SOIL EROSION.—II.

T. EDEN.

LOSS OF FERTILITY.

Loss in fertility of a soil on account of erosion may be due to a number of causes. In the majority of cases the first effect to be felt is a deterioration of tilth. In tropical soils that are hand-cultivated the production of a good tilth is not so noticeable as during the preparation of a seed bed by mechanical cultivation. Nevertheless a good tilth can be judged by the relative freedom of a soil from caking and cracking, and steps can be taken to restore a measure of friability to a heavy soil and body to a light one by suitable cultivation operations, no matter how laborious this may prove.

The loss of nutrients in the soil and in the run-off water that carries it along is not, like loss of tilth, an easily noticeable wastage except in the light of diminishing crop returns, but it can reach alarming dimensions. The magnitude of the losses due to soil erosion have been measured in America by means of both chemical analyses and crop studies; the one method supplements the other.

Analysis provides a fairly rapid method of assessing the possibility of important fertility losses but it is by no means infallible. Most soils change their composition as the depth increases so that, as erosion proceeds, the gradient, or profile as it is called, of nutrient concentration alters in a corresponding manner. Some soils however are very uniform in profile and very deep so that even though quantities of soil are being washed away, the profile changes not at all, and analysis may fail to show how great is the damage suffered. On the whole if the soil is examined *in situ* the gradient or profile for nitrogen is the safest indication as well as being generally the most important.

In a few experiments it has been found possible to collect and analyse the eroded soil. One of the most complete experiments is that at the Missouri Experiment Station which answers very fully the question as to how much, and in what form, loss of nitrogen occurs.

Both the eroded soil and the run-off water were collected and analysed so as to give in pounds per acre the readily soluble inorganic nitrogen content and the corresponding amount for the less soluble organic form.

Annual Losses of Nitrogen in Soil and Run-off Water.

Pounds per Acre.

Plot.	Soil	Nitrogen in Soil.		Nitrogen in Run-off.	
		Insoluble.	Soluble.	Insoluble.	Soluble.
A	8900	92·39	3·01	2·00	0·229
B	9400	71·42	2·45	2·07	0·219

It is at once apparent how much nitrogen is removed in the eroded soil. Each year more than enough to raise a good crop of any farm produce is lost, most of it in an insoluble form. The soluble nitrogen is low, but that might be expected after the thorough leaching to which the eroded soil is subjected. The run-off water on the other hand contains relatively little nitrogen, and the very low concentration of soluble nitrogen is remarkable. What happens to the soluble nitrogen that is undoubtedly present in the surface soil where bacterial activity and nitrification are most pronounced; a good arable soil may contain as much as fifty per cent. of its nitrogen in soluble form ? The explanation probably lies in the fact that the first portions of rain drive the soil moisture containing soluble nitrogen into the deeper layers of the soil so that although this particular type of nitrogen may be lost eventually in seepage, it is not markedly depleted as a direct result of erosion.

In so far as these well authenticated results are of general application they suggest that in climates involving heavy rainfalls organic nitrogen is at least as easily lost through erosional agencies as its more soluble counterpart. Nitrogen losses can therefore only be prevented by minimising soil losses.

Turning from analyses to crop studies, the evidence for the serious consequences of erosion is just as striking. Mosier and Gustafson took an eroded site and attempted to grow crops in pot culture on soil derived from the most severely eroded parts of the site. The results were poor in the extreme. By adding the common soil nutrients they greatly improved the production and thus demonstrated that nutrient deficiency was the main cause of poor growth.

Percentage Yields for Manured and Unmanured Eroded Soil.

	Unmanured.	Phosphate Potash & Lime.	Nitrogen & Lime.	Nitrogen Phosphate & Lime.
Wheat.				
9-year averages.	100	115	460	550
Oats.				
5-year averages.	100	111	330	440

Phosphate and potash without nitrogen produced only small increments; nitrogen gave the most striking result, and nitrogen and phosphate in combination proved to be the chief requirements. In addition to the cropping studies the same workers analysed the soils taken from the site. The undulating land on the area was rather richer in nutrients than the steeper hilly land. The comparative richness of the soil washed down to the bottom of the area sufficiently indicates how the higher areas were depleted. The pot culture experiments were carried out on the soil from hilly land.

Composition of Eroded Sites and Eroded Soil.

	Organic matter Tons per acre.	Nitrogen lbs. per acre.	Phosphorus lbs. per acre.
Undulating land	23·1	2330	819
Hilly land	17·1	1805	746
Bottom land	45·3	4693	1403

It may seem on casual inspection that even on the eroded portions substantial reserves were left, but the cropping figures undoubtedly give the surer indication of the real value of eroded soil.

Manuring operations in estate and farm agriculture should aim at keeping the potential nutrient wealth of the soil at least constant if not actually increasing. Figures such as the American soil work provides, show most clearly how unnecessarily expensive that policy must become unless the root problem of erosion is tackled first of all.