

# SOIL EROSION ON GENTLE SLOPES AND FLAT LAND

By Dr. R. MACLAGAN GORRIE,

*Soil Conservation Officer, Department of Agriculture.*

**M**OST of the coconut area which has suffered severe losses through the droughts of the last three years and which has been under the consideration of the Marginal Coconut Committee is almost flat or has very gentle slopes of up to 1 in 50.

Popular opinion has it that such lands do not suffer from erosion, but this is plain nonsense. One does not have to quote foreign statistics such as those of the Sholapur Agricultural Station (*vide* page 17 of *Ceylon Coconut Quarterly*, Vol. 1, No. 2, 1950) convincing as their data undoubtedly are. One need only study these gentle slopes and flattish lands to see what soil movement has taken place. In the last 60-70 years since these lands were cleared of scrub jungle and planted with coconut palms, there has been a tremendous soil loss from the upper slopes, whereas under forest conditions in the North Western Province the grey top-soil which overlies the red kabook sub-soil is 8-10 inches deep and is free of stones. Pebbles only appear in quantity in the red kabook itself. Under frequent chena clearing and burning this grey soil gets shallower but is nevertheless recognisable even on high ground. Under 60-year-old coconuts it is no longer present and the upper parts of all long slopes have a top cover of the granular pebbles locally known as *borella*. Where have these pebbles come from? Surely from the breakdown of the kabook after the primaeval grey soil has all been washed away by sheet erosion.

This process is hastened by heavy grazing or soil treatment such as injudicious ploughing down the hill which exposes the soil crumbs to the beat of rain drops and the heavy drip from the palm fronds. It is also hastened by the cutting of sloping drains between rows of palms whose original square planting layout is up and down hill. And it is hastened by drought such as has been experienced these last three years, for with exposure the desiccated soil breaks down from its normal crumb structure to a pulverised dust which is readily carried off in great quantity when at last the rain does come.

Towards the bottom of each long slope these fine silts and clays are deposited wherever the run-off is ponded back or fails to drain clear away. In many cases existing ponds and tanks become silted up or a swamp is formed where these accumulating layers of very finely-divided material are dumped. In moderation this soil transportation is, of course, of value to the coconuts in the lower reaches of each long slope at the expense of the higher reaches, but in excess the dumping of fine soil is a nuisance because it interferes seriously with the natural drainage of the area so that only the paddy crops profit and the coconuts are ruined by water-logging.

The underground water-table beneath these gentle sloping lands of the N.W.P. conforms gradually to such changes. While the forest remains intact the water-table keeps at a more or less consistent depth in the kabook clay, usually at about 12 to 15 feet below the surface no matter whether on the upland ridges or in the natural hollows. After such slopes are cleared for cropping, or planted with coconuts, the water-table gets out of balance because the upland ridges are starved

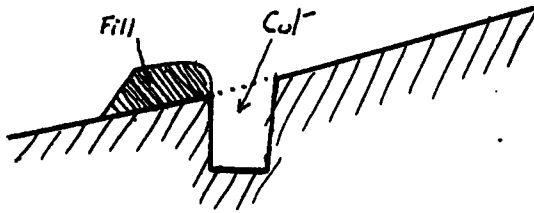
of water, the previous strong percolation having been replaced by a total run-off with no percolation. In time, therefore, the water-table sinks away from the ridge tops which become quite desiccated, but the gradual increase of swampy conditions in the natural hollows builds up a local water-table unpleasantly near the surface. The present condition of many neglected coconut estates is an indication of this altered balance in the underground water-table; in the early stages the palms on the higher ground drew upon this store and were reasonably productive, but as time goes on desiccation increases and their yield falls off faster than on the middle and lower slopes where the water-table is still accessible to the palm roots.

Wherever a reasonable amount of soil and water conservation work such as trenches filled with husks has been done over a longish period of years, the palms along the upper slopes have profited and are still productive, but there are very few estates where one could claim that no run-off occurs. This should, of course, be the aim of every estate; every drop of rain should be absorbed where it falls, and none should be allowed to escape. Even the road drainage from estate roads should be trapped wherever it can readily be led off and re-distributed into diversion trenches or ditches where it will be absorbed into the ground.

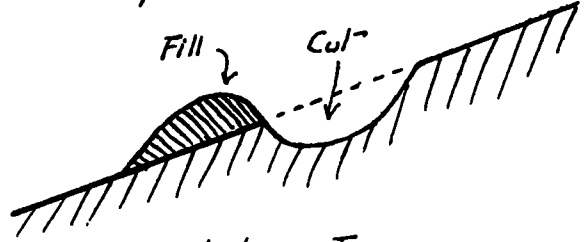
The diversion ditch differs slightly from the contour ditch. Both have the same purpose, namely of ensuring percolation of rain into the soil instead of letting it run away into the nearest river, but each contour ditch is kept dead flat and true on the contour throughout its length, and the ditches are spaced near enough to one another so that all the rain falling on the ground is caught and held by the trench next below. The diversion ditch on the other hand is laid out with a very slight down-grade because it is intended deliberately to lead away any accumulation of surface drainage such as occurs along a road. Where only a short length of road is involved, up to say 200 feet of road side, the diversion ditch can be made about as long again. If the road length is much more than this or if more than 5-7 acres of catchment are to be brought in, it may be advisable to lead the diversion ditch into a pond or take its lower end into the nearest natural drainage channel. The pace at which water is thus led away can easily be controlled by having frequent cross-ties of earth or stone across the bottom of the ditch on the same principle as the lock and spill sections in the 1 in 80 drains on tea estates. Another way to ensure complete absorption is to flatten out the last few hundred feet into a true contour.

The main point in N.W.P. is to keep the water as near the top of each hill as possible by starting your contour ditching right at the crown of the hill and diverting water from all roads while they are still traversing the upper slopes. In making contour ditches or diversion ditches in coconut estates the question of subsequent grazing should be kept in view. If husks are to be buried in a trench the deeper this trench is the better, but if the hole is to be left open, as is essential when diverting road drainage on to the land, the cross section should be saucer-shaped rather than a trench with vertical sides, so that grazing cattle may not break their legs. Something after the fashion of the American broad-base terrace with a maximum depth of 15-18 inches and a span of 12 feet is the best from this point of view. (See Diagram 1). Shallow terraces of this type can be led through the palms along a strict contour much more easily than a deep trench and do less harm to roots when the alignment brings these close to any individual palms (Diagram 2). A further point on the construction of contour ditches (and one which is commonly misunderstood in Ceylon) is that the earth dug from the trench should be packed on the *lower side of the trench*, not the upper. When conserving water from run-off one wants the largest cubic capacity for the minimum of earth-works and this is provided by packing all the earth on the down-hill side, thus increasing the "bath tub" effect of each length of trench, (See Diagram 3).

Maximum depth of cut 15-18 inches  
 Total span of cut and fill, 12-14 feet.



Vertical Trench.



Broad-base Terrace

DIAGRAM 1.

What is the best cross-section?

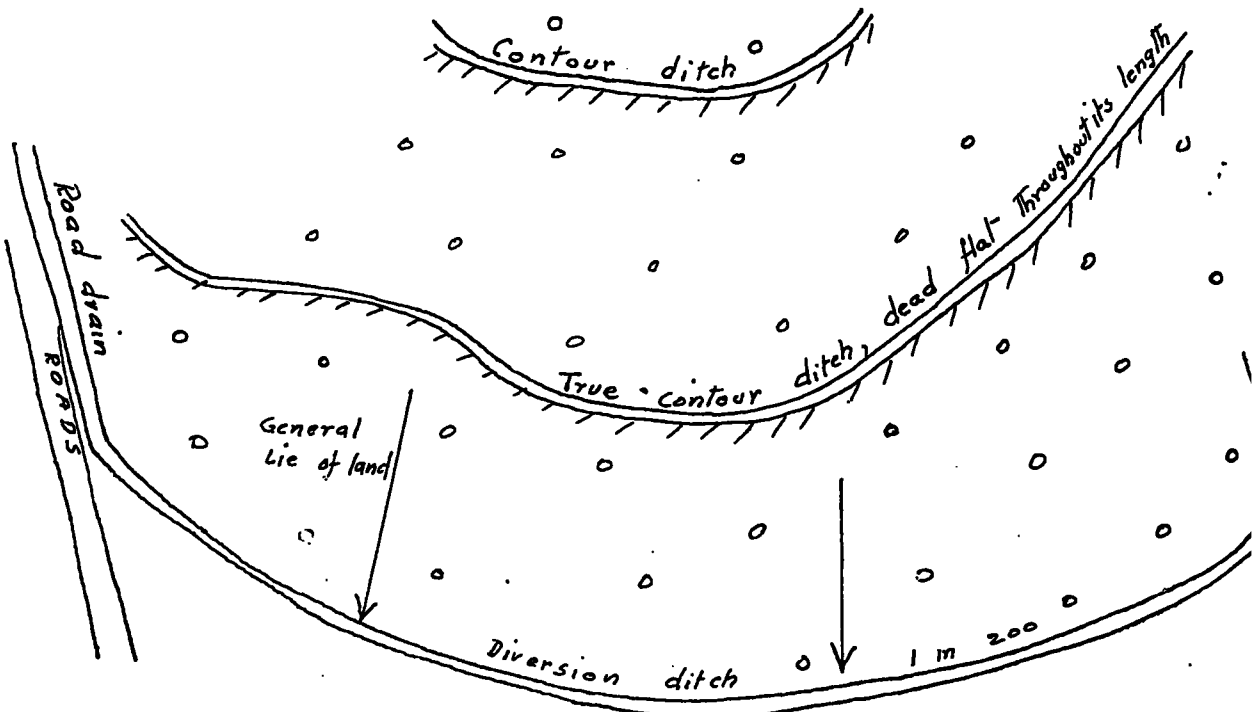
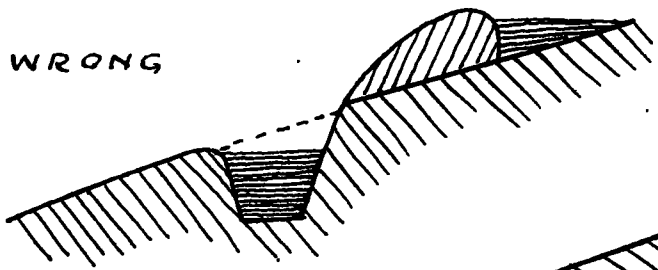


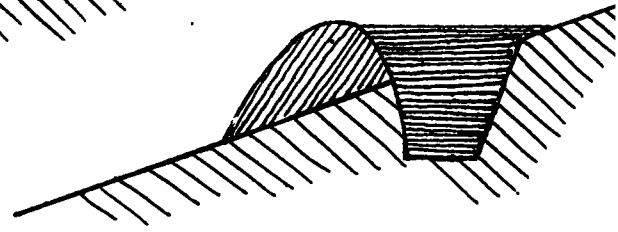
DIAGRAM 2.

Broad base terrace must be kept truly on contour, to prevent any water movement but to guide water diversion for a road should be a specific gradient of say 1 in 200.

A. WRONG



B. CORRECT



Comparison of water holding capacity of trench with dug earth piled as in A. above the trench, wrong. B. below the trench, correct.

DIAGRAM 3.