot. If preparation is inadequate, a detailed inspection is required. Competent buyers are scarce and their services are expensive. If they must be used for detailed inspections, the cost of buying becomes very high. Also mills must allow for the risk of loss due to shrinkage and quality variation. Such losses can be more closely estimated in wools which have been uniformly prepared. Farm preparation, therefore, may reduce the selling cost on the central market as well as the mill's cost of buying.

Better grower preparation would probably affect the costs of moving wool to market very little. Established transportation rates make no distinction between wool of various types of preparation and no savings in costs per hundred pounds would result from tagging. However, if heavy shrinkage tags were not shipped, the proportion of the gross value of the tagged wool that is accounted for by transportation costs would be reduced.

Storage cost is a minor item in the total cost of services at central market warehouses. Physical handling, grading, and inspection services account for most of the warehouse cost. Since most of the handling is manual, costs of labor become large when wool is handled two or more times in preparing it for sale. Handling charges allowed by the Commodity Credit Corporation in 1950 ranged from 1.25 cents per

pound for lots of more than 5,000 pounds to 3.50 cents for the smaller lots.[17] Some handling services could be eliminated if the wool arrived in central markets in large lots of uniform quality.

Since on-farm grading is not feasible in an area such as eastern South Dakota, there is no possibility of the individual producer reducing marketing costs by this means. However, the amount of sorting necessary varies inversely with the degree of preparation of the wool. Farm preparation of fleeces could, if carried out to a high enough degree, fulfill about the same role as sorting in the mill. Rates charged for sorting depend mainly on the labor costs involved and are thus closely related to the degree of preparation of the wool as it is received at the mill. Manufacturers indicate that the rate (pounds output per hour) of sorting untagged Fleece wool manually is only one-sixth to one-third that of skirted and graded Australian wool. In addition untagged Fleece wool is not suited to the use of conveyor belts in sorting. Since belts can increase the output by up to 50 percent, the inability to utilize them in the sorting of unprepared wool greatly increases the manual labor, and thus the cost, of sorting such wool. At 1951 wage rates, an estimated 0.66 cent a pound reduction in sorting costs in mills was indicated for properly prepared Territory wool as against unprepared wool of the same type.[18] It seems logical that the reduction in sorting costs for well prepared Fleece wool, as compared to unprepared wool of the same type, would be at least as

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[17] Ibid., p. 69.

[18] Ibid., p. 71-72.

great when the higher labor costs of the present time are considered.

The net reduction in cost of central market labor inputs that would come from skirting and grading Territory wool on the ranch was calculated by the authors of a United States Department of Agriculture study to be 1.1 cents per grease pound. The authors point out that other possible reductions in central market costs may be effected through avoidance of storage in a central market warehouse for grading, elimination of one truck transshipment, lower buying costs because the well-prepared clip may be sold on sample rather than inspection, and because the clip would change hands fewer times. Thus they conclude that ranch preparation might reduce the costs of marketing and processing by more than 1.1 cents per pound.[19]

Little empirical investigation has been made of price elasticities of supply and demand for wool. The price elasticity of demand for scoured wool at the 1949 no-support price has been estimated at -0.75.[20] This indicates that a change of one percent in the price of scoured (washed) wool on the non-government-supported market would have resulted in an inverse change of 0.75 percent in the quantity demanded. The greater opportunity for substitution and the wider range of uses for refined products relative to that of raw materials tends to result in an increase in the elasticity of a commodity as it moves through the processing or manufacturing stage. Therefore,

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[19]Ibid., p. 74.

[20]George Mehren, "Comparative Costs of Agricultural Price Support in 1949," The American Economic Review, 41, No. 2, May 1951, p. 722.

one would expect that the elasticity for wool at the farm level (grease basis) would be less than that for wool on the scoured basis and that the elasticity for the finished wool product at the consumer level would be greater. The price elasticity of supply for wool at the farm level can be assumed to be quite low in the short run, because of the fixed nature of the inputs. Over a longer run period of several years one would expect that the output of wool would respond more closely to price changes, so that the supply elasticity would be greater the longer the time period considered.

Figure 6 shows a possible disposition of gains between producers and consumers resulting from production and marketing practices which reduce marketing and manufacturing costs. It will be assumed that the reduction on marketing and manufacturing costs is greater than the cost incurred in carrying out the farm practices so that there is a net reduction in total marketing and processing costs. The aggregate supply and demand curves shown are short run curves. Both curves are inelastic, but the demand curve is relatively less inelastic than the supply curve. The supply curve is the basic curve at the producer level. It is based on the cost of producing wool on the farm. The demand curve is basic at the consumer level. It is based on the desires and purchasing power of consumers for wool. The producer demand curve is derived from the consumer demand curve by deducting marketing and manufacturing costs from the basic curve. The consumer supply curve is derived from the producer supply curve by adding marketing and manufacturing costs to the basic curve.

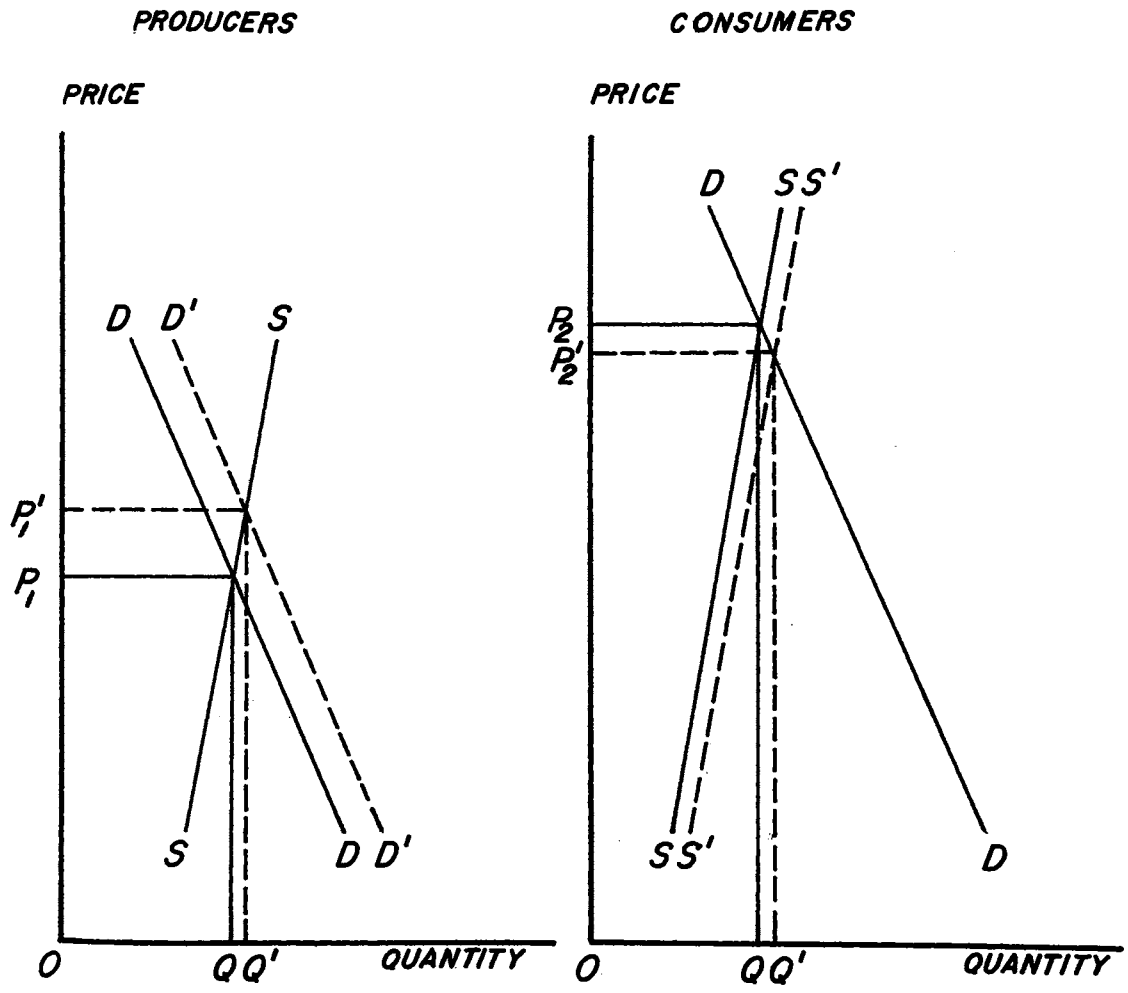

Figure 6. Producer and Consumer Supply and Demand Curves for Wool

Changes in marketing costs will not affect the basic curves but will change the derived curves. With a net reduction in marketing costs the derived demand curve at the farm level is shifted vertically upward by the amount of the reduction, or from D to D'. The derived supply curve of consumers is shifted vertically downward from S to S', an amount again equal to the net reduction in marketing costs. Assuming that marketing charges are fixed per unit of output the new derived demand and supply curves are parallel to the original curves. The quantity produced and consumed increases from OQ to OQ'. At the producer level price is increased from OP_1 to OP_1'. The consumer gains by a price drop from P_2 to P_2'. Thus the producer accrues most of short run benefits from the reduction in marketing costs.

In the above analysis it is assumed that none of the gain accrues to manufacturing or marketing agencies. It is likely that in the short run these firms would also share in the benefits of reduced marketing costs.

In the long run the producers supply curve would tend to be more elastic than in the short run. This is due to producers being more responsive to price increases over a longer time period, as more inputs become variable. The elasticity of demand of the consumer would probably change relatively less, if at all, as a result of considering a long run situation. That is, time, per se, would not be expected to cause as great a change in demand elasticity as in supply elasticity.

The long run analysis follows the same lines as did the short run analysis. Referring again to Figure 6, it can be seen that a supply curve with less slope will result in a larger output and a

lower price to the producer compared to the short run. The consumer will gain more in the form of lower prices than in the short run.

Assume that producers do realize an initial gain from a reduction in marketing costs, that the individual producer remains free to change his level of output, and that new firms can enter the market at any time. The short and long run adjustments of the firm and industry are as follows.

A reduction in marketing costs increases the price to the producer in the short run. The consumers' (or manufacturers') aggregate demand curve for wool is represented in Figure 7 by line Dc and the aggregate demand curve for wool at the farm level is represented by line Dp. The vertical distance between the two demand curves represents the marketing margin. If a more thorough preparation of wool by the producer resulted in a reduction in marketing costs then this would be represented by a movement of the farm demand curve from Dp to Dp'. If OQ_1 is the quantity produced before the quality improvement program is initiated, then the price to the producer would be OP_1 and the price to the consumer (manufacturer) would be OP_1'. After the reduction in marketing costs the price to the producer would move to OP_2. This is the short run adjustment with all inputs fixed.

In the longer run output is increased and price to the producer decreases relative to the short run. Figure 8 shows the marginal cost (supply) curve and the marginal revenue curve of an individual producer. The marginal revenue curve MR_1 corresponds to price OP_1 on the industry curve in Figure 7. The marginal revenue curve MR_2 corresponds to the price OP_2 on the industry curve after marketing costs have been reduced.

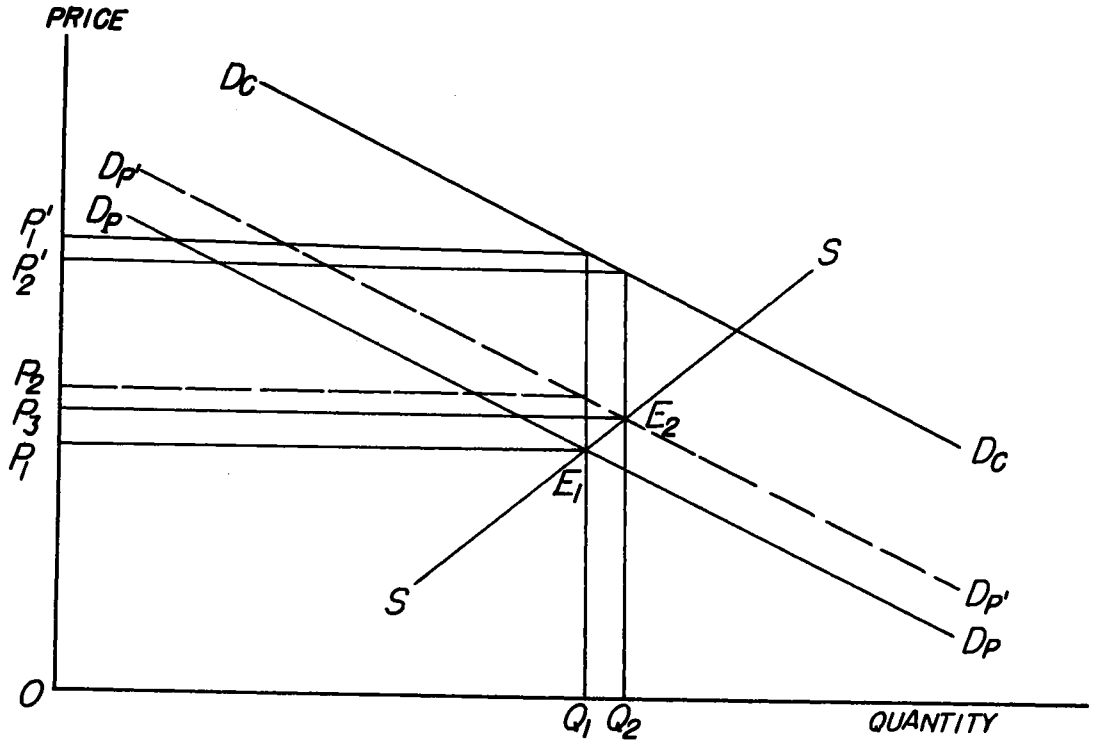

Figure 7. Industry Supply and Demand Curves for Wool

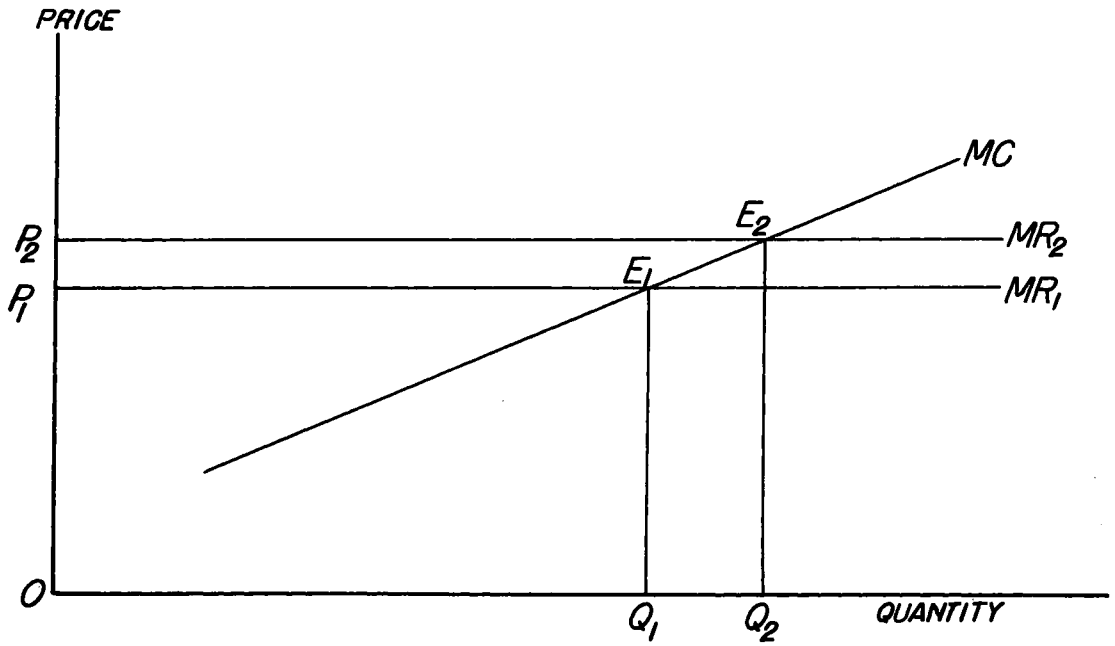

Figure 8. Marginal Cost and Marginal Revenue Curves for a Wool Producer

With the increase in marginal revenue from MR_1 to MR_2, the producer will, if acting rationally under the assumptions imposed, move from equilibrium point E_1 to equilibrium point E_2 and increase production from OQ_1 to OQ_2. If all producers react in the same manner, the increase in aggregate production can be shown on the industry curve as a movement along the supply curve from E_1 to E_2. The quantity produced will increase from OQ_1 to OQ_2. The increased supply will cut the consumer's demand curve De at a lower point and decrease the price to the consumer from OP_1' to OP_2'. The increased quantity will decrease the price paid to the producer from OP_2 to OP_3.

Under conditions approaching pure competition, the increased price to the producer will stimulate existing firms to expand production and will encourage new firms to enter the industry. The result will be a further increase in output and a reduction in the price to the producer and the consumer. The longer the period of time, the less will be the slope of the supply curve (more elastic) and the greater will be the quantity of wool produced. After all long run adjustments are made, the individual producer will probably receive only a slightly, if any, higher price, because of the structure of the market. In the long run, the consumer (including processing and manufacturing firms) stands to gain most from the reduction in costs, even though the producer may be able to realize short run benefits.

It has been pointed out that in the local market individual growers may be able to obtain premium prices from particular buyers with whom they have established a reputation for proper preparation.

But in general, it appears that wool growers would be better able to gain lasting benefits of proper preparation through working together.

If a large marketing agency, such as the Cooperative Wool Growers' of South Dakota, Minnesota, Iowa, and Nebraska were able to exert some degree of monopoly power in the sale of wool, the gains achieved could be returned to the producer in the form of a higher final price on pooled wool.

CHAPTER IV

PROCEDURE USED

Sampling Design

Brookings County, located in east central South Dakota, was selected as the area from which to procure the experimental material for the wool quality study. Several reasons contributed to the selection of Brookings County as the sampling area. One reason was that the average size of the farm flock was near the midpoint (48 ewes per farm) of the range (26 to 100 ewes per farm) of average farm flock sizes for counties in eastern South Dakota (Figure 1). Experience and judgment indicated that the production and marketing practices followed by farmers with sheep in Brookings County were similar to those used by farmers with farm flocks in other areas of the state.

From a practical viewpoint, Brookings County was a feasible area from which to obtain experimental material. The proximity of the South Dakota Agricultural Experiment Station to all points in the County enabled the researchers to keep in close contact with the cooperators during the shearing season and thus obtain a larger amount of information than would have otherwise been available. The location of a South Dakota Woolgrowers' Association warehouse in Brookings made it possible to get the current price quotation whenever wool was purchased from a farmer.

The farm flock was used as the primary sampling unit. Individual animals were used as the sub-units. The cost of obtaining fleeces (exclusive of the cost of the wool) was estimated to be $75.00 per farm sampled plus $0.50 per animal. Approximately $1500.00 was available for use in obtaining experimental material. An estimate of the standard deviation of a population variable is determined by dividing the range of values for the variable by six. The yield of clean wool in the fleece was selected as the most relevant variable. Farm flock fleeces yield from 30 percent to 70 percent clean wool. Dividing the range of 40 by six gives a standard deviation 6.67 percent. Since farm flock fleeces are known to have a wide range of variability in quality, including yield, within flocks, the standard deviation was estimated to be seven percent both among and within flocks.

The formula for determining the number of sub-units (n_2) to sample per primary unit (n_1) is:

n_2 = the square root of $\frac{C_1 s_2^2}{C_2 s_1^2}$[21], where C_1 and C_2 equal the cost of sampling per flock and per animal, respectively, and s_1^2 and s_2^2 equal the variance or standard deviation squared of the yield among and within flocks, respectively. With the variances estimated at the same value n_2 = the square root of the cost ratio, $\frac{C_1}{C_2}$

or the square root of $\frac{\$75.00}{\$\ 0.50} = 12.25$

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[21]George W. Snedecor, Statistical Methods, Fifth Edition, (Ames, Iowa, 1956), pp. 512-517.

The number of primary units to sample was determined by using the cost formula: cost = $C_1 n_1 + C_2 n_1 n_2$; or \$1500.00 = \$75.00 n_1 + \$0.50 x $12n_1$, and n_1 = 18.52. The indicated sample size was $n_1 n_2$ or 12 x 18 = 216 fleeces.

In order to get a representation of wool from various areas of the County the 23 townships were grouped into four geographic areas. Three of these areas included six townships each, the fourth included five townships (Figure 9). From each area one township was selected at random to be sampled. A listing of farms reporting 30 or more head of adult sheep was compiled from the 1958 county assessment records. Two townships listed 17 such flocks, one listed eight, and one reported two. Five farms were selected at random from each of the first three townships. The two farms were included in the fourth.

Flock size ranged from 28 to 195 ewes on the 17 farms sampled. Only four flocks exceeded 75 head, however (Table VI). Twelve ewes were randomly selected from each flock for use in the experiment.

Treatments Applied

The treatments used in the experiment consisted of shearing the tags from the posterior of the sheep prior to shearing the remainder of the fleece and keeping these tags separated from the main fleece. Tags consist of wool contaminated with feces and urine. This wool is dirty and stained. If wet, the tags will cause further contamination of the clean wool with which they come in contact when compressed within the entire fleece. Under certain conditions mold

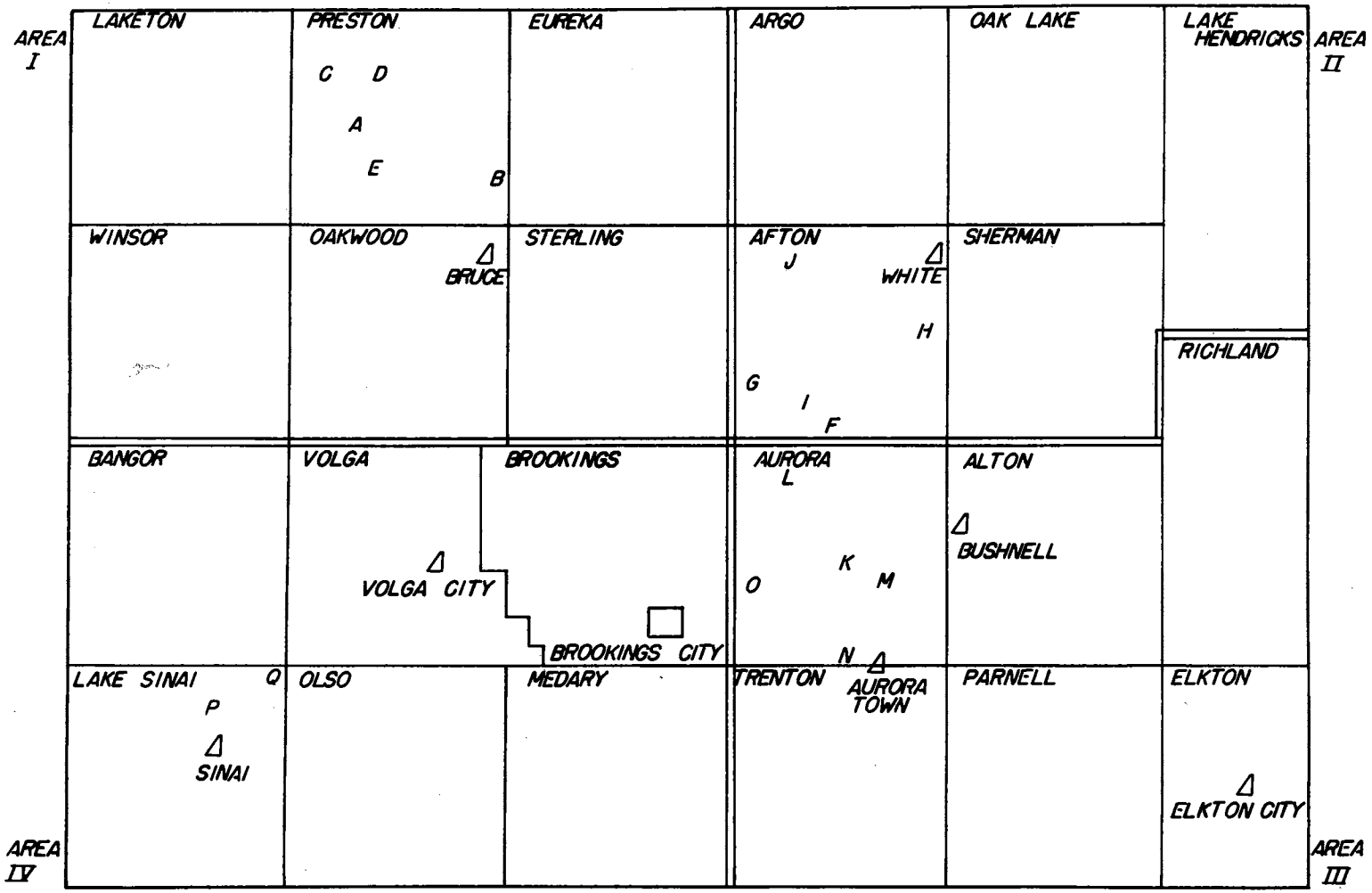

Figure 9. Location of Farm Cooperators, Showing Areas and Townships, Brookings County, South Dakota, 1959

TABLE VI

TAGGING AND SHEARING DATES AND NUMBER OF EWES PER FARM, BROOKINGS COUNTY, SOUTH DAKOTA WOOL STUDY COOPERATORS, 1959

Cooperator (Code Designation)	Tagging Date	Shearing Date	No. Ewes
	Preston Township		
A	Feb. 26	June 12	60
B	March 21	May 27	74
C	March 20	May 27	28
D	April 3	April 6	48
E	Feb. 26	March 21	34
	Afton Township		
F	March 20	April 29	31
G	March 20	May 25	31
H	March 3	March 6	179
I	Feb. 26	March 24	36
J	March 20	April 9	30
	Aurora Township		
K	March 3	April 3	150
L	Feb. 26	June 9	35
M	March 24	June 17	36
N	Feb. 26	March 24	60
O	March 21	April 11	150
	Lake Sinai Township		
P	April 4	April 13	41
Q	March 3	March 25	195

and mildew develop in the wet areas of the fleece. Removing the tags prior to, or at the time of shearing has a potential for increasing the farm value of the fleece by (1) preventing quality deterioration of clean wool, (2) narrowing the risk allowance that the buyer must make for foreign matter, stained wool, and other losses possible when tags are not removed from the fleece, (3) reducing the time necessary for sorting when fleeces are opened, and (4) increasing the yield of the fleece.

The twelve ewes selected on each farm were identified by branding with scourable paint. Numbers one through four were not tagged. They served as the control group. Numbers five through eight were tagged on the day of shearing, just ahead of the shearing operation. Numbers nine through twelve were tagged prior to shearing.

The tagging was performed by a research worker. Shearing of the fleeces was done by the cooperating farmer's shearer, usually a professional custom shearer. The tags were placed in a plastic bag and sealed to preserve the original moisture content until analyzed in the laboratory. Fleeces were tied with paper twine as they came from the shearer.

Plans were made to remove tags from one group of ewes (Numbers 9-12) approximately two weeks prior to shearing. However, due to changes in farmers' shearing dates the actual time interval between tagging and shearing this group varied from three days to more than three months. Tags were removed from these ewes between February 26 and April 4, 1959. The tagging and shearing dates for each cooperator are shown in Table VI.

Shearing was done between March 6 and June 17. Each group of fleeces was stored in a dry, unheated room from the time of shearing until July 2. Fleeces were then moved for the purpose of visual grading and thereafter placed in the laboratory for analysis.

Laboratory Technique

The physical and chemical properties of wool determine its value and its use as a textile fiber. The major physical characteristics of wool include the yield of clean fibers, the length of the fiber, and the fineness of the fiber.

> Visual inspection and assessment of a lot of wool are the usual basis for preparation and sale. While considerable uniformity exists in the grading practices of the industry, the inherent difficulties of classification, and the fact that the operations are performed by various agencies, at different times, and under varying conditions, often lead to differences of opinion as to the accuracy of appraisals made by graders, handlers, and Government appraisers.
>
> Within recent years, wool technologists have developed scientific means of measuring some of the more important physical properties of wool. They have devised laboratory tests for the determination of such factors as fineness, length, and yield on small quantities or samples of wool. These may be applied to commercial-size lots of wool through sampling, and their reliability in this connection is largely dependent on the samples selected being representative of the lot.[22]

The major physical characteristics determining wool quality were measured in the laboratory for each fleece included in the

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[22]E. M. Pohle et. al., Value-Determining Physical Properties and Characteristics of Domestic Wools, United States Department of Agriculture, Agricultural Marketing Service, Livestock Division, Marketing Research Report No. 211, (Washington, D.C., February, 1958), p. 1.

experiment. The procedures used for determining yield, length, and fineness conform to the standards employed by the American Society for Testing Materials (ASTM) for determining the physical properties of wool.

Yield

Wool as shorn from sheep contains varying amounts of natural grease, dirt, and different kinds of vegetable matter. These extraneous substances are removed from the wool through a washing process termed "scouring." The loss, known in the trade as "shrinkage," may range as high as 80 percent and as low as 30 percent. The percentage of clean wool remaining is referred to as the "yield."

Each fleece was weighed prior to laboratory analysis. Fleece weights were recorded to the closest gram and adjusted to a standard 12 percent moisture basis. Thereafter the fleece was untied, spread on a table and sampled. Three samples of 200 to 300 grams each were taken for determining yield. Each sample was weighed individually. A sample of approximately 40 grams was taken for moisture determination. A hook sample of 50 locks was selected for length and diameter or grade measurements.

The three yield-determining samples were run individually through a mechanical opener in order to remove loose dirt, dust, and chaff. Each sample was then reweighed and scoured in vats with a water-detergent solution. Thereafter the samples were oven-dried and weighed. The moisture sample was weighed, oven-dried and reweighed to determine the percentage of moisture in each fleece

at the time that the laboratory analysis was made. Clean wool weights were adjusted to a standard 14 percent moisture equivalent before final yield was determined.

The yield of the tags was similarly determined. The tags from each fleece were weighed, oven-dried, and reweighed to determine moisture content. The tags were then scoured, dried, and weighed for yield determination. Scoured tag weights for yield determination were also adjusted to a standard 14 percent moisture basis.

Three samples were used for yield determination in order to have a check on representativeness of sampling the fleece and accuracy of weighing procedure. The average of the individual results was used as the yield for each fleece.

Length

Length is one of the more important physical properties of the wool fiber. It is very significant from the standpoint of utility and value. It is a basis for the classification and description of wool, whether marketed as grease wool or wool top.

To describe length, such terms as strictly combing or staple, French combing, baby or short French combing, and clothing are used in wool trading. These terms mean that within a grade, staple wools are the longest, French combing comes next, then short French combing, etc. Generally, longer wools of the same grade are worth more than shorter wools. It is recognized that these length terms do not indicate precise lengths, nor in the practice of trading do they

stand for the same lengths in the various grades. Length classification of wool by grade is shown in Table VII.

In the experiment the 50 locks of wool selected from each fleece by a grab or hook sample were measured for length. Each lock was placed on a black felt cloth and extended to the normal length of the fibers; that is, the crimp was not removed from the fibers. Measurement was made to the nearest centimeter (one centimeter is equal to 0.3937 inch). The 50 measurements were averaged to determine the fiber length for each fleece.

Grade or Fineness

The word grade when used in connection with wool refers to the quality of wool from the standpoint of fineness or fiber diameter.

There are two systems of grade terminology, the blood or American system and the English or numerical or spinning count system. These two systems are used alternatively or interchangeably in the trade.

The blood or American system terms originally specified wool types grown on sheep with fractional quantities of Merino blood. Merino wool was called Fine. Other wools were grouped according to their respective degrees of coarseness as compared with the Merino. In the American system seven grades are generally used. They are Fine, Half Blood, Three-eighths Blood, Quarter Blood, Low-quarter Blood, Common, and Braid.

The wool grade terms "numerical" and "count" are alike in meaning. They are associated with yarn nomenclature and presumably

TABLE VII

STAPLE LENGTH DESIGNATION BY SPINNING COUNT
AND BLOOD SYSTEM GRADES

Commercial Length Class	64's and up Fine	62's-60's 1/2 Blood	58's-56's-54's 3/8 Blood	50's-48's 1/4 Blood	46's Low 1/4 Blood	44's-40's-36's Common and Braid
			(unstretched staple length in inches)			
Staple	2.5 and longer	3.0 and longer	3.5 and longer	4.0 and longer	4.5 and longer	5.0 and longer
Good French Combing	2.0	2.5	3.0	3.5	---	---
Average French Combing	1.5	2.0	2.0	2.5	---	---
Short French Combing	1.0	1.5	---	---	---	---
Clothing and Stubby	Under 1.0	Under 1.5	Under 2.0	Under 2.5	Under 4.5	Under 5.0

Source: Jack Buttle, Preparing New Mexico Wool for Market, Agricultural Extension Service, New Mexico State University, Circular 303, (University Park, New Mexico, September 1959), p. 9.

originally designated the highest count of yarn into which the wool could be spun, the yarn count being the measure of the relative fineness or dimension of yarn. For example, a 64's grade of wool when processed and spun to capacity theoretically results in 64 hanks of yarn. A hank is 560 yards of yarn, spun from one pound of wool top.

Both of these systems have lost their original significance, but the names associated with them are generally known and accepted as signifying various degrees of fineness in the wool fiber. The numerical system is in general use in the international trading of wool. The blood system is used domestically in the United States. The grade equivalents of the two systems are shown in Table VIII.

There have been official United States standards for grades of grease wool since 1923. These standards are represented by physical samples. The basis of these grade standards is fineness, or average fiber diameter, determined by visual inspection.

The official United States standards for wool top (combed wool fibers) from the grade 80's through 50's have been defined on a micron basis since 1939. Similar specifications for the lower grades, 48's through 36's, and for the additional grade 54's were added January 1, 1953.

The grade standards classify apparel wools on the basis of gradations of fineness. These gradations are extremely small. For example, the difference in average fiber diameter between the finest and coarsest of the 14 grades of wool top is about 23 microns. One micron is equal to one ten-thousandth of a centimeter or approximately one twenty-five-thousandth of an inch.

TABLE VIII

RANGES OF FIBER DIAMETER AND FIBER COUNT PERMISSIBLE, BY GRADE

Fiber Diameter in Microns	No. Fibers per 125 Square Centimeter Area	Spinning Count Grade	Blood System Grade
17.7-19.1	160-135	80's)	
19.2-20.5	134-119	70's)	Fine
20.6-22.0	118-104	64's)	
22.1-23.4	103-92	62's)	
23.5-24.9	91-81	60's)	1/2 Blood
25.0-26.4	80-72	58's)	
26.5-27.8	71-65	56's)	3/8 Blood
27.9-29.3	64-59	54's)	
29.4-30.9	58-53	50's)	
31.0-32.6	52-47	48's)	1/4 Blood
32.7-34.3	46-43	46's)	Low 1/4 Blood
34.4-36.1	42-39	44's)	Common

Source: ASTM Standards on Textile Materials, American Society for Testing Materials, Philadelphia, Penn., November 1956, p. 588.

The sub-samples or locks of wool used for length measurements were replaced in the length and fineness sample for each fleece. The sample was thoroughly mixed and a sub-sample was selected for measuring fiber diameter or fineness and scoured in carbon tetrachloride. Each sub-sample was placed in a thick cross-section device about one thirty-second inch in width, packed to a given degree, and cross-sectioned on both sides with a razor blade. The cross-section device was placed in a micro projector which magnifies the field 500 times. A count of the fibers in a 125 square centimeter viewing area was made.

This count became the means of determining, via chart values, the average diameter of the fibers. Final grade determination for each fleece was based on the average of the measurements obtained from two readings. The fiber diameter, measured in microns, and the number of fibers per 125 square centimeter area can be reduced to either blood or count system grade (Table VIII).

Condition

Condition refers to the degree of natural oil and foreign matter in wool. Wool that is heavy in condition usually yields less clean wool when it is scoured than wool that is light in condition.[23]

The wool trade uses three terms to designate condition in grease wool. "Choice" is used to describe wool of light or the best condition. "Bright" designates wool of an average condition. The term "Semi-bright" refers to wool of a very heavy condition.

The amount of dirt and dust in the fleece has a close relationship to the condition of the fleece. A schedule was devised relating the percentage of original fleece weight lost through the dusting process to the wool condition designations. Dusting consists of opening the fleece mechanically and spreading the fibers to allow loose dirt, dust, and chaff to sift out. Condition designations were determined as follows:

Less than 7 percent of original weight lost in dusting = Choice.

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[23]Ibid., p. 59.

Seven percent through 17.9 percent of original weight lost in dusting = Bright.

Eighteen percent or more of original weight lost in dusting = Semi-bright.

Summary of Procedure

Farm flocks and animals within flocks were sampled to obtain experimental material on which to apply the treatments designed to improve wool quality. Three methods of handling the tags in the fleece were tested. The fleeces were individually sampled and analyzed in the laboratory for the primary physical characteristics determining wool quality and value. These four characteristics--yield, length, fineness, and condition--were measured and the results statistically analyzed by variance analysis. Differences among treatment means were tested for significance by Snedecor's F test. The physical characteristics for each fleece were compiled for purposes of determining the overall grade of each fleece. Grease wool prices and clean wool prices were used to provide bases for valuation of the fleeces. Variance analysis and Snedecor's F test were used to analyze fleece value. Costs of farm tagging were computed to arrive at the net value of the treatments. The fleeces used in the experiment were graded visually to enable the comparability of laboratory and visual grading results to be determined.

CHAPTER V

ANALYSIS OF QUALITY MEASUREMENTS

The primary factors affecting wool quality, which were determined for each fleece in the experiment, include yield of clean wool, staple length, staple diameter or grade, and condition. In addition the following other characteristics affecting fleece quality and value were examined: moisture content, weight, yield of clean wool in tags, and the percentage of tags in the fleece.

This chapter presents the results of the laboratory and statistical analysis of physical properties of the wool used in the experiment, and their interpretation. Each characteristic was analyzed by farm and by treatment. Grade, length, and condition results for each fleece were combined to form a basis for the valuation of the fleece. These steps were a prerequisite to determining the value of removing tags on the farm.

Results of Moisture, Weight, and Yield Determination

Moisture Content

The normal or average moisture content for grease wool is 12 percent. If wool containing urine and feces is included in the fleece a higher moisture content would be expected. This was found to be the case. The group of untagged fleeces (Treatment I) had a mean moisture content of 14.12 percent. The moisture content of the

individual fleeces in this group ranged from 7.67 percent to nearly 35 percent. The mean moisture contents for the groups of fleeces tagged prior to shearing (Treatment (III) and at the time of shearing (Treatment II) were 11.23 percent and 10.52 percent, respectively. The highest moisture content in an individual fleece in these two groups of fleeces was 18.55 percent; the lowest was 6.03 percent. The number of fleeces of specified moisture content, by treatments, is shown in Table IX.

The mean moisture content of the fleeces comprising an experimental unit (four sheep) was greater for the untagged fleeces (I) than for those tagged at shearing (II) on each of the 17 farms. The fleeces tagged prior to shearing (III) had a lower average moisture content per experimental unit than those left untagged on 15 of the 17 farms. The relationship of the time of tagging to moisture content of the fleece is not distinct. The average percentage of moisture was greater for the early tagged group on 12 farms. On five farms the late tagged group showed a higher average moisture content (Appendix Table I).

Because the moisture content was in the low range of percentages it was necessary to transform the data to obtain a normal distribution prior to making an analysis of variance. The arcsin transformation was used.[24] Transformed data for the percentage of moisture in the fleece are shown in Appendix Table II.

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[24]Snedecor, pp. 316-319.

TABLE IX

NUMBER OF FLEECES OF SPECIFIED MOISTURE CONTENT AND MINIMUM AND MAXIMUM MOISTURE CONTENT, BY TREATMENT

Moisture Content	Fleeces Untagged	Fleeces Tagged Prior to Shearing	Fleeces Tagged at Shearing
		(number of fleeces)	
over 15%	11	5	2
10-15%	53	41	35
less than 10%	4	22	31
Total	68	68	68
Maximum	34.70%	10.55%	16.67%
Minimum	7.67%	7.23%	6.03%

The analysis of variance revealed that the mean moisture content differed significantly among treatments at the one percent level of confidence, using Snedecor's F test.[25] Untagged fleeces had a mean moisture content significantly higher at the one percent level than did the tagged fleeces. The difference in mean moisture content between the two tagged groups was not statistically significant (Table X).

The F value for farm x treatment interaction was not significant. This indicates that the higher mean moisture content of the untagged fleeces is consistent over all the 17 farms included in the sample.

[25] Ibid., pp. 244-250.

TABLE X

ANALYSIS OF VARIANCE OF MOISTURE CONTENT OF FLEECES

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	92.9798	5.8112	
Treatments	2	354.3499	177.2750	49.99**
I vs II + III[1]	1	339.8515		95.83**
II vs III	1	14.4984		4.14
Farm x Treatment Interaction	32	113.4056	3.5464	0.63
Experimental error	159	856.5448	5.5983	
Total (CFM)	209	1,417.5611		

[1] I = fleeces not tagged

II = fleeces tagged at time of shearing

III = fleeces tagged prior to shearing

** = significant difference at one percent confidence level

F (treatments) $= \frac{177.2750}{3.5464} = 49.99$, greater than $F_{.01} = 5.35$

F(I vs II + III) $= \frac{339.8515}{3.5464} = 95.83$, greater than $F_{.01} = 7.51$

F(II vs III) $= \frac{14.4984}{3.5464} = 4.14$, less than $F_{.05} = 4.15$

F(farms x treatments) $= \frac{3.5464}{5.5983} = 0.63$, less than $F_{.05} = 1.45$

The moisture content of the tags was considerably greater than that of the fleeces. The average moisture content of all tags was 21.51 percent. Three flocks had tags with an average moisture content of less than 15 percent; the lowest was 11.99 percent. The highest farm average moisture content for tags was 34.16 percent, but tags from individual sheep contained as much as 58 percent moisture. Such high moisture material would have the effect of lowering the yield of clean wool if left in the fleece. (Appendix Table III).

Weight

Fleece and tag weights were measured in grams and converted to pounds. The weights were recorded before and after adjusting to a 12 percent moisture content. In each case the untagged fleeces had the highest moisture content (Table XI). Because of the high moisture content of the untagged fleeces, the average weight of this group decreased when adjusted to a 12 percent basis. The weights of the tagged fleeces increased when adjusted. Unadjusted and adjusted fleece weights are shown in Appendix Tables IV and V.

Analysis of variance of the total weight of the fleece including tags, adjusted to a 12 percent moisture content, showed no significant difference in mean weights among treatments (Table XII). Tagging would not be expected to affect the total weight of the fleece.

The tags were removed from the untagged fleeces after a storage period of approximately four months. The wet, dirty wool had contaminated surrounding clean wool in the fleece. This contamination accounted at least partially for this group of tags having the highest

TABLE XI

MEAN WEIGHT OF FLEECES AND TAGS, BY TREATMENT, UNADJUSTED AND ADJUSTED FOR MOISTURE CONTENT

	Fleeces Untagged	Fleeces Tagged Prior to Shearing	Fleeces Tagged at Shearing	Ave.
		(pounds)		
Unadjusted Fleece Weight	11.01	10.23	10.03	10.42
Adjusted Fleece Weight[1]	10.77	10.30	10.18	10.42
Unadjusted Tag Weight	0.65	0.31	0.38	0.45
Adjusted Tag Weight[1]	0.64	0.25	0.34	0.41

[1]Weight computed on a 12 percent moisture basis.

average weight (Table XI). The moisture content of the tags removed after storage was the same as that of the respective fleeces in this group. The mean weight of these tags was changed very little by adjusting to a 12 percent moisture basis. The mean weights of the other groups of tags were lowered by adjusting for moisture. Tag weights are listed in Appendix Tables VI and VII.

The difference in mean tag weights among treatments was statistically significant at the one percent level of confidence, as was the difference between treated groups and the control group. Leaving tags in the fleece during a storage period results in contamination of surrounding wool and in a greater amount of tags when removed. The difference in mean weights of tags removed early and late was not

TABLE XII

ANALYSIS OF VARIANCE OF TOTAL WEIGHT OF FLEECE, INCLUDING TAGS, ADJUSTED FOR MOISTURE CONTENT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	670.0642	14.8790	
Treatments	2	2.5487	1.2744	0.26
Farm x Treatment Interaction	32	158.6772	4.9587	1.14
Experimental error	153	664.8429	4.3454	
Total (CFM)	203	1,496.1330		

$F(\text{treatments}) = \frac{1.2744}{4.9587} = 0.26$, less than $F_{.05} = 3.30$

$F(\text{farms x treatments}) = \frac{4.9587}{4.3454} = 1.14$, less than $F_{.05} = 1.45$

statistically significant (Table XIII).

Farm x treatment interaction was significant at the one percent confidence level. This suggests that management practices other than the removal of tags affect the amount of tags in the fleece. Some of these factors might include the housing and bedding used and the type of feeds fed (scouring or non-scouring rations). Removal of tags prior to storage of the fleece cannot be expected to result in a lower tag weight on all farms.

Yield

The yield of clean wool is the quality factor which the treatments, the removal of tags from the fleece, would be expected

TABLE XIII

ANALYSIS OF VARIANCE FOR WEIGHT OF TAGS, ADJUSTED FOR MOISTURE CONTENT

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	4.1488	0.2593	
Treatments	2	5.7055	2.8527	26.86**
I vs II + III[1]	1	5.4052		50.90**
II vs III	1	0.3003		2.83
Farm x Treatment Interaction	32	3.3995	0.1062	2.53**
Experimental error	153	6.4171	0.0419	
Total (CFM)	203	19.6709		

[1] I = tags removed after storage of fleece

II = tags removed at time of shearing

III = tags removed prior to shearing

** = significant difference at 1 percent confidence level

$F(\text{treatments}) = \frac{2.8527}{0.1062} = 26.86$, greater than $F_{.01} = 5.35$

$F(\text{I vs II + III}) = \frac{5.4052}{0.1062} = 50.90$, greater than $F_{.01} = 7.51$

$F(\text{II vs III}) = \frac{0.3003}{0.1062} = 2.83$, less than $F_{.05} = 4.15$

$F(\text{farms x treatments}) = \frac{0.1062}{0.0419} = 2.53$, greater than $F_{.01} = 1.68$

to affect. The removal of tags which are high in moisture content and foreign matter should logically result in an increase in the yield of clean wool in the fleece. In order to determine the validity of this hypothesis the yield of clean wool was calculated for each fleece (1) with tags removed and (2) with tags included. Tags were removed from one group of sheep prior to shearing (III), from a second group at the time of shearing (II), and from the third group tags were sorted from the fleeces after a storage period (I). The latter treatment is the equivalent of sorting at the wool warehouse or no farm treatment relative to tags.

The yield of clean wool for fleeces with tags excluded was calculated by use of the formula:

$$\text{percent of clean wool} = \frac{\text{total weight of scoured, ovendry samples}}{.86\ (\text{total adjusted weight of samples})} \times 100.$$ [26]

The factor (.86) reduces the adjusted sample weight to a moisture-free basis. The resulting yields of clean wool for fleeces without tags ranged from 33.41 percent to 70.83 percent. One of the factors influencing the yield of clean wool is the breed of sheep. Since farm flock sheep are often heterogeneous regarding breed, a wide variation in yield is to be expected, both between farms and within flocks. Average yield per farm varied from 42.50 percent to 61.40 percent (Appendix Table VIII).

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[26] American Society for Testing Materials Committee D-13 on Textile Materials, ASTM Standards on Textile Materials, (Philadelphia, November 1956), pp. 571-572.

The formula used for calculating the yield for fleeces with tags included was:

$$\text{percent of clean wool} = \frac{\text{weight of ducted fleece} \times \text{total weight of scoured ovendry samples}}{.86\ (\text{adjusted fleece weight}) \times \text{total weight of samples after ducting}} + \frac{\text{weight of ovendry tags}}{.86\ (\text{adjusted fleece weight})} \times 100,$$[27] where the weight of the ducted fleece equals (original fleece weight minus tag weight) times percent of original weight remaining after ducting, and (.86) again reduces adjusted weights to a moisture-free basis. The range of yields is similar to that of the tagged fleeces: from 32.24 percent to 68.34 percent for the individual fleeces and from 42.14 percent to 60.67 percent for farm averages. The same individual fleeces and farms showed the extreme low and high yields as in the case of the tagged fleeces (Appendix Table IX).

The gain in the percentage of clean wool resulting from the removal of tags gives a measure of the loss in yield due to the presence of tags in the fleece. The percentage increase in the yield of clean wool resulting from the removal of tags was computed for each fleece. The following example illustrates the method of computation for Farm A, Fleece No. 1.

Clean wool in fleece with tags excluded (Appendix Table VIII)	= 54.34 %
Minus clean wool in fleece with tags included (Appendix Table IX)	= 50.03 %
Gain in percentage of clean wool as a result of removing tags (Table XIV)	= 4.31 %

[27] Ibid.

This percentage increase for each fleece is recorded in Table XIV.

There was a gain in the percentage of clean wool in the fleece as a result of removing tags in 200 of the 204 fleeces. Three of the exceptions occurred on the same farm and the same treatment (Farm A, Treatment III). The other exception was from Farm J, Treatment I. In each case the yield of clean wool from tags was greater than that of the fleece without tags. These tags were evidently quite free of foreign matter. Three of them showed a low moisture content also.

The highest average gain in yield from removing tags was for the group of fleeces where tags were removed after storage (I). The smallest mean increase occurred in the fleeces tagged prior to shearing (III). Maximum, minimum, and average increase in yield of clean wool, by treatment, is shown in Table XV. The larger gain in yield for the fleeces from which tags were not removed until after storage indicates a greater relative loss in yield when fleeces are left untagged at the farm. The group of fleeces with tags removed after storage had a higher moisture content than those groups with tags removed at the farm. A higher percentage of tags could be expected for this group of fleeces also, because of contamination of surrounding wool by the tags.

The mean increase in yield of clean wool for all treatments, by farms, ranged from 0.28 percent to 1.32 percent. No relationship is apparent between the average percentage of clean wool in the fleece (tags excluded), by farm, and the average increase in yield due to removal of tags, by farm. A comparison of the rankings of the 17 farms on the above two characteristics revealed that seven farms ranked

TABLE XIV

PERCENTAGE INCREASE IN YIELD OF CLEAN WOOL RESULTING FROM REMOVAL OF TAGS, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(percent)												
A	4.31	.25	.63	1.78	2.44	.56	.85	1.03	-.02	.29	-.46	-.11	.96
B	1.29	1.99	1.17	.72	1.41	.88	1.67	.41	.35	.15	1.14	.08	.90
C	.33	.97	.50	1.17	.17	.69	.87	1.08	.17	.07	.23	.26	.54
D	.51	.72	1.17	1.44	.40	.43	1.12	.17	1.19	.88	.22	.10	.70
E	1.95	.40	1.31	1.11	.48	.12	1.09	.21	.64	.33	.52	.60	.73
F	.35	.14	.62	.38	.23	.11	.11	.15	.43	.30	.43	.15	.28
G	.05	.87	.94	.60	.44	.97	.64	.62	1.04	.29	.26	.13	.57
H	.47	1.05	1.04	1.31	.40	.31	.53	.24	.49	.51	.30	.71	.61
I	.24	3.07	1.33	1.48	.92	1.05	1.08	1.21	.49	2.32	.96	1.64	1.32
J	.51	-.26	.63	1.28	.45	.12	.35	.34	.09	.28	.22	.29	.36
K	1.08	.11	1.44	1.26	.34	.36	.77	.85	.40	.18	.35	.35	.62
L	.78	.64	2.17	1.64	1.43	.63	3.10	.54	.49	.32	.37	.28	1.03
M	1.23	1.73	1.39	2.30	.42	.10	2.12	.37	.35	.88	.31	.29	.96
N	2.49	.86	.87	.53	.54	.28	1.18	.23	.17	.17	1.38	.04	.73
O	.60	3.16	.22	1.53	.58	.79	1.90	.62	.93	.44	.47	.13	.95
P	.54	.80	1.56	1.66	.30	.27	.16	0	.55	.06	.38	.13	.53
Q	.50	2.15	1.31	1.54	.56	.98	2.52	.56	.52	1.14	.67	3.15	1.30
Average				1.11				.72				.48	.77

TABLE XV

MAXIMUM, MINIMUM, AND AVERAGE INCREASE IN YIELD OF CLEAN WOOL DUE TO REMOVAL OF TAGS, BY TREATMENT

	Tags Removed After Storage	Tags Removed at Shearing	Tags Removed Prior to Shearing	Ave.
		(percent)		
Maximum	4.31	3.10	3.15	
Minimum	- 0.26	0	- 0.46	
Average	1.11	0.72	0.48	0.77

higher in yield of clean wool, seven ranked higher in the percentage increase in yield for all treatments combined, and three farms held the same ranking on both characteristics. The level of fleece yield does not appear to be related to the increase in yield which can be expected by the removal of tags, considering all methods of tag removal together. That is, fleeces yielding a high percentage of clean wool could not be expected to show a greater increase in yield as a result of removing tags than fleeces of lower yield.

Variance analysis was employed to determine whether the treatment means for increase in yield of clean wool because of tagging differed. The arcsin transformation was used to obtain a normal distribution of the percentage data.[28] The transformed data are shown in Appendix Table X.

The analysis of variance indicated that the treatment means differed significantly at the one percent confidence level, using

[28] Snedecor, pp. 313 and 319.

Snedecor's F test. The mean of Treatment I (tags removed after storage of fleece) was significantly greater at the one percent level than the mean of Treatments II plus III (tags removed at shearing and prior to shearing). The mean of Treatment II was significantly greater than that of Treatment III at the five percent level (Table XVI). Thus the conclusion would be made that the removal of tags after storage of the fleece results in a significantly greater increase in the yield of clean wool than does removal of tags prior to storage. The removal of tags at shearing results in a significantly greater increase in yield than does the removal of tags prior to shearing, although this conclusion cannot be made with as high a degree of confidence as can the other. The significance of the interaction component of the analysis of variance, at the five percent confidence level, limits the above conclusions to less than general applicability. Removal of tags prior to storage may not result in a smaller increase in yield than removal after storage for all farm clips. Other management factors and the breed of sheep may be influential in determining the effect of tag removal on yield.

An increase in yield as a result of tagging can be interpreted as equivalent to a loss in yield if fleeces are not tagged. Since the tags must be removed at some point in time prior to scouring and processing the fleece into wool top, the greater the gain in yield from tagging the greater is the loss in yield due to leaving the tags in the fleece up to that time. The results of the analysis on yield by treatments supports the hypothesis that the earlier in the spring season that tags are separated from the fleece the smaller will be the loss in yield of the fleece.

TABLE XVI

ANALYSIS OF VARIANCE OF INCREASE IN YIELD OF CLEAN WOOL

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	177.9357	11.1210	
Treatments	2	157.3557	78.6778	13.78**
I vs II + III[1]	1	124.1707		21.75**
II vs III	1	33.1850		5.81*
Farm x Treatment Interaction	32	182.6691	5.7084	1.64*
Experimental error	153	533.6878	3.4882	
Total (CFM)	203	1,051.6483		

[1] I = Tags removed after storage of fleece.

II = Tags removed at time of shearing.

III = Tags removed prior to shearing.

* = significant difference at 5 percent confidence level.

** = significant difference at 1 percent confidence level.

$F(\text{treatments}) = \frac{78.6778}{5.7084} = 13.78$, greater than $F_{.01} = 5.35$

$F(\text{I vs II + III}) = \frac{124.1707}{5.7084} = 21.75$, greater than $F_{.01} = 7.51$

$F(\text{II vs III}) = \frac{33.1850}{5.7084} = 5.81$, greater than $F_{.05} = 4.15$

$F(\text{farms x treatments}) = \frac{5.7084}{3.4882} = 1.64$, greater than $F_{.05} = 1.45$

The percentage (yield) of clean wool in the tags would be expected to be less than the yield of the fleeces from which the tags came. The average yield of tags was 32.09 percent for the entire experiment. The average tag yield by treatment was 28.54 percent (I), 32.32 percent (II), and 35.41 percent (III). These data indicate that the earlier tags are removed from the fleece the less is the loss of weight resulting from moisture and foreign matter. The average yield of clean wool in tags, by farm, ranged from 27.03 percent to 33.98 percent. This range of tag yields was much less than was the range of average fleece yields, by farm. This suggests that perhaps some of the variables affecting fleece yield, such as genetic factors, do not have as great an effect on yield of tags. The percentage of clean wool in tags is shown in Appendix Table XI.

Percentage of Tags in Fleece

Tags comprised 5.77 percent of the total fleece, by weight, for the group of fleeces from which tags were sorted after storage. In comparison, tags comprised 3.61 percent of the total fleece-tag weight for the fleeces tagged at shearing and 2.97 percent for the group of fleeces tagged prior to shearing (Appendix Table XII).

Individual fleeces were comprised of from 1.00 percent to 13.72 percent tags. One-sixth of the fleeces not tagged prior to storage had more than ten percent tags. None of the fleeces in the other two groups had as much as ten percent tags. Ninety-five percent of the fleeces tagged prior to shearing had less than five percent tags. More than 80 percent of the fleeces tagged at the time of

shearing had less than five percent tags. Just one-third of the fleeces from which tags were sorted after storage contained less than five percent tags (Table XVII).

A variance analysis of the percentage of tags in the fleece was made, using transformed data (Appendix Table XIII). Significant differences were found among treatment means at the one percent confidence level. The mean percentage of tags in fleeces not tagged at the farm was significantly higher than the mean percentage of tags in the fleeces tagged prior to and at the time of shearing (one percent confidence level). There was no statistically significant difference

TABLE XVII

NUMBER OF FLEECES HAVING SPECIFIED PERCENTAGE OF TAGS AND MINIMUM AND MAXIMUM PERCENTAGE OF TAGS, BY TREATMENT

Percentage of Tags in Fleece	Tags Removed After Storage	Tags Removed at Shearing	Tags Removed Prior to Shearing
		(number of fleeces)	
over 10%	11	0	0
5-10%	34	14	5
less than 5%	23	54	63
Total	68	68	68
Maximum	13.72%	8.52%	9.28%
Minimum	1.34%	1.07%	1.00%

in the means of the two groups of fleeces tagged at the farm. Farm-treatment interaction was significant at the five percent level of confidence (Table XVIII).

The significant difference between Treatment I vs II + III indicates that tagging provides a means of reducing the proportion of tags in the fleece. The timing of the tagging operation is not critical. The significant interaction term reveals that removal of tags before storing the fleece will not reduce the percentage of tags on all farms. This can be attributed to variations in flock management practices.

Staple Length Measurements

There is no basis for expecting the length of the wool fibers or staple to be affected by the removal of tags from the fleece. Staple length is a function of breeding and such management practices as the length of time since the previous shearing and the level of nutrition. The variation in staple length could be expected to be small between treatments and large within flocks (due to breed differences) and between farms (due to breed and management differences).

Treatment mean staple lengths were 3.09 inches, 3.02 inches, and 3.08 inches for Treatments I, II, and III, respectively. Average length by farm ranged from 2.63 inches to 3.70 inches. Staple length of fleeces from Farm N varied from 2.60 inches to 5.92 inches, or a difference of three and one-third inches. The longest length recorded was nearly six inches, the shortest less than two inches. Twelve of the 204 fleeces measured more than four inches in fiber

TABLE XVIII

ANALYSIS OF VARIANCE OF PERCENTAGE OF TAGS IN THE FLEECE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	427.9119	26.7445	
Treatments	2	521.1900	260.5950	24.85**
I vs II + III[1]	1	479.8739		45.77**
II vs III	1	41.3161		3.94
Farm x Treatment Interaction	32	335.5099	10.4847	1.61*
Experimental error	153	994.4058	6.4994	
Total (CFM)	203	2,279.0176		

1 I = Tags removed after storage of fleece.

II = Tags removed at time of shearing.

III = Tags removed prior to shearing.

* = significant difference at 5 percent confidence level

** = significant difference at 1 percent confidence level

$F(\text{treatments}) = \frac{260.5950}{10.4847} = 24.85$, greater than $F_{.01} = 5.35$

$F(\text{I vs II + III}) = \frac{479.8739}{10.4847} = 45.77$, greater than $F_{.01} = 7.51$

$F(\text{II vs III}) = \frac{41.3161}{10.4847} = 3.94$, less than $F_{.05} = 4.15$

$F(\text{farms x treatments}) = \frac{10.4847}{6.4994} = 1.61$, greater than $F_{.05} = 1.45$

length; one was under two inches. The overall average length was 3.06 inches (Table XIX).

Analysis of variance of staple length in centimeters reveals that the differences in treatment means are not significant (Table XX). Staple lengths in centimeters are shown in Appendix Table XIV.

Length of staple must be correlated with fiber diameter to determine length-grade designation.

Staple Diameter or Grade Measurements

The diameter or fineness of the wool fiber would not be affected by the treatments applied in the experiment. The fiber count per 125 square centimeter area averaged from 71 to 74 for the three treatments. The overall average was 72. All of these counts fall in the range of grades 56's and 58's on the spinning count system or three-eighths blood on the blood grade system. Differences in breeding will be reflected in fineness of fiber. The average fiber count per farm ranged from a high of 95, which is grade 62's or one-half blood, to a low of 57, grading 50's or quarter blood. Fleeces included in the experiment graded from 44's or Common (fiber count = 37) to 70's or Fine (fiber count = 129). The total two-sample fiber count for each fleece is shown in Appendix Table XV.

The fiber count was used for the analysis of variance of staple diameter. There is no significant difference among treatment means for staple diameter measurements (Table XXI).

TABLE XIX

STAPLE LENGTH IN INCHES, BY TREATMENT AND FARM

Farm	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
Fleece No.	1	2	3	4	5	6	7	8	9	10	11	12	
						(inches)							
A	2.99	2.50	2.32	2.01	2.98	2.82	3.12	2.46	2.92	3.47	2.53	3.06	2.76
B	2.98	3.20	2.37	3.71	2.87	3.43	3.37	2.54	2.76	2.64	2.79	2.34	2.92
C	2.87	2.17	2.46	3.42	2.15	2.69	2.53	2.74	3.14	2.37	2.62	2.96	2.68
D	2.88	3.02	3.06	2.43	2.70	2.79	3.38	2.74	2.54	2.85	2.64	2.95	2.82
E	4.09	2.59	3.40	3.16	2.73	2.66	2.96	2.35	3.34	3.46	4.13	3.38	3.19
F	2.70	3.38	2.92	3.23	3.29	2.85	2.78	2.66	3.03	2.81	2.58	2.84	2.92
G	3.14	3.63	3.18	3.48	3.52	3.49	3.44	3.06	3.46	3.49	3.62	3.61	3.43
H	3.38	2.61	2.58	2.53	2.78	2.27	2.46	2.84	3.00	2.21	2.55	2.38	2.63
I	2.04	3.33	3.05	3.42	3.08	3.50	3.06	3.04	2.94	4.19	3.58	3.30	3.21
J	2.94	2.88	3.03	2.59	2.08	2.69	2.41	3.02	3.00	2.91	2.55	2.87	2.75
K	3.20	2.62	2.92	2.96	2.51	3.21	1.96	2.70	2.54	2.51	2.13	3.13	2.70
L	3.37	3.38	3.57	4.09	4.08	3.69	3.30	3.97	3.24	3.28	3.28	3.06	3.52
M	3.59	2.23	3.31	3.37	2.59	2.73	2.30	3.73	3.80	4.16	3.30	2.66	3.15
N	3.16	3.22	5.92	2.60	3.10	2.94	5.13	2.78	3.65	2.78	2.65	3.20	3.43
O	3.50	3.97	2.89	3.88	2.88	3.90	4.38	4.14	3.52	4.28	3.84	3.24	3.70
P	2.96	3.16	3.08	4.12	3.67	3.40	3.28	2.89	2.72	3.31	3.22	3.47	3.27
Q	2.57	2.86	2.73	3.13	2.93	2.93	3.21	2.93	3.34	2.55	2.81	3.89	2.99
Average				3.09				3.02				3.08	3.06

TABLE XX

ANALYSIS OF VARIANCE OF STAPLE LENGTH IN CENTIMETERS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	133.93	8.371	
Treatments	2	1.08	0.540	0.38
Farm x Treatment Interaction	32	45.80	1.431	0.93
Experimental error	153	234.45	1.534	
Total (CFM)	203	415.26		

$F(\text{treatments}) = \frac{0.540}{1.431} = 0.38$, less than $F_{.05} = 3.30$

$F(\text{farms x treatments}) = \frac{1.431}{1.534} = 0.93$, less than $F_{.05} = 1.45$

Condition Determination Results

The condition of the fleece is largely a function of management. The types of housing and penning facilities, grazing areas, and feeds will determine the amount of foreign matter in the fleece. Grease wool condition was determined by measuring the percentage of fleece weight lost through dusting of the fleece. The process of dusting removes loose dirt, dust, and chaff from the fleece. Removal of tags from the fleece would not be expected to affect dusting results, since the foreign matter in tags is wet, clinging material. The formula used was: percentage of weight lost in dusting = 100 - $\frac{\text{total weight of samples after dusting}}{\text{total weight of original samples}}$

TABLE XXI

ANALYSIS OF VARIANCE OF STAPLE DIAMETER OR GRADE

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	112,984	7,061.5	
Treatments	2	1,362	681.0	0.87
Farm x Treatment Interaction	32	25,093	784.2	1.18
Experimental error	153	101,621	664.2	
Total (CFM)	203	241,060		

$F(\text{treatments}) = \frac{681.0}{784.2} = 0.87$, less than $F_{.05} = 3.30$

$F(\text{farms x treatments}) = \frac{784.2}{664.2} = 1.18$, less than $F_{.05} = 1.45$

Treatment means for percentage of weight lost through dusting were 14.60 percent, 14.89 percent, and 14.83 percent for Treatments I, II, and III, respectively. The overall mean was 14.77 percent (Table XXII).

The effect of management practices upon the amount of foreign matter in the fleece is revealed by examining the average weight lost through dusting, by farms. Farm H had a mean loss of 7.20 percent. The smallest loss was 3.77 percent, the greatest was 10.21 percent. Five of the 12 fleeces were rated as Choice for condition (less than seven percent of weight lost through dusting). This flock was penned and housed on a hard, dry surface and grazed on pasture with permanent cover. It was also sheared early in the season

TABLE XXII

PERCENTAGE OF FLEECE WEIGHT LOST THROUGH DUSTING, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(percent)												
A	13.21	19.95	19.61	21.02	16.02	13.96	11.23	19.46	21.32	17.58	17.76	19.03	17.51
B	18.53	19.94	28.18	20.09	29.69	25.44	23.33	17.19	19.30	19.20	13.54	18.19	21.05
C	15.63	15.66	17.04	11.17	13.42	17.09	17.90	19.23	11.14	19.17	17.63	18.87	16.16
D	6.23	10.97	12.13	16.48	14.91	10.98	10.82	12.71	12.69	20.30	7.98	15.82	12.67
E	7.74	8.82	9.96	9.11	13.29	10.50	13.06	10.46	12.73	10.99	8.79	14.88	10.65
F	29.61	26.16	32.80	30.66	25.20	29.67	23.83	27.40	23.85	25.92	29.95	32.21	28.10
G	31.16	34.02	17.47	24.88	23.31	17.31	18.69	18.44	24.16	22.18	20.11	24.42	23.01
H	6.16	8.01	6.73	7.50	8.84	8.76	7.34	5.59	3.77	7.50	5.95	10.21	7.20
I	12.97	7.70	8.76	10.12	13.93	8.03	7.77	6.45	11.57	7.65	7.26	7.23	9.12
J	21.50	23.65	14.22	11.81	21.08	19.67	22.51	14.83	11.56	11.91	13.54	15.96	16.85
K	15.95	14.86	8.78	8.00	12.82	12.26	14.19	11.51	13.70	10.75	18.96	13.55	13.61
L	16.94	9.33	11.21	13.39	15.00	13.95	12.83	14.40	14.77	15.38	14.37	18.54	14.18
M	9.69	15.48	11.00	12.42	13.14	13.52	17.28	14.57	18.60	11.37	13.34	17.03	13.95
N	9.51	10.14	11.34	14.49	13.37	11.16	13.02	13.49	15.85	8.26	11.44	10.13	11.85
O	7.16	8.04	15.11	9.76	15.53	10.27	11.76	9.55	16.63	8.39	11.22	17.30	11.73
P	16.88	10.79	13.61	12.91	10.98	14.86	15.65	12.88	18.38	9.77	9.00	10.43	13.01
Q	11.10	8.76	11.08	7.54	11.26	10.42	10.89	12.35	9.25	13.16	12.28	4.76	10.24
Average				14.60				14.89				14.83	14.77

(March 6) before blowing dirt and dust, typical of the area during the spring months, were present.

In contrast, the fleeces from Farms F and G showed average losses in weight through dusting of 28.10 percent and 23.01 percent, respectively. On Farm H dusting loss ranged from 23.83 percent to 32.31 percent. All of these fleeces were Semi-bright, the lowest condition rating. Two fleeces rated Bright on Farm G, but one fleece contained more than 34 percent loose dust and dirt. The flocks on these two farms were grazed during the spring months on fields subject to blowing dirt. They were sheared late in the season (April 29 and May 25, respectively).

The data for percentage of fleece weight lost through dusting were transformed by the arcsin formula to obtain a normal distribution so that variance analysis could be employed. The transformed data are shown in Appendix Table XVI. Analysis of variance of these data shows differences in treatment means are not statistically significant. The farm x treatment interaction is significant at the one percent confidence level (Table XXIII). Management factors other than the removal of tags are responsible for the amount of dust, dirt, and vegetable matter in the fleece.

Compilation of Grade, Length and Condition Measurements

The results of the laboratory determination of length, grade, and condition were compiled to formulate the overall quality designation for each fleece. Grade was designated on the blood system, according to the criteria shown in Table VIII. Fiber length was classified as

TABLE XXIII

ANALYSIS OF VARIANCE OF PERCENTAGE OF FLEECE WEIGHT LOST THROUGH DUSTING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	3,331.2156	208.2010	
Treatments	2	6.2538	3.1269	0.33
Farm x Treatment Interaction	32	299.2175	9.3505	6.82**
Experimental error	153	209.8738	1.3717	
Total (CTM)	203	3,846.5607		

** = Significant difference at 1 percent confidence level.

$F(\text{treatments}) = \frac{3.1269}{9.3505} = 0.33$, less than $F_{.05} = 3.30$

$F(\text{farms x treatments}) = \frac{9.3505}{1.3717} = 6.82$, greater than $F_{.01} = 1.68$

Staple, Good French Combing, Average French Combing, Short French Combing, or Clothing, using the information given in Table VII as the basis for classification. The condition designation schedule (pages 67-68) was employed to translate the percentage of fleece weight lost through dusting into a condition rating of Choice, Bright, or Semi-bright. Seedy and Burry fleeces were determined by visual inspection. Table XXIV shows the compilation by fleece number and farm.

Nearly one-half of the 204 fleeces graded three-eighths blood. Most of the remainder graded one-half blood or quarter blood. The

TABLE XXIV

FLEECE GRADE, LENGTH, AND CONDITION AS DETERMINED BY LABORATORY ANALYSIS, BY FLEECE NUMBER AND FARM

Farm	Fleece Number 1	2	3	4	5	6
A	3/8AFr,B	3/8AFr,S	3/8AFr,S	3/8AFr,S	1/4AFr,B	3/8AFr,B
B	L1/4Clo,S	1/4AFr,S	FGFr,S	1/2Stp,S	3/8AFr,S	3/8GFr,S
C	1/4AFr,B	3/8AFr,B	1/2AFr,B	3/8GFr,B	1/4Clo,B	3/8AFr,B
D	1/2GFr,C	1/2Stp,B	1/4AFr,B	1/4Clo,B	1/2GFr,B	3/8AFr,B
E	1/2Stp,B	3/8AFr,B	3/8GFr,B (Burry)	3/8GFr,B	3/8AFr,B	1/2GFr,B
F	1/4AFr,S	1/4AFr,S (Burry)	1/4AFr,S	1/4AFr,S	3/8GFr,S	3/8AFr,S
G	3/8GFr,S	1/4GFr,S	L1/4Clo,B	1/4AFr,S	3/8Stp,S	1/4AFr,B
H	1/2Stp,C	3/8AFr,B	1/2GFr,C	1/2GFr,B	3/8AFr,D	3/8AFr,B
I	3/8AFr,B	1/4AFr,B	3/8GFr,B	3/8GFr,B	3/8GFr,B	3/8Stp,B
J	3/8AFr,S (Seedy)	1/2GFr,S (Seedy)	3/8GFr,B	FStp,B	1/2AFr,S	3/8AFr,S
K	1/2Stp,B	1/2GFr,B	1/2GFr,B	1/2GFr,B	1/2GFr,B	1/2Stp,B
L	1/2Stp,B	3/8GFr,B	3/8Stp,B	3/8Stp,B	3/8Stp,B (Burry)	3/8Stp,B
M	FStp,B	1/2AFr,B	FStp,B	1/2Stp,B	FStp,B	1/2GFr,B
N	3/8GFr,B	1/4AFr,B	3/8Stp,B	3/8AFr,B	3/8GFr,B	3/8AFr,B
O	3/8Stp,B	1/2Stp,B	3/8AFr,B	3/8Stp,B	3/8AFr,B	1/2Stp,B
P	3/8AFr,B (Seedy)	1/4AFr,B	3/8GFr,B	3/8Stp,B	1/4GFr,B	1/4AFr,B
Q	3/8AFr,B	3/8AFr,B	1/4AFr,B	1/4AFr,B	1/4AFr,B	1/2GFr,B

TABLE XXIV (Continued)

Farm	Fleece Number 7	8	9	10	11	12
A	1/4AFr,B	3/8AFr,S	3/8AFr,S	3/8CFr,B	3/8AFr,B	3/8CFr,S
B	3/8CFr,S	FStp,B	3/8AFr,S	3/8AFr,S	3/8AFr,B	1/2CFr,S
C	L1/4Clo,B	L1/4Clo,S	3/8CFr,B	3/8AFr,S	1/4AFr,B	1/4AFr,S
D	3/8CFr,B	3/8AFr,B	1/4Clo,B	1/4AFr,S	3/8AFr,B	3/8AFr,B
E	1/2CFr,B	1/2AFr,B	3/8CFr,B	1/2Stp,B	3/8Stp,B	3/8CFr,B
F	3/8AFr,S	1/4AFr,S (Burry)	1/4AFr,S	1/4AFr,S	3/8AFr,S	1/4AFr,S
G	3/8CFr,S	3/8CFr,S	1/4AFr,S	1/4AFr,S	3/8Stp,S	L1/4Clo,S
H	1/2AFr,B	FStp,C	1/2Stp,C	1/2CFr,B	1/2CFr,C	3/8AFr,B
I	3/8CFr,B	3/8CFr,C	3/8AFr,B	1/4Stp,B	ComClo,B	1/4AFr,B
J	3/8AFr,S	3/8CFr,B (Seedy)	1/2Stp,B (Seedy)	3/8AFr,B	3/8AFr,B	1/2CFr,B
K	1/2SFr,B	3/8AFr,B	1/2CFr,B	3/8AFr,S	1/2AFr,S	3/8CFr,B
L	3/8CFr,B	3/8Stp,B	FStp,B	1/2Stp,B	1/2Stp,B	1/2Stp,S (Burry)
M	FCFr,B	1/2Stp,B	1/2Stp,S	1/2Stp,B	3/8CFr,B	3/8AFr,B
N	3/8Stp,B	1/4AFr,B	3/8Stp,B	1/4AFr,B	3/8AFr,B	1/4AFr,B
O	1/2Stp,B	3/8Stp,B	3/8Stp,B	1/2Stp,B	3/8Stp,B	3/8CFr,B
P	3/8CFr,B	L1/4Clo,B	1/4AFr,S	3/8CFr,B	1/4AFr,B	1/4AFr,B
Q	1/4AFr,B (Burry)	1/4AFr,B	3/8CFr,B	1/4AFr,B	3/8AFr,B	1/4CFr,C

TABLE XXIV (Continued)

KEY:

Grade	Length	Condition
F = Fine	Stp = Staple	C = Choice
1/2 = one-half blood	GFr = good French combing	B = Bright
3/8 = three-eighths blood	AFr = average French combing	S = Semi-bright
1/4 = quarter blood	SFr = short French combing	
L1/4 = low quarter blood	Clo = clothing	
Com = common		

most frequently designated length classification was Average French Combing (44 percent). Staple and Good French Combing lengths each comprised about one-fourth of the total. More than 70 percent of the fleeces were rated as Bright for condition. Only four percent of the fleeces were Choice. Five fleeces were found to contain excessive chaff and other vegetable matter. Four of these fleeces, designated as Seedy, were from a single flock. The type of dry roughage being fed was responsible for this condition. Six fleeces, from four flocks, contained excessive cockleburs and were rated as Burry. Grade, length, and condition data are summarized in Table XXV.

Summary of Quality Analysis

The yield, length, grade, and condition of the experimental fleeces were measured in the laboratory as a step toward determining the value of tagging. The statistical analysis of the above factors plus fleece and tag weights, the percentage of moisture in the fleece, and the percentage of tags in the fleece indicate the effect of tagging on fleece quality. The mean percentages of moisture and tags in the fleece and the mean weight of the tags were significantly lower for both tagged groups (II and III) than for the untagged group (I). The mean percentage increase in yield of clean wool due to removal of tags was significantly less in the tagged fleeces (II and III) than the control group (I). Fleeces tagged prior to shearing (III) showed a significantly smaller increase in yield as a result of removing tags than did fleeces tagged at the time of shearing (II).

TABLE XXV

NUMBER AND PERCENTAGE OF FLEECES OF SPECIFIED GRADE, LENGTH, AND CONDITION, AS DETERMINED BY LABORATORY ANALYSIS

Grade	No.	Percent	Length	No.	Percent
Fine	9	4	Staple	47	23
1/2 blood	46	23	Good Fr. combing	56	28
3/8 blood	98	48	Ave. Fr. combing	90	44
1/4 blood	44	22	Short Fr. combing	1	*
Low 1/4 blood	6	3	Clothing	10	5
Common	1	*			
Totals	204	100	Totals	204	100

Condition	No.	Percent	Other	No.	Percent[1]
Choice	8	4	Seedy	5	2
Bright	144	71	Burry	6	3
Semi-bright	52	25			
Totals	204	100	Totals	11	5

* = less than one-half of one percent.

[1] Percentage based on total experiment (204 fleeces).

The statistical analysis revealed that the effect of tagging on tag weight, increase in yield of clean wool, and the percentage of tags in the fleece is not consistent over all farms. This can be attributed to the wide variation in the level of management applied among farm flocks.

Tagging can be expected to reduce fleece moisture content in all farm flocks, and to lower the amount and proportion of low quality wool and increase the yield of clean wool on many farms. Tagging prior to shearing can be expected to result in a smaller loss in yield due to tags than tagging at the time of shearing.

CHAPTER VI

VALUE OF TREATMENTS

This chapter presents the results of the two separate analyses which were employed to determine the economic loss resulting from the presence of tags in farm flock fleeces. Grease wool prices were applied to tag weights in one analysis. Yield differences due to removal of tags were valued on a clean wool price basis in the second analysis. Comparisons of the results of the analyses serve as a means of assessing the consistency of the physical data and give an insight to the source of economic loss due to tags.

Losses Due to Amount of Tags in the Fleece

The tag component of a fleece represents an economic loss to the producer selling on a graded basis, inasmuch as the tag price is below fleece prices. When wool is sold on an ungraded basis, the tags (including surrounding wet and stained wool) are typically removed from the fleece by the buyer and discounted in price or rejected. The magnitude of this loss is equal to the weight of the tags multiplied by the difference between the fleece price and the tag price, or the fleece - tag price differential. This formula was used to determine the loss in each fleece due to the presence of tags. Tag weights were adjusted to a 12 percent moisture content since the analysis was based on a marketing and pricing system under which the

fleece and tags would normally adjust to this level. The null hypothesis was that the mean loss in value due to the presence of tags in the fleece did not differ significantly among treatments. The treatments were: removal of tags from the fleece after a storage period of approximately three months (I), removal of the tags from the fleece at the time of shearing (II), and removal of the tags from the fleece prior to shearing (III).

Final settlement prices on eastern South Dakota wool pooled with the South Dakota Wool Growers' Association formed the basis for calculating grease wool prices. The unweighted average price for each grade for the years 1955 through 1959 was computed. The average deduction on pooled wool from eastern South Dakota was subtracted from each of the computed prices to arrive at the average net return for the five year period. The average annual deduction per hundredweight for the five year period was $7.43. Freight charges comprised $3.06 of the total, while $4.37 was listed as "other." The $4.37 deduction includes the cost of grading, sorting, assembling into merchantable lots, warehousing, and any other costs associated with selling. The five years used for computing grease wool prices include one year of relatively high prices (1957), two years of relatively low prices (1958 and 1959), and two years with prices near the average for the period. Government incentive payments to producers were in effect during each of the five years. A schedule of grease wool prices used in the study is shown in Table XXVI.

The mean loss per fleece due to tags was 17.5 cents, 9.0 cents, and 6.6 cents for Treatments I, II, and III, respectively. The total

TABLE XXVI

SCHEDULE OF AVERAGE PRICES RECEIVED FOR EASTERN SOUTH DAKOTA WOOL POOLED WITH THE SOUTH DAKOTA WOOL GROWERS' ASSOCIATION, BY GRADE, GREASE BASIS, 1955-1959[1]

Grade by Length and Condition	Net Price[2] (cents per lb.)
Fine, Staple, Choice	38.7
Fine, Staple, Bright	34.4
Fine, Staple, Semi-bright	27.7
Fine, French Combing, Choice	31.9
Fine, French Combing, Bright	27.6
Fine, French Combing, Semi-bright	23.4
Fine, Clothing, Choice	29.7
Fine, Clothing, Bright	26.0
Fine, Clothing, Semi-bright	23.0
Fine, Burry or Seedy	26.3
1/2 Blood, Staple, Choice	40.2
1/2 Blood, Staple, Bright	35.2
1/2 Blood, Staple, Semi-bright	29.0
1/2 Blood, Baby,[3] Choice	32.0
1/2 Blood, Baby, Bright	27.0
1/2 Blood, Baby, Semi-bright	24.7
1/2 Blood, Clothing, Choice	30.3
1/2 Blood, Clothing, Bright	27.6
1/2 Blood, Clothing, Semi-bright	25.0
Medium,[4] Staple, Choice	40.9
Medium, Staple, Bright	35.9
Medium, Staple, Semi-bright	30.2
Medium, Baby, Choice	35.5
Medium, Baby, Bright	31.8
Medium, Baby, Semi-bright	30.2
Medium, Clothing, Choice	31.9
Medium, Clothing, Bright	28.5
Medium, Clothing, Semi-bright	24.4
1/2 Blood and Medium Burry or Seedy	27.1

TABLE XXVI (Continued)

Grade by Length and Condition	Net Price[2] (cents per lb.)
Low 1/4 Blood, Clothing, Choice	39.0
Low 1/4 Blood, Clothing, Bright	35.0
Low 1/4 Blood, Clothing, Semi-bright	29.5
Common and Braid	32.3
Tags	4.4

[1]Estimates were made in instances in which prices were not quoted for a given grade in each of the five years.

[2]Average deductions per pound for the period were: freight, 3.06 cents; other, 4.37 cents; total, 7.43 cents.

[3]Baby = French combing length in one-half, three-eighths, and one-fourth blood grades.

[4]Medium = Three-eighths and one-fourth blood grades.

Source: Cooperative Wool Growers of South Dakota, 101 27th Avenue SE, Minneapolis 14, Minnesota.

loss per experimental unit (four fleeces) was the largest in group I on each of the 17 farms. The maximum loss for an individual fleece was much higher in group I than in either of the other two groups. However, the minimum losses were comparable for all treatments (Table XXVII). This indicates that some minimum loss due to light, dry tags probably will be present regardless of the time of removal of tags from the fleece. Removing tags prior to a storage period would not be expected to result in any appreciable prevention of loss due to these tags. A comparison of the maximum and mean losses by groups indicates that at the upper limit and on the average the loss in value due to tags may be

TABLE XXVII

MAXIMUM, MINIMUM, AND AVERAGE LOSS IN VALUE OF FLEECE DUE TO AMOUNT OF TAGS, GREASE PRICING BASIS, BY TREATMENT

	Tags Removed After Storage	Tags Removed At Shearing	Tags Removed Prior to Shearing	Ave.
	(cents per fleece)			
Maximum	55.4	29.6	23.0	
Minimum	2.2	2.2	1.6	
Average	17.5	9.0	6.6	11.0

reduced by 45 to 50 percent by removing tags at the time of shearing and by approximately 60 percent by removing tags prior to shearing. The loss in value due to amount of tags for each fleece in the experiment is shown in Table XXVIII.

The lowest mean loss per fleece by flocks for all treatments was 4.9 cents, on Farm F; the highest was 21.6 cents, on Farm L. Such differences might be the result of either breed or management factors, or both. Within treatments and flocks, differences in the amount of loss due to tags were a maximum of 35.8 cents per fleece for Treatment I (Farm M), 15.2 cents for Treatment II (Farm O), and 18.1 cents for Treatment III (Farm I). Since management factors are essentially constant within a flock these differences between individual observations can be attributed to breed and age variables. However, improved management practices such as clean lot and barn floors and non-scouring rations could narrow loss differences within flocks by reducing individual fleece losses which are high, while

TABLE XXVIII

LOSS IN VALUE OF FLEECE DUE TO AMOUNT OF TAGS, GREASE PRICING BASIS, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(cents per fleece)												
A	26.8	3.7	5.8	16.2	17.3	7.7	7.7	7.6	3.5	3.3	2.2	3.9	8.8
B	16.8	11.1	8.7	11.3	16.2	7.2	13.9	9.3	6.7	3.7	5.5	4.3	9.6
C	7.7	12.0	17.6	13.4	4.1	5.5	8.0	8.0	4.9	5.3	6.3	6.5	8.3
D	5.0	6.5	16.2	10.8	3.7	6.0	10.7	5.2	8.7	9.7	2.5	5.8	7.6
E	51.7	18.1	21.3	28.8	9.9	4.9	11.0	4.4	9.9	8.6	14.8	9.3	16.0
F	4.9	3.6	8.4	5.1	6.0	4.6	3.0	4.1	6.0	5.3	3.2	5.1	4.9
G	9.0	8.6	30.3	20.4	5.9	14.8	8.1	7.2	5.8	5.8	6.7	5.3	10.6
H	7.9	12.0	11.9	5.6	4.4	3.8	3.7	4.1	5.0	3.3	3.6	5.5	5.9
I	2.2	24.2	12.3	17.3	11.8	6.9	11.5	15.2	4.6	22.7	6.4	9.6	12.0
J	12.5	6.8	21.9	41.7	3.8	2.8	8.4	7.9	3.0	5.8	6.6	5.6	10.6
K	26.5	14.0	23.2	23.2	6.3	3.1	8.0	8.5	5.4	5.6	4.3	6.6	11.2
L	26.2	24.9	49.8	37.5	15.4	24.9	29.6	23.6	8.7	6.8	7.4	5.0	21.6
M	31.8	19.6	33.3	55.4	14.7	15.4	17.9	8.3	6.9	15.4	7.7	7.1	19.4
N	18.6	6.6	30.9	3.6	4.1	2.2	15.4	4.4	4.1	1.6	1.9	3.0	8.0
O	6.9	29.3	7.7	18.0	7.9	9.5	23.1	11.0	14.2	8.0	8.8	4.9	12.4
P	17.2	12.0	28.2	30.6	5.5	7.1	6.3	6.1	7.2	7.1	7.1	7.9	11.8
Q	2.7	12.9	9.3	15.6	7.4	4.9	19.2	3.6	4.9	5.2	5.5	23.0	9.0
Average				17.5				9.0				6.6	11.0

having little effect on the losses from fleeces which are low, under present management practices.

Analysis of variance reveals that the mean loss in fleece value due to tags differs significantly among treatments at the one percent level of confidence, using Snedecor's F test. The mean of the control group (tags removed after storage) is significantly greater than that of the treated groups, at the one percent level. The mean losses of the two treated groups do not show a statistically significant difference. The F value for farm - treatment interaction is not significant, revealing that the effect of tagging on fleece value is consistent over all farms (Table XXIX).

Losses in fleece value were reduced 10.9 cents when tags were removed prior to shearing and 8.5 cents when tags were removed at the time of shearing, relative to removal of tags after storage of the fleece. The reduction in loss due to the removal of tags from the fleece at or before shearing represents the value of the treatments on a per fleece basis. The value of the treatments per pound of grease wool was calculated by dividing the per fleece values by the mean weight of the fleeces included in the experiment (10.61 pounds). These values are shown in Table XXXIV.

Losses Due to Difference in Fleece Yield

An alternative method of analyzing the economic loss associated with the presence of tags in the fleece is by placing a valuation on the difference in the yield of clean wool in the fleece with the tags included and excluded. The loss in value of the fleece in cents per

TABLE XXIX

ANALYSIS OF VARIANCE OF LOSS IN FLEECE VALUE DUE TO AMOUNT OF TAGS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	3,795.82	237.24	
Treatments	2	4,450.22	2,225.11	24.29**
I vs II + III[1]	1	4,257.01		46.48**
II vs III	1	193.21		2.11
Farm x Treatment Interaction	32	2,930.79	91.59	0.22
Experimental error	153	6,212.04	406.02	
Total (CFM)	203	17,388.87		

[1] I = Tags removed after storage of fleece.

II = Tags removed at time of shearing.

III = Tags removed prior to shearing.

** = significant difference at 1 percent confidence level.

$F(\text{treatments}) = \frac{2225.11}{91.59} = 24.29$, greater than $F_{.01} = 5.35$

$F(\text{I vs II + III}) = \frac{4257.01}{91.59} = 46.48$, greater than $F_{.01} = 7.51$

$F(\text{II vs III}) = \frac{193.21}{91.59} = 2.11$, less than $F_{.05} = 4.15$

$F(\text{farms x treatments}) = \frac{91.59}{406.02} = 0.22$, less than $F_{.05} = 1.45$

pound of grease wool is equal to the difference in yield (fleece yield with tags excluded minus fleece yield with tags included) multiplied by the clean wool price. The loss in value was calculated on this basis for each fleece. The null hypothesis was that the mean loss in value, due to a lower yield resulting from the presence of tags, did not differ significantly among treatments.

Clean wool prices were based on the Boston market as reported by the United States Department of Agriculture. Annual average prices for the years 1955 through 1959 were used to compute a mean base price for each grade. Since clean wool prices are reported on the Boston market for only specified staple lengths in each grade, prices for other grade-length combinations were computed from the schedule of premiums and discounts used in determining wool futures contract prices. In each case the price reported by the United States Department of Agriculture was used as the base from which other prices in that grade were computed. A schedule of five year average Boston clean wool prices, the pricing formula and computed prices, by grades, is given in Table XXX.

Mean losses in value due to lower yield were reduced 36 percent when tags were removed at shearing and 58 percent when tags were removed prior to shearing, as compared to removal of tags after storage. The total loss was the greatest for the control group on 15 farms. On Farm G the loss was the highest for Treatment II, while on Farm Q Treatment III showed the highest loss. The mean loss in value per pound of grease wool resulting from the lower yield of clean wool when tags were left in the fleece is shown for each treatment in Table XXXI.

TABLE XIII

AVERAGE BOSTON FLEECE WOOL PRICES, 1955-1959, PRICING BASIS FOR WITHIN GRADE PRICES, AND COMPUTED PRICES, BY GRADE, CLEAN BASIS

Grade	Ave. Boston Price 1955-59[1]	Pricing Basis[2]	Computed Price
	(cents per lb.)		(cents per lb.)
Fine:			
Delaine	139.2	(reported price)	139
Staple	128.7	+8%	130
Gd. Fr. C.		+4%	127
Ave. Fr. C.		-2%	121
Sh. Fr. C. & Clo.	110.9	(reported price)	111
1/2 Blood:			
Staple	120.6	+8%	121
Gd. Fr. C.		+6%	120
Ave. Fr. C.		Par	115
Sh. Fr. C.		-5%	110
3/8 Blood:			
Staple	105.9	Par	106
Gd. Fr. C.		Par	106
Ave. Fr. C.		-6%	100
1/4 Blood:			
Staple	101.5	Par	102
Gd. Fr. C.		Par	102
Ave. Fr. C.		-3%	98
Clothing		-6%	95
Low 1/4 Blood:			
Clothing	95.4	(reported price)	95
Common & Braid:			
Clothing	88.9	(reported price)	89

[1]Prices for 1955-1957 from Wool Statistics and Related Data Through 1957, United States Department of Agriculture, Agricultural Marketing Service, Statistical Bulletin No. 250, (Washington, D.C., May, 1959), pp. 124-128; prices for 1958 and 1959 from Supplement For 1959 to Wool Statistics and Related Data Through 1957, Supplement for 1959 to Statistical Bulletin No. 250, (Washington, D. C., December 1959), pp. 118-122.

[2]Based on premiums and discounts for wool futures contracts as reported in Hedging Wool and Wool Tops, prepared by Nichols and Company, 140 Federal Street, Boston, Mass., December, 1952, p. 8.

TABLE XXXI

MAXIMUM, MINIMUM, AND AVERAGE LOSS IN VALUE PER POUND OF GREASE WOOL DUE TO DIFFERENCE IN YIELD, CLEAN PRICING BASIS, BY TREATMENT

	Tags Removed After Storage	Tags Removed At Shearing	Tags Removed Prior to Shearing	Ave.
	(cents per pound of grease wool)			
Maximum	4.31	3.29	3.21	
Minimum[1]	0.05	0	0.04	
Average	1.20	0.77	0.50	0.82

[1]Does not include the four fleeces which showed a higher yield with tags included than with tags removed.

The lowest losses in value on individual fleeces were approximately equal for all treatments. The maximum loss in group III was more than one cent a pound higher than the maximum loss in either of the other groups. Mean losses per farm for all treatments varied from 0.28 to 1.34 cents per pound. Losses in cents per pound of grease wool for individual fleeces are shown in Table XXXII.

Snedecor's F test shows that treatment mean losses in value differ significantly at the one percent confidence level, as does the difference between the mean of the control group and that of the treated groups. The mean loss for group II is significantly larger than that for group III at the five percent level. The interaction of farms and treatments is not statistically significant. The treatment results are applicable to each of the farms sampled. The analysis of variance and significant differences are given in Table XXXIII.

TABLE XXXII

LOSS IN VALUE PER POUND OF GREASE WOOL DUE TO DIFFERENCE IN YIELD, CLEAN PRICING BASIS, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(cents per pound of grease wool)												
A	4.31	0.25	0.63	1.78	2.39	0.56	0.83	1.03	-0.02	0.31	-0.46	-0.12	0.96
B	1.23	1.56	1.48	0.87	1.41	0.93	1.77	0.53	0.35	0.15	1.14	0.10	0.96
C	0.32	0.97	0.58	1.24	0.16	0.69	0.83	1.03	0.18	0.07	0.22	0.25	0.54
D	0.61	0.87	1.15	1.37	0.48	0.43	1.19	0.17	1.13	0.86	0.22	0.10	0.72
E	2.36	0.40	1.39	1.18	0.48	0.14	1.31	0.24	0.68	0.40	0.55	0.64	0.81
F	0.34	0.14	0.61	0.37	0.24	0.11	0.11	0.15	0.42	0.29	0.43	0.15	0.28
G	0.05	0.89	0.89	0.59	0.47	0.95	0.68	0.66	1.02	0.28	0.28	0.12	0.57
H	0.57	1.05	1.25	1.57	0.40	0.31	0.61	0.31	0.59	0.61	0.36	0.71	0.70
I	0.24	3.01	1.41	1.57	0.98	1.11	1.14	1.28	0.49	2.37	0.85	1.61	1.34
J	0.51	-0.31	0.67	1.66	0.52	0.12	0.35	0.36	0.11	0.28	0.22	0.35	0.40
K	1.31	0.13	1.73	1.51	0.41	0.44	0.85	0.85	0.48	0.18	0.40	0.37	0.72
L	0.94	0.68	2.30	1.74	1.51	0.67	3.29	0.57	0.62	0.39	0.45	0.34	1.12
M	1.60	1.99	1.81	2.78	0.55	0.12	2.69	0.45	0.42	1.06	0.33	0.29	1.08
N	2.64	0.84	0.92	0.53	0.57	0.28	1.25	0.22	0.18	0.17	1.38	0.04	0.75
O	0.64	3.82	0.22	1.62	0.58	0.96	2.30	0.66	0.98	0.53	0.50	0.14	1.08
P	0.54	0.78	1.65	1.76	0.31	0.26	0.17	0	0.34	0.06	0.37	0.13	0.55
Q	0.50	2.15	1.28	1.51	0.55	1.18	2.47	0.55	0.55	1.12	0.67	3.21	1.31
Average				1.20				0.77				0.50	0.82

TABLE XXXIII

ANALYSIS OF VARIANCE OF LOSS IN VALUE PER POUND OF GREASE WOOL DUE TO DIFFERENCE IN YIELD

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Farms	16	18.6161	1.1635	
Treatments	2	16.8110	8.4055	22.55**
I vs II + III[1]	1	14.4339		38.72**
II vs III	1	2.3771		6.38*
Farm x Treatment Interaction	32	11.9295	0.3728	0.84
Experimental error	153	67.5536	0.4415	
Total (CFM)	203	114.9102		

[1] I = Tags removed after storage of fleece.

II = Tags removed at time of shearing.

III = Tags removed prior to shearing.

* = significant difference at 5 percent confidence level.

** = significant difference at 1 percent confidence level.

$F(\text{treatments}) = \frac{8.4055}{0.3728} = 22.55$, greater than $F_{.01} = 5.35$

$F(\text{I vs II + III}) = \frac{14.4339}{0.3728} = 38.72$, greater than $F_{.01} = 7.51$

$F(\text{II vs III}) = \frac{2.3771}{0.3728} = 6.38$, greater than $F_{.05} = 4.15$

$F(\text{farms x treatments}) = \frac{0.3728}{0.4415} = 0.84$, less than $F_{.05} = 1.45$

Removal of tags after storage resulted in a loss of 0.70 cent per pound more than removal of tags prior to shearing, and 0.43 cent per pound more than removal of tags at the time of shearing. Early tagging resulted in a 0.27 cent per pound smaller loss than tagging at the time of shearing.

The losses due to yield changes were computed on a per fleece basis by multiplying the loss per pound by the mean adjusted fleece weight for each group. Subtracting the mean loss per fleece for each treatment from the mean loss per fleece for the control group (I) gives the relatively smaller loss, or the gain, from removing tags at an earlier date. The computations and results were:

Control (I): 1.20¢ loss per lb. x 10.77 lb.	=	12.92¢ loss per fleece
Treatment III: 0.50¢ loss per lb. x 10.55 lb.	=	5.28¢ loss per fleece
Gain (III vs I)	=	7.64¢ per fleece

Control (I): 1.20¢ loss per lb. x 10.77 lb.	=	12.92¢ loss per fleece
Treatment II: 0.77¢ loss per lb. x 10.52 lb.	=	8.10¢ loss per fleece
Gain (II vs I)	=	4.82¢ per fleece

Comparing the Analyses

The gross value of the treatments, per fleece and per pound, as determined by each of the analyses is summarized in Table XXXIV. The gain for each treatment is greater on a grease pricing basis than on a clean pricing basis. The difference in the results obtained by the two analyses could be attributed to imperfections in the pricing system, that is, inconsistencies in grease wool - clean wool price

TABLE XXXIV

GROSS VALUE OF TREATMENTS BY PRICING BASIS, PER FLEECE AND PER GREASE POUND

Pricing Basis	Tags Removed Prior to Shearing (cents per fleece)	Tags Removed Prior to Shearing (cents per grease lb.)	Tags Removed at Shearing (cents per fleece)	Tags Removed at Shearing (cents per grease lb.)
Grease Basis	10.90	1.03	8.50	0.80
Clean Basis	7.64	0.70	4.82	0.43
Difference[1]	3.26	0.33	3.68	0.37

[1] Grease pricing basis result minus clean pricing basis result.

relationships, or to the omission of consideration of relevant factors in one of the analyses. Inasmuch as losses other than yield reduction result from tags being left in the fleece, the latter hypothesis cannot be rejected. Losses due to non-scourable stains, increased processing costs, and lower order uses of contaminated wool cannot be measured on the basis of yield, while the grease basis pricing system could be expected to reflect these factors. The tag weight - grease price method of analyzing losses due to tags may be the more accurate means of determining the value of tagging.

The differences in results obtained by the two analyses were quite consistent. The average difference in value per fleece for the two treatments is 3.47 cents. The average per fleece difference in value of treatments divided by the mean weight of the fleeces (10.61 pounds) gives a per pound difference of 0.33 cent. This is comparable to the per pound differences for the two treatments.

An upward adjustment of 3.47 cents per fleece or 0.33 cent per pound to the gains computed on the clean pricing basis gives results very nearly equal to those obtained on the grease pricing basis. This adjustment represents an approximate measure of losses due to tags not attributable to a reduction in fleece yield.

Summary of Value Analyses

The largest mean losses in fleece value occurred where tags were retained in the fleece during a storage period. Lowest losses were found where tags were removed prior to shearing. The gross value of removing tags before shearing was approximately 11 cents per fleece or one cent per pound. Removing tags at shearing showed a gross value of about 8.3 cents per fleece or 0.8 cent per pound.

The yield difference - clean price method of analysis resulted in losses lower than those determined by tag weight - grease price analysis. Reduction in yield of clean wool would not be expected to account for all of the economic loss due to contamination by tags.

Farm x treatment interaction was not significant in the analysis of variance for either method of determining the value of tagging. The conclusion can be made that the effects of tagging on fleece value are consistent over all farms. Each farm can be expected to show a higher gross fleece value when tags are removed before the fleece is stored.

CHAPTER VII

ALTERNATIVE COSTS AND RETURNS TO PRODUCERS

Cost of Treatments

The current charge made by custom shearers in eastern South Dakota for the removal of tags as a separate operation is ten cents per animal. The most important labor requirement for the producer is penning the flock. Collecting and bagging the tags requires little time, probably not more than ten minutes for the typical size flock. Inasmuch as tagging prior to shearing typically would be performed during a season of low labor requirements for the producer his labor can be treated as a fixed cost.

The tagging of those animals from which tags were removed at the time of shearing was performed as a separate operation in the experiment. The principal purpose for this was to assure that the tagging would be carried out uniformly for all treatments and farms. Tags removed at the time of shearing can be sorted as efficiently and more economically by separation from the fleece after shearing and prior to tying the fleece. That is, the tagging and shearing are performed as one operation. Shearers do not make an additional charge for tagging in this case. The cost of tagging is equal to the labor cost for sorting and bagging the tags. The estimated time required for sorting and bagging the tags is one-half minute per fleece. This estimate is based on the researchers' experience in handling wool and

on the results of studies of wool sorting at the time of shearing.[29] The cost of removing tags at the time of shearing, using a wage rate of $1.50 per hour for wool handling, is 1.25 cents per fleece.

Net Returns

The net return to producers for removing tags prior to shearing was approximately one cent per fleece or one-tenth cent per pound of grease wool. Removal of tags at the time of shearing resulted in a net return of about seven cents per fleece or two-thirds cent per pound. The method and results of computing net returns are shown in Table XXXV.

Tagging and crutching of ewes (removing wool in the flank and udder area) prior to lambing is a recommended practice for producers who do not shear the flock before lambing. The merit of tagging prior to lambing results from the time saved and the convenience afforded the operator if the ewe needs assistance in giving birth. The danger of infection due to the introduction of foreign matter into the birth canal is also lessened when tags are not present. The removal of wool in the udder area enables the lamb to suckle more easily. While no monetary benefit can be estimated from the use of this practice it would appear to have an economic value. If ewes are not sheared before lambing, tagging prior to shearing would enable the producer to carry out this practice at no additional cost.

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[29] Russell F. McDonald and Richard R. Newberg, Farm Sorting of Fleece Wool for Market, Ohio Agricultural Experiment Station, Research Bulletin 849, (Wooster, Ohio, February 1960), p. 12.

TABLE XXXV

GROSS RETURNS, COSTS, AND NET RETURNS TO PRODUCERS RESULTING FROM REMOVAL OF TAGS, BY TREATMENT AND PRICING BASIS

	Grease Pricing Basis	Clean Pricing Basis
A. Tags Removed Prior to Shearing		
	(cents per fleece)	
Gross Return[1]	10.90	7.64
(adjustment factor)[2]		+ 3.47
		11.11
Cost	- 10.00	-10.00
Net Return	0.90	1.11
	(cents per lb.)[3]	
	0.085	0.105
B. Tags Removed at Time of Shearing		
	(cents per fleece)	
Gross Return[1]	8.50	4.82
(adjustment factor)[2]		+ 3.47
		8.29
Cost	- 1.25	- 1.25
Net Return	7.25	7.04
	(cents per lb.)[3]	
	0.68	0.66

[1]Data from Table XXXIV.

[2]Adjustment for gain in value due to tagging not accounted for by increase in yield of clean wool (pages 115-116).

[3]Net return per fleece divided by average fleece weight (10.61 lb.).

Crutching will be performed at the time of tagging at no additional cost if the owner specifies. Therefore tagging before shearing, when the flock is sheared after lambing, results in an additional net gain to the owner in the form of time saved at lambing and potentially lowered mortality rates for ewes and lambs.

Implications of Results

The expected gross and net returns from the two methods of tagging are shown for some typical size farm flocks in Table XXXVI. Although the gross returns are greater when tags are removed prior to shearing, the higher cost of removing tags as a separate operation results in very small net returns. The attractiveness of tagging before shearing, from the producer's standpoint, would be almost entirely due to the value to the management factors discussed above.

The net returns from removing tags at the time of shearing, while larger than that for earlier tagging, would amount to only a few dollars per flock on the typical eastern South Dakota farm.

Several factors limit the attractiveness of tagging as a means of wool quality improvement to farm flock owners. The relatively small physical and economic gains possible through tagging, together with the small flock size and comparative unimportance of the sheep enterprise in the total farm operation, would tend to minimize the incentive of the typical flock owner in eastern South Dakota to adopt the practice.

The results of the study revealed that fleeces with tags removed prior to shearing had a gross value of one cent per grease

TABLE XXXVI

EXPECTED GROSS AND NET RETURNS PER FLOCK, BY TIME OF TAGGING AND SIZE OF FLOCK

A. Tags Removed Prior to Shearing

Return per Fleece[1]		Size of Flock: 25 head	60 head	100 head
Gross:	11.0¢	$2.75	$6.60	$11.00
Net:	1.0¢	0.25	0.60	1.10

B. Tags Removed at Time of Shearing

Return per Fleece[1]		Size of Flock: 25 head	60 head	100 head
Gross:	8.4¢	$2.10	$5.04	$8.40
Net:	7.15¢	1.79	4.29	7.15

[1] Gross and net returns were computed by averaging the results of two pricing bases (Table XXXV).

pound greater than untagged fleeces and that fleeces with tags removed at the time of shearing were worth 0.8 cent per pound more than untagged fleeces. Although these results were obtained by application of graded prices the value of wool sold on an ungraded basis would be increased by the same increment. The theoretical analysis developed in Chapter III indicates that these short run gains to producers could be expected to persist while a minority of the producers followed the practice. If most or all of the producers adopted the practice the gains would tend to accrue to marketing firms and consumers, because of the highly competitive market structure under which the producer operates.

Even the immediate benefits to producers who adopt the practice of tagging depends upon buyers' willingness to accept the results of the experiment. It is particularly difficult to appraise the value of a given practice to a clip of wool sold on the cash or ungraded basis, inasmuch as all quality factors affecting the value of the wool must be appraised and weighed mentally in arriving at a price. The value of tagging in this case is just one additional factor to be appraised and weighed. The individual producer with a knowledge of the value of tagging might be able to exert some bargaining influence in negotiating a cash sale with a local buyer. Because of the buyer's greater knowledge of the product, however, the producer's bargaining position would probably not be appreciably enhanced. Cooperative marketing on a graded pricing basis would seem to afford a more adequate means for the producer to exert an increase in bargaining power to assure that the benefits from quality improvement accrue to him. Selling on a graded basis would assure the producer remuneration on the basis of the quality of wool produced. A marketing agency handling a substantial volume of wool of a known quality would be in a stronger bargaining position in the marketplace than would an individual grower.

Theoretical analysis reveals that under a free market pricing system productive resources tend to move out of less profitable enterprises and into more profitable uses. The net gains possible from tagging fleeces are almost certainly not great enough to cause a shifting of resources into the sheep and wool enterprise on the typical eastern South Dakota farm. An increase in the output of

wool as a result of the adoption of tagging would not be expected on farms where the sheep enterprise is largely supplemental to other enterprises. On those farms where sheep and wool production constitute a major enterprise the incentive to adopt a practice showing a net economic gain, and to expand production as a result of the gain, would be increased.

The study was not conducted in such a way as to determine whether marketing costs would be lowered as a result of farm tagging of fleeces. Marketing costs could be expected to be reduced if tagged fleeces lessened the degree of inspection and price risk allowance for the buyer or lowered the sorting and handling requirements for the mill.

The tagging of fleeces is only one means that the producer has for increasing the quality and uniformity of the wool clip and in affording greater accuracy in determining the value of his product at the local market level. Some of the other quality improvement practices which were observed to be deficient on the farms included in the study may be briefly summarized:

1. The selection of more uniform breeding stock.
2. Higher level management in the form of
   a. clean housing and lot facilities, with more dry bedding;
   b. non-scouring rations, including keeping sheep off early spring pasture prior to shearing or tagging;
   c. non-chaffy feedstuffs which cannot become embedded in the fleece;

d. keeping sheep off grazing areas having materials which cling to the fleece, especially cockleburs;

e. keeping sheep off uncovered cropland, especially before the fleece is sheared and during dry, windy weather;

f. a clean shearing floor, free from straw, chaff and dirt.

The adoption of items (b) through (e) may be in conflict with the supplemental nature of the farm flock enterprise. That is, the gain from utilization of feed resources which would otherwise be lost may be equal to, or greater than, the gain in the value of the wool clip as a result of following the practices.

There is a maximum increase in the quality and value of the wool clip which can be achieved through the adoption of tagging or other practices with a given set of resources and the given quantity of wool which results. With the existing nature of the sheep enterprise in relation to the entire farm operation on eastern South Dakota farms, this maximum appears to be quite low.

Summary of Cost and Net Return Analysis

Removing tags prior to shearing can be expected to result in only a very small net gain to the producer, because of the cost of removing tags as a separate operation. When tags are sorted from the fleece at the time of shearing the net return is approximately seven cents per fleece. The expected net return per farm as a result of tagging is limited by the small number of animals in the typical farm flock.

The ability of the producer to realize the benefits of tagging depends upon his competitive position in the marketplace. Cooperative marketing is a means through which the bargaining power of the producer might be enhanced.

It is unlikely that the practice of tagging will cause a reallocation of farm resources or an increase in the output of wool on farms where wool production is supplemental to other farm enterprises.

Practices other than tagging can be adopted to improve farm flock wool quality. Some of these practices may not be economically feasible because of the place of the sheep enterprise in the total farm operation.

CHAPTER VIII

A COMPARISON OF VISUAL AND LABORATORY GRADING RESULTS

Standards of quality for wool grade or fineness and staple length are defined in terms of continuous units, measurable by scientific instruments. Grease wool, however, is priced on the basis of visual evaluation of quality factors. A comparison of the results of laboratory measurement of wool quality factors with the results of a visual evaluation of the same factors was made (1) to determine the extent of agreement between the two methods of assessing wool quality, and (2) to measure the benefit of tagging as valued by laboratory determined quality standards relative to those which would have resulted from the use of visual grading.

The 204 fleeces included in the experiment were graded visually by a wool grader from the South Dakota Wool Growers' Association on July 2, 1959. Each fleece was individually examined and evaluated. The grader was asked to evaluate the fleeces as he would if he were grading wool for the cooperative. The information given by the grader included grade or fineness (blood system), fiber length, and condition. The grader also commented on the presence of foreign matter in the fleeces. This included tags, burs, straw and chaff.

It should be pointed out that the individual who graded the fleeces was a buyer grader. That is, he was an employee of the Wool Growers' Association assigned to evaluate wool at the local warehouse

level for cash purchase by the cooperative. His duties did not include the grading of pooled wool for sorting into lots for sealed bid or other type of sale.

The results of the visual evaluation of grade, length, condition, and presence of seeds and burs in the wool are compiled in Table XXXVII. These will be compared with the laboratory measurements shown in Table XXIV.

Visual evaluation resulted in higher proportions of the fleeces being classified in one-fourth and low one-fourth blood grades than did laboratory grading. Conversely, fewer fleeces were graded one-half and three-eighths blood by the visual grader (Table XXXVIII).

Eighty percent of the fleeces were placed in the Staple length class by visual evaluation. Fewer than one out of four fleeces were designated as Staple length by laboratory measurement. Length classifications for the two methods of grading are compared in Table XXXIX.

Condition designation results were quite similar for the two grading methods. The visual grader placed a somewhat larger proportion of fleeces in the Choice and Bright categories than was found by the laboratory method (Table XL).

The designation of seedy and burry fleeces was identical for the two methods. In both cases these factors were evaluated by visual examination.

A comparison of the number of fleeces deviating in visual grade from the laboratory grade classification, by quality factor and degree of difference, and by value, is shown in Table XLI. Fewer than

TABLE XXXVII

FLEECE GRADE, LENGTH, AND CONDITION AS DETERMINED BY VISUAL EVALUATION, BY FLEECE NUMBER AND FARM

Farm	Fleece Number 1	2	3	4	5	6
A	3/8Stp,S	1/2Stp,B	3/8Baby, S	3/8Baby,S	3/8Stp,S	3/8Stp,B
B	L1/4Clo,S	L1/4Clo,S	1/2Stp,B	3/8Stp,B	1/4Stp,S	1/4Stp,S
C	3/8Stp,B	3/8Baby,B	1/2Baby,B	3/8Stp,B	3/8Baby,B	3/8Baby,B
D	1/2Stp,B	1/2Stp,B	3/8Stp,B	3/8Stp,B	1/2Stp,B	3/8Stp,B
E	3/8Stp,B	3/8Stp,B	1/4Stp,B (Burry)	1/4Stp,B	1/2Stp,B	3/8Stp,B
F	1/4Stp,S	L1/4Clo,S (Burry)	1/4Stp,S	1/4Stp,S	1/4Stp,S	3/8Stp,S
G	1/4Stp,S	L1/4Clo,B	L1/4Clo,B	L1/4Clo,B	1/4Stp,S	L1/4Clo,B
H	3/8Stp,C	1/4Baby,C	3/8Stp,B	3/8Stp,C	1/4Baby,C	3/8Baby,C
I	3/8Baby,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	3/8Stp,B	1/4Stp,B
J	3/8Stp,B (Seedy)	1/2Stp,B (Seedy)	3/8Stp,B	FStp,B	1/2Clo,B	3/8Baby,B
K	3/8Stp,B	3/8Stp,B	1/4Stp,B	3/8Stp,B	3/8Stp,B	3/8Baby,B
L	3/8Stp,B	3/8Stp,B	1/4Stp,B	1/4Stp,B	3/8Stp,B (Burry)	1/4Stp,B
M	1/2Stp,B	FStp,B	FStp,B	1/2Stp,B	FStp,B	1/2Stp,B
N	1/4Stp,B	1/4Stp,B	L1/4Clo,B	1/4Baby,B	1/4Stp,B	3/8Stp,B
O	1/2Stp,B	3/8Stp,B	1/2Stp,B	1/4Stp,B	1/2Stp,B	3/8Stp,B
P	1/4Stp,B (Seedy)	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B
Q	1/2Stp,B	3/8Stp,B	1/4Stp,C	3/8Stp,B	1/4Stp,B	1/2Stp,C

TABLE XXXVIII (Continued)

Farm	Fleece Number 7	8	9	10	11	12
A	3/8Stp,B	1/4Baby,S	3/8Stp,B	1/2Stp,B	3/8Stp,B	3/8Stp,S
B	L1/4Clo,B	FStp,B	3/8Stp,B	3/8Stp,S	1/4Baby,S	FStp,B
C	1/4Stp,B	1/4Baby,B	1/2Stp,B	3/8Baby,B	3/8Stp,B	1/4Stp,B
D	1/2Stp,B	3/8Stp,B	1/2Stp,B	3/8Stp,B	1/2Stp,B	3/8Stp,B
E	3/8Stp,B	FStp,B	1/4Stp,B	3/8Stp,B	1/4Stp,B	3/8Stp,B
F	3/8Stp,B	1/4Stp,S (Burry)	1/4Stp,B	1/4Stp,S	3/8Stp,S	1/4Stp,S
G	L1/4Clo,S	1/4Stp,S	1/4Stp,B	L1/4Clo,S	L1/4Clo,S	L1/4Clo,B
H	1/2Stp,C	1/2Stp,C	3/8Stp,C	1/2Clo,C	1/2Stp,C	3/8Baby,C
I	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B
J	3/8Stp,B	1/2Stp,B (Seedy)	1/2Stp,B (Seedy)	1/2Stp,B	1/2Stp,B	1/2Stp,B
K	3/8Baby,B	3/8Stp,B	3/8Stp,B	3/8Baby,B	3/8Baby,B	1/4Stp,B
L	3/8Stp,B	1/4Stp,B	3/8Stp,B	3/8Stp,B	3/8Stp,B	1/2Stp,B (Burry)
M	FStp,B	3/8Stp,S	1/2Stp,B	3/8Stp,B	3/8Stp,B	FStp,B
N	L1/4Clo,B	1/4Baby,B	1/4Stp,B	1/4Stp,B	3/8Baby,B	1/4Stp,B
O	1/4Stp,B	3/8Stp,B	3/8Stp,B	1/2Stp,B	3/8Stp,B	1/2Stp,B
P	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B	1/4Stp,B
Q	1/4Stp,B (Burry)	1/4Stp,B	1/4Stp,C	1/4Baby,B	3/8Stp,C	1/4Stp,C

TABLE XXXVII (Continued)

KEY:

Grade	Length	Condition
F = Fine	Stp = Staple	C = Choice
1/2 = one-half blood	Baby = Baby (French combing)	B = Bright
3/8 = three-eighths blood	Clo = clothing	S = Semi-bright
1/4 = quarter blood		
L1/4 = low quarter blood		

TABLE XXXVIII

PERCENTAGE OF FLEECES OF SPECIFIED GRADE AS DETERMINED BY LABORATORY ANALYSIS AND VISUAL EVALUATION

Grade	Laboratory Result	Visual Result
	(percent of total fleeces)	
Fine	4	4
1/2 blood	23	17
3/8 blood	48	37
1/4 blood	22	35
Low 1/4 blood	3	7
Common	*	0
Totals	100	100

* = less than one-half of one percent.

TABLE XXXIX

PERCENTAGE OF FLEECES OF SPECIFIED LENGTH AS DETERMINED BY LABORATORY ANALYSIS AND VISUAL EVALUATION

Length	Laboratory Result	Visual Result	
	(percent of total fleeces)		
Staple	23	80	
Good Fr. Combing	28		} Baby: (see explanation below)[1]
Ave. Fr. Combing	44	12	
Short Fr. Combing	*		
Clothing	5	8	
Totals	100	100	

* = less than one-half of one percent.

[1]Three length designations were used by the grader. The term "Baby" designates wool of French combing lengths in one-half, three-eighths, and one-fourth blood grades.

TABLE XL

PERCENTAGE OF FLEECES OF SPECIFIED CONDITION AS DETERMINED BY LABORATORY ANALYSIS AND VISUAL EVALUATION

Condition	Laboratory Result	Visual Result
	(percent of total fleeces)	
Choice	4	8
Bright	71	78
Semi-bright	25	14
Totals	100	100

one-half of the fleeces were placed in the same grade by visual evaluation as by laboratory measurement. The visual grader placed more fleeces below the laboratory grade than above. A majority of the fleeces was designated one length classification higher visually than by measurement. Only one out of three was placed in the same length category. The condition designation was identical for more than three-fourths of the fleeces. When overall grading results were used to determine fleece value, 75 percent of the fleeces showed a higher value in cents per pound of grease wool when graded visually.

The mean errors and the mean biases of the visual grading results, using the laboratory grading results as the standards, were computed for grade, length, condition, and value. The methods of computation were: mean error equals the absolute sum of the deviations divided by the number of fleeces (204) and mean bias equals the algebraic sum of the deviations divided by the number of fleeces. Grade, length, and condition deviations were computed on the basis of

TABLE XLI

NUMBER OF FLEECES DEVIATING IN VISUAL EVALUATION FROM LABORATORY CLASSIFICATION, BY QUALITY FACTOR AND DEGREE OF DIFFERENCE, AND BY VALUE

Number of Classes (Visual minus Lab.)	Quality Factor			
	Grade[1]	Length[2]	Condition[3]	Value[4]
	(number of fleeces)			
+ 2	3	5	0	152
+ 1	29	118	38	
0	95	67	159	45
- 1	69	11	7	7
- 2	8	3	0	
Totals	204	204	204	204

[1]Grade Classes: Fine, 1/2 blood, 3/8 blood, 1/4 blood, Low 1/4 blood, Common

[2]Length Classes: Staple, Baby or French Combing, Clothing

[3]Condition Classes: Choice, Bright, Semi-bright

[4]Number of fleeces of higher, the same, and lower value in cents per grease pound when evaluated visually as compared with laboratory classification.

classes. Deviations in value were calculated in cents per grease pound. The mean errors were 0.588 grade class, 0.711 length class, 0.221 condition class, and 3.41 cents per pound. Visual grades were found to have a mean downward bias of one-fourth grade. Visual length and condition evaluations showed mean upward biases of one-half and one-seventh of one classification, respectively. Fleece value based on visual grading results had a positive bias of 3.28 cents per grease pound (Table XLII).

TABLE XLII

MEAN ERROR AND MEAN BIAS OF VISUAL GRADE, LENGTH, CONDITION, AND VALUE DESIGNATIONS, USING LABORATORY DERIVED RESULTS AS A STANDARD

	Grade	Length	Condition	Value
		(percent of class interval)		(cents per lb.)
Mean Error	0.568	0.711	0.221	3.41
Mean Bias	-0.245	+0.544	+0.147	+ 3.28

Conclusions and Implications

The validity of the grade and length results obtained by laboratory measurements is based upon these measurements having been made in accordance with the standards set forth by the American Society for Testing Materials. A slight deviation was made in the case of length measurements. The average of the 50 observations, rather than the bulk of the observations in the sample, was used to obtain staple length. The possibility of the result being influenced by the presence of extreme values was minimized by using a large number of observations. Therefore this deviation from ASTM procedure probably had little effect on length measurement results.

The laboratory procedure used to obtain condition ratings was devised by the researchers. The ratings were determined by objective measurement. Visual evaluation of condition deviated less from the laboratory rating than did those of grade and length.

It is possible that visual grading of wool does not conform to laboratory devised quality standards. In this experiment, however,

there is a hypothesis which cannot be rejected without investigation. It is that a grader evaluating wool for cash purchase need not grade accurately. This might be the result of (1) a large number of purchases, so that errors in quality evaluation become a calculable risk, (2) sorting and blending of wools of various qualities by the buyer to meet minimum standards, and (3) a pricing system for cash purchase of wool which is not sensitive enough to quality factors to be affected by grading errors. Here again the greater knowledge of the product which the buyer possesses, relative to the seller, might be a factor, although in this study buyer-graded wool was overpriced rather than underpriced.

The use of fleece values based on laboratory grading makes the result of the experiment on the conservative side, relative to the use of values based on visual grading, inasmuch as laboratory derived values were below visually derived values. Thus the losses due to tags (and the gains from tagging) were lower than would have resulted had visual grade values been used.

The results of this grading comparison lend strength to the proposition presented in the theoretical analysis. Under the current method of marketing wool on the cash basis the producer has no assurance that he will be paid the actual value of his wool clip. The buyer's errors in assessing the value of a wool clip are averaged over many purchases. But the producer sells only one clip each year. He may be underpaid or overpaid the actual value of his wool, including the farm preparation of the clip. The wool industry needs a method of valuing wool for cash purchase which affords a greater accuracy

in price determination. This appears to be a necessary prerequisite to the adoption of farm practices which improve quality and reduce marketing costs.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The pattern of sheep and wool production in the eastern one-half of South Dakota is similar to that of other midwestern states. The enterprise is supplemental to the major farm enterprises to the extent that it provides for the utilization of labor and feed otherwise not used. It is competitive on the typical farm, having 30 to 60 ewes, for capital and labor at critical seasons.

The farm flock is sheared between March 1 and July 1. Typically, custom shearers are employed to do the shearing. Eastern South Dakota farmers market their wool through local independent buyers or through a cooperative, the South Dakota Wool Growers' Association. Wool marketed through local buyers or sold on a cash basis to the cooperative Association is priced on an average or ungraded basis. When wool is pooled with the cooperative a graded price basis is used. Wool of three-eighths blood and one-fourth blood grades comprises the largest proportion of the total production from eastern South Dakota farms.

Knowledge of the value of farm preparation of wool is lacking. Wool producers in eastern South Dakota who offer tagged or sorted wool for sale must accept the same price as that paid for unprepared wool. The pricing system is not effective in allocating and promoting the efficient use of resources, or in providing an incentive for

product improvement. The problem has been recognized by researchers and wool marketing personnel. It exists in varying degree throughout the fleece wool producing area of the United States, which accounts for one-fourth to one-third of domestic wool production.

The objectives of the study were:

1. To determine the theoretical effects of improved methods of shearing and handling wool on quantities produced, prices received, apportionment of benefits between producers and consumers, farm resource allocation, producers' bargaining power, and marketing costs.
2. To develop and test practical methods of farm preparation of fleeces which could be expected to improve the quality of the wool.
3. To determine the effects of the preparation treatments on the quality and value of farm flock wool.
4. To determine the additional costs to producers of alternative methods of wool preparation.
5. To ascertain the net value, under given market conditions, of wool prepared by alternative methods.

This study attempts to show the need for a pricing system which gives weight to the quality of the product at the producer level, and to determine the value of tagging as a quality improving management practice. Producer adoption of a quality improving practice cannot be expected until these criteria are satisfied.

The aggregative economic effects of farm practices which result in product quality and value improvement may differ from the initial

effects on the individual producer. Similarly, the longer run economic impact may differ from the immediate results. A theoretical analysis was developed to explain the probable economic results of farm adoption of practices which improve wool quality and reduce marketing costs.

The adoption of production and marketing practices which would enable producers to sell their product on a pricing basis reflecting quality differences would tend to increase production of a high quality product. The gain to society as a result of pricing according to consumer preferences would accrue to the producer or the consumer, depending upon the relative price elasticities of supply and demand. In the short run it appears that producers would benefit from quality improvement. In the long run consumers would gain most of the benefits from quality improvement.

The pricing of wool on the basis of quality would increase the economic attractiveness of the sheep and wool enterprise, relative to competing enterprises, for the producer who adopts quality improving practices. Conversely, the producer of low quality wool would be worse off. The result would be a tendency for the high quality producer to expand the sheep and wool enterprise and for the low quality producer to shift resources away from wool production.

Improvement in the bargaining power of the producer is mainly dependent upon the development of farm methods of wool preparation which will improve wool quality and uniformity, the acceptance and use of these practices by the producer, and the ability of the producer to operate on a less than perfectly elastic demand schedule. The latter condition might be best achieved through cooperative marketing.

A reduction in marketing costs resulting from quality improvement could be expected to yield a short run price increase to the producer. However, after long run adjustments the gains from reduced marketing costs would accrue to consumers and processing firms.

Twelve sheep were selected from each of 17 farms in Brookings County for use in the study. Three treatments were applied, with four replications on each farm. The treatments used in the randomized block design were: (Treatment III) removal of tags from the fleece prior to shearing, (Treatment II) removal of tags from the fleece at the time of shearing, and (Treatment I) retention of tags in the fleece during a storage period (control). The experiment showed both methods of tag removal to be practical for farm application as quality improving practices. Laboratory analysis for the determination of weight, moisture content, yield, fiber length, and fiber diameter or grade was performed in accordance with standards prescribed by the American Society for Testing Materials. The percentage of dirt and dust in the fleece was used as the basis for assigning condition ratings to grease wool.

Variance analysis and Snedecor's F test were used to detect significant differences in each quality factor and in fleece value among treatments.

Tagging can be expected to reduce fleece moisture content, lower the amount and proportion of low quality wool in the fleece, and increase the yield of clean wool in the fleece.

There was no statistical difference among treatment means for fleece weight, length, grade, and condition. Removal of tags would

not be expected to affect these quality factors. Moisture content of the fleece was significantly less in the farm tagged fleeces than in the fleeces with tags removed after storage. The tag weight of the control group was significantly greater than that of the farm tagged groups. The increase in yield of clean wool due to removal of tags was significantly less in the farm tagged fleeces than in the control group. (Increase in yield from removing tags is a measure of the loss in yield from leaving tags in the fleece.) The percentage of tags in the fleece was significantly higher when tags were removed after a storage period than when tags were removed at the farm. The differences between the means of early and late tagged fleeces for moisture, tag weight, and percentage of tags were not statistically significant. Fleeces tagged prior to shearing showed a significantly smaller increase in yield of clean wool than those tagged at shearing.

The farm x treatment interaction was statistically significant in the variance analysis for tag weight, increase in yield of clean wool, percentage of tags in the fleece, and condition rating. The effect of tagging on these quality factors cannot be expected to be consistent for all farm flocks. This can be attributed to the wide variation in the level of management applied among farm flocks. Data on quality factors and statistical significance are summarized in Table XLIII.

The most prevalent grade of wool in the experimental fleeces was three-eighths blood. Average French combing was the most common length classification. A majority of the fleeces was in the Bright condition category.

TABLE XLIII

MEAN TREATMENT VALUES BY QUALITY FACTOR AND STATISTICAL SIGNIFICANCE OF TREATMENT MEANS AND FARM X TREATMENT INTERACTION

Quality Factor	Treatment Mean[1]			Statistical Significance of Farm x Treatment Interaction[2]
	I	II	III	
Fleece Moisture (%)	14.12	10.52**	11.23**	No
Fleece Weight (lb.)	10.77	10.52	10.55	No
Tag Weight (lb.)	0.64	0.34**	0.25**	Yes (1%)
Increase in Yield (%)[3]	1.11	0.72**	0.48**[4]	Yes (5%)
Tags in Fleece (%)	5.77	3.61**	2.97**	Yes (1%)
Length (inches)	3.09	3.02	3.08	No
Grade (fiber count)	148.	143.	142.	No
Condition (%)[5]	14.60	14.89	14.83	Yes (1%)

[1] I = Tags removed after storage of fleece.

II = Tags removed at time of shearing.

III = Tags removed prior to shearing.

[2] Significance determined by Snedecor's F test.

[3] Percentage increase in yield of clean wool due to removal of tags.

[4] Significantly less than Mean II at 5 percent confidence level (Snedecor's F test).

[5] Percentage of original fleece weight lost through dusting.

** = significantly less than Mean I at 1 percent confidence level (Snedecor's F test).

The two analyses used to determine the value of the treatments showed that farm tagging reduced fleece losses. The losses in value per fleece due to tags were 17.5 cents, 9.0 cents, and 6.6 cents for Treatments I, II, and III, respectively. The difference in mean loss between the control group and each farm tagged group, or the gain in value due to tagging, was 8.5 cents per fleece for the group tagged at shearing and 10.9 cents per fleece for the group tagged prior to shearing. These differences were statistically significant and were consistent over all farms. Variance analysis of the value of tagging due to change in yield of clean wool showed that tag losses were significantly and consistently lower when tags were removed prior to storing the fleece.

The prices used for determining loss due to tags were the 1955-1959 average annual net prices, by grade, paid for eastern South Dakota wool consigned to the South Dakota Wool Growers' Association. The value of tagging due to change in yield of clean wool was computed on the basis of the 1955-1959 average annual graded clean wool prices at Boston as reported by the United States Department of Agriculture.

The yield difference * clean price method of analysis indicated losses of 0.33 cent per pound or 3.47 cents per fleece less than those determined by tag weight * grease price analysis. These differences give some indication of the economic benefit of removing tags not accounted for by an increase in yield.

A clip of wool is worth one cent per pound more when the tags are separated from the fleece prior to shearing than when the tags

remain in the fleece during a three-month storage period. If the tags are separated from the fleece at the time of shearing the clip is worth 0.8 cent per pound more than if left untagged. The cost of tagging prior to shearing is 10 cents per fleece. When tags are removed at the time of shearing the cost is 1.25 cents per fleece. The expected net value of tagging to the grower is approximately one cent per fleece for removing tags before shearing or seven cents per fleece for removing tags at the time of shearing. The greater physical gains from early tagging result in lower economic benefits because of the greater cost of removing tags as a separate operation. However, some reductions in labor and death losses may result from tagging prior to lambing when the flock is sheared after the lambing season. The gross value, cost, and net value of tagging, by treatment, on a per fleece and per pound basis are summarized in Table XLIV.

The gains from tagging would have been greater if visual grading results had been used to value the fleeces rather than laboratory results. Visual evaluation of fleece quality compared to laboratory measurements showed a downward bias of one-fourth grade class and upward biases of one-half length class, one-seventh condition class, and 3.28 cents per pound in value. Before concluding that visual wool grading is inconsistent with laboratory standards it would be necessary to show that the buyer cannot nullify grading errors by averaging many purchases, blending wool to meet minimum grade standards, and utilizing a pricing system insensitive to quality factors.

TABLE XLIV

GROSS VALUE, COST, AND NET VALUE OF TAGGING, BY TREATMENT, PER FLEECE AND PER POUND

A. Tags Removed Prior to Shearing

	per fleece	per pound
Gross Value	11.0¢	1.0¢
Cost	10.0¢	0.905¢
Net Value	1.0¢	0.095¢

B. Tags Removed at Time of Shearing

	per fleece	per pound
Gross Value	8.4¢	0.8¢
Cost	1.25¢	0.13¢
Net Value	7.15¢	0.67¢

The results of the grading comparison indicate that visual grading of wool for cash purchase does not assure the seller of being paid the actual value of his wool clip. A more accurate method of valuing wool on the basis of quality is necessary to provide an incentive for producers to adopt practices which improve quality. A pricing system reflecting product quality differences is also a prerequisite to efficient resource allocation. To the extent that the results of the study are effective in promoting a more accurate pricing basis for wool at the producer level, resource allocation will be improved.

The physical and economic gains possible through tagging are small. With the typical size flock in eastern South Dakota the expected

net return would be under ten dollars per farm. Gains of this magnitude may not be great enough to cause a shifting of resources from competing enterprises into wool production such as to increase the aggregate output of wool in the farm flock area.

The one cent per grease pound greater value of tagged wool clips relative to untagged clips represents the short run price increase which the theoretical analysis indicated would result from product improvement. The net returns resulting from the initial increase in market price can be expected to diminish if farm tagging becomes a generally adopted practice. After long run economic adjustments are made the market price for farm tagged wool may be about equal to that of untagged wool prior to farm adoption of tagging. The benefits of quality improvement will then accrue to marketing firms and consumers.

There are several factors which reduce the incentive to adopt farm tagging of fleeces:

(1) The relatively small physical and economic benefits of tagging;

(2) The small number of animals in the typical farm flock;

(3) The supplementary nature of the sheep enterprise in the overall farm operation;

(4) The lack of assurance of being paid for the actual value of the wool clip.

There is a maximum increase in the quality and value of the wool clip which can be attained through the adoption of tagging or other practices with a given set of resources and the given quantity of wool which results. Because of the supplementary nature of the

farm flock sheep enterprise, the maximum appears to be quite low.

The tagging of fleeces is only one of the management practices necessary for maintaining or improving fleece quality. Several of the practices which improve fleece quality may be incompatible with the supplementary nature of the farm flock sheep and wool enterprise and therefore may not be economically feasible from the standpoint of the entire farm operation.

The wool producer's ability to improve his bargaining position was indicated to depend upon the development of methods of preparation which improve fleece quality, the acceptance and use of such practices by the producer, and the ability of the producer to sell under demand conditions of less than perfect elasticity. Tagging was found to be practical for farm adoption, although there are several factors which limit its attractiveness to the farm flock producer. Other management practices may contribute as much or more to quality improvement in a given flock. Because of the number of factors affecting the value of wool it is difficult to assess the effect of a given management practice on the value of an individual farm wool clip at the local market level. The producer's ability to realize the benefits of tagging is also dependent upon the willingness of buyers to accept the results of the experiment. Cooperative marketing is one means by which the individual producer can realize the benefits of product improvement. However, if a cooperative effort is based only on quality improvement, the gains from a quality improving practice will tend to disappear in the long run.

Marketing costs can be expected to be reduced if tagging lessens the degree of inspection and price risk allowance or lowers the sorting and handling requirements for the mill. The study was not designed to measure the effect of tagging on marketing costs. However, such economies as exist can be expected to accrue to marketing firms and consumers in the long run.

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APPENDICES

APPENDIX A

GLOSSARY OF WOOL TERMS

Apparel wool---------- Wool suitable for making clothing or apparel, as distinguished from carpet wool.

Baby combing---------- Wools below strictly combing length. This term, often used synonymously with French combing, properly applies to wools coarser than merinos, and about 2 or 2 1/2 inches in length, depending on the grade. Such fiber may be worked with French combs, or with Bradford combs set to handle the shorter lengths.

Black wool---------- Entirely or partly colored fleeces. An occasional black fiber in an otherwise perfect fleece will clean it with the greys. Sometimes all off-colors, as browns and greys, are thrown into one off-color sort designated as "blacks."

Braid wool---------- Long, coarse, and strong wool with luster and braiding quality.

Breech wool---------- Wool, usually the coarsest in the fleece, from the lower parts of the hindquarters.

Bright wool---------- Light appearing, clean wool, such as is grown in the farming States, as contrasted with semi-brights or farm States wool grown on black prairie soils in some areas of the West, mainly west of the Missouri River. "Semi-brights" are dark in color, apparently due to the soil on which grown, in combination with climatic conditions, i.e., dust formation. Such wools usually scour to a good white. Semi-brights contrast with the normally still darker territory wools, most of which also scour to a good white.

Burry wool---------- Wool that contains burs from any plants. Fine burry, medium burry refer to the grade of wool.

Choice wool---------- The lightest appearing, cleanest color classification of grease wool (see also bright wool).

Clean basis---------- Quotations of prices that are based on the estimated weight of fiber after removal of the grease and foreign matter.

Clean value---------- Market value of the wool after all foreign matter has been removed by scouring.

Clip---------- The weight or type of wool from all of the sheep in a particular area. In this study a clip refers to all the fleeces from a single farm in a given year.

Clothing wool---------- Wool too short to comb economically.

Combing---------- A straightening of wool fibers, and the extraction of shorter lengths (noils) and of small particles of vegetable matter clinging to and tangled with the wool, from the continuous rope-like strand of long, parallel fibers (top), which is used for making worsted yarns.

Combing wool---------- The longer wool suitable for worsted yarns.

Common(wool)---------- Coarse wool of English grade 44's.

Crutchings---------- Wool shorn from the breech and inside the hindlegs. Also may refer to wool shorn from these areas before the regular shearing as a part of the flock management.

Dead wool---------- Wool removed from dead sheep. This does not include wool from slaughtered sheep.

Delaine wool---------- Fine farm-flock wools originating in Ohio, Michigan, Pennsylvania, and West Virginia and of strictly combing lengths.

Domestic wool---------- Wool produced in this country in contrast to foreign grown wool.

Fine(wool)---------- Wool from sheep with a large proportion of merino blood. Wool of small fiber diameter (English 64's and up).

Fleece wool---------- A term applied to wool produced mainly east of the Missouri and Mississippi Rivers, primarily by small farm flocks.

French combing---------- Too short to comb in the English system but long enough to comb on a French comb.

Grade(wool)---------- Relates primarily to fineness, or diameter, of the fibers.

Grading(wool)---------- Classifying of entire fleeces (without opening or breaking them) according to fineness and length of fiber and suitability for different mill needs.

Grease wool---------- Wool as it comes from the sheep.

Half-blood(wool)-------- A grade of domestic wool obtained from sheep that are half merino blood; the equivalent of English 60's and 62's.

Lamb's wool---------- Wool shorn from lambs up to about 7 months old. It is softer and has higher spinning properties than wool of similar quality shorn from older animals. Lamb's wool also tends to "rise" to the surface in yarn drawing and weaving, thus giving a better appearance to the fabric.

Low quarter-blood wool-- Wool equivalent to English 46's in fineness.

Medium wools---------- Wool ranging from about high quarter-blood to low half-blood in grade (about 52's to 58's).

Quarter-blood wool------ Domestic wool of a certain degree of fineness (bulk American 48's and 50's).

Rejects---------- Fleeces or parts of fleeces that are not suitable for regular lots of graded wools because of being badly stained, having undesirable color, etc.

Scouring---------- The washing process to which wool and fabrics are subjected in order to remove grease and dirt.

Seedy wool---------- Wool containing excessive seed or chaff.

Semi-bright wool-------- (See bright wool).

Shearing---------- Removal of a fleece with shears or clippers.

Shrinkage---------- Percentage of the weight of grease wool lost in scouring.

Skirting---------- Removal of belly, britch, neck, leg, and stained portions from the main part of the fleece and sometimes the backs. It is almost universally done in preparing Australasian wool for market and to a considerable extent is practiced in South Africa and South America.

Sorting---------- Breaking up the individual fleeces into a number of quality lines, according to the uses to which the wool is to be put in the mill, and also according to the character or evenness of the fleece.

Stained(wool)---------- Colored from contact with manure, urine, or by bacterial action.

Staple---------- Territory fine combing wool is always referred to as territory fine staple. Staple properly refers to the length of the fiber, but in a more restricted sense it is used for a lock of wool in the fleece.

Staple wools---------- Those that more than meet the minimum length requirements for a combing wool.

Tagging---------- Removal of tags from fleece.

Tags---------- Heavy manure-covered wool locks.

Territory wool---------- Wool produced in certain Western States, largely those in the Rocky Mountain area. The term originated through the fact that most of these States were important for wool growing before they were admitted to Statehood.

Three-eighths-blood wool---------- A term designating a given degree of fineness in domestic wool (54's - 58's quality) between low half-blood and quarter-blood. It originally was applied to wool from sheep with three-eighths of merino blood.

Top---------- A continuous untwisted, loose, rope-like strand of wool made up largely of the longer fibers resulting from the combing process.

Vegetable matter---------- Various kinds of bur (some of which, as noxious or bur-clover seed pods and needle grass, must be removed by carbonization), straw, chaff, seed, etc.

Virgin wool---------- Wool not previously used in the manufacture of fabrics.

Woolen---------- Fabrics or yarn made of uncombed wool.

Worsted---------- Fabrics or yarn made of combed wool.

Yield---------- The quantity of clean wool obtained from a specified amount of grease wool.

APPENDIX B

APPENDIX TABLE I

MOISTURE CONTENT OF FLEECES, BY TREATMENT AND FARM

Fleece No.	Fleeces Untagged				Fleeces Tagged at Shearing				Fleeces Tagged Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
						(percent)							
Farm													
A	14.47	13.44	17.72	13.73	10.07	10.91	9.20	11.05	14.61	8.71	10.70	11.78	12.28
B	11.95	12.07	11.43	11.55	8.68	16.60	12.07	10.98	11.24	9.77	9.96	10.68	13.33
C	12.06	15.48	14.23	25.73	10.32	10.24	9.02	7.70	8.41	9.70	10.81	11.40	12.09
D	13.13	11.90	12.82	12.29	8.99	11.41	9.51	8.33	12.92	10.62	13.82	7.96	11.14
E	14.72	17.71	13.68	12.72	7.18	11.16	16.67	13.60	10.91	16.41	14.73	9.12	12.38
F	12.10	12.15	13.39	11.94	6.30	12.96	9.77	11.71	13.10	12.63	11.34	9.09	11.38
G	11.14	13.22	13.76	11.80	10.59	11.36	11.72	11.43	7.97	8.67	11.14	15.73	11.55
H	13.01	13.92	19.94	9.64	10.26	9.80	9.90	9.55	10.96	12.04	8.79	10.73	10.74
I	17.81	11.49	14.72	12.97	11.21	8.81	12.47	9.38	11.40	15.63	9.91	12.82	12.39
J	13.85	11.97	13.70	9.50	9.77	8.60	11.57	10.94	10.94	11.55	10.92	8.44	10.98
K	13.80	13.30	14.35	12.56	9.92	11.92	9.90	11.22	11.54	9.29	8.79	11.89	10.71
L	13.39	11.55	11.98	16.96	11.01	9.79	8.90	8.76	11.11	9.00	9.28	8.95	10.89
M	12.38	34.70	8.79	7.67	10.82	10.67	9.89	11.80	7.23	12.29	10.55	11.59	13.03
N	14.46	23.41	14.86	18.48	9.93	9.94	11.99	13.25	12.97	12.41	9.89	8.28	12.92
O	12.03	11.85	11.90	17.70	7.98	11.02	12.11	9.25	16.02	11.33	11.88	9.96	11.09
P	14.86	14.08	15.74	21.43	9.17	13.68	11.17	13.06	12.34	12.56	10.67	12.79	13.46
Q	13.81	14.28	12.55	13.31	6.03	8.54	12.46	9.42	11.47	10.08	11.49	12.12	11.30
Average				14.12				10.52				11.23	11.96

APPENDIX TABLE II

TRANSFORMED DATA FOR PERCENTAGE OF MOISTURE IN FLEECE, BY TREATMENT AND FARM

Fleece No.	Fleeces Untagged				Fleeces Tagged at Shearing				Fleeces Tagged Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
	(angle equal arcsin square root of percentage)												
Farm													
A	22.36	21.51	24.89	21.75	18.50	19.29	17.66	19.41	22.47	17.17	19.09	19.98	20.34
B	20.22	20.33	19.76	19.86	17.14	24.04	20.33	19.35	19.59	18.21	18.40	19.07	19.69
C	20.32	23.17	22.16	30.48	18.74	18.67	17.48	16.11	16.86	18.15	19.20	19.73	20.09
D	21.16	20.18	20.98	20.52	17.45	19.74	17.96	16.77	21.07	19.02	21.83	16.39	19.42
E	22.57	24.89	21.70	20.90	15.54	19.53	24.10	21.64	19.29	23.90	22.57	18.55	21.26
F	20.36	20.40	21.46	20.22	14.63	21.10	18.21	20.01	21.22	20.82	19.68	17.55	19.64
G	19.41	21.32	21.77	20.09	18.99	19.69	20.02	19.76	16.39	17.13	19.50	23.36	19.78
H	21.14	21.91	26.52	18.09	18.68	18.24	18.34	18.00	19.33	20.31	17.25	19.12	19.74
I	24.96	19.81	22.57	21.11	19.56	17.27	20.68	17.83	19.73	23.28	18.35	20.98	20.51
J	21.85	20.24	21.72	17.95	18.21	17.05	19.88	19.32	19.32	19.86	19.30	16.89	19.30
K	21.81	21.39	22.26	20.75	18.36	20.20	18.34	19.57	19.86	17.75	17.25	20.17	19.81
L	21.46	19.86	20.25	24.32	19.38	18.23	17.36	17.22	19.47	17.46	17.74	17.41	19.18
M	20.60	36.09	17.25	16.08	19.21	19.06	18.33	20.09	15.60	20.50	25.52	19.90	20.68
N	22.35	28.94	22.02	25.46	18.37	18.38	20.26	21.34	21.12	20.63	18.33	16.72	21.16
O	20.30	20.13	20.18	24.88	16.41	19.39	20.37	17.71	23.60	19.67	20.16	18.40	20.10
P	22.68	22.04	23.37	27.58	17.63	21.70	19.52	21.18	20.57	20.75	19.06	20.95	21.42
Q	21.82	22.20	20.74	21.40	14.22	16.99	20.67	17.87	19.79	18.51	19.81	20.38	19.53
Average				21.92				18.86				19.51	20.10

APPENDIX TABLE XII

MOISTURE CONTENT OF TAGS, BY TIME OF REMOVAL AND FARM

Fleece No.	Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	5	6	7	8	9	10	11	12	
				(percent)					
Farm									
A	34.70	7.38	12.31	14.67	13.89	11.11	62.50	23.60	22.52
B	29.50	47.44	20.33	10.71	16.43	8.45	10.11	8.60	18.94
C	18.88	30.77	33.12	37.44	9.88	19.13	13.09	13.18	21.84
D	35.54	26.67	35.27	11.63	42.17	34.87	5.00	58.08	31.15
E	23.70	19.27	29.48	10.59	50.00	25.50	41.93	15.53	27.00
F	21.48	6.82	7.14	5.19	21.48	10.68	13.85	9.28	11.99
G	20.69	24.74	16.17	30.34	48.99	25.93	21.97	45.86	29.34
H	11.27	21.13	11.27	4.08	14.93	9.68	12.07	13.83	12.28
I	15.53	17.43	16.00	12.83	6.85	30.98	21.55	31.89	20.13
J	16.48	7.84	26.42	16.77	17.19	15.31	19.33	18.26	17.20
K	10.00	9.52	11.18	11.51	44.91	50.77	25.00	49.74	26.58
L	19.71	13.86	21.92	16.16	22.67	10.10	32.63	23.93	20.12
M	21.05	10.46	26.84	23.24	11.72	23.96	16.54	15.45	19.66
N	11.39	8.82	15.22	14.67	22.06	14.29	25.00	38.03	18.71
O	10.77	17.76	24.49	14.64	10.45	11.67	13.28	8.64	13.96
P	42.45	30.41	25.41	19.00	22.36	47.48	43.01	43.14	34.16
Q	8.55	11.46	19.31	27.40	21.51	15.22	36.42	21.43	20.16
Average									21.51

APPENDIX TABLE IV

FLEECE WEIGHTS BY TREATMENT AND FARM (NOT ADJUSTED FOR MOISTURE CONTENT)

Fleece No.	Fleeces Untagged				Fleeces Tagged at Shearing				Fleeces Tagged Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(pounds)												
A	7.33	5.92	7.32	10.03	9.85	8.33	7.86	7.14	9.51	6.73	8.98	8.71	
B	9.54	8.34	11.72	12.45	14.04	10.87	10.53	12.67	7.46	8.82	5.40	11.09	
C	9.40	7.49	11.77	11.18	10.46	8.53	8.07	8.73	9.32	12.47	10.56	11.11	
D	8.83	8.16	11.56	7.68	8.51	8.35	10.20	8.19	10.48	12.47	8.61	9.82	
E	17.69	12.54	14.26	15.94	12.32	11.27	12.26	7.45	15.68	12.76	15.25	10.07	
F	11.03	12.00	13.90	12.56	12.76	13.13	11.26	9.68	11.36	10.46	9.64	8.48	
G	11.36	11.92	13.71	14.35	9.80	13.16	12.81	13.08	8.80	11.89	12.37	12.19	
H	8.06	9.46	8.53	9.24	9.01	8.77	7.43	8.16	8.80	7.34	7.32	7.62	
I	6.26	9.03	8.69	10.66	10.13	8.71	10.15	9.72	8.57	13.61	8.58	9.84	
J	13.52	11.03	13.29	12.04	6.45	7.68	10.40	13.99	12.56	11.97	11.82	9.20	
K	9.81	10.68	13.87	12.32	10.09	8.19	7.52	8.83	8.31	7.82	7.50	12.52	
L	10.37	16.84	15.37	16.72	13.59	15.58	14.46	13.33	14.44	11.55	13.20	11.68	
M	14.78	10.90	13.18	16.61	13.48	13.53	10.62	10.35	10.89	15.91	12.77	11.73	
N	7.85	6.55	20.54	6.49	6.77	4.90	11.96	7.14	10.81	6.20	5.24	7.86	
O	10.62	10.78	11.24	10.94	6.44	12.38	10.94	12.45	10.64	12.86	12.59	12.82	
P	10.05	9.02	9.10	10.81	7.70	9.57	8.93	6.78	7.99	9.50	10.56	9.18	
Q	7.68	7.83	8.91	9.24	10.67	7.05	9.51	7.19	8.26	6.36	7.68	11.02	
Average				11.01				10.03				10.23	10.42

APPENDIX TABLE V

FLEECE WEIGHTS ADJUSTED TO 12 PERCENT MOISTURE EQUIVALENT, BY TREATMENT AND FARM

Fleece No.	Fleeces Untagged 1	2	3	4	Fleeces Tagged at Shearing 5	6	7	8	Fleeces Tagged Prior to Shearing 9	10	11	12	Ave.
						(pounds)							
Farm													
A	7.17	5.82	6.84	9.83	10.07	8.43	8.12	7.21	9.22	6.98	9.11	8.73	
B	9.55	8.34	11.79	12.52	14.57	10.30	10.52	12.82	7.52	9.05	5.53	11.26	
C	9.40	7.19	11.48	9.43	10.66	8.70	8.35	9.16	9.70	12.80	10.71	11.18	
D	8.71	8.17	11.45	7.66	8.80	9.40	10.48	8.53	10.37	12.66	8.43	10.27	
E	17.14	11.73	13.98	15.81	12.99	11.38	11.62	7.31	15.87	12.12	14.76	10.40	
F	11.02	11.98	13.68	12.56	13.58	12.99	11.54	9.71	11.22	10.38	9.72	8.76	
G	11.47	11.76	13.44	14.38	9.96	13.25	12.85	13.17	9.20	12.34	12.49	11.67	
H	7.97	9.25	7.76	9.48	9.19	8.99	7.51	8.38	8.90	7.34	7.59	7.71	
I	5.84	9.09	8.42	10.54	10.22	9.03	10.09	10.00	8.63	13.05	8.78	9.74	
J	13.22	11.04	13.03	12.38	6.62	7.98	10.45	14.16	12.71	12.03	11.97	9.57	
K	9.61	10.48	13.50	12.24	10.32	8.20	7.70	8.91	8.35	8.06	7.77	12.53	
L	10.20	16.93	15.38	15.77	13.74	15.97	14.97	13.82	14.59	11.94	13.60	12.09	
M	14.72	8.08	13.66	17.43	13.66	13.74	10.87	10.37	11.48	15.86	11.82	11.79	
N	7.63	5.70	20.05	6.01	6.92	5.02	11.96	7.04	10.69	6.17	5.37	8.19	
O	10.62	10.80	11.25	10.23	6.73	12.49	10.93	12.84	10.15	12.96	12.60	13.12	
P	9.72	8.81	8.72	9.65	7.95	9.38	9.01	6.69	7.96	9.43	10.71	9.10	
Q	7.52	7.62	8.86	9.10	11.39	7.33	9.46	7.40	8.31	6.50	7.61	11.00	
Average				10.77				10.18				10.30	10.42

APPENDIX TABLE VI

WEIGHT OF TAGS BY TIME OF REMOVAL AND FARM (NOT ADJUSTED FOR MOISTURE CONTENT)

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
	(pounds)												
Farm													
A	1.01	0.16	0.27	0.72	0.86	0.27	0.29	0.33	0.16	0.12	0.19	0.20	
B	0.67	0.48	0.45	0.45	0.88	0.51	0.66	0.31	0.31	0.16	0.20	0.20	
C	0.28	0.46	0.77	0.58	0.18	0.26	0.34	0.45	0.18	0.25	0.24	0.28	
D	0.19	0.21	0.59	0.45	0.27	0.26	0.53	0.19	0.55	0.57	0.09	0.44	
E	1.73	0.70	0.96	1.06	0.41	0.23	0.59	0.19	0.63	0.33	0.71	0.35	
F	0.21	0.16	0.36	0.22	0.30	0.19	0.12	0.17	0.30	0.23	0.14	0.21	
G	0.39	0.38	1.01	0.88	0.26	0.63	0.37	0.39	0.44	0.30	0.29	0.34	
H	0.22	0.45	0.47	0.24	0.16	0.16	0.16	0.11	0.15	0.14	0.13	0.21	
I	0.09	0.88	0.47	0.64	0.45	0.24	0.44	0.50	0.16	1.04	0.26	0.46	
J	0.56	0.30	0.81	1.35	0.20	0.11	0.42	0.37	0.14	0.22	0.26	0.25	
K	0.88	0.61	1.01	0.99	0.26	0.09	0.33	0.30	0.37	0.43	0.25	0.42	
L	0.86	0.90	1.58	1.26	0.75	0.81	1.21	0.79	0.33	0.22	0.31	0.26	
M	1.06	1.13	1.07	1.72	0.54	0.72	0.93	0.31	0.28	0.58	0.29	0.27	
N	0.70	0.28	1.00	0.14	0.15	0.07	0.51	0.16	0.15	0.06	0.09	0.16	
O	0.22	0.95	0.28	0.61	0.29	0.33	0.87	0.36	0.44	0.26	0.28	0.18	
P	0.78	0.45	1.07	1.09	0.30	0.32	0.27	0.22	0.35	0.44	0.41	0.45	
Q	0.11	0.49	0.34	0.58	0.26	0.21	0.64	0.16	0.20	0.22	0.20	1.02	
Average				0.65				0.38				0.31	0.45

APPENDIX TABLE VII

WEIGHT OF TAGS ADJUSTED TO 12 PERCENT MOISTURE EQUIVALENT, BY TIME OF REMOVAL AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
	(pounds)												
Farm													
A	0.98	0.16	0.25	0.70	0.63	0.28	0.28	0.33	0.15	0.12	0.08	0.17	
B	0.67	0.48	0.46	0.46	0.70	0.31	0.60	0.31	0.29	0.16	0.20	0.21	
C	0.28	0.44	0.75	0.49	0.17	0.20	0.26	0.32	0.18	0.23	0.23	0.28	
D	0.18	0.21	0.59	0.45	0.19	0.22	0.39	0.19	0.36	0.42	0.09	0.21	
E	1.68	0.66	0.94	1.05	0.36	0.21	0.47	0.19	0.36	0.28	0.47	0.34	
F	0.21	0.16	0.36	0.22	0.26	0.20	0.13	0.18	0.26	0.23	0.14	0.22	
G	0.39	0.37	0.99	0.88	0.23	0.54	0.35	0.31	0.25	0.25	0.26	0.21	
H	0.22	0.44	0.43	0.24	0.16	0.14	0.16	0.12	0.14	0.14	0.13	0.20	
I	0.08	0.89	0.45	0.63	0.43	0.22	0.42	0.49	0.17	0.72	0.23	0.35	
J	0.55	0.30	0.80	1.39	0.19	0.12	0.36	0.35	0.13	0.21	0.24	0.24	
K	0.86	0.60	0.99	0.99	0.27	0.10	0.34	0.31	0.23	0.24	0.21	0.24	
L	0.85	0.91	1.58	1.19	0.68	0.79	1.08	0.75	0.29	0.22	0.24	0.22	
M	1.06	0.84	1.11	1.80	0.49	0.66	0.77	0.27	0.28	0.50	0.28	0.26	
N	0.68	0.24	0.98	0.13	0.15	0.08	0.49	0.16	0.13	0.06	0.07	0.11	
O	0.22	0.95	0.28	0.57	0.29	0.31	0.75	0.35	0.45	0.26	0.28	0.18	
P	0.76	0.44	1.03	0.97	0.20	0.26	0.23	0.20	0.31	0.26	0.26	0.29	
Q	0.10	0.47	0.34	0.57	0.27	0.21	0.58	0.13	0.18	0.19	0.20	0.74	
Average				0.64				0.34				0.25	0.41

APPENDIX TABLE VIII

PERCENTAGE OF CLEAN WOOL IN FLEECE, EXCLUDING TAGS, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
	(percent)												
Farm													
A	54.34	41.81	43.58	42.31	47.84	48.76	59.31	53.15	38.88	46.90	48.69	39.56	47.09
B	49.50	54.99	33.41	52.73	42.78	40.50	52.58	36.22	50.96	49.67	63.05	37.29	46.97
C	53.58	47.03	41.86	58.13	41.22	50.70	54.74	51.76	46.63	45.33	48.87	47.86	49.98
D	55.95	55.63	50.78	56.27	52.66	56.52	56.47	51.22	52.44	50.99	56.06	46.28	53.44
E	44.48	45.22	53.52	53.43	43.48	47.81	47.45	42.95	54.80	46.17	47.25	47.04	47.80
F	49.03	46.55	43.48	47.27	54.31	41.25	46.54	47.94	44.33	50.62	58.47	47.97	48.15
G	38.37	63.81	41.52	48.31	45.99	48.66	51.47	42.18	49.91	43.88	44.34	46.88	47.11
H	59.84	58.31	54.41	57.07	60.36	56.83	63.91	56.38	67.35	54.61	55.29	55.15	58.29
I	53.71	63.91	56.23	57.04	51.64	63.77	54.75	57.74	57.72	56.98	65.69	58.40	56.13
J	41.85	40.88	47.20	36.29	34.85	46.49	45.61	47.26	43.39	47.12	37.93	41.15	42.50
K	49.06	44.47	54.48	52.56	50.05	46.20	44.66	51.93	47.31	39.83	45.75	47.31	47.80
L	50.41	44.03	64.81	55.63	55.70	47.39	51.08	49.68	45.09	42.81	50.85	44.94	50.20
M	48.08	36.01	47.12	52.03	38.53	34.11	43.57	49.05	42.19	49.02	48.84	39.60	44.01
N	70.83	67.98	54.96	58.90	67.18	64.87	54.58	52.23	52.63	61.81	65.46	65.40	61.40
O	59.49	63.95	47.93	58.03	52.74	53.89	59.14	55.00	51.51	51.08	55.15	50.82	54.89
P	48.34	54.77	53.35	49.40	61.08	51.28	49.37	49.56	48.48	55.09	56.32	51.02	52.34
Q	53.86	63.75	65.78	68.45	55.96	54.43	58.26	62.48	64.45	61.27	58.55	62.37	60.80
Average				51.94				50.88				50.69	51.17

APPENDIX TABLE IX

PERCENTAGE OF CLEAN WOOL IN FLEECES WITH TAGS INCLUDED, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(percent)												
A	50.03	41.56	42.95	40.53	45.40	48.20	50.46	52.12	38.90	46.61	49.15	39.67	46.13
B	48.21	53.40	32.24	52.01	41.37	39.62	50.91	35.81	50.61	49.52	61.91	37.21	46.07
C	53.25	46.06	41.36	56.96	41.05	50.01	53.87	50.68	46.46	45.26	48.64	47.60	48.43
D	55.44	54.91	49.61	54.83	52.26	56.09	55.35	51.05	51.25	50.11	55.84	46.18	52.74
E	42.53	44.82	52.21	52.32	43.00	47.69	46.36	42.74	54.16	45.84	46.73	46.44	47.07
F	48.68	46.41	42.86	46.89	54.08	41.14	46.43	47.79	43.90	50.32	53.04	47.82	47.86
G	38.52	62.94	40.58	47.71	45.55	47.69	50.83	41.56	48.87	43.59	44.08	46.75	46.56
H	59.37	57.26	53.37	55.76	59.96	56.52	63.38	56.14	66.86	54.10	54.99	54.44	57.68
I	53.47	60.84	54.90	55.56	50.72	62.72	53.67	56.53	57.23	54.66	64.73	56.76	56.82
J	41.34	41.14	46.57	35.01	34.40	46.37	45.26	46.92	43.30	46.84	37.71	40.86	42.14
K	47.98	44.36	53.04	51.30	49.71	45.84	43.89	51.08	46.91	39.65	45.40	46.96	47.18
L	49.63	43.34	62.64	53.99	54.27	46.76	47.98	49.14	44.61	42.49	50.48	44.66	49.16
M	46.85	34.28	45.73	49.73	38.11	34.01	41.45	48.68	41.84	48.14	48.53	39.31	43.06
N	68.34	67.12	54.09	58.37	66.64	64.59	53.40	52.00	52.46	61.64	64.08	65.36	60.67
O	58.89	60.79	47.71	56.50	52.16	53.10	57.24	54.38	50.58	50.64	54.68	50.69	53.95
P	47.80	53.97	51.79	47.74	60.78	51.01	49.21	49.56	47.93	55.03	55.94	50.89	51.80
Q	53.36	61.60	64.47	66.91	55.40	53.45	55.74	61.92	63.93	60.13	57.88	59.22	59.50
Average				50.82				50.16				50.21	50.40

APPENDIX TABLE X

TRANSFORMED DATA FOR INCREASE IN YIELD OF CLEAN WOOL RESULTING FROM REMOVAL OF TAGS, BY TIME OF REMOVAL AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(angle equal arcsin $\times$ square root of percentage)												
A	11.98	2.87	4.55	7.67	8.99	4.25	5.29	6.10	-0.81	3.09	-3.89	-1.90	4.02
B	6.52	7.27	6.21	4.87	6.82	5.38	7.42	3.67	3.39	2.22	6.13	1.62	5.13
C	3.29	5.65	4.05	6.21	2.36	4.76	5.35	5.96	2.36	1.52	2.75	2.92	3.93
D	4.09	4.07	6.21	6.90	3.63	3.76	6.07	2.36	6.26	5.38	2.69	1.81	4.50
E	8.02	3.63	6.58	6.05	3.97	1.99	5.99	2.63	4.59	3.29	4.13	4.44	4.61
F	3.39	2.14	4.52	3.53	2.75	1.90	1.90	2.22	3.76	3.14	3.76	2.22	2.94
G	1.28	5.35	5.57	4.44	3.90	5.65	4.59	4.52	5.85	3.09	2.92	2.07	4.09
H	3.93	5.88	5.85	6.58	3.63	3.19	4.17	2.81	4.01	4.09	3.14	4.83	4.34
I	2.81	10.09	6.63	6.99	5.50	5.88	5.96	6.32	4.01	8.76	5.62	7.36	6.33
J	4.09	-2.92	4.55	6.50	3.85	1.99	3.39	3.34	1.72	3.03	2.69	3.09	2.94
K	5.96	1.90	6.90	6.45	3.34	3.44	5.03	5.29	3.63	2.43	3.39	3.39	4.26
L	5.07	4.59	8.47	7.36	6.87	4.55	10.14	4.21	3.97	3.24	3.49	3.03	4.58
M	6.37	7.56	6.78	8.72	3.72	1.81	8.37	3.49	3.39	5.38	3.19	3.09	5.16
N	9.08	5.32	5.35	4.17	4.21	3.03	6.24	2.75	2.36	2.36	6.75	1.15	2.73
O	4.44	10.24	2.69	7.11	4.37	5.10	7.92	4.52	5.53	3.80	3.93	2.07	5.14
P	4.21	5.13	7.18	7.40	3.14	2.98	2.29	0	4.25	1.40	3.53	2.07	2.80
Q	4.05	8.43	6.58	7.13	4.29	5.68	9.14	4.29	4.13	6.13	4.69	10.22	6.23
Average				5.64				4.48				3.49	4.53

APPENDIX TABLE XI

PERCENTAGE OF CLEAN WOOL IN TAGS, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(percent)												
A	19.76	27.75	22.80	15.00	17.32	30.34	35.01	30.44	39.87	29.60	70.71	44.55	31.93
B	26.88	23.95	19.92	28.43	19.05	21.21	24.61	19.26	41.97	40.85	30.03	32.96	27.43
C	36.88	26.88	29.50	30.58	31.58	27.18	33.30	29.81	37.12	42.23	38.39	37.54	33.42
D	27.15	23.52	24.22	34.26	39.37	43.02	33.77	43.61	28.72	31.03	35.15	43.91	33.98
E	21.05	32.72	29.35	31.44	28.78	42.13	23.82	34.33	38.41	32.76	35.65	29.26	31.64
F	26.16	31.34	16.94	22.75	44.40	33.67	36.42	39.22	27.62	36.54	28.16	41.86	32.09
G	31.84	31.05	24.60	33.19	28.92	27.48	28.51	20.63	27.80	31.62	33.29	42.55	30.12
H	37.24	31.09	30.62	29.06	36.53	39.31	39.96	37.04	37.57	26.34	37.09	28.44	34.11
I	31.25	28.04	27.20	27.86	30.00	25.01	28.62	32.97	31.71	24.18	32.74	21.44	28.42
J	25.58	43.79	31.66	21.35	19.52	38.13	36.74	34.22	35.85	30.92	28.27	30.97	31.42
K	31.86	36.46	30.00	31.82	37.44	14.78	26.54	26.62	37.65	36.27	34.88	35.41	31.64
L	35.36	26.76	29.36	29.23	28.30	34.70	24.57	40.12	23.34	25.90	34.99	32.23	30.40
M	26.65	16.64	27.58	25.66	27.54	32.06	17.28	36.12	28.62	24.08	35.07	27.10	27.03
N	36.80	41.07	31.98	29.05	43.62	46.81	25.45	41.60	39.73	45.22	42.75	63.95	40.67
O	26.22	24.22	25.96	26.18	41.48	23.75	33.37	32.89	28.36	29.07	34.15	42.22	30.66
P	35.58	33.20	34.54	28.32	53.71	43.24	43.87	49.94	35.62	53.71	46.03	48.01	42.15
Q	15.51	25.21	27.23	37.72	32.50	20.46	18.15	36.67	43.43	26.73	32.66	25.16	28.45
Average				28.54				32.32				35.41	32.09

APPENDIX TABLE XII

PERCENTAGE OF TAGS IN FLEECE, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(percent)												
A	13.72	2.67	3.72	7.15	8.50	3.18	3.52	4.64	1.72	1.70	2.12	2.24	4.57
B	7.01	5.82	3.88	3.65	6.04	5.00	6.27	2.40	4.09	1.73	3.54	1.82	4.27
C	2.97	6.14	6.57	5.17	1.71	2.96	4.06	4.88	1.84	1.98	2.20	2.54	3.59
D	2.11	2.54	5.13	5.90	3.02	3.14	5.06	2.22	5.28	4.53	1.04	4.24	3.68
E	9.79	5.63	6.72	6.64	3.13	2.01	5.08	2.56	3.96	2.70	4.79	3.41	4.70
F	1.93	1.34	2.60	1.76	2.19	1.49	1.07	1.74	2.65	2.18	1.47	2.43	1.90
G	3.41	3.35	7.34	6.14	2.56	4.77	2.86	2.97	7.73	2.41	2.32	2.96	4.05
H	2.79	4.74	5.53	2.58	1.70	1.74	2.08	1.29	1.66	1.86	1.68	2.68	2.53
I	1.40	9.80	5.38	5.99	4.43	2.66	4.36	4.97	1.86	7.96	2.91	4.67	4.70
J	4.16	2.68	6.13	11.24	3.03	1.41	4.06	2.59	1.11	1.79	2.19	2.64	3.59
K	8.97	5.75	7.32	8.06	2.56	1.13	4.35	3.43	4.40	5.32	3.17	3.39	4.82
L	8.32	5.36	10.29	7.55	5.44	5.07	8.11	5.71	2.26	1.82	2.28	2.13	5.36
M	7.20	10.38	8.14	10.34	3.98	5.20	8.52	3.01	2.45	3.65	2.48	2.30	5.64
N	8.88	4.27	4.88	2.11	2.19	1.49	4.23	2.35	1.40	1.00	1.64	1.91	3.03
O	2.08	8.84	2.48	5.57	4.25	2.68	7.97	2.81	4.36	2.04	2.23	1.36	3.89
P	7.81	4.96	11.79	10.09	3.85	3.47	2.98	3.29	4.45	4.62	3.82	4.93	5.51
Q	1.40	6.22	3.82	6.25	2.26	2.88	6.74	2.17	2.46	3.32	2.66	9.28	4.12
Average				5.77				3.61				2.97	4.11

APPENDIX TABLE XIII

TRANSFORMED DATA FOR PERCENTAGE OF TAGS IN FLEECE, BY TIME OF REMOVAL OF TAGS AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(angle equal arcsin square root of percentage)												
A	21.74	9.41	11.12	15.50	16.95	10.28	10.81	12.44	7.53	7.49	8.37	8.60	11.69
B	15.35	13.96	11.36	11.02	14.23	12.92	14.50	8.91	11.67	7.56	10.84	7.75	11.67
C	9.93	14.35	14.85	13.14	7.51	9.91	11.62	12.76	7.79	8.09	8.53	9.17	10.64
D	8.36	9.17	13.09	14.06	10.01	10.20	13.00	8.57	13.28	12.29	5.85	11.89	10.81
E	18.23	13.73	15.02	14.93	14.19	8.15	13.02	9.21	11.38	9.46	12.65	10.65	12.55
F	7.98	6.65	9.28	7.62	8.51	7.02	5.92	7.58	9.37	8.49	6.97	8.97	7.86
G	10.65	10.22	15.72	14.35	9.18	12.62	9.74	9.93	16.14	8.93	8.76	9.91	11.34
H	9.61	12.58	13.60	9.24	7.49	9.24	8.29	6.52	7.40	7.84	7.45	9.42	9.06
I	6.80	18.24	13.41	14.17	12.15	9.39	12.05	12.88	7.84	16.39	9.83	12.48	12.14
J	11.77	9.42	13.09	19.59	10.03	6.82	11.62	9.26	6.05	7.69	8.51	9.35	10.27
K	17.43	13.87	15.70	16.49	9.18	6.10	12.04	10.67	12.11	13.34	10.26	10.61	12.32
L	16.76	13.39	18.71	15.95	13.49	13.01	16.55	13.82	8.64	7.75	8.68	8.39	12.93
M	15.56	18.79	16.58	18.76	11.51	13.18	16.97	10.00	9.00	11.02	9.06	8.72	13.26
N	17.34	11.93	12.76	8.35	8.51	7.02	11.87	8.81	6.80	5.74	7.36	7.94	9.54
O	8.29	17.30	9.06	13.65	11.90	9.42	16.40	9.65	12.05	8.21	8.59	6.70	10.94
P	16.23	12.87	20.08	18.52	11.32	10.73	9.95	10.45	12.18	12.42	11.27	12.93	13.24
Q	6.80	14.44	11.27	14.49	8.64	9.77	15.05	8.47	9.02	10.50	9.39	17.74	11.30
Average				13.44				10.73				9.63	11.27

APPENDIX TABLE XIV

STAPLE LENGTH IN CENTIMETERS, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(centimeters)												
A	7.60	6.35	5.90	5.11	7.57	7.17	7.92	6.25	7.42	8.82	6.43	7.76	7.02
B	7.58	8.13	6.02	9.43	7.30	8.72	8.57	6.45	7.00	6.70	7.08	5.95	7.41
C	7.30	5.52	6.25	8.70	5.47	6.85	6.42	6.95	7.98	6.03	6.65	7.52	6.80
D	7.33	7.68	7.77	6.17	6.86	7.08	8.58	6.95	6.18	7.23	6.70	7.50	7.19
E	10.38	6.58	8.65	8.02	6.93	6.75	7.53	5.97	8.48	8.80	10.50	8.58	8.08
F	6.85	8.58	7.42	8.20	8.35	7.23	7.07	6.77	7.70	7.15	6.55	7.22	7.42
G	7.97	9.23	8.08	8.85	8.93	8.87	8.75	7.78	8.78	8.87	9.20	9.17	8.71
H	8.58	6.62	6.55	6.43	7.05	5.77	6.25	7.22	7.63	5.62	6.47	6.05	6.69
I	5.18	8.45	7.75	8.68	7.83	8.90	7.78	7.73	7.48	10.65	9.10	8.37	8.16
J	7.47	7.32	7.70	6.60	5.28	6.83	6.13	7.66	7.62	7.40	6.47	7.30	6.98
K	8.14	6.67	7.42	7.53	6.38	8.15	4.98	6.87	6.45	6.37	5.42	7.95	6.86
L	8.55	8.58	9.08	10.39	10.37	9.38	8.38	10.08	8.22	8.32	8.33	7.77	8.95
M	9.12	5.67	8.42	8.57	6.57	6.93	5.85	9.48	9.65	10.58	8.38	6.77	7.17
N	8.03	8.17	15.03	6.60	7.88	7.46	13.03	7.05	9.28	7.05	6.73	8.13	8.70
O	8.88	10.08	7.35	9.87	7.33	9.90	11.13	10.52	8.95	10.87	9.75	8.22	9.40
P	7.53	8.02	7.82	10.47	9.33	8.65	8.32	7.35	6.90	8.42	8.18	8.82	8.32
Q	6.52	7.27	6.93	7.95	7.45	7.45	8.15	7.45	8.48	6.48	7.14	9.88	7.60
Average				7.85				7.68				7.82	7.78

APPENDIX TABLE XV

FIBER COUNT FOR GRADE PURPOSES, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(total number of fibers in two 125 square centimeter areas)												
A	128	149	140	135	109	125	116	118	139	145	131	146	132
B	90	95	227	166	134	134	122	210	133	155	123	202	149
C	111	131	168	134	107	128	88	85	141	136	115	104	121
D	206	164	109	103	163	133	132	129	111	115	159	135	138
E	205	154	158	145	156	167	191	205	134	185	160	136	166
F	111	106	101	113	134	118	121	105	107	100	141	104	114
G	126	101	90	116	142	102	124	140	109	100	145	85	115
H	167	139	182	173	133	159	164	224	178	204	177	126	169
I	129	112	145	137	139	131	131	133	118	101	74	100	121
J	159	167	146	254	189	142	131	158	180	143	141	185	166
K	202	183	164	205	166	205	169	145	187	151	173	129	173
L	167	144	135	152	147	125	144	151	212	164	180	202	160
M	239	170	257	180	210	197	214	169	176	169	140	151	189
N	147	110	128	136	127	148	142	106	146	110	143	202	137
O	155	171	151	145	157	164	173	156	155	205	124	153	159
P	120	100	143	144	104	104	122	91	102	145	99	94	114
Q	138	149	112	96	116	175	104	98	140	108	142	111	124
Average				148				143				142	144

APPENDIX TABLE XVI

TRANSFORMED DATA FOR PERCENTAGE OF FLEECE WEIGHT LOST THROUGH DUSTING, BY TREATMENT AND FARM

Fleece No.	Tags Removed After Storage				Tags Removed at Shearing				Tags Removed Prior to Shearing				Ave.
	1	2	3	4	5	6	7	8	9	10	11	12	
Farm	(angle equal arcsin square root of percentage)												
A	21.31	26.52	26.29	27.29	23.60	21.94	19.58	26.18	27.50	24.79	24.92	25.86	24.65
B	25.50	26.52	32.07	26.63	33.01	30.29	28.88	24.49	26.06	25.99	21.59	25.24	27.19
C	23.28	23.31	24.38	19.52	21.49	24.42	25.03	26.01	19.50	25.97	24.82	25.75	23.62
D	14.46	19.34	20.38	23.95	22.72	19.35	19.21	20.89	20.87	26.78	16.41	23.44	20.65
E	16.15	17.28	18.40	17.57	21.38	18.91	21.18	18.87	20.90	19.27	17.25	22.69	19.15
F	32.97	30.76	34.94	33.62	30.13	33.00	29.22	31.56	29.24	30.60	33.18	34.58	31.98
G	33.93	35.68	24.71	29.92	28.87	24.59	25.61	25.43	29.44	28.10	26.65	29.61	28.54
H	14.37	16.44	15.04	15.89	17.30	17.22	15.72	13.68	11.20	15.89	14.12	18.64	15.46
I	21.11	16.11	17.22	18.55	21.91	16.46	16.19	14.71	19.88	16.06	15.63	15.60	17.45
J	27.63	29.10	22.16	20.10	27.34	26.33	28.33	22.65	19.87	20.19	21.59	23.55	24.07
K	23.54	22.68	17.24	16.43	20.98	20.49	22.13	19.83	21.72	25.66	25.81	21.60	21.51
L	24.30	17.79	19.56	21.46	22.79	21.83	20.99	22.30	22.61	23.09	22.28	25.51	22.04
M	18.14	23.17	19.37	20.64	21.25	21.58	24.56	22.44	25.55	19.70	21.42	24.37	21.85
N	17.96	18.57	19.68	22.37	21.45	19.51	21.15	21.55	23.46	16.70	19.77	18.56	20.06
O	15.52	16.47	22.88	18.20	13.21	18.69	20.05	18.00	24.06	16.84	19.57	24.58	19.84
P	24.26	19.18	21.65	21.06	19.35	22.68	23.30	21.03	25.39	18.21	17.46	18.84	21.03
Q	19.46	17.22	19.44	15.93	19.60	18.83	19.27	20.58	17.71	21.27	20.51	12.60	18.54
Average				21.98				22.40				22.26	22.21

VITA

Gerald E. Marousek

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN ECONOMIC ANALYSIS OF THE EFFECTS OF ALTERNATIVE SHEARING METHODS ON WOOL QUALITY IN EASTERN SOUTH DAKOTA

Major Field: Agricultural Economics

Biographical:

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