

# SOIL EROSION.

## THE MEMORANDUM OF THE IMPERIAL BUREAU OF SOIL SCIENCE.

### (REVIEW)

The recent Memorandum of the Imperial Soil Bureau\* summarises work and inquiries into soil erosion in India, Ceylon, South Africa, New Zealand, Nyasaland, and the United States of America. For the purposes of this review only those aspects of the problem of combating the damage which are relevant to tea cultivation are reproduced. At the same time comparisons will be made with the evidence given by the Tea Research Institute before the Ceylon Committee.

### WATER RETENTION.

The memorandum draws attention to the fact that even though soil erosion may appear to be a very slow process, it is in fact very rapid in comparison with the reverse process of building up soil in an agricultural sense. Virgin soils opened for cultivation are often the product of many centuries of soil-building through the agencies of forest and grass-land. Coupled with the actual loss of soil is the loss of water supply. In the Union of South Africa, evidence was given of the marked decrease in underground water, and in Nyasaland the gradual deepening of gullies due to erosion caused a lowering of the water table with consequent harmful effects upon the moisture of the surface layers of soil upon which crops under cultivation depend during periods of drought. These findings confirm the recommendations stressed in our evidence that, wherever possible, water should be kept on the land by increasing the soil permeability and by such devices as bunds, contour and banded drains.

### TRANSPORT OF FINE EARTH.

Interesting figures are quoted for the sizes of particles that can be transported in streams of running water such as occur in normal drains. Our evidence emphasized the fact that unless the flow in drains was checked, the ordinary silt-pit was relatively inefficient as a collector of the valuable fine particles. The memorandum gives the following figures for the transportation of particles of various kinds:—

Silt requires a velocity of	0.25 ft. per second.
Loam requires a velocity of	0.50 „ „
Sand requires a velocity of	1.00 „ „
Gravel requires a velocity of	2.00 „ „
1 in. Pebbles require a velocity of	3.50 „ „
Broken Stone requires a velocity of	4.00 „ „
Chalk and Soft Shale require a velocity of	6.00 „ „

\* Imperial Bureau of Soil Science. Technical Communication No. 5. Soil Erosion. December, 1929.

In the supplementary evidence of the Institute reference will be found to the quantity of water the drains in the Felsing system can deliver. From a modification of the same formulae, the velocity of water in a 1 in 30 open drain can be derived. The value for a 3 in. flow amounts to 0.88 ft. per second. It is therefore evident that silt and loam are frequently lost in drains where the silt-pitting system is such that no positive barrier is imposed to diminish the velocity of the running stream. The memorandum points out that since, as demonstrated above, the velocity of run-off is the all important factor in erosion, short heavy downpours are most significant as erosive agents, and total rainfall is a very inadequate measure of erosive power.

#### SLOPE OF LAND.

The importance of slope of land in helping erosion is obvious, and to give this a quantitative confirmation the memorandum quotes a three-year experiment in Missouri where starting from a gradient of 1 in 27, each 1% increase in gradient resulted in an increase in erosion of 25%. Such figures throw into high relief the necessity of terracing and bunding *above* drains, whereby the effective slope is substantially decreased.

#### NATURE OF SOIL.

The differences that exist in susceptibility to erosion in different soils have received very little attention, but our evidence is in keeping with the Bureau's memorandum in viewing permeability as important. Speaking of experiments with various soils, the memorandum says: "It seems likely that these differences are due to permeability; the plastic clays become water-logged almost at once, the surface run-off is therefore high and the transporting power of the water very great."

#### EFFECT OF VEGETATION AND AGRICULTURAL SYSTEMS.

Passing to the influence of various systems of cultivation and green manuring, the American work provides interesting data. An eroded and non-eroded soil of the same type were subjected to pot-culture cropping tests with the following results:—

	Eroded.	Non-Eroded.
Water-holding capacity	46.8 %	67.2 %
Nitrogen content	0.16%	0.49 %
Humus	0.60%	14.60%
Dry weight of wheat produced	5.5 lbs.	12.1 lbs.
Water requirement per lb. dry matter produced	472	343

No more striking evidence of the fundamental differences between eroded and non-eroded soil could be imagined. The eroded soil is low in humus, water-holding capacity, and in nitrogen. It produces an inferior crop and requires more water per unit of crop to do so, whilst being at a disadvantage in its retentive power for moisture.

Further evidence is also presented on the loss of soil nutrients which the loss of soil involves. Of particular interest in Ceylon are experiments at Missouri showing nutrient losses on soils where the

treatments included clean weeding, continuous cropping with the same crop, a rotation which provided for a cover crop of clover, and permanent cover.

	Amounts removed in one year in lbs. per acre.		
	Nitrogen	Phosphorus	Calcium.
No crop, clean weeding ...	88.88	47.47	879.88
Continuous Wheat ...	92.58	10.83	75.99
Rotation Maize, Wheat, Clover	5.94	2.22	41.47
Continuous Blue Grass sod ...	0.56	0.09	0.64

The effect of clean weeding is to remove more nitrogen, phosphorus, and calcium in the absence of any crop than is removed by wheat, even taking into consideration the demands of the crop itself. Losses grow progressively smaller, as the cover becomes more efficient.

In South Africa in the evidence of the Drought Commission, erosion is shown to cause the loss of half or more of the nitrogen, potash, and phosphorus in a number of cases.

#### PREVENTATIVE MEASURES.

The preventative measures advocated by the U.S.A. Bureau of Soils may be quoted in full. They correspond in detail to those of our own evidence.

- (a) *Treatment of the soil*:—this may include keeping texture in good condition by deep tillage so that its range of moisture capacity is large.
- (b) *Treatment of cover*:—this has for its objects:—
  - (1) Protection by shielding from direct rain beat; dissipating heavy rains into small particles which easily soak in; accumulating debris to form mulch; reducing evaporation.
  - (2) Promotion of soil plant circulation by catching and retaining water, retarding run-off, keeping the soil moist and open, and allowing root taps (i.e., tips) to ramify near the surface, and
  - (3) Enrichment of the soil by amassing mulch, facilitating root development, decomposing inorganic substances by carbonic acid and conserving humus.
- (c) *Treatment of slopes*:—this may involve cultivation along contours, terracing, vineyarding, building retaining walls, and providing transverse belts of woodlands which widen as the slope steepens and narrow as it flattens."

The reference to evaporation reduction corresponds to the prevention of drying and caking of soil mentioned in our evidence as detrimental to the permeability of the surface soil.

The memorandum concludes with a detailed discussion of terracing in a form not suitable for tea, and refers in brief to the Felsing system of banded drains.

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