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INFLUENCE OF CLIMATIC CONDITIONS ON RETURNS FROM RANGE IMPROVEMENT

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Introduction

Many livestock ranchers in the foothill range area of California are using range improvement practices such as brush removal, range seeding, and fertilization as a means of increasing returns from forage and livestock production. In a recent study, alternative improvement practices to provide feed at critical production periods on foothill ranges and to increase the level of forage and livestock production, were evaluated for use by the major types of beef cattle operations found in the foothill area.[2/] Cow-calf operations producing weaner calves, cow-yearling operations, and stocker-feeder units were included in the analysis. This study suggests that within certain limitations as to price, cost, and production conditions, ranch income can be increased through the use of suitable range improvements. However, the study also indicates that many of the improvement practices applicable in the foothill area require relatively large initial investments

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2/ Rader, Lynn, C. O. McCorkle, Jr. and Douglas D. Caton, "An Economic Analysis of Range Improvements for Beef Cattle Production in the Sierra Foothill Area of California." Manuscript submitted for publication by the University of California Agricultural Experiment Station.

which must be recovered over a period of years. As a consequence, uncertainties associated with forage and livestock production become particularly important in decisions to engage in range improvement.

Major sources of uncertainty in range improvement and livestock production are related to possible variations in prices and to variability in production response resulting largely from climatic conditions. Historical fluctuations and trends in prices, and in climatic conditions, provide useful indicators to establish bounds on the variations in the returns which can be expected from improvement practices. However, adequate procedures have not been developed to completely incorporate these factors in an evaluation of range improvements.

Alternative levels of livestock prices (holding other determining variables at specified levels) were used to reflect the effects of the variation in prices experienced in the foothill area in recent years on returns from range improvements. What appears to be a useful means of assessing the effects of climatic conditions on forage and livestock production was also explored. This paper deals with the potential influence of variations in forage production on returns from selected range improvement practices.

Forage Production Response to Climatic Conditions

As with dryland crop production, adverse climatic conditions may cause partial or complete failure of many types of range improvement practices. For example, range seedings are very seldom "completely successful." Reseeding studies in Eastern Colorado indicate a 50 percent chance of complete failure

with the initial seeding.[3/] This, of course, applies only to the particular Colorado situation, but is indicative of the uncertainty experienced with range seeding practices. Unfavorable climatic conditions may not adversely affect practices such as brush removal or fertilization as severely as they do seeding. However, production response may still be delayed because of low temperatures and/or a lack of sufficient rainfall.

Annual fluctuations in the production of native vegetation at the San Joaquin Experimental Range in Madera County illustrate possible effects of climatic conditions on forage production in the California foothills.[4/] Average annual production of vegetation on this range area over a 25 year period has been about 1,700 pounds per acre.[5/] However, production has varied from 690 pounds to 2,600 pounds per acre. Since livestock producers in the foothills are especially concerned with the possibility that forage supplies may fall below some minimum level, the probability that realized production will be at specified levels below the average is of particular interest.

Analysis of the San Joaquin data suggests there is about a 50 percent chance that forage production will be 5 percent or more below the 25 year average in any given year, (Table 1). However, there is only a 25 percent

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3/ Sitler, Harry G. Economic Possibilities of Seeding Wheatland to Grass in Eastern Colorado, U.S. Agricultural Research Service, ARS 43-64, February 1958.

4/ The San Joaquin Range is typical of the variation in annual vegetation and forage production in the foothill area although it is probably not representative of the general level of production.

5/ Bentley, J. R. and M. W. Talbot, Efficient Use of Annual Plants on Cattle Ranges in the California Foothills, USDA Circular 870, Washington, D.C., May, 1951; Bentley, J.R. and R. F. Buttery, "Bumper Forage Crops--It Takes More than Just High Rainfall," Western Livestock Journal, August 2, 1957; Duncan, D. A. and J. N. Reppert, A Record Drought in the Foothills, Pacific Southwest Forest and Range Experiment Station, U.S. Forest Service, Berkeley, California, Miscellaneous Paper 46, March 1960.

chance that production will be 15 percent or more below average, and a 5 percent chance it will be 50 percent or more below the 25 year average.

Table 1

Estimated Chance of Reduced Forage Production as a Result of Climatic Conditions 1/

Expected Situation	Below Average	Percent chance that forage production will be below average by given amounts 1%	5%	10%	15%	25%	50%
		----------or more----------					
Below average 2/ production in any given year	50	--	50	40	25	15	5
Below average 3/ production over a 5 yr. period	60	60	35	20	5	-- 4/	-- 4/
Below average 3/ production over a 10 yr. period	30	25	15	-- 4/	-- 4/	-- 4/	-- 4/

1/ Based on 25 year records of forage production at the San Joaquin Experimental Range.

2/ Based on comparison of given year forage production with the 25 year average production.

3/ Based on comparison of the moving average production for 5 and 10 year periods with the 25 year average production.

4/ Less than 5 percent chance based on San Joaquin forage production data.

For five year intervals within the span covered by the San Joaquin data, there is a 35 percent chance that production in any five year period will be 5 percent or more below average, and only a 5 percent chance it will be 15 percent or more below the long term average. Over ten year intervals, the chance that forage production will be below average is considerably less. Based on the San Joaquin data there is only a 15 percent chance that production will be 5 percent or more below the 25 year average, and the probability is very low that it will be 10 percent or more below average over any ten year period. Thus, the experience at the San Joaquin range suggests that significant year to year fluctuations in forage production can be expected but, as expected, the chances of production being significantly below a long term average becomes less for longer time periods.

It is these annual fluctuations in forage production that create livestock management problems in the foothill area and contribute to uncertainty in year to year management decisions. Ranchers normally attempt to protect against this type of uncertainty by maintaining sufficient flexibility in their livestock operations to permit livestock feed requirements to be balanced with current forage supplies through changes in livestock inventories (purchase or sale of young animals) or purchase of additional feed.

Although relationships between climatic conditions and forage production on both native and improved range have not been determined, the influence will be quite similar for plant species with similar growth requirements. Assuming that forage production on improved range will respond to climatic conditions in a manner similar to native range, there is a relatively good chance that

forage yield may be from 5 to 10 percent below that expected (assuming expectations are based on long term averages) in the year a practice is initiated. However, the chances that climatic conditions in the foothill area will be unfavorable enough to cause a complete failure appear to be relatively low. This suggests that for practices such as nitrogen fertilization, which normally involve annual investments in fertilizer materials, ranchers may be well-advised to lower their expectations of return from this type of practice by at least 10 percent for planning purposes.

Forage production and returns from practices such as range seeding depend on initial success and continuing production. Thus, when ranch operators plan for improvement they are concerned with the joint chance of unfavorable conditions in the year a practice is initiated and the possibility of reduced production over the interval for which production is planned. For planning periods of from 5 to 10 years the chances appear to be relatively low that the initial year will be 50 percent or more below average. For five year periods, however, data for the foothill area indicate about a 30 percent chance that the initial year will be 25 percent or more below average and the period 5 percent or more below average. This would seem to suggest that ranch operators may want, for planning purposes, to reduce expected returns from this type of practice by at least 5 and probably more than 5 percent to allow for the possible influence of climatic conditions.

Effects of Climatic Conditions on Returns from Range Improvement

The potential effects of below average forage and livestock production on returns from improvement are illustrated by two practices evaluated for use by cow-calf operators producing weaner calves. Annual applications of nitrogen fertilizers on native range in the foothill area result in increased production of more nutritious forage. Fertilized ranges can be utilized by cow-calf operators during the green forage period--February through April--to provide increased rates of calf weight gains.

Returns from nitrogen fertilization of native range were evaluated on an annual basis. The estimated annual rate of return on investment in improvement at the most profitable rate of improvement and utilization was about 44 percent (Table 2).[6/] This rate of return is based on the assumption that forage and livestock production will meet expectations, in this case the average production experienced in fertilization trials.[7/] A reduction of 10 percent in forage and livestock production, which the San Joaquin data suggests is quite probable in any given year, would reduce the estimated rate of return on investment to about 30 percent.[8/] While the possibility of extremely

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6/ Based on average prices paid for stocker calves at the Stockton market over the 1959-64 period, and estimated 1964 improvement and livestock production costs.

7/ Expected production and returns could be based on the average or the most common (modal) level of production experienced by ranch operators in fertilization trials. The average production was selected as the criterion for an expected level.

8/ A direct relationship between forage and livestock production is assumed although the livestock producers response to fluctuating forage supplies is much more complex. Ranch operators normally have the alternative of utilizing ranges more heavily in poor forage years to maintain livestock production. However, this practice cannot be continued over time without a deterioration in range condition and eventual reduction in forage yield. Thus, the rate of stocking and, consequently livestock production on a particular range must ordinarily be related rather closely to available forage supplies in any given year.

Table 2

Potential Effects of Climatic Conditions
on Returns from Nitrogen Fertilization
for Increased Production with
Cows and Calves

Acreage Fertilized	Annual value of beef production[1/]	Annual cost of fertilization[2/]	Increased annual net returns	Rate of return on investment in improvement
Average conditions				
175	$3,344	$2,319	$1,025	44.2%
Forage Production 10% below average (40% chance)				
175	$3,010	$2,319	$ 691	29.8%
Forage Production 50% below average (5% chance)				
175	$1,672	$2,319	$-647	-27.8%

1/ Based on increased calf gains valued at the average price received for stocker calves at the Stockton market over the 1959-1964 period.

2/ Based on estimated 1964 costs for fertilzer materials and application.

unfavorable climatic conditions is much more remote, there is a small chance that production will be 50 percent or more below average in any given year. If nitrogen were applied in a year when this was the case, estimated returns from fertilization would not cover improvement costs.

Rose clover seeding followed by sulphur fertilization can be used in the foothill area to increase forage production and provide forage of improved quality. As compared to native range, where livestock weight gains decline as vegetation matures and becomes dry in the late spring, clover seedings can be utilized to maintain weight gains with calves and yearlings well into the dry forage period.

Returns from rose clover seeding for use by cow-calf operators were evaluated over a 5 year interval, as initial costs of seeding must be recovered over a period of time. Assuming average forage and livestock production for the period, the estimated annual rate of return on investment in improvement was about 7.7 percent, (Table 3). However, analysis of the San Joaquin forage production data suggests ranchers may want to reduce their expectations of returns from this type of practice by at least 5 percent. A reduction of this amount in forage and livestock production would result in an average annual rate of return on investment of about 6.4 percent. The more remote chance, about 1 in 20, that forage and livestock production will be 15 percent or more below average for the five year period would reduce the estimated annual rate of return on investment in clover seeding to 3.6 percent.

Table 3

Potential Effects of Climatic Conditions on Returns from Clover Seeding and Sulphur Fertilization to Provide Required Forage Production for Cows and Calves during the Late Spring Grazing Period

Acreage seeded	Annual value of increased beef production [1/]	Discounted investment in improvement [2/] (5 year period)	Increased net returns [2/] (5 year period)	Average annual rate of return on investment in improvement
Average conditions				
195	$1,591	$3,866	$1,495	7.7%
Forage and livestock production 5% below average (35% chance)				
195	$1,511	$3,866	$1,243	6.4%
Forage and livestock production 15% below average (5% chance)				
195	$1,352	$3,866	$ 691	3.6%

1/ Based on increased calf gains valued at the average price received for stocker calves at the Stockton market over the 1959-1964 period.

2/ Annual costs and returns discounted at 5 percent.

Summary

Evaluation of the potential effects of climatic conditions on returns from improvement practices is limited by available data. However, the present analysis is useful to point up the fact that ranch operators must consider the effects of climatic conditions in planning for range improvement and to give some idea of the relative impact reduced forage supplies may have on returns from improvement practices. The analysis suggests that suitable forage production data, if and when available, can be used as a basis for evaluating uncertainties associated with climatic conditions.