

Soil Erosion.

With Special Reference to Rubber.

C. E. A. DIAS.

EROSION is the removal of soil material by air or water in motion. I shall deal only with erosion caused by water.

Cause of Erosion.—Erosion occurs whenever rain falls on unprotected sloping land—such as our clean-weeded estates—so rapidly or in such quantities that the soil cannot absorb the water as fast as it falls. Only that water which is not absorbed by the soil—the “run-off”—causes erosion. The “run-off” depends on:—

1. The slope or topography of the land.
2. The texture and structure of the soil.
3. The vegetative covering.
4. The character of the rainfall.

1. **The slope or Topography of the land.**—The run-off from hilly land is the greatest and causes the most erosion.

2. **The Texture and Structure of the soil.**—Coarse soils absorb a much larger proportion of the rainfall than the fine grained ones. The rate of absorption depends on the size of the pores, and not on the total pore space in the soil. This fact explains the rapid absorption of rainfall by the coarse-grained soils, and the slower action of the fine-grained ones. However, if the latter are loose and open from recent tillage, their absorption compares favourably with that of the coarser soils.

3. The Vegetative Covering.—The surface of a natural forest is usually covered with leaves and twigs which protect it from erosion. Estates that have recently been planted with cover crops, especially creeping plants, and are well established, are also protected from further erosion. Such surfaces suffer little so long as this protection remains undisturbed.

4. The Character of the Rainfall.—A gentle rain will be absorbed entirely by almost all soils since it does not fall more rapidly than the water can percolate through the soil, thus preventing complete saturation of the surface. The rainfall we get in Ceylon, especially in the low-country, cannot be termed gentle rain by any means. The heavy torrential rain in Ceylon soon saturates the surface, and then absorption by the soil cannot take place any faster than percolation from the surface into the lower strata.

The Results of Erosion.—The removal of organic matter and nitrogen. The surface soil contains the greatest part of the organic matter and so is the richest and most productive part of the soil. The removal of any appreciable amount of this stratum reduces the amount of plant food, especially the nitrogen, rendering the soil less productive than formerly. It also exposes the yellowish or reddish sub-soil which is heavier and more difficult to work than the original surface soil. They are less productive than the original land, and even the regular application of artificial manure will not bring them back to their former condition. The soil that is carried off by the run-off finds its way to the canals and rivers, thus filling their beds and causing floods.

In the United States, 10,600,000 acres of farm land have been abandoned and 3,800,000 acres have been devastated by soil erosion.

In Ceylon we have no statistics of this sort. However, any one travelling during the rainy months in the planting districts would see our rivers running red, carrying volumes of rich surface soil.

Some time ago I had occasion to make certain measurements on a well cultivated rubber estate, and found that in a small area of about 1800 square feet of surface, no less than 91 cubic feet of top soil had been carried off by the run-off within the last 20 years, thus exposing the lateral roots of the trees very badly. I should call this surface top soil the Capital of the land. Ceylon being an entirely agricultural country, and depending solely on its agricultural products for its maintenance and prosperity, this surface top soil is the Capital of the Island. It is up to one and all of us to do everything we can not only to protect this vitally important Capital of the Island, but also to preserve it for the benefit of the generations unborn.

Methods of Prevention and Reclamation.—I propose to deal with this subject under the headings “ New Clearings ” and “ Old Plantations.”

Prevention—New Clearings.—Soon after a jungle is felled, burned and cleared, the first thing to be done is to sow all kinds of green manure seed, both erect and creeping. This should be followed by pegging out the land to plant on the contour of the ground, let it be for tea, rubber or coconut. Holes should be cut and refilled with top soil, and after that contour platforms should be cut at such distances and sizes, dipping into the hill so as to hold all the rainwater that falls on the ground and prevent the run-off described above. I need not describe here the exact work of contour platforms as a lecture was delivered on this subject some time ago, and this method of planting is now fairly known and adopted in most parts. I can now safely say that contour platforms have been a success. If these are cut to a proper mathematical working all the rain that falls on the ground is arrested and the “ run-off ” is prevented. This water sinks into the ground and since there is no “ run-off,” there is no erosion. Moreover, rubber planted on contour platforms grows extremely well and is far ahead of rubber of the same age planted under the old system. Another method of preventing erosion is to establish a vegetative covering. The best covering for this purpose is nitrogenous green manure creeping cover plants such as *Vigna oligosperma*, now known as *Dolichos Hosei*, *Calopogonium* and *Centrosema* for rubber and coconut, and *Indigofera endecaphylla* for tea.

I have found that *Vigna* will not grow readily in a new clearing. *Vigna* grows better under a shade. Therefore I would start planting *Tephrosia candida* and *Tephrosia Vogelli* after the contour platforms are cut and when these are full grown, start planting *Vigna* under the shade of *Tephrosia*. When planting *Vigna*, if cuttings are not available on the spot, it is best to plant it 12 ft. by 12 ft. and about 4 or 5 slips 3 ft. long burying them in the middle. If the weather is bad shading can easily be done with a few branches of *Tephrosia*. This should take root and extend 4 or 5 feet in about three months. Further cuttings can be taken from these patches and interplanted this time 6 ft. by 6 ft., and by this means within a year to 18 months of first planting, a new clearing can be easily fully covered with *Vigna*.

Calopogonium and *Centrosema* grow very well in new clearings, but these have the disadvantage of creeping up the plants.

I do not like *Desmodium*. When a new clearing is burnt, and if selective weeding is resorted to, *Desmodium* comes up very fast. In some places, within a year, a beautiful cover is established. But very soon this gets very woody and tends to

retard the growth of rubber. I am getting all my new clearings cleared of this green manure. If contour platforms are cut, I would keep the platform area clean weeded for a couple of years. If the planting is done under the old method, then I would advise that a space of at least 6 ft. in circumference be kept clean weeded all round the rubber plants.

Reclamation—Old Plantations.—I have experimented with old rubber and old coconut with success. In the case of rubber, stone terraces were built on the lower side of the rubber tree or trees on the contour of the ground to be on a level with the root collar of the tree whenever there were exposed roots. These exposed roots were covered with soil taken from pits cut about 30 feet apart in the drains to a size of 30 cubic feet. These pits not only supplied earth to cover these exposed roots but act as reservoirs, and conserve the rain-water and prevent the "run-off." After this, creeping leguminous plants were established. Under old rubber, I have tried several varieties of green manure both erect and creeping. It had good success only with *Tephrosia candida* of the erect plants and *Vigna* of the creeping plants. The greatest difficulty is experienced in establishing the first few plants of your cover crops. In certain places, however much you may plant, it may take root but it will not extend. In such places you have to help it on with a little manure. Then you have to watch whether they are attacked by snails. You cannot find them during the day. They hide under leaves or stones and only come out at night. So it is necessary to send out some intelligent coolies with torches at night and collect them night after night. During dry weather they are not active, but in rainy weather they are very active and can easily be caught at night. As a rule, snails are found near buildings, and very few are found away from buildings.

In reclaiming old washed out soil I would always plant *Tephrosia candida* with manure as a first step and bury the loppings once in six months for a year or two. This will help to replace some of the washed out organic matter and nitrogen. When *Tephrosia* is fully established, *Vigna* can be planted and it will readily take root and establish itself. The surface is thus kept covered with soil-binding creeping leguminous crops. On old coconut plantations, individual contour platforms were cut dipping and sloping into the higher side of the ground with a drain 2 ft. by 2 ft. by 6 ft. on the furthest and lowest side of the platform. I find this work most valuable especially in districts where the rainfall is less than 80 inches a year, and they help to arrest all the "run-off" rain water and thereby the severe effects of a drought are minimised.

I had no opportunity of tackling tea estates, so I shall leave them alone.

On eroded, exhausted soil, it may not be possible to grow nitrogenous cover plants without any help. Most Ceylon soils are deficient in the element Phosphorus to such an extent that it becomes the limiting factor. It is especially important in the growth of legumes. Its addition helps to make possible the building up of soil by the larger growth of nitrogenous soil-renovating crops. In addition to this it improves and increases the crop whatever it may be.

In certain parts some planters object to cover plants for fear of snakes and leeches. On most of my estates I have a good cover of *Vigna* established for the last 3 years. On three of these no venomous snakes have been seen so far. In one estate, a cobra was killed after watching for it for three months. This was a cobra that had lived in a rock cave close by. However, if a small fee is given for each head, there should be no trouble from snakes. With regard to leeches, if you prevent cattle from trespassing on your estates, you can keep off leeches.

I feel that I have now occupied your precious time far too long, and before concluding, I must acknowledge my indebtedness to Lippincotts College Texts on Agriculture for some very valuable information on this subject.

Discussion.

HIS EXCELLENCY.—Ladies and gentlemen, we are all very much indebted to Mr. Dias for the very interesting paper which he had just read. He has indeed placed the whole planting community under a deep debt of obligation for the experimental work he has done on his estates and the tests he had carried out for the prevention of soil erosion and with regard to the usefulness of cover crops in rubber plantations.

Continuing His Excellency remarked that the subject of soil erosion was one of the most important which had come before the Conference. It was important not only to the planter himself by reason of the soil being washed away but also to the rest of the community owing to the silting of rivers by soil which instead of doing good to the estates to which it belonged did harm to the unfortunate people living down the waterways. The subject was raised the previous evening in the paper read by Mr. Holland in relation to cover crops and the time was too late then to allow the discussion to continue. He (the speaker) would like the discussion to include any questions in regard to tea which were not disposed of the previous evening. They would, no doubt, discuss the subject of soil erosion primarily in relation to rubber and incidentally to tea and coconut.

MR. STOCKDALE enquired from Mr. Dias which *Desmodium* he was referring to. The small leafed *Desmodium triflorum* or the larger leafed species.

MR. DIAS replied that the small leaf was more harmful than the big. He further stated that the small leaf "desmodium" had a tendency of binding the ground.

MR. WANIGASEKERE enquired whether forking would overcome that binding tendency.

MR. DIAS replied that if they forked they removed its beneficial covering effects entirely. What is the good of having something that has to be planted, removed and replanted.

MR. A. N. PHILBRICK asked whether there was anybody present who could give him his experience of cover crops in new tea clearings. On the estate he had to deal with, there was heavy clay sub-soil. His personal experience was that he could not with any degree of satisfaction establish young tea if they planted their cover crops at the same time. It was his experience that if they planted cover crops a year or two later, it was like shutting the stable door after the horse had bolted as the soil then would have been washed off. He wished to know whether *Indigofera* would do well.

MR. SOLOMONS stated that he found the planting of *Indigofera* in steep places come up very satisfactorily. Further, the establishment of cover crops depended a good deal on the nature of the soil and the conditions under which it was cleared. Generally speaking one should not experience difficulty in establishing some sort of cover crop. *Desmodium* in some districts came up almost at once but it practically suffocated the plants. As regards forking the difficulty was to carry it out at the right time.

MR. A. T. SYDNEY SMITH.—As has been already pointed out by Mr. Solomons, *Desmodium triflorum* practically suffocates the plant, and I have seen clearings very seriously kept back not in one case but in many cases. You may say 'fork it.' The difficulty is to carry out the forking at the right time.

Continuing Mr. Smith stated that it was his experience that *Indigofera* grew freely in old tea. There were, however, places where tea itself was good cover and was a natural protection to the soil and it was a very moot point whether that did not meet all the circumstances of the case. On estates where tea had itself provided such a protection soil erosion had been reduced greatly. It was only where those conditions did not exist that soil erosion occurred.

MR. STOCKDALE stated that with regard to the question raised by Mr. Philbrick that morning in regard to the use of cover crops in young tea, there was a prevailing opinion as far as he could gather among the planting community that the planting of such cover crops did in many cases retard the growth of young tea. He (the speaker) had seen the clearings of Mr. Horsfall and there had been no set-back in that case. On the other hand, he had seen one case in the Ratnapura District where the naturally grown *Desmodium* which Mr. Dias referred to were left and for the first year or two, the tea thrived very well but subsequently there was a retardation and the cover crops had to be taken off. Therefore, he thought, they would be wise at the moment to consider in young tea contour terraces and contour hedges of such plants as *Boga medeloa*.

He personally was greatly in favour of planting definite contour hedges of tea above the drains and of putting the plants in not more than 1 foot apart. These contour hedges of tea should help to solve the solution of soil erosion in tea.

With regard to older tea, there was no difficulty in growing cover crops. Experience on the Experiment Station had shown no retardation of growth, and no reduction of crops.

In conclusion, Mr. Stockdale stated that the paper that Mr. Dias had read to them that morning indicated clearly what he had been doing in his estates. He had also given the results of his experiments to the public and he thought that the Agricultural Community were greatly indebted to Mr. Dias for that information and for his public-spirited action in making it available.

MR. R. G. COOMBE emphasised the evil of scraping instead of weeding as a matter that the planting community should take up whole-heartedly. By a little more weeding instead of scraping, he said, a great deal could be done to conserve the soil. The use of the hand and some other instrument which will not scrape would go a long way towards reducing soil erosion. The scraper should be entirely forbidden.

MR. A. R. WESTROP gave an account of his observations in Malaya and Sumatra. He stated that Mr. Dias had mentioned the difficulty of establishing Vigna. In Sumatra, he found in the American plantations, the whole of their steep land covered with very fine growth of Vigna whether on the shade or in the open, and they appeared to experience no difficulty. He emphasised the point mentioned by Mr. Dias about planting green manure immediately land was felled.

At this stage HIS EXCELLENCY asked MR. J. MITCHELL to open the discussion on "Cover crops and green manuring in rubber cultivation."
