AN APPRAISAL OF THE PROBABLE SUCCESS OF
THE NATIONAL WOOL MARKETING ACT OF 1954

by

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TABLE OF CONTENTS

The precipitous decline in sheep numbers during the 1940's
resulting in a decrease in shorn wool production from 370 million
pounds to 215 million pounds[1] directed attention to an unhealthy
domestic wool industry. A survey by the Production and Marketing
Administration[2] disclosed that during this period in 11 of the top
wool producing states an average of 50 percent of the wool pro-
ducers reduced sheep numbers, and an additional 30 percent of the
wool producers discontinued production entirely. Of the 30 per-
cent who stopped production, 60 percent did not intend to return
to sheep production. This decrease in production, together with
increased population and increased per capita consumption, caused
the proportion of domestic production to consumption to fall to
approximately 30-35 percent,[3] the remainder being supplied by im-
ports. This is the lowest proportion on record. At the present
rate of per capita consumption the expected growth of population
alone would necessitate an increase in wool production of 50 per-
cent by 1965 if domestic production continues to comprise 35 per-
cent of total consumption.[4] During the peak in domestic produc-
tion from 1930-1939, 88 percent of consumption was supplied by
United States wool producers.[5]

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[1]United States Department of Agriculture, _Agricultural Statistics 1952_, p. 346.

[2]United States Department of Agriculture, Production and Marketing Administration, _Domestic Wool Requirements and Sources of Supply_, p. 99.

[3]_Ibid._, p. 20.

[4]James R. Gray, _Southwestern Sheep Production and Costs per Ranch, With Emphasis on Wool and the Wool Situation_, p. 1.

[5]C. L. Harlan, _United States Wool and its Relation to the World Situation_, p. 1.

Since wool is considered an essential and strategic commodity, the Production and Marketing Administration recommended that domestic production be stimulated to comprise 50 percent of total consumption. This proportion was deemed necessary to eliminate possible shortages arising from military emergencies and to reduce seasonal fluctuations in supply. Imported wool arrives in largest quantities approximately six months after the peak in domestic supply, and if equal proportions were supplied from both sources seasonal fluctuations would be reduced. Since consumption of wool is relatively stable throughout the year, seasonal fluctuations in supply necessitates stockpiling to meet demands.

The Agricultural Marketing Act of 1949, which supported wool prices at 60-90 percent of parity proved inadequate to maintain production as wool production continued to decline after its enactment.

In an effort to stimulate production, the National Wool Marketing Act of 1954 was passed. This Act provides a support price at whatever level the Secretary of Agriculture deems advisable to stimulate production of shorn wool to 300 million pounds, grease basis[1] provided that the support price so determined does not exceed 110 percent of parity. If the support price so determined does not exceed 90 percent of parity the price support level shall be 60-90 percent of parity as the Secretary deems advisable to encourage production of 360 million

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[1]Hereafter when shorn wool is referred to it shall be construed to mean grease basis unless otherwise designated.

pounds of shorn wool. The support shall take the form of loans, purchases, incentive payments, or any other means the Secretary deems advisable to create the least adverse effects on foreign trade, except that any support above 90 percent of parity must be made by means of direct payments to producers. The Secretary may make adjustments in support prices and payments for differences in grade, quality, type and other factors to the extent he deems advisable.

The price support level is a national average price. At 110 percent of parity the price will be supported by payments to producers sufficient to bring the national average price up to 65 cents per pound. At 90 percent of parity the price was 52.3 cents per pound.

This study attempts to answer two questions: (1) What level of production will be stimulated by a price of 110 percent of parity, and (2) What price support level will stimulate the desired production of 300 million pounds of shorn wool under existing price structures.

These questions have importance because an unsuccessful piece of legislation does not justify the cost of its enactment. It is believed that the level of 110 percent of parity was not selected by an objective economic analysis but was the result of compromise, arbitration with pressure groups, and custom. It is believed that certain production economic methods may prove useful in the appraisal of some agricultural policies and may be employed to a greater degree in the future.

SCOPE AND METHOD

Scope

This anlysis seeks to explain the causal forces that moti-
vated sheep producers to decrease production during the 1940's.
The basic assumption must be made that producers strive to
maximize profit or minimize loss. In regard to this assumption
George Stigler says[1]:

> No economist would deny that all entrepreneurs are
> subject to other desires that may conflict with profit
> maximization, nor even that some of these other forces
> may be widespread and important. Rather the position is
> that profit maximization is the strongest, the most
> universal and the most persistent of the forces govern-
> ing entrepreneurial behavior.....If, for example, an
> undefined and unmeasured "sense of fairness" is put into
> the theory of the firm, we can no longer predict what
> the firm will do.

Thus the assumption of profit maximization or loss minimi-
zation is essential to the analysis. If it becomes more
profitable to produce a different product, a shift to the pro-
duction of the more profitable product will occur. An analysis
of shifts in production must consider the profitability of pro-
ducing alternate products. Certain areas of the United States
have sufficient resources to produce a wide variety of products
and an analysis in these areas would be complicated. The area
used in this study involves the 14 states generally considered
to comprise the range livestock area. They are North Dakota,
South Dakota, Texas, Montana, Idaho, Wyoming, Colorado, New

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[1]George J. Stigler, The Theory of Price, p. 149.

Mexico, Arizona, Utah, Nevada, Washington, Oregon, and California. This area was selected for several reasons. Approximately 75 percent of the domestic shorn wool is produced in this area, so any increase in production can be expected to come largely from this area. The Production and Marketing Administration says[1]:

> Long time trends in wool production and changes in the general agricultural economy in various regions indicate that Texas and the eight western Mountain states (Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada) are the areas which must be looked to for significant increases in wool production during the next decade, somewhat lesser increases being probable in the West North Central States. Elsewhere the possibilities of significant expansion appears to be very limited.

The reduction in sheep numbers during the 1940's was largest in the nine states named.

Due to its unfavorable topography, low rainfall and low soil fertility, most of the area is unsuitable for crop production. However, most of the area supports enough native vegetation to produce range livestock. Cattle and sheep are the only farm animals with economic significance that can utilize native vegetation profitably. This reduces the analysis to two enterprises.

The Model

In the 14 state region described above, sheep and cattle are competitive for a large proportion of resources. If more

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[1]Op. cit., Domestic Wool Requirements and Sources of Supply, p. 4.

sheep are produced cattle production must be reduced. The
model showing possible combinations of cattle and sheep which
can be produced can be displayed in three dimensions as in
Fig. 1. It is an aggregative model and analysis of individual
firms is not considered. On the Y axis is depicted gradations
in resource utilization including land, labor, capital and
management. On the X_1 and X_2 axes are displayed numbers of
sheep and cattle. The line OB shows levels of cattle numbers
that can be produced if no sheep are produced. Line OA shows
levels of sheep numbers that can be produced if no cattle are
produced. When all possible combinations are produced the pro-
duction surface OAB is generated. By passing horizontal planes
through the surface OAB the intersections form lines depicting
all possible combinations of cattle and sheep numbers that
could be produced at different resource levels. These lines
may be called iso-resource curves and can be projected down on
the base plane and displayed as in Fig. 2.

Since many different combinations of sheep and cattle can
be produced at any given resource level the decision to produce
a particular combination must be based on the relative prices
of the two products. Optimum resource allocation occurs when
the marginal rate of substitution between two products equals
the negative reciprocal of their price ratios. It may be stated
symbolically by the equation $\dfrac{dX_1}{dX_2} = \dfrac{PX_2}{PX_1}$. The left hand side of
the quation is the marginal rate of substitution of X_1 for X_2,
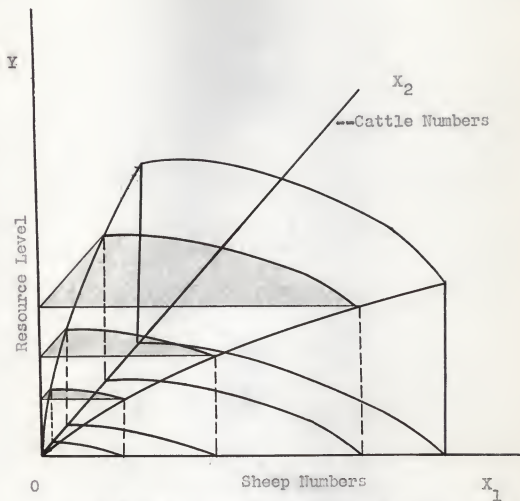or the quantity of X_1 which must be sacrificed to produce an

Fig. 1. Theoretical production surface showing
all possible combinations of sheep and
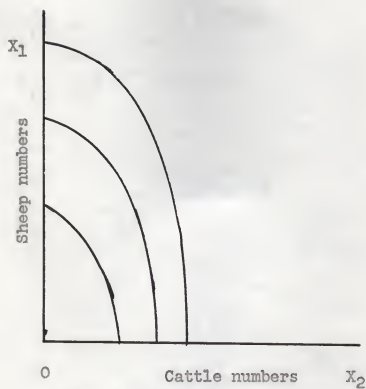cattle that can be produced at varying
resource levels.

Fig. 2. Projection of iso-resource curves onto base plane showing all combinations of sheep and cattle that can be produced at three resource levels.

increment of X_2. Multiplying both sides of the equation by dX_2 and again by PX_1 gives the equation $PX_1 \ dX_1 = PX_2 \ dX_2$, which states that the value of the quantity of X_1 which must be sacrificed to produce an increment of X_2 is equal to the value of the increment of X_2. Once the iso-resource curve for cattle and sheep is derived exact quantities of sheep and cattle that will be produced can be determined for any price ratio. By including the new wool support price in the computation of the price ratio the quantity of sheep that will be produced can be determined. Since the production of wool is a direct function of sheep numbers wool production can also be determined, providing the answer to question one.

By computing the necessary sheep production to produce 300 million pounds of shorn wool, determining the slope of the iso-resource curve at that point, and solving for the price ratio, the price of wool necessary to produce the desired production will be determined, providing the answer to question two.

The Method

An iso-resource curve may be derived for an individual firm by a detailed cost-budget plan examining the advantages or disadvantages of producing combinations of the two products as opposed to specialized production. An iso-resource curve for an individual firm may also be derived by experimentation employing many different resource levels and many different combinations of the two products and fitting an equation to the data. This type of analysis, even if the data were available, would

not suffice for an aggregative model. There is no a priori
reason why substitution rates for an individual firm would coin-
cide with substitution rates for a region consisting of 14 states.
An area so large contains many heterogeneous resource bundles.
Climatic conditions in the mountains of Washington differ from
the Mojave Desert in Nevada, causing the marginal rates of sub-
stitution between cattle and sheep to differ. Similarly, the
very large ranches in Texas differ in production practices from
the family operated ranches in Idaho, causing the marginal rates
of substitution to differ. A method of aggregation of different
sizes of enterprises, different climatic conditions, and dif-
ferent skills of producers would be difficult. The method of
deriving an iso-resource curve for the entire Western range
area must employ different techniques.

A beginning was achieved by observing the shifts of pro-
duction in this area with the changes in relative profitability
over time. By observing the numbers present on farms at dis-
crete time periods during a shift in production a rough idea of
the substitution rate was ascertained. Knowledge of different
combinations of sheep and cattle which actually were produced
from 1920 to 1954 formed the basis for the derivation of the iso-
resource curve. This method entailed the use of only a small
portion of the production surface, the rest becoming irrelevant.
Although a large portion of the production surface will remain
a mystery, more faith can be placed in the portion considered
than if a few observations were scattered over a wide area of
the surface. The use of time series data to derive an iso-

resource curve which is a simultaneous production situation, involves two basic assumptions--(1) there must have been no change in technology during the period used; or if a change in technology occurred the years of different technology must be randomly scattered over all segments of the data so that they may be averaged out by a regression line; and (2) there must have been a constant level of resources and a constant level of resource utilization. Or if a change in either occurred the changes must have been random so that they may be averaged out by a regression line. To the extent that either or both of these assumptions lack validity a limitation is placed on the methodology.

A change in technology during the period used would affect both the shape and the slope of the curve, the degree of error being dependent on the concentration of a period of higher technology in one segment of the data, as well as the degree of change of technology. It is believed that no significant change in technology occurred during the period. According to H. R. Hochmuth:[1]

> Total output or production on many types of farms can be increased sharply by such things as heavy applications of fertilizer, use of improved and higher yielding varieties of crops, shifting to more intensive crops, changing cropping rotation, and increased mechanization which permits operators to handle larger enterprises. Most of these methods are not open to sheep raisers.

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[1] H. R. Hochmuth, Commercial Family-Operated Sheep Ranches, Intermountain Region 1930-1950, p. 56.

The same is said of cattle raisers:[1] "Total output or production on many types of farms can be increased sharply by any number of means . . . This is not true of cattle raisers."

Since the improved production practices mentioned are the ones that permit the largest changes in technology, and since these methods are not available to range livestock producers, it is obvious that changes in technology for range livestock producers are limited.

In a study by the Montana State College Agricultural Experiment Station data was provided on physical efficiency from 1930-1952 on cattle ranches.[2] Indices of gross ranch production and total inputs were computed and from these a production per unit input index was derived. In their own words the total input per unit of production[3] is:

> Algebraically, it is the sum of all items used in production, each multiplied by its respective base price; divided by the sum of all items or units produced, each multiplied by its respective base price, the base period being the same for both numerator and denominator. In other words, it is total cost per unit of production as given above, adjusted for changes in price. As all costs have been adjusted for change in price level, the ratio of input per unit of production or output becomes a measure of physical efficiency in production.

A regression analysis using production per unit input as the dependent variable and time as the independent variable revealed no significant trend at the 95 percent confidence level.

[1]H. R. Hochmuth, Commercial Family-Operated Sheep Ranches, Intermountain Region 1930-1950, p. 21.

[2]James R. Gray, Organization, Costs, and Returns on Cattle Ranches in the Northern Great Plains 1930-1952, p. 95.

[3]The index is in production per unit of input, but input per unit production was defined. Both are derived in the same way.

If a change in technology had existed it would be revealed in
increased physical efficiency. Since sheep are produced with
the same basic resources it is believed that similar results
would have been obtained by a similar analysis had the data
been available. Thus the assumption of constant technology in
range livestock production seems justifiable.

While the condition of equilibrium used explains the propor-
tion in which two commodities will be produced with a given re-
source, it does not explain the level of resources or the in-
tensity with which those resources are utilized. It is believed
that a constant level of resources was available for production
during the period. Data provided by the USDA on pasture and
range land available for grazing[1] reveals that 1,066 million
acres were available in 1920, 1,042 million acres in 1930, 1,065
million acres in 1940, and 1,052 acres in 1945. This represents
a negligible change in land acreage available during the period.
The fixed nature of the supply of land causes competition for
shares in its supply. Practically no productive land remains
unutilized because of lack of management. Marion Clawson says
of the distribution of Federal grazing land to producers[2]:

"In most areas the number of potential applicants and the
number of livestock they would like to graze far exceeds the
capacity of the available resource."

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[1]L. A. Reuss, Inventory of Major Land Uses in the United
States, p. 30.

[2]Marion Clawson, The Western Range Livestock Industry, p. 114.

Thus a constant level of management is applied to a fixed land resource.

Regarding labor supplies Clawson says[1]:

"There has always been a certain amount of romance surrounding ranching, which has often enabled it to obtain ample labor at relatively low wages."

Of capital he says[2]: "For the most part, the range livestock industry is able to obtain all the capital it needs."

Since a constant supply of land existed and since there were no shortages of the other factors of production each factor was exploited until the ratios of their marginal productivities to their prices were equalized and no effect on output and hence no bias in the regression was encountered from this part of the analysis. The main variation was due to changes in forage conditions due to weather, and is sufficiently random in nature to be averaged out by the regression line.

The assumption of constant intensity of resource utilization remains to be justified. The assumption is justifiable by the nature of the range livestock industry. Being a purely competitive industry no producer considers an attempt to vary production with intent to influence price. Production is based principally on marginal cost. The marginal cost curve is believed to be downward sloping or horizontal up to a certain output

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[1]Marion Clawson, The Western Range Livestock Industry, p. 84.
[2]Loc. cit.

where it turns sharply upward. The negatively inclined or horizontal portion is due to increasing or constant returns of the variable factors - labor, capital and management - to the fixed factor land.

The sharply rising portion of the marginal cost curve is due to the fixed supply of land. When production has reached the point where land is being fully utilized further increases are inefficient and costly. Intensive practices such as increased fertilization and irrigation cannot be used to substitute for land in an extensive farming system where land is used in its raw state. Because of the inelastic supply of land the producers build their enterprise to the most efficient size compatible with their resources and maintain that size. Since their individual marginal cost curves are nearly vertical at the relevant operating range, the marginal revenue curves can fluctuate through a wide range without causing a very large change in output. Both owned and leased land is relatively fixed in tenure, and expansion of holdings is difficult, impeding consolidation for purposes of scale efficiency. This characteristic in itself tends to cause a stable production and a stable resource utilization.

Another cause of stable production is hesitancy to liquidate breeding herds to meet variations in price. Unconsumed forage is lost and seldom is the beneficent effect on the future range conditions enough to make up for it. Similarly, overstocking to meet price fluctuations is seldom profitable, because the adverse effect on the range may be felt for years.

The risk incurred by overstocking is greater than a constant rate of conservative stocking. In dry years overstocking amplifies the poor range conditions and liquidation is often necessary. Conservatively stocked ranges can withstand dry years with relatively little forced liquidation. In conjunction with this, the forces causing producers to liquidate or enlarge are common to the whole industry, and mass movements adversely affect price. Producers will be buying at high prices and selling at low prices.

For these reasons the assumption of a constant level of resource utilization does not seem too heroic. Exceptions are such periods as extended drought conditions and liquidation because of fear of depression. These cases will be treated later.

Data Used

The basic data used was numbers of stock cattle and stock sheep on farms January 1 from 1920 to 1954 in the 14 range states.[1] Stock cattle and stock sheep were used because they are the only class of livestock in direct competition for the range resources. Dairy cattle and cattle on feed were subtracted out when necessary because they are produced under feedlot conditions. January 1 data was used because it represents more closely the intentions to produce the following year. Young breeding stock will have been retained to replace aged animals,

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[1]*Agricultural Statistics*, United States Department of Agriculture.

and the culls and other market animals will have been sold. The
January 1 figure is not biased by variation in production rates
due to autonomous circumstances such as a figure later on in the
year would be. The period from 1920-1954 was selected because
it includes a period of considerable shift from cattle to sheep
in the 1920's as well as a shift from sheep to cattle in the
1940's. A period in which there are shifts in production is
necessary to obtain observations through a considerable range on
the iso-resource curve. The plotted data is displayed in Fig. 3.
A definite competitive relationship is evident although the
curvature of the data is not discernible. The scattered points
in Fig. 3 do not present a true picture unless certain adjust-
ments are made. Approximately 7,000,000 horses and mules were
present on farms in this area in 1920. The constant downward
trend to 1,200,000 in 1954 continually released more and more
resources for cattle and sheep. This disparity in horse and
mule numbers between the two extremes of data causes some of the
points in later years to appear in a different iso-resource curve.
It was decided to subtract all horses and mules from the data
except the number on farms in 1954. It is believed that this
number is necessary for the production of cattle and sheep, pro-
duction of horses and mules for profit having ceased for all
practical purposes. Adjusting the data to conform to constant
horse and mule production will eliminate the effects of the
trend in increased available resources due to decreased horse
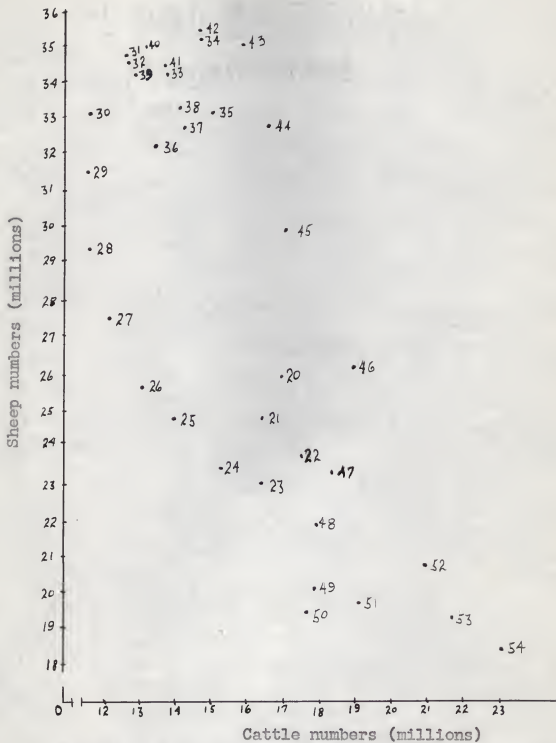and mule numbers.

Fig. 3. Scatter diagram of cattle and sheep numbers present on farms 1920-1954.

One must ask the question, "If there had been less horses, how would the additional resources have been distributed between cattle and sheep?" The proportions of cattle and sheep on farms in any particular year represent decisions as to the relative profitability of the two enterprises. The assumption must be made that the additional resources vacated by horses will not change the decisions of producers as to the relative profitability of the two enterprises and the same proportion would prevail. The adjustment was made in the following manner. Animal numbers were converted into animal units on the basis of forage requirements. According to the standards used by the United States Department of Agriculture-- 1 horse = 1 animal unit, 1 cow = .75 animal units, and 1 sheep = .12 animal units. If in a particular year total animal units attributable to sheep and cattle were comprised of 65 percent cattle and 35 percent sheep, then 65 percent of the horse animal units are added to cattle and 35 percent are added to sheep. Cattle and sheep animal units are then converted back to numbers. This was done for every year. The data was plotted in Fig. 4. Some of the scatter has been reduced. The remaining scatter is attributable to various causes, some explainable and some due to random variations.

Some of the data is clearly unusable. Overstocking during World War I necessitated a liquidation during the early 1920's. A period of liquidation overshadows the substitution and no method of adjustment was considered satisfactory. The shift
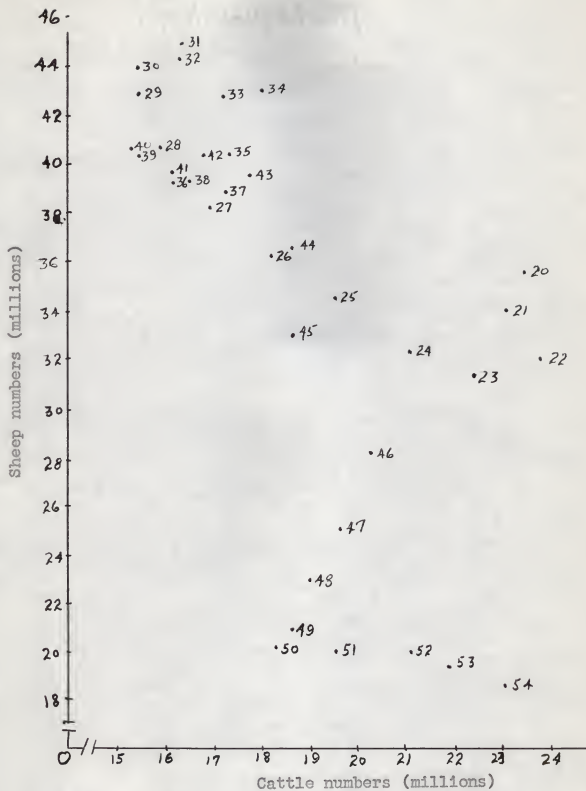
Fig. 4. A scatter diagram showing combinations of cattle and sheep on farms Jan. 1, 1920-1954, adjusted for trend in horse and mule numbers.

from cattle to sheep from 1923 to 1929 was quite significant.
However, during this period there was a reduction of cattle
numbers not entirely accounted for by the increase in sheep num-
bers. Resources did not flow immediately into sheep production
and the total animal units declined continuously during the period.
A look at economic conditions at that time reveals the reasons
for a shift in production of less than expected proportions.
After World War I farm prices dropped drastically and retail
prices remained relatively stable. This situation persisted for
a number of years until many farmers were in financial distress.
Extension of farm credit was tightened and a number of cattle
producers underwent bankruptcy. Sheep producers were in a rela-
tively good position. However, considerable capital is needed
to change enterprises and many producers lacked the capital to
make the change. Some cattle producers did not shift production
because they expected the profitability of cattle to increase
relative to sheep. Strains of hopefulness continued during most
of the period. Possibly some cattle producers hesitated to shift
because of the remnants of antagonism for sheep remaining from
the range wars. At any rate, the substitution during this period,
although significant, is considered biased. The period from
1929 to 1939 witnessed stable production of both sheep and cattle
and is of no use in determining the iso-resource curve.

The period from 1939 to 1946 represents a period of sub-
stantial shift from sheep to cattle. The shift was perpetuated
readily as is evidenced by the relatively stable total number of

animal units on farms. Capital was available to finance a change in enterprises and no hesitation was evident. This period is suitable for use. Although some differences in condition of the range was noted, logical adjustments are possible. The period from 1947 to 1950 contains considerable liquidation due to general fear of depression after World War II, rendering this period unusable.

The period from 1939 to 1946 provides eight observations which are sufficient for the statistical tests and manipulations. Correction for range conditions was made in the following manner. Animal numbers were considered to be a function of the range condition of the previous five years. Range condition data was taken from Agricultural Statistics. It is an estimate of amount of available forage as compared with a long time normal, and is weighted on the basis of relative importance of different areas of livestock production. A time interval of five years was considered appropriate to achieve the full effects of a change in range conditions. One year of heavier rainfall does not affect the number of livestock in the breeding herd if followed by normal years. Only unusual years in sequence affect size of breeding herd. Even after several unusually good years of forage conditions it takes additional time to increase the breeding herd. Heifers retained from a calf crop do not enter production for two years. In years of abnormally poor forage conditions liquidation may take place somewhat quicker than increasing breeding herds in good years. Probably a more suitable figure

for a change from good conditions to poor conditions will be four years. However, the period used consists of a change from poor conditions to good conditions so a time lag of five years was used.

The range conditions for the period 1934 to 1946 was averaged. If for a particular year the average of the previous five years differed from the average for the entire period cattle and sheep numbers were adjusted accordingly. If the average range conditions for five years was 5 percent better than normal, total animal units were increased 5 percent. The additional animal units were distributed between sheep and cattle according to the proportion on farms that year. The results are plotted in Fig. 5. The equation of the line is $Y = 114.68 - 4.5636X$, where Y is sheep numbers and X is cattle numbers. An F test for curvilinearity was made using the general equation for a standard second degree parabola with a vertical axis, but no significant reduction in variance was achieved at the 95 percent level of probability. The iso-resource curve was judged to be linear within the range of the data. The value of the Y-intercept is meaningless in this case since it represents the number of sheep that could be produced if no cattle were produced. This would require a projection beyond the range of the data, and such projections are subject to very large errors. A priori reasoning would indicate a supplementary range instead of a linear range beyond the limits of the data so that additional production of one enterprise necessitates increasingly larger sacrifices of the other. This would be true if some resources were not equally
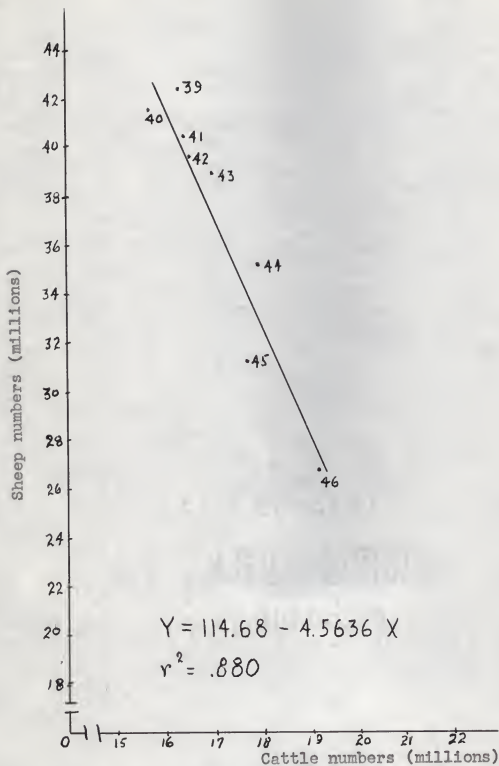
Fig. 5. Relevant portion of iso-resource curve.

suited for both enterprises, or if some producers were more
skillful in the production of one enterprise, or if for any rea-
son the replacement of one enterprise with the other resulted in
a loss in efficiency. It is believed that one or more of these
factors existed.

Marion Clawson says[1]:

> Sheep, under some conditions, are less dependent
> upon water than cattle. On the winter desert ranges,
> sheep will use snow for water. On the very high moun-
> tain ranges, the heavy dew on the vegetation greatly
> reduces the need for water for sheep.

This indicates some resources which are more suitable for
sheep than for cattle, so that the marginal rate of substitution
of cattle for sheep is greater than for other resources.

Marion Clawson says again[2]: "Cattle make more efficient
use of grass than do sheep."

This statement was qualified in subsequent paragraphs to
include only the tall, coarse grass areas of parts of the North-
ern Great Plains and was not intended to be as universal in
nature as it sounds at first reading. However, it indicates that
there are areas that are more suitable for cattle than sheep,
tending to create a supplementary range at the other end of the
iso-resource curve.

The portion of linearity has considerable economic signifi-
cance. It represents the extent of resources nearly equally
suited for both sheep and cattle. When it becomes profitable

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[1] Marion Clawson, op. cit, p. 73.
[2] Ibid., p. 25

for any resources to be shifted in production it is equally
profitable for all of the resources contained in the linear
portion to shift. Theoretically, equilibrium between the two
extremes can be achieved only when the price ratio coincides
with the slope of the iso-resource curve, and since it would be
equally profitable to produce any combination of sheep and cat-
tle contained in the linear portion, it would be an indetermi-
nate situation. Probably it would prompt no shift at all, but
if a shift was started it might proceed for the whole of the
linear portion.

This explains the precipitous nature of the shifts in pro-
duction that were witnessed twice in three decades. If the
price ratio is very close to equality with the slope of the iso-
resource curve, a slight change can reverse the profitability
of the two enterprises and a substantial shift occurs. A look
at historic price ratios may clarify the idea further.

Price Ratios

Since the measurements of production of cattle and sheep
are in numbers of animals the price ratio must be in production
value per head. If one cow substitues for five sheep the value
of animal products produced by the cow must have five times the
value of one sheep in a similar time period in an equilibrium
situation. The method of determining the production values for
cattle and sheep can be achieved only through an examination of
the two enterprises separately.

The majority of cattle ranches in this area derive income

solely from the production of new animals. One calf crop can be produced annually. A calf can be grown to an average of 400 pounds a year. In years of plentiful forage the calves may be held over for another year in order to be marketed at a heavier weight. However, this entails the possession of extra resources and cannot be construed as being part of the annual production. The calf crop was treated as having been sold the same year they were born. The average in percent calf crop in the area from 1941 to 1950 was 81.8 percent. Since percent calf crop has a bearing on production value per stock animal this factor must be considered. Approximately 20 percent of the stock cows are culled and sold and replacements are retained from the heifers in the calf crop. The value of culled animals is a factor to consider in the production value. An average culled cow weighs 1,000 pounds and will grade common to medium.

The equation for obtaining production value is .818 .5(4P_s) ≠ .3(4P_h) ≠ .2(10P_c) where P_s is the price per hundredweight of 300-500 pound good to choice stocker steers, P_h is the price per hundredweight of 300-500 pound stocker heifers, and P_c is the price per hundredweight of common to medium cows. The coefficient .5 represents half of the calf crop being comprised of steers, of which all are sold. The coefficient .3 represents the portion of the calf crop comprised of salable heifers, and the coefficient .2 represents the portion of sales made up by cows.

Income from sheep ranches is obtained from two sources--

sale of lambs and sale of wool. The average lamb crop in this
area from 1941 to 1950 was 87.3 percent. One lamb crop is pro-
duced annually. The average sale weight per lamb is difficult
to determine. In some specialized areas in Idaho and Oregon
lambing takes placed under sheds in early winter and lambs are
large enough by spring to obtain maximum utilization of lush
spring ranges. These lambs are marketed as grass fat lambs at
a weight of approximately 75-85 pounds. In other areas lambs
are born later on the open range and are sold in the fall as
feeder lambs at a weight of approximately 60-65 pounds. Since
about 70 percent of the lambs are sold as feeder lambs and 30
percent as grass fat lambs, a figure of 70 pounds was selected
as an average. This figure was confirmed by a conversation with
Dr. T. Conald Bell[1] as being most nearly correct. Approximately
20 percent of the aged ewes are culled and sold each year. Aver-
age weight of culled ewes was considered to be 120 pounds. Most
ranchers in this area use fine wool ewes and medium wool, mutton
type rams to produce a lamb of better mutton quality. This
makes it impossible to retain replacements from the lamb crop, so
all of the lambs are sold and replacements are purchased else-
where. The difference in cost is not great between buying re-
placements and retaining replacements from the lamb crop. Pro-
duction value was computed as if replacements were retained from
the lamb crop.

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[1]Dr. T. Donald Bell, Professor, Animal Husbandry, Kansas
State College.

Sheep are shorn once annually and an average fleece weight of 8.68 pounds was obtained in this area through the years 1941 to 1950. Marketable lambs are not shorn and the shorn wool is obtained essentially from breeding herds and lambs on feed.

The equation for production value is

$.873 \quad .8(.7P_L) \neq .2(1.2P_E) \quad \neq 8.68P_W$ where P_L is the price per hundredweight of good to choice feeder lambs at Omaha, P_E is the price perhundredweight of common to medium ewes, and P_W is the national average price per pound received by farmers for wool.

The entire production value ratio is given by the equation:

$$P.V = \frac{.818 \quad .5(4P_S) \neq .3(4P_H) \quad \neq .2(10P_C)}{.873 \quad .8(.7P_L) \quad \neq .2(1.2P_E) \neq 8.68P_W}$$

Prices were all average prices received by farmers during the marketing period August through November at Omaha.[1] Omaha prices were used because a large number of western livestock are marketed at Omaha.

The production value ratio was computed for each year and the results are given in Table 1. A definite shift from a slope of less than the iso-resource curve to one of greater slope occurred in 1938. The reasons for a shift in profitability during this year are (1) a record lamb crop in 1938 combined with a lessened demand for feeder lambs because of unfavorable results from lamb feeding the previous year, caused the price of lambs

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[1]United States Department of Agriculture, Agricultural Marketing Service, Market News.

Table 1. Prices per cwt. of salable classes of ranch livestock at Omaha livestock market and production value ratio, 1933 to 1954.

Year	300-500 lb. Stocker Steers	300-500 lb. Stocker Heifers	Common to Medium Cows	Feeder Lambs	Common to Medium Ewes	Wool cents per lb.	Pro- duction Value Ratio
1933	5.11	3.72	2.50	6.02	1.38	20.6	3.3
1934	4.75	3.63	2.69	5.28	1.21	21.9	3.5
1935	7.89	6.34	4.71	8.51	2.21	19.3	4.4
1936	6.68	5.76	4.46	7.33	1.93	26.9	3.7
1937	8.25	7.12	5.65	9.23	2.60	32.0	4.0
1938	8.92	7.15	5.62	7.44	2.38	19.1	5.6
1939	10.30	9.11	5.77	8.25	2.43	22.3	5.6
1940	10.75	9.11	5.97	8.63	2.35	28.4	5.4
1941	10.72	9.39	5.96	8.63	2.38	35.5	5.3
1942	14.05	12.83	8.29	12.62	4.29	40.1	4.9
1943	13.58	12.32	10.23	12.10	5.05	41.7	5.1
1944	12.50	11.25	7.70	12.50	4.03	42.3	4.9
1945	13.74	12.44	10.86	14.62	5.03	42.3	4.7
1946	17.02	15.50	9.91	17.31	6.64	42.3	4.6
1947	22.35	20.20	15.32	21.48	7.30	41.9	5.5
1948	27.28	26.02	17.20	23.22	8.57	49.2	5.9
1949	24.70	22.78	14.03	23.01	7.84	49.4	5.2
1950	32.64	30.23	19.33	28.40	12.35	62.1	5.4
1951	38.97	36.41	23.78	31.89	11.83	100.0	5.4
1952	28.46	25.28	15.31	21.83	5.25	53.3	6.1
1953	17.29	15.31	8.56	16.93	4.31	54.7	4.3
1954	20.23	17.09	8.02	17.53	3.90	54.7	5.6

Source: United States Department of Agriculture, Market News.

to weaken, (2) a smaller than average calf crop combined with a large corn crop and a large carryover of corn from the previous year caused the price of stocker and feeder cattle to strengthen, and (3) increased industrial activity during the year caused a large increase in the demand for beef than for lamb. A further explanation of the effect of industrial activity on the demand for meat appears in a later section.

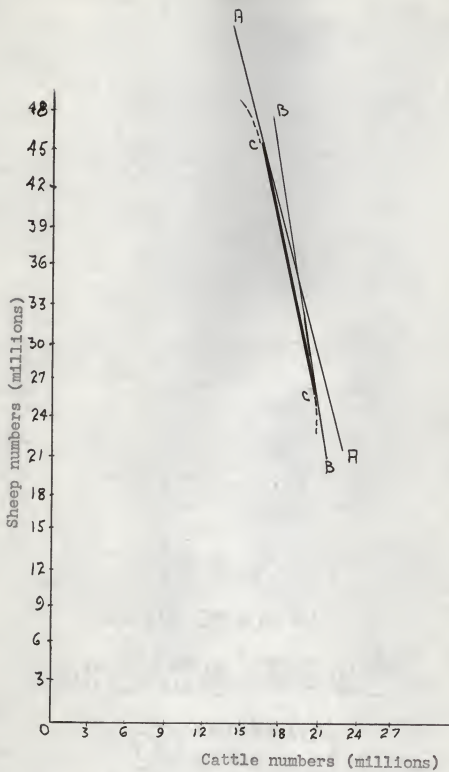Graphic illustration of this shift is shown in Fig. 6. The

Fig. 6. Iso-resource curve and production value
ratio lines.

iso-resource curve is CC. The production value ratio line be-
fore is AA. Tangency is evident at a point on the iso-resource
curve representing a relatively large sheep production and a
relatively small cattle production. This was the most profitable
combination for such a production value ratio. If the production
value ratio line is considered as a constant income line, or a
line showing all combinations of cattle and sheep production
that would produce a given income, and if numerous other constant
income lines were drawn in of the same slope, the iso-resource
curve would be tangent to a higher income line than any other in-
come line which it touches. Thus, tangency indicates greatest
profit. The production value ratio line after 1938 is shown by
BB. Tangency indicates a maximum profit situation of higher
cattle production and lower sheep production than it was profit-
able to produce before 1938.

Although the shift in profitability occurred in 1938, actual
shift in production did not start until 1940. This delay was
caused by several factors.

After a long period of favorable prices for sheep, pro-
ducers were hesitant to shift for what might have been a short-
run situation. Part of the delay can be explained by immo-
bility of resources. Further evidence of linearity of the iso-
resource curve is the fact that although the price ratio re-
mained relatively stable from 1938 through 1947 the shift con-
tinued once started although the price ratio has not increased.

The determination of the slope of the iso-resource curve
and the formulation of an equation for determining the produc-

tion value ratio provides the tools for answering both questions posed at the beginning of the text. The first question was, "What level of production will be stimulated by a price of 110 percent of parity?" Using the cattle prices and sheep prices of 1954 as an example, the substitution of 65 cents per pound into the equation as the price of wool gives a production value ratio of 5.27. This slope is greater than the marginal rate of substitution of -4.56 and consequently will not induce farmers to shift from cattle to sheep. Although it will improve some-what the position of sheep producers it will not stimulate the desired production. A specific answer to the question must be that in the 14 state region no increase in wool production will be stimulated by the National Wool Marketing Act of 1954.

An answer to the second question, "What price support level will stimulate the desired production of 300 million pounds of shorn wool, under existing price structure?" can be obtained with the tools provided. A production value ratio of 4.56 or less will provide the desired production. Substituting 1954 cattle prices and sheep prices into the price ratio equation and solving for the price of wool gives 87.7 cents per pound, or a price of 130 percent of parity. Under current price structures a price of less than 150 percent of parity will not cause producers to shift from cattle to sheep and cannot there-fore stimulate the desired production.

DYNAMIC CONSIDERATIONS

The foregoing analysis is a static model and while it was useful in obtaining a solution to the problem posed, it is necessarily limited in scope. There are certain implications remaining not discussed. The price level of wool that might promote a shift in production from cattle to sheep may differ from the price necessary to maintain sheep production at the desired level. When wool production increases lamb and mutton supplies increase proportionally. The two are joint products, the proportion being relatively fixed. If the demand for lambs is relatively inelastic, as is commonly believed, the price will lower proportionally more than production will increase, and total revenue will decline. As the price of lambs is an important part in the profitability of sheep production lower revenues from lambs may cause the profitability of sheep production to decline. Thus it would require a higher price to maintain wool production at the desired level than the price required to cause the initial shift in production. The price of 150 percent of parity obtained in the foregoing analysis may be insufficient to maintain the desired production. A more complete analysis would entail the formulation of a demand curve equation for lamb and mutton or a similar equation relating price to quantity so that a price could be predicted that would be relevant for the higher level of production.

The importance of lambs in the profitability of sheep production is seen by considering the relative proportion contributed to income by wool and lambs in the past. In a study by the Production and Marketing Administration,[1] the average percentage of wool growers' income derived from shorn wool during 1900-1910 was 44.4. The demand for lambs had not yet developed and sheep were grown principally for wool. Large numbers of wethers were kept and only enough lambs were raised to replenish herds. During the period 1920-1929 the percentage of total income derived from wool dropped to 38.6 and more emphasis was placed on lamb production. The proportion has remained relatively stable since 1920 at 38 percent wool and 62 percent lamb. The success of a price policy supporting the lesser important product of a joint product combination is necessarily limited in effect. Possibly more control of production could be obtained by stimulating the demand for lamb. This was recognized by legislators and provision was made to release funds for advertising lamb and wool products. Discussion of this program is beyond the scope of the thesis.

The effect of lamb prices on the profitability of sheep production was seen during World War II. The price of wool was limited by a ceiling. The demand for beef increased due to increased salaries of industrial workers, who are large consumers of beef in prosperous times. The demand for lamb did not increase

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[1]Op. cit., Domestic Wool Requirements and Sources of Supply, p. 81.

nearly as much as beef. Lamb is consumed chiefly by white collar workers in certain regions of the United States. Salaries of white collar workers did not increase as much as industrial workers. Although the production of lamb dropped and the production of beef increased, the price of lamb dropped relative to beef, causing the price ratio to swing favorably toward beef.

Although the increased production of sheep would necessitate a reduction in production of cattle in the range states, and although the demand for beef is also commonly believed to be inelastic (but not as inelastic as lamb) it is believed that the price of beef will not be greatly affected. Off-setting increases in beef production are probable in other areas. An area of considerable potential in beef production is the Southwestern area of the United States. Since there are slightly more than 90 million cattle in the entire United States, and a shift in production in the Western states to sheep would entail the sacrifice of only about five or six million, it is believed that no great effect would be felt on beef cattle prices. However, the shift in production would increase sheep numbers by approximately 50 percent and the effects on lamb prices would be great.

SUMMARY AND CONCLUSIONS

An appraisal of the probable success of the National Wool Marketing Act of 1954 is a problem in optimum resource allocation on a regional scale. The success of the program, which is designed to stimulate production, is dependent on its ability to change the relative profitability between the production of

sheep and wool and the production of alternative products such
as cattle. In the range livestock area, which is expected to
be the area most likely to increase wool production, the only
major competitive product is cattle. Hence, the success of the
program depends largely on the rates of substitution between
cattle and sheep in this area. A product - product model of the
type used in production economics was selected as the static
hypothetical model. Since this was a problem in reginal analy-
sis the methods employed for individual firm analysis was con-
sidered inadequate. It was decided to concentrate on a single
iso-resource curve corresponding to a long run level of avail-
able resources. Data used was numbers of stock animals on
farms in the range livestock area on January 1 from 1920 to 1954.
A sufficient range of observations was obtained to derive a
usuable portion of the iso-resource curve. The assumptions
necessary for this procedure were a constant level of technology,
or a random scatter of years of changed technology, and a con-
stant level of resource utilization, or a random scatter of
years of changed resource utilization. Random variations intro-
duce no large errors into a regression analysis. The equation
of the data was $Y - 114.68 - 4.5636 X$. The coefficient of X
is the marginal rate of substitution of sheep for cattle, and
does not change for the range of the data. A priori reasoning
indicates a supplementary range beyond the limits of the data
because of some resources being more suited for one enterprise
than the other.

Optimum resource allocation occurs when the marginal rate of substitution is equated with the reciprocal of the price ratio. If the price ratio is less than 4.56 producers will produce a combination of relatively high sheep numbers and relatively low cattle numbers. The desired production of wool will be produced at this price ratio, although the exact amount is indeterminate as it is beyond the range of the data. At a price ratio of more than 4.56 producers will produce a combination of relatively high cattle numbers and relatively low sheep numbers, the exact amounts being beyond the range of the data. Such a combination will not, however, produce the desired wool production.

Computation of the price ratio using the price of wool corresponding to 110 percent of parity and current livestock prices yielded a price ratio of 5.27 which cannot yield the desired production under the criteria set up in the analysis. Using current prices and solving for a wool price that would yield a price ratio of 4.56 gave a price of 87.6 cents per pound or a price of 150 percent of parity. This price would yield the desired production if price structures did not change.

The conclusion was that the National Wool Marketing Act of 1954 has little chance of success.

ACKNOWLEDGMENT

BIBLIOGRAPHY

Books

Clawson, Marion. _The Western Range Livestock Industry_. New York: McGraw-Hill Book Company, Inc., 1950.

Croxton, Frederick E. and Dudley J. Cowden. _Applied General Statistics_. New York: Prentice-Hall, 1939.

Heady, Earl O. _Economics of Agricultural Production and Resource Use_. New York: Prentice-Hall, Inc., 1952.

Kammlade, William G. _Sheep Science_. New York: J. B. Lippincott Company, 1947.

Snedecor, George W. _Statistical Methods_. Ames, Iowa; Iowa State College Press, 1946.

Stigler, George J. _The Theory of Price_. New York: The Macmillan Company, 1952.

Bulletins

Broadbent, Dee A., George T. Blanch, and W. Preston Thomas. _An Economic Study of Sheep Production in Southwestern Utah_. Utah State Agricultural Experiment Station Bulletin 325, August 1946.

Breimyer, Harold F. _100 Million Cattle?_ Agricultural Marketing Service, United States Department of Agriculture. Statement prepared for the Western Farm Economics Meeting, Estes Park, Colorado, July 26, 1954.

Cooper, J. M. _Range Sheep Production_. United States Department of Agriculture Farmer's Bulletin No. 1710, 1940.

Davidson, R. D. _Federal and State Rural Lands, 1950, With Special Reference to Grazing_. United States Department of Agriculture Circular 909, May 1952.

Gray, James R. and Chester B. Baker. _Organization, Costs, and Returns on Cattle Ranches in the Northern Great Plains 1930-1952_. Montana State College Agricultural Experiment Station Bulletin 495, December 1953.

Gray, James R. Southwestern Sheep Production and Costs Per
    Ranch with Emphasis on Wool and the Wool Situation. United
    States Department of Agriculture, Agricultural Research
    Service, Address given at 5th Annual Wool Clinic, Vaugn,
    New Mexico, March 10, 1955.

Harlan, C. L. United States Wool and its Relation to the World
    Situation. Foreign Agriculture Report No. 48. April 1950.

Heady, Earl O., Roger Wordworth, Damon V. Catron, and Gordon C.
    Ashton. New Procedures in Estimating Feed Substitution Ratio
    and in Determining Economic Efficiency in Pork Production.
    Iowa State College Agricultural Experiment Station Research
    Bulletin 409, May 1954.

Hochmuth, H. R. and Wylie D. Goodsell. Commercial Family-Opera-
    ted Cattle Ranches Intermountain Region 1930-47. United
    States Department of Agriculture, Bureau of Agricultural
    Economics, November 1948.

Hochmuth, H. R., and Earl R. Franklin. Sheep Migration in the
    Intermountain Region, United States Department of Agri-
    culture Circular No. 624.

Hochmuth, H. R. Commercial Family-Operated Sheep Ranches Inter-
    mountain Region 1930-50. United States Department of
    Agriculture Agricultural Information Bulletin No. 85. May
    1952.

Hormay, August L. Moderate Grazing Pays on California Annual-
    Type Ranges. United States Department of Agriculture
    Leaflet No. 239, August 1946.

Hutchings, Selar S. Managing Winter Sheep Range For Greater
    Profit. United States Department of Agriculture Farmers
    Bulletin No. 2067.

Mann, L. B. Western Cattle and Sheep Areas. Farm Credit Ad-
    ministration Circular No. c-103, September 1936.

Pickrell, K. P. An Economic Study of Range Sheep Production
    in Arizona. University of Arizona Agricultural Experiment
    Station Bulletin No. 134, December 1930.

Rouss, L. A., H. H. Morton, and F. J. Marschner. Inventory of
    Major Land Uses in the United States. United States De-
    partment of Agriculture Miscellaneous Publication No. 663,
    n. d.

Wooten, H. H. Major Uses of Land in the United States, United
    States Department of Agriculture, Technical Bulletin 1082,
    October 1953.

Working, Elmer J. _Demand for Meat_. Institute of Meat Packing, University of Chicago, 1954.

Governmental Documents

United States Department of Agriculture, _Agricultural Statistics_, Washington, D. C.: Government Printing Office, 1935-1954.

United States Department of Agriculture, Agricultural Marketing Service. (Livestock Division) _Market News_. Washington.

United States Department of Agriculture, _Livestock and Meat Situation_, Washington: Government Printing Office.

United States Department of Agriculture, Agricultural Marketing Service, _Crops and Markets_, Washington, D. C.: Government Printing Office.

United States Department of Agriculture, Agricultural Marketing Service, _The Agricultural Situation_, Washington, D. C.: Government Printing Office.

Articles

Heady, Earl C. "Elementary Models in Farm Production Economics Research," _Journal of Farm Economics_, XXX, May 1948.

AN APPRAISAL OF THE PROBABLE SUCCESS OF
THE NATIONAL WOOL MARKETING ACT OF 1954

by

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The hypothesis of this study is that certain types of economic analyses can be used to appraise the probable degree of success of some agricultural programs to a greater extent than they are currently being used. Since agricultural policies are playing an ever increasing role in the development of agriculture, such economic analyses as are helpful should not be overlooked. This study demonstrates the feasibility of using some tools in production economics to assist in an appraisal of the probable success of the Natural Wool Marketing Act of 1954, which provides a support price of 110 percent of parity for shorn wool in an effort to stimulate production to 300 million pounds.

Since the 14 Western states comprising the range livestock area produce approximately 75 percent of total shorn wool production it can be expected that most of the increase in production will come from this area. The success of the Act will depend largely on its ability to stimulate production in this area. The only other product that can compete with sheep in this area is cattle. Cattle and sheep utilize essentially the same resources. Since the two enterprises are largely competitive, producers shift from the production of one product to the production of the other as relative profitability dictates. Total resources in this area are constant over time except for random fluctuation of range conditions due to weather. The supply of land is fixed. Given this bundle of resources there is theoretically an infinite number of different combinations of sheep and cattle that can be produced. The decision to produce a

given combination of cattle and sheep must be based on relative
prices. The optimum resource combination is achieved when the
marginal rate of substitution between the two enterprises is
equal to the negative reciprocal of the price ratios.

The problem was to find a curve that represented all possi-
ble combinations of cattle and sheep that could be produced
within a relevant range. Observation of numbers of stock animals
on farms at discrete time periods during historical shifts in
production provided the basis for solution. Data was collected
on numbers of stock sheep and stock cattle on farms January 1
from 1920 to 1954. This period contained two significant shifts
in production--a shift from cattle to sheep as well as a shift
from sheep to cattle. The data was adjusted for trends in
horse and mule numbers and for changes in range conditions.
Some of the data was unusable, but a period from 1939 to 1946
containing a substantial shift from sheep to cattle proved use-
ful. The linear equation $Y = 114.68 - 4.5636 X$ fitted the
data as well as any. Y represents sheep numbers and X repre-
sents cattle numbers. The marginal rate of substitution of
cattle for sheep is -4.56, the coefficient of X, and remains
constant throughout the limits of the data. If the value of
animal products produced by one cow is less than 4.56 times the
value of animal products produced by one ewe, producers will
produce a combination of sheep and cattle represented by a
point at the upper extremity of the regression line. if the
price support level of 110 percent parity will cause the pro-
duction value ratio to be less than 4.56 the Act will be success-

ful.

The production value of cattle is a function of the percent
calf crop, weight of salable calves, weight of culled cows,
prices of all salable classes of livestock, and percentage of
total sales made up by each class of livestock. The production
value of sheep is a function of the percent lamb crop, weight
of salable lambs, weight of culled ewes, prices of all salable
classes of sheep, and weight and price of fleece.

Computing the production value ratio with average weights,
current prices and $.65 per pound wool (110 percent parity)
yielded a figure of 5.27 which is greater than 4.56, indicating
that the National Wool Marketing Act of 1954 cannot succeed if
present price structure prevails.

Using current prices and average weights and solving for a
wool price that would yield a production value ratio of 4.56
gave a price of 87.6 cents per pound, or a price of 150 percent
of parity. A price of less probably will not stimulate the de-
sired production in this 14 state area.

Since this problem was solved without unreasonable assump-
tions or departure from sound economic principles it is be-
lieved that this type of economic analysis may be used success-
fully in the appraisal of certain agricultural programs.