Analysis of Fence Construction Costs

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The Oregon Range Evaluation Project (EVAL), in John Day, Oregon, was an 11-year interagency effort to implement various intensities of management on private and federal rangeland. The approach was to develop coordinated resource management plans for private and associated federal lands. For each plan, EVAL set a priority for improvements and, in cooperation with owners and managers, selected the range improvements that met goals and objectives consistent with resource conservation and management philosophy.

Plans were developed for 21 ranches and 18 associated allotments. These plans included the selection and scheduling of more than 1,000 range improvements for implementation during a short period. The objective was to apply "state-of-the-art" range management techniques and to monitor the effects of management on resources and associated products.

The EVAL project provided a unique opportunity to capture and analyze the costs of constructing fences. A system was established to trace the actual labor, equipment, and material used in constructing fences, by size of the fence project and by ecosystem. From 1976 through 1984, the EVAL project constructed 127 fences on more than 210 miles of forest and range land.

Procedures

All fences, private and public, were constructed to the same specifications. Cooperators, contractors, and agency personnel implementing range improvements were required to record the amounts and kinds of labor, equipment, and material used for each fence. Contractors did most of the construction work on federal lands; minor amounts were done by federal employees. On private lands, the work was split between contractors and private landowners.

Labor was recorded by type of work and was separated into skilled and unskilled. Equipment was recorded by type and total time used, miles driven, and work accomplished. Cost information was for the amount and kind of labor, material, and equipment used, rather than the actual dollars spent on the project. Actual costs would have shown the effect the EVAL project had on local contracting; the demand for contractors was more than could be supplied by the local economy. A list of rates and charges was established for labor, equipment, and material (F.O.B. John Day, Oregon), based on 1978 dollars. These rates were applied to each type of fence construction to determine 1978 dollars for each cost category and converted to 1986 dollars by applying price indices. All costs can be converted to a different base year by using indices reported annually by the USDA Statistical Reporting Service.

Definitions for labor followed closely those in Duran and Kaiser (1972). Skilled labor included all labor requiring special training or knowledge, such as chain-saw operators, truck drivers, and heavy equipment operators. Unskilled labor included post-hole diggers, fence builders, and other hand laborers. Some work required two people, one to operate equipment and the other to act as a guide or to move materials and drive another vehicle with materials to the site. Thus, the time reported as "driving" was considered skilled labor, whereas the time used assisting another operator was considered unskilled, even though the same person was involved.

Fences were usually constructed through more than one ecosystem. Because costs varied by ecosystem, it was important to track the percentage of each ecosystem involved. Each fence was mapped by ecosystem, and the percentage of the total fence length in each ecosystem was recorded. For example, a 2-mile fence constructed through a Douglas-fir (1.0 miles), a ponderosa pine (0.75 miles), and a mountain grassland (0.25 mile) ecosystem was recorded as 50, 37.5, and 12.5 percent, respectively, of each.

Fence costs were allocated to their ecosystem components by regression analysis based on the proportion of fence length in each ecosystem with each cost category. For each type of fence, four regression equations were estimated, one each for skilled labor, unskilled labor, equipment, and material (Table 1).

Permanent Wire Fence

The average cost for forested (Douglas-fir, ponderosa pine, larch, and lodgepole pine) ecosystems was 60 percent greater than for non-forested ecosystems. In forested ecosystems, the costs were about evenly divided among cost categories; in non-forested ecosystems, costs were mainly for material and unskilled labor. Thus, forested ecosystems required additional investments in skilled labor and equipment. Size of fence projects was a significant factor for unskilled labor and materials. Large fences required less unskilled labor per mile ($148) than small fences because of the time required to move materials and equipment at the beginning and end of each project. Dividing this time among more miles of fence results in reduced per-mile labor expense. The cost of materials was $189 per mile more for large projects than for small ones; more on-site materials were used for short

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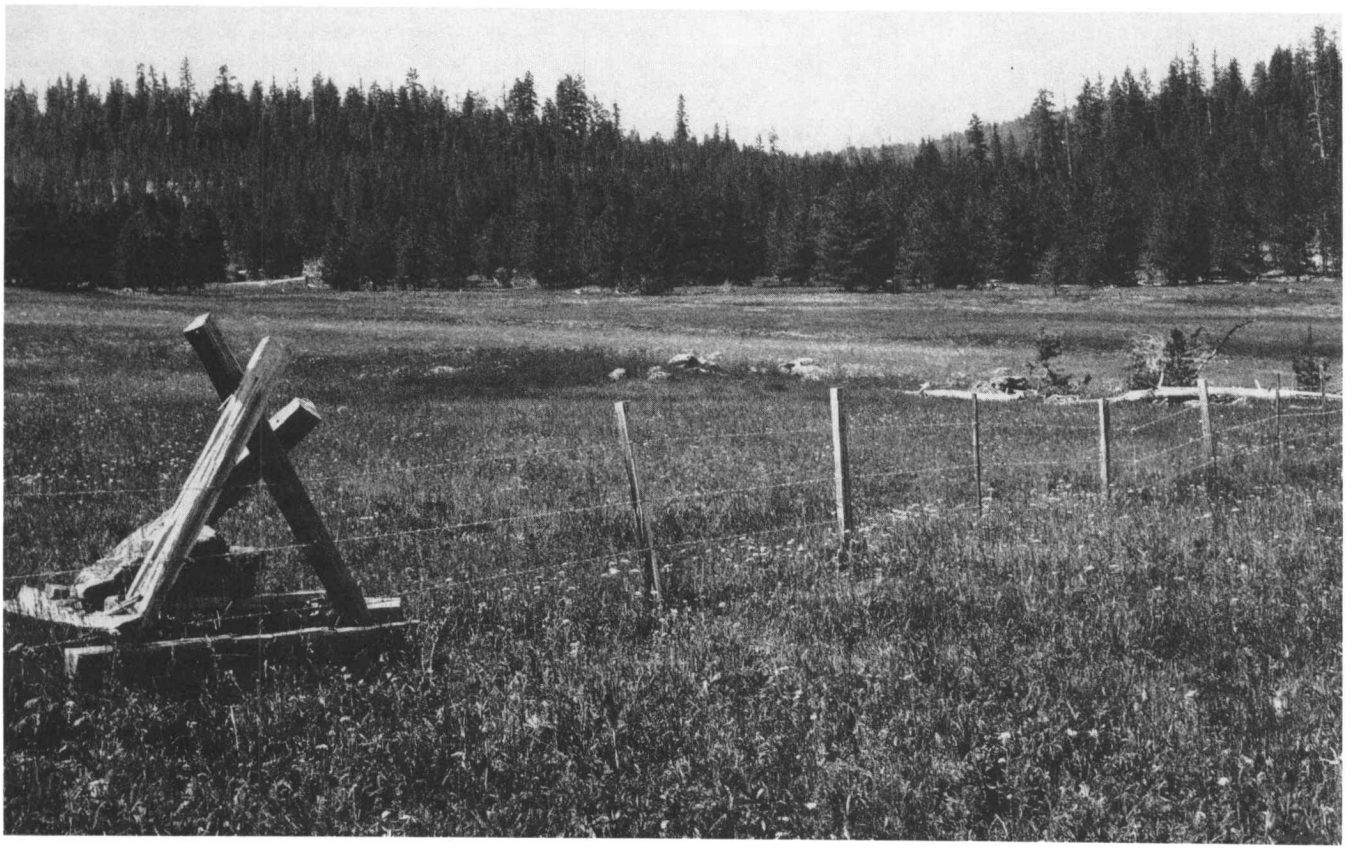
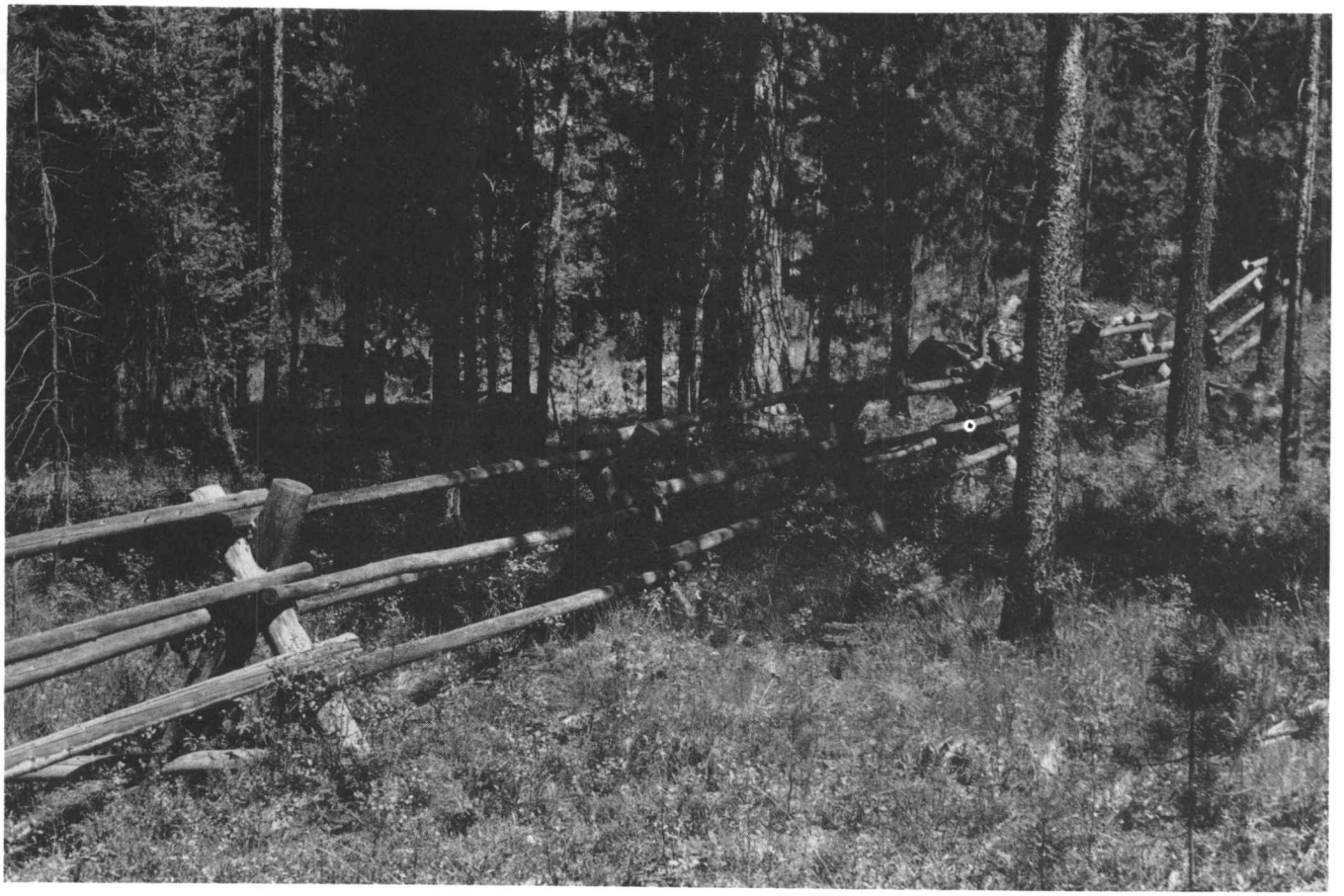


Typical permanant wire fence in the mountain grassland and mountain meadow ecosystem.



Buck-and-pole fence typical in the forested ecosystems.

fences. These two offsetting factors, unskilled labor and material costs, resulted in no significant size of fence factor in total average costs.

Let-down Wire Fence

The size of the project did not significantly influence per-mile costs. Labor was more than 50 percent of the total cost for the forested sites, whereas most of the expense for non-forested ecosystem was for material and equipment.

Wire-fence Reconstruction

Size of the project did not significantly influence per-mile costs. Costs for materials were generally small because old fence materials were reused and new wooden posts and stays were made from materials on the site. As with fence construction reconstruction on forested sites was more expensive than on non-forested sites. Most costs were for labor on forested sites, whereas most costs on non-forested sites were for materials. One fence cost substantially more because very little of the old fence material could be used in the reconstruction and made the total costs for the ponderosa pine ecosystem high.

Fence Removal

Costs were split between labor and equipment. Average total costs per mile were reduced by $88 per additional mile of fence removed, and unskilled and skilled labor costs $38 and $23, respectively. Combined labor costs show small differences among ecosystems ($344 to $388), whereas equipment differences are substantial ($201 to $331). The ponderosa pine ecosystem, which had the highest total cost, had the highest cost for equipment.

Fence Construction Factors

Equipment expenses included costs for transporting crews and material to the work sites. Fence removal required little, if any, chain-saw or heavy equipment work

Table 1. Fence costs by ecosystem and type of fence.

Fence category and ecosystem	Average cost per mile, 1986 base year[1]				
	Skilled	Unskilled	Equipment	Material	Total
Permanent wire fence:	----------	----------	Dollars	----------	----------
(97 cases, 154 miles)					
Larch	1111	1909	1533	906	5462
Douglas-fir	977	1143	1217	1611	4951
Ponderosa pine	787	1416	1104	1140	4448
Sagebrush	445	1232	622	1214	3515
Mountain grassland		1123		1839	3131
Mountain meadow		720		1833	2867
Juniper		1042		1664	2839
Overall average	639	1235	838	1514	4226
Change in per-mile cost[2]		-148		189	
Let-down wire fence:					
(16 cases, 45 miles)					
Douglas-Fir	1302	1850	1086	1495	5733
Lodgepole pine		3091		1403	5217
Sagebrush		1456		2202	5208
Larch	1093	1258	997	1386	4734
Alpine		963	1087	1009	3615
Overall average	1039	1430	1012	1508	4989
Wire fence reconstruction:	----------	----------	Dollars	----------	----------
(14 cases, 12 miles)					
Ponderosa pine	1181	2276	1120		4673
Douglas-fir		1804			3290
Larch	616		758		2029
Mountain grassland		637		1071	1919
Overall average	323	1339	316	645	2623
Fence removal:					
(46 cases, 65 miles)					
Ponderosa pine	148	228	331		704
Larch	139	249	219		609
Douglas-fir	166	178	201		550
Overall average	142	214	214	2	572
Change in per-mile cost	-23	-38			-88

[1]Costs that did not differ significantly from zero are left blank. Costs may not sum to the total shown because costs are regression coefficients. Overall averages are simple means. Costs converted from 1978 to 1986 dollars by multiplying with 1.51 (ratio of 1986 and 1978 prices paid index for agricultural production items with non-farm origin).

[2]Change in per-mile fence construction costs for each additional mile of fence constructed. Negative values indicate reductions in average cost per mile; positive values indicate an increase in average cost per mile.

Rock jacks were commonly used in construction of wire fences on the shallow or rocky soils.

to clear rights-of-way. Significantly greater amounts of skilled labor were required for constructing let-down wire fences than for other fences. Fence removal and reconstruction required the least amount of skilled labor.

Differences in the amount of unskilled labor required were not significant for fence construction or reconstruction. Fence removal required the least amount of unskilled labor. Larger wire-fence construction and removal projects had a lower cost per mile for unskilled labor.

Fence removal was the only fencing project where average total cost per mile decreased as fence length increased. Based on this finding, average costs might be reduced if fence removal is done as one project. If the use of labor is a concern, planning projects for constructing and removing permanent wire fences may reduce the per-mile expense for unskilled labor.

Costs for reconstructing fences were significantly less than for either permanent or let-down wire-fences, primarily because of the low requirements for equipment and material. Costs for let-down fences are usually higher than costs for permanent wire fences. Let-down fences, however, require more skilled labor for construction than any other wire fence, primarily due to the more complex specifications and wire tension requirements.

Planning fences for range improvements should include careful consideration for the ecosystems involved. Modifying the fence layout to avoid an ecosystem with higher construction costs may be possible. Permanent wire fences constructed in Douglas-fir and larch ecosystems are the most expensive, those in mountain meadow and juniper the least expensive. The size of the fence project undertaken does not appear to affect the per-mile costs for new fence construction; however, cost savings are $88 per mile when larger fence removal projects are undertaken.

Literature Cited

Duran, Gilbert, and H.F. Kaiser. 1972. Range management practices: Investment costs, 1970. USDA Agriculture Handbook 435. 38 p.