TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE PORTLAND, OREGON SOIL CONSERVATION SERVICE

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The attached information on Acreage Increase Due to Slope by E. William Anderson, State Range Specialist, was published in Journal of Range Manangement Vol 25, No. 4, Pages 316 - 317.

It may be helpful in a number of ways to those of you who deal with resource programs in hilly or mountainous areas.

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Attachment

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Acreage Increase Due to Slope

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Acreage usually is determined from a map. Maps represent plane or horizontal distances and acreages. Actual surface areas exceed map acres according to steepness of the terrain. Table 1 shows the degree to which actual surface acres exceed map acres according to slope gradient.

Areas having 40 to 75% slope gradients are common in the mountainous West. Surface acres on these steep areas exceed map acreages by 9 to 25%. Very steep areas having slope gradients in excess of 75% are less common but do occur over sizeable areas. They are important locally as watersheds, game ranges, and, to a lesser degree, as livestock ranges. They often provide excellent scenery.

It is not uncommon among resource workers and others to encounter those who do not understand "percent" slope. To them, for example, a 100% slope is straight up—90°. Actually, a 100% slope has a vertical rise of one foot for each foot of horizontal distance. In construction it is called a one-to-one slope. It is a 45° slope. Figure 1 graphically illustrates how slopes of various gradients look when drawn in cross-section.

Acreage increase due to slope becomes implicated in resource planning and management of very steep areas. For example, actual surface acreage might be important for predicting such items as the amount of potential water represented by a snowpack.

Table 1. Percent slope, corresponding degree of slope, and percent increase in surface acres over horizontal map acreage.

Slope (%)	Slope (Degrees)	% Acreage increase[1]
5	2° 52′	0
10	5 43	0
15	8 32	1
20	11 19	2
25	14 02	3
30	16 42	4
35	19 17	6
40	21 48	8
45	24 14	10
50	26 34	12
55	28 49	14
60	30 58	17
65	33 01	19
70	34 59	22
75	36 52	25
80	38 40	28
85	40 22	31
90	41 59	35
95	43 32	38
100	45 00	41
125	51 20	60
150	56 19	80
175	60 15	102
200	63 23	123

[1] Increase surface acres over horizontal map acres.

Surface acreage is one of several factors involved in the amount of grazing use that is actualy obtained from very steep rangelands or grazed woodlands under good management. Cook (1966) concluded that actual use is the most accurate method of determining the amount of grazing obtainable on a particular mountain slope.

Also involved is the question of whether or not very steep slopes produce more vegetation per unit of horizontal area than do moderate slopes. Some accept the concept that the spatial requirement of plants is dependent upon vertical spacing rather than slope surface

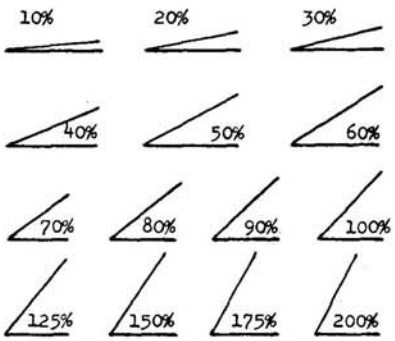

FIG. 1. Graphic presentation of slope steepness as related to percent slope.

area. A good example often cited is the way trees grows vertically on all slopes and can tolerate only so much crowding together irrespective of slope gradient. Whether or not this concept applies to herbaceous vegetation on slopes steep enough to significantly increase the actual acreage over map acreage might be debated. White (1967), studying purple needlegrass (*Stipa pulchra* Hitchc.) on slopes between 5 and 50% gradient, found that basal area intercept and quadrat frequency were greater on steep slopes than on moderate slopes. On the other hand, he found that clipped weights for all live plants were greater on the gentle slopes. Since "steep" slopes he studied were less than 50% gradient, they increased map acreage less than 12%. One might question whether or not the same results would have been obtained in regard to herbage yields on very steep slopes that increase map acreage in excess of 20%.

Forage on very steep slopes usually is considered to be less available than on moderate slopes for cattle grazing (Mueggler, 1965; and Cook, 1966). This probably does not apply to grazing by wildlife whose natural habitat includes very steep

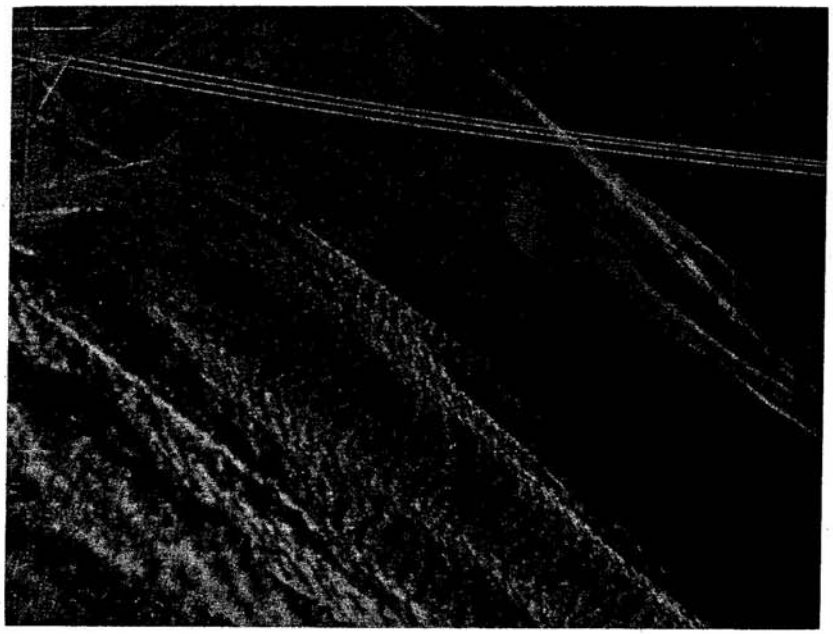

FIG. 2. Cattle grazing on a 90 percent slope in the Imnaha—Hells Canyon rangelands of northeastern Oregon.

areas. It also applies to a lesser degree to grazing by cattle that are accustomed to very steep terrain, and to situations where an entire pasture consists of very steep land. Figure 2 shows Hereford cattle (circled) grazing a slope having 90% gradient. This is a common sight in the famous Imnaha—Hells Canyon rangelands of northeastern Oregon where slopes this steep, and steeper, extend about 4,000 ft upward from the river. The cattle that graze from bottom to top and between the rimrocks on these precipitous slopes are raised locally on this kind of terrain. Flat-land cattle would probably starve to death on these very steep but very good rangelands.

It is imperative in resource planning and management of very steep areas to fully consider and provide for stability of the resource. Some very steep sites remain stable under judicious grazing use. Others are affected detrimentally merely by having animals walk across them.

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