A Cost-Benefit Analysis of Seeding Abandoned Farm Land to Crested Wheatgrass by the Preparatory Crop Method

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THE selection of site, adapted species, and the proper time and method of planting are important factors to consider when planning to reseed deteriorated range land. Equally basic is the careful evaluation of the costs of and probable returns from the reseeding itself. This is especially true on privately owned ranches where reseeding, like all other sound range improvement practices, must pay its own way within a reasonable time. In reseeding, the direct benefits from increased herbage production alone must more than pay the reseeding costs. Otherwise, reseeding of private range lands cannot be fully justified.

In this respect, the vast expanses of plowed and abandoned range land throughout the West afford the best possible chance for successful reseeding. These areas are producing little forage, but have fairly uniform soil fertility and rainfall. The knowledge of how to reseed them is well established. During the past 15 years more than 1,500,000 acres of this type of land in Montana alone have been successfully reseeded to perennial grasses, primarily crested wheatgrass (*Agropyron cristatum*). Grazing animals do well on such reseeded range (Fig. 1). In general, the initial costs of seeding have been reasonable and the long-time dividends received have proved to be high. Herbage production and subsequent grazing returns from the reseeded areas

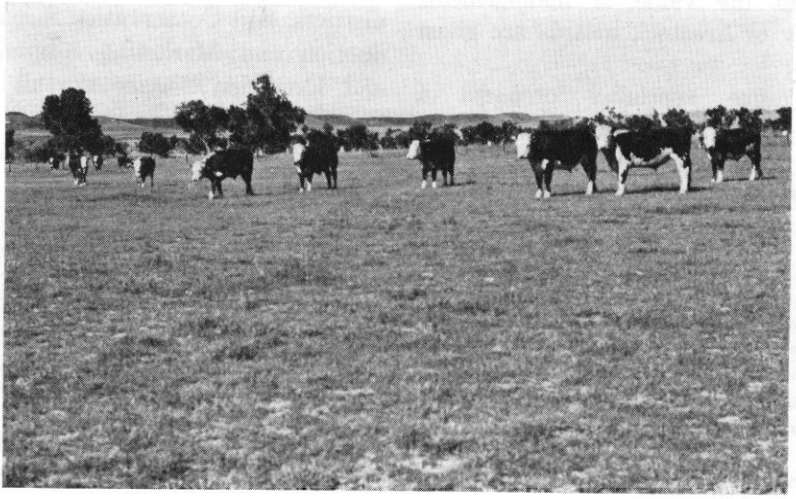

FIGURE 1. Grazing animals do well on reseeded crested wheatgrass range

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have been increased three to six times or more. These direct returns alone have been more than enough to justify the costs. Indirect benefits, such as watershed protection, reliable, well balanced herbage production, and over-all stabilization of the livestock industry have added to the returns and made these seedings highly profitable.

Recent development and application of cheaper, more effective planting methods have further improved the practicability of seeding abandoned plowed range land. Perhaps the most successful and by far the most practicable of these is the "preparatory crop method" of seedbed preparation, which has been used extensively throughout Montana for the past five years.

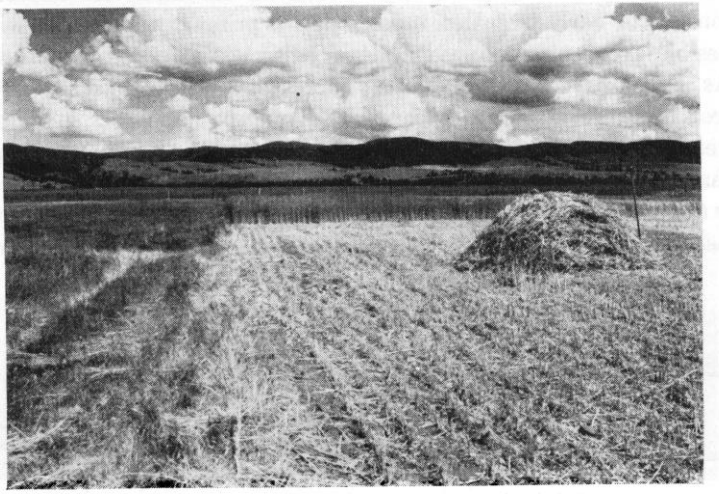

FIGURE 2. Preparatory crops can be harvested for hay, if desired, with good results

PREPARATORY CROP METHOD

The preparatory crop method is an efficient means of converting formerly plowed, cheatgrass-infested land to high, sustained forage production. It involves a season's cropping to a cereal grain followed by the seeding of a perennial forage grass. The cereal crop is harvested either as hay or grain depending on chances for the best returns (Fig. 2). Except in unusual cases, the returns from the harvested crop are ample to cover seeding costs. This prompt cash return is a direct benefit not realized from seeding operations where other planting methods are used. The cropping procedure also insures better seeding success. Past experience has clearly shown that dense cheatgrass (*Bromus tectorum*) must be eliminated or greatly reduced if reseeding is to be successful. This method not only eliminates cheatgrass by thorough plowing, but it also leaves a firm, stubble-protected seedbed in which to drill the perennial grass seed.

The soundness of preparing a range seedbed by cereal cropping was first demonstrated in Montana in 1943, in experimental plantings by the Northern Rocky Mountain Forest and Range Experiment Station (Research Note Number 38, "Seeding Crested Wheatgrass on Cheatgrass Land," by C. Allan Friedrich, March 1945). Stanley Antrim, a stockman and cooperator of the station, recognized its possibilities and pioneered

direct application of the method on his own sheep range.

Description and Use History of Study Area

The Antrim sheep range is located along the west foothills of the Sapphire Mountains in the lower Bitterroot Valley. It is part of a dry, alluvial benchland composed primarily of shallow, gravelly silt loam soils. It ranges in elevation from 3,200 to 4,000 feet. Average annual precipitation is approximately 12 inches at the lower elevations and 15 inches on the higher benches. This is mainly distributed through the spring and fall months. This range was originally bunchgrass, but during the war-inspired dry-farming boom of the early twenties, most of the accessible areas were plowed and cropped. As the production of crops, mainly wheat, became unprofitable and the fields were abandoned, cheatgrass invaded and has since formed the dominant cover. Since about 1935 this area has been used extensively for spring-fall sheep range.

In 1940 Antrim began reseeding small selected sites to crested wheatgrass. By 1943 about 150 acres had been successfully seeded by drilling on fresh plowing but the costs were high and not conducive to large-scale application on his range. With discovery of the preparatory crop method as a cheap, practical means of seedbed preparation, Antrim started large-scale range reseeding.

Method of Analysis

During the four-year period, 1943–1946, more than 1,000 acres on the Antrim ranch were seeded to crested wheatgrass by the preparatory crop method. Records of seeding costs, crop returns, and grazing use were kept for most of the area. In some instances complete records could not be maintained for individual seedings because numerous small areas were seeded simultaneously. Only those field operation records which were most definite and complete have been considered in this analysis. Therefore, the report is primarily concerned with the direct seeding costs and crop returns of only 585 acres of the total amount seeded.

The principal items, machine operation, labor, seed, protection from grazing, and deferment from grazing use, for which costs were incurred in the cropping and reseeding processes are itemized separately in Table 1.

TABLE 1

Costs of seeding crested wheatgrass by the preparatory crop method

Item	Preparatory crop		Crested wheatgrass		Total	
	Per acre	Total 585 acres	Per acre	Total 585 acres	Per acre	Total 585 acres
Machine operation	$ 5.70	$3,334.50	$0.55	$ 321.75	$ 6.25	$3,656.25
Labor	3.15	1,842.75	0.40	234.00	3.55	2,076.75
Seed	1.36	793.80	1.97	1,152.60	3.33	1,946.40
Protection	1.09	640.00	—	—	1.09	640.00
Grazing deferment	0.125	73.12	0.25	146.25	0.375	219.37
Total cost	$11.42	$6,684.17	$3.17	$1,854.60	$14.59	$8,538.77

Direct returns realized from the preparatory crop and the increased grazing benefits from the seeded areas are discussed in turn and balanced against the costs in the final analysis. Costs per acre for labor and machinery operations are the 4-year averages, 1943 through 1946,

computed directly from records kept by the operator. Those for grain and crested wheatgrass seed were current at the time of seeding. Fencing costs were correlated with Agricultural Adjustment Administration standards for 1944–45. Land-use deferment costs are based on the 1943–1946 average yearly rental per acre for similar range land in the general vicinity. Other important items are: the acres seeded, rate of seeding, crop yield, and grazing use.

Economic Aspects Reviewed

Costs

The total costs of seeding the 585 acres were approximately $8,538.78 or about $14.59 per acre. Planting and harvesting of the preparatory crop alone accounted for $11.42 per acre or 78 percent of the total. The remaining $3.17 or 22 percent was the average cost per acre of seeding the crested wheatgrass into the grain stubble.

Machine operation.—Those expenses concerned with plowing, harrowing, rolling, drilling, combining, and transportation for the grain, and drilling the crested wheatgrass amounted to $6.25 per acre or 42.8 percent of the total costs of reseeding. Of this $5.70 was chargeable to planting and harvesting the preparatory crop and the remaining $0.55 was the cost of drilling the crested wheatgrass in the grain stubble. Included here were the costs incurred for gas, oil, plowpoint replacements, and minor equipment repairs that could be tied directly to the seeding operations.

Labor.—This was the next big item with an average cost of $3.55 per acre or 24.4 percent of the total. The preparatory crop was responsible for $3.15 of this, and $0.40 per acre was attributed to the drilling of the crested wheatgrass. The labor and machinery operation costs were consistently higher throughout the grain cropping procedures than would be expected normally. In general, working conditions were difficult due to site adversities and unsatisfactory equipment. For instance, the operator estimated that the costs of harvesting alone were nearly doubled because of the necessity of using an old, inefficient grain combine.

Seed.—Seed cost $3.33 per acre or 22.9 percent of the total. The average costs of $1.36 per acre for grain and $1.97 per acre for crested wheatgrass seed were comparatively high for this type seeding. This was partly due to slightly inflated prices through the four-year period. Rather heavy seeding rates, 60 pounds per acre for grain and 8 to 10 pounds for crested wheatgrass were also justly responsible.

Protection from grazing.—About two miles of sheep-tight fence was constructed at a total cost of $640 or about $1.09 per acre. The fences were woven wire topped with one strand of barbed wire. They were constructed in 1944 and 1945 to protect the grain crops, but served to good advantage later to control grazing on the crested wheatgrass. All costs concerned with fence construction were charged to the preparatory crop. The expense for fencing was generally in line with the 1944–45 standard cost of $0.90 per rod set forth by the Agricultural Adjustment Administration for this type of fence construction. Judging from these per-acre costs, the amount of fencing which can be safely included in reseeding operations on sheep range is limited, especially since protection from grazing can be accomplished more economically in conjunction with the regular herding practices which are generally necessary anyway.

Grazing deferment.—Information as to the money invested, or average grazing returns from the land were not available

for this analysis. Therefore, the actual deferment costs were not definitely established. However, during the past six years similar grazing land in the general vicinity has had a yearly lease value (including the land tax) of from 20 to 30 cents per acre. With this as a basis the average lease value of 25 cents per acre, per year, was assumed to be the grazing value lost in deferment. Most of these seedings resulted in retirement of the land from grazing through a full 18-month period, one-third of which was chargeable to the preparatory crop and two-thirds to the crested wheatgrass. In this respect, costs of deferment due to the planting and harvesting of the preparatory crop amounted to $73.12 or 12.5 cents per acre. Those due to the crested wheatgrass amounted to $146.25 or 25 cents per acre. The total cost of deferring the 585 acres through an 18-month period was $219.37 or 37.5 cents per acre. This figured 2.6 percent of the total reseeding costs.

Returns

The four-year total grain yield from the 585 acres, when converted to cash value, amounted to approximately $11,195.25 or about $19.14 per acre. This represents the prompt, tangible cash return that has been described as the primary advantage of the preparatory crop over other methods for reseeding cheatgrass infested, abandoned lands.

The direct returns from the crested wheatgrass, although readily apparent, were more difficult to evaluate. The advantages in herbage yield or actual use were not determined during the four-year period. However, fairly accurate records were kept of the grazing use obtained from 350 acres through 1947 and 1948 (Table 2).

TABLE 2

Record of grazing use on a portion of the Antrim sheep range showing the yearly per-acre increase in grazing value due to reseeding

ACRES	YEAR OF RECORD	NUMBER SHEEP GRAZED	NUMBER DAYS GRAZED	TOTAL SHEEP DAYS	SHEEP DAYS PER ACRE	SHEEP MONTHS PER ACRE	YEARLY VALUE/ ACRE
350	1947 spring	325 (+620 lambs)	45	14,525	41.5	1.4	
350	1947 fall	1,900	15	28,500	81.4	2.7	
350	1948 spring	534 (+675 lambs)	50	26,700	76.3	1.9	
350	1948 fall	2,000	8	16,000	45.7	1.5	
Total 2-year grazing use						7.5	
Seeded range—average yearly grazing use						3.75	$0.80
Unseeded range—average yearly grazing use[1]						1.18	0.25
Increase in grazing value due to reseeding						2.57	$0.55

[1] By assuming the grazing use of 3.75 sheep months per acre representative for crested wheatgrass and correlating it with facts known about the Antrim range, the average grazing use from the cheatgrass range was computed thus:

Total range area seeded and grazed	1,200	acres
Total cheatgrass range grazed	3,800	acres
Average number sheep grazed per year	2,000	head
Average length of grazing season	4½	months
Average yearly grazing use (total range)	9,000	sheep months

Then: 3.75 × 1,200 = 4,500 sheep months yearly grazing use from total seeded range
9,000 − 4,500 = 4,500 sheep months yearly grazing use from total cheatgrass range
4,500 ÷ 3,800 = 1.18 sheep months per acre from cheatgrass range

The average use of the crested wheatgrass as determined here amounted to 3.75 sheep months per acre as compared to 1.18 sheep months per acre for the cheatgrass range. In terms of this comparative grazing use, the value of the seeded areas was computed at $0.80 per acre per year or an increase of $0.55 per acre over the value of the unseeded range. In addition to this increased return, other benefits, not recorded, such as better balanced forage and feed supplies and greater ewe and lamb weights would undoubtedly result from reseeding.

Cost-benefit Evaluation

As shown in Table 3, reseeding operations on this range were highly profitable. The cash benefits from the preparatory crops were primarily responsible. These alone netted an average $4.55 per acre more than the combined per-acre costs of cropping and reseeding. In addition to this prompt cash return, the benefits in increased grazing due to reseeding amounted to $0.28 per acre for the second year plus $0.55 per year thereafter. With good management grazing capacity could be increased to return even a greater grazing benefit.

natural and operational. The natural factors concerned with site, weather, current costs, land values, etc., are conditions of the times and not directly regulated by the individual. However, the operational factors, choice of practical methods, species, equipment, etc., can and must be effectively controlled if economic stability is to be maintained. This was evident throughout the seeding of the Antrim range.

The initial costs here were unusually high. The costs of seed, labor, materials, equipment operation, and upkeep were steadily on the increase. Adversities of site pushed the costs even higher. Under these conditions, economic seeding could not have been realized without efficient management; in this case, primarily by application of the preparatory crop to help defray the costs of seeding.

The crop returns were higher than expected when the method was applied. The plantings were made through a series of years having very favorable rainfall for grain production and every crop was harvested as grain. The yields were slightly below the long-time average for non-irrigated land in Ravalli County but as revenue they were amplified by high, current grain prices.

TABLE 3

Cost-benefit evaluation of reseeding by the preparatory crop method on the Antrim range

Average costs per acre (initial cash outlay) to plant and harvest preparatory crop	$11,42	
to seed crested wheatgrass into the crop stubble	3.17	
Total costs per acre	$14.59	
Average returns per acre (direct cash value) from preparatory crop (a first-year return, nonrecurrent)	$19.14	
from increased grazing value (none the first year, half of full value, $0.28, the second year and full value, $0.55, recurrent thereafter)	$ 0.83	
Total returns per acre reseeded	$19.14 + $0.28 + $0.55 recurrent	
Net cash gain per acre reseeded (3-year period)	$ 4.55 + $0.28 + $0.55 recurrent	

Factors Affecting Costs and Returns

The economics of reseeding are controlled by a combination of factors, both

This study did not determine to what extent the greater returns were offset by

the higher costs. However, the following examples show how this material can be used basically to determine if the seedings would have been feasible under varying physical and economic conditions:

1. Would seeding with the same degree of seedbed preparation have been justified under the existing economic conditions without the benefit of the preparatory crop? With such a procedure, total costs would have been $8.86 per acre for reseeding. Seed, protection, and deferment costs would remain the same but machine operation and labor would increase to $3.35 and $2.20 per acre, respectively. Assuming the same return in increased grazing computed at full value after the first year and including interest at 5 percent, it would require about 17 years to meet the seeding costs. From the standpoint of increased forage alone, these costs would be prohibitive on the smaller ranches. However, by knowing where the costs were excessive, efficient management could promote a marked over-all cost reduction. This actually occurred with a similar seeding not included in this analysis. Machine operation and labor costs were cut about one-third by use of better adapted equipment. Fencing was not included and rate of seeding was reduced. As a result, the over-all costs of this later planting were estimated at slightly over $5.00 per acre.

2. What would the cost-benefit evaluation of these seedings have been with the same economic conditions, but with less favorable moisture?

A reduction in moisture or a less favorable distribution would have resulted in reduced yields from the preparatory crop. Some plantings would have been harvested for hay and a few perhaps for grain but with a much lower yield. Assuming all 585 acres had gone into hay production yielding a ton per acre at an average value of $12.00, the return would have been $12.00 per acre. If haying costs can be assumed about equal to combining costs, the average return per acre would have amounted to $2.59 less than the total cropping and seeding costs. At $0.55 per acre per year return from increased grazing, the cost of seeding would be met by the end of the fifth year. Seedings under these conditions would still have been economically sound.

Following the same line of reasoning, had the crops been harvested for grain but with only half the yield, the return per acre would have averaged only $9.45 or $5.14 per acre less than the total. The return from increased grazing would meet this deficiency the tenth year after seeding. This would still have been good practice on most ranches.

Application of Results to This and Other Areas

The areas and conditions which obtained for the seedings used in this analysis are typical of thousands of acres of abandoned plowed land in the Bitterroot Valley alone. Also, closely similar are some three million acres more throughout Montana that are either now abandoned or subject to abandonment in the near future. All of these can and many should be seeded to a perennial grass cover. Use of the preparatory crop offers a practical means of making these seedings profitable. The results reported herein are representative of what can be expected elsewhere under similar conditions. However, as indicated previously, when physical and economic conditions vary, the cost-benefit evaluation will vary accordingly.

Summary

Upwards of three million range acres throughout Montana are either in the plowed-abandoned stage now or have been recropped in recent years. As grain

prices decline or dry years occur the less productive areas will again be retired from crop production. Most of this acreage provides an excellent opportunity for successful reseeding. AND MUCH OF THE SEEDING CAN BE DONE WITH A PROMPT CASH RETURN THAT WILL MORE THAN COVER RESEEDING COSTS. This is currently being done in some sections of the State by use of the preparatory crop method of seedbed preparation. This method was applied in making numerous seedings of crested wheatgrass through the four-year period 1943-1946, on the Antrim sheep ranch near Stevensville, Montana. A cost-benefit evaluation of 585 acres of these seedings was made possible from records kept by the operator.

The four-year average cost of seeding was $14.59 per acre. Machine operation, plowing, harrowing, and rolling, drilling, combining, transportation, upkeep, etc., accounted for nearly half the cost with $6.25 per acre or 42.8 percent of the total. Labor amounted to $3.55 per acre or 24.4 percent. Seed costs followed closely with $3.33 per acre or 22.9 percent. One dollar and nine cents per acre went for fence construction and $0.38 per acre for land-use deferment. In percentages, these were 7.5 and 2.6, respectively. All together $11.42 per acre or 78 percent of the total costs were attributed directly to planting and harvesting the preparatory crop. Seeding of the crested wheatgrass accounted for the remaining 22 percent.

The return for grain harvested from the 585 acres during the four-year period amounted to $19.14 per acre. An additional $0.55 per acre per year was realized from the increase in grazing value due to reseeding.

The cash benefits from the preparatory crop alone netted $4.55 per acre more than the combined per acre costs of cropping and seeding. In addition, 55 cents per acre per year was realized after the second year through the increased grazing value of the seeded areas.

However, seeding with the same degree of preparation could not have been justified under the existing operational and economic conditions without the benefits from the preparatory crop. In this case it would have cost approximately $8.86 per acre to reseed. With an increased grazing value of only 55 cents per acre, it would require 17 years to meet the initial investment. Small operators could not afford to wait this long.

Other assumptions show that the same seeding procedure under less favorable moisture conditions would probably have still turned out well for the operator. For instance, had it been necessary to harvest the preparatory crop for hay rather than grain, the prompt cash return would have been sufficient to cover all but about $2.59 of the initial costs. Or, if the harvest had been for grain, but with only half the yield, the cash return would have defrayed all but $5.14 of the costs. In both cases, seeding would have been economically feasible.