SOIL EROSION—III.

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THE EFFECT OF GROUND COVER AND LITTER.

Measurements of loss of fertility in soils subject to erosion are closely linked with the actual loss of soil. Numerous data are available showing how serious this can be, the difficulty in interpreting such figures being that the conditions responsible for the losses vary considerably from place to place according as climate, topography and soil type themselves change. These aspects of the problem will be referred to in their turn but the most important practical feature of soil erosion studies will always be the relationship of the crops grown to the severity of the loss. In the present section of this article three related features will be dealt with: the nature of the crop, the effect of living ground cover, and the effect of debris shed by the crop or crops under cultivation.

THE SPACING OF THE CROP.

One of the most prevalent fallacies regarding soil erosion in Ceylon is that a good covering of tea offers adequate protection. This is demonstrably not the case. Granted that the beating action of heavy rain is minimised by the foliage, such protection as this affords leaves untouched the question of the rate at which the bare soil beneath can absorb the rain which ultimately reaches it. So long as the percolation rate of water through the soil remains less than the precipitation rate at the bare ground surface soil erosion is bound to occur in varying degrees of severity on sloping land. The only remedy is to *fix* the soil.

Interesting figures dealing with liability to erosion of various types of crop are given by Bates and Zeasman at Wisconsin. From measurements of run-off over a period of years they arrived at the following average figures for different types of crop, expressed as the percentage of rain that ultimately became run-off. Forest land

Forest	...	2·8	Small grain	...	25·6
Wild pasture	...	7·2	Maize	...	25·7
Cultivated hay	...	17·7	Seeded pasture		26·7

stands in a class apart; it combines high and ground cover and a layer of litter about which more will be said later. Natural pasture is highly efficient, but all forms of cultivated crops, no matter how closely planted, allow of considerable erosion. This is understandable when one considers that during part of their growth a large part of the superficial area over which they are distributed is really bare fallow. A crop of the maize type regularly spaced is a poor protection in spite of its leafy growth, giving as it does the opportunity for a quarter of the total rainfall to appear as soil-transporting run-off.

These results do not stand alone; they are remarkably confirmed by the classic experiments at the Missouri Experiment Station over a period of six years. On these plots where a useful comparison can be made they agree well with the Minnesota results.

Run-off as Percent Rain.

Grass Sod.	...	11·55
Wheat.	...	25·19
Maize.	...	27·38

To return to the consideration of tea; here is a widely planted crop regularly denuded of foliage and having a relatively complete cover for only a limited time. Even at this favoured period, for reasons outlined above, the bushes' efficiency in the preventing of erosion is far from satisfactory. In short, to rely upon tea foliage to prevent erosion is to turn a blind eye to the necessities of the situation.

LITTER AS A PREVENTATIVE.

There is no need to press further the claims of ground cover as the best control measure, and attention will be directed to some new and remarkable work on the effect of litter from trees on soil and water movement. Investigations have been in progress for some time at the Forestry Research Station, California, on the percolation

of rainfall through forest soils. Lowdermilk transferred forest soil layer by layer into a series of specially constructed tanks which were subjected to artificial rain falling at known rates for various time periods. The whole apparatus is a model of careful conception, allowance being made for collecting and measuring run-off and percolation water with considerable refinement. After allowing time for settlement of the soils in the tanks, the leaf mould litter on the surface of half of them was carefully burned off by means of a blow-lamp torch. The results from no fewer than eighty trials are summarised below.

Surface Run-off as percentage of Run-off and Seepage 200 inches artificial rain.

Soil Type.	Aiken.		Holland.		Altamont.	
	Burned.	Unburned.	Burned.	Unburned.	Burned.	Unburned.
70 runs 1927.	30·7	3·5	31·2	13·0	47·8	4·1
10 runs 1928.	38·7	0·7	40·8	21·9	62·6	1·3

Though there are differences in detailed behaviour between the three types of soil, to which reference will be made later in dealing with soil erosion on different kinds of soil, these data are consistent in showing how little run-off the naturally littered soil allows. This in itself severely restricts the amount of soil that can be removed, besides curtailing the opportunity for such run-off as occurs to become loaded with soil particles.

A STUDY OF PERCOLATION RATES.

But the results are chiefly of interest because of Lowdermilk's explanation of the phenomenon. Is the decrease in run-off due simply to the sponge-like capacity of the litter ? That can hardly be the case since even in the less favourable instance of the Holland soil the litter would be compelled on this hypothesis to hold up between 60 and 70 inches of rain. Lowdermilk showed that the absorption capacity of the litter was experimentally insufficient to

retain the apparent run-off deficit, and suggests that the litter, by keeping the soil underneath porous, enhances its natural capacity for percolation. In order to demonstrate this he percolated ordinary soil with clear water first and with muddy water afterwards. The result was a 90 per cent. diminution in percolation within six hours of using the turbid water; the seepage remained clear. On reverting to clear water no improvement was observed. This confirms his view that in the absence of litter the small clay particles of the soil are washed down into the soil pores and become a filter. Such a filter even though insignificant in thickness would completely determine the percolation rate of the soil underneath. On Lowdermilk's explanation the percolation effect of litter becomes of greatest importance whilst the absorption effect takes only a secondary place. In Czecho-Slovakia similar results have been obtained. After complete saturation of the litter the percolation through the soil remained undiminished. Further work at the Central States Forest Experimental Station, U.S.A., bears out the results of these investigations. The percolation of water through littered forest soil and similar unlittered agricultural land was measured depth by depth. Taking the agricultural soil as unity there were remarkably superior percolation rates on forest soils.

Depth. inches.	Percolation rate of forest soil: agricultural soil at unity.
1	50
3	17
8	2·5

Further investigation showed that it was not necessary to go to the length of completely denuding the land by agricultural operations in order to destroy the percolation effect. Grazing in forest soils had an effect just as marked.

This work brings out a new and important point—that litter, by which is meant unhumidified vegetable remains, has an effect in inducing rapid and continuous percolation that even richly supplied humus soil cannot equal, and that as a corollary litter counters soil erosion effectively and preserves the underground water supplies for use in drought conditions.

GREVILLEAS IN TEA.

The point of contact of this work with tea culture is, it seems to us, the use of the Grevillea. It is a matter of constant comment that the Grevillea cover in many planting districts has of late years been severely depleted and to many planters this is now a matter for regret. The arguments for and against Grevillea must be thought out by individuals to suit their local requirements, but direct observation and the experiments just quoted make it certain that its use offers a positive contribution not only to soil erosion prevention but to porosity and aeration of permanently cultivated land.