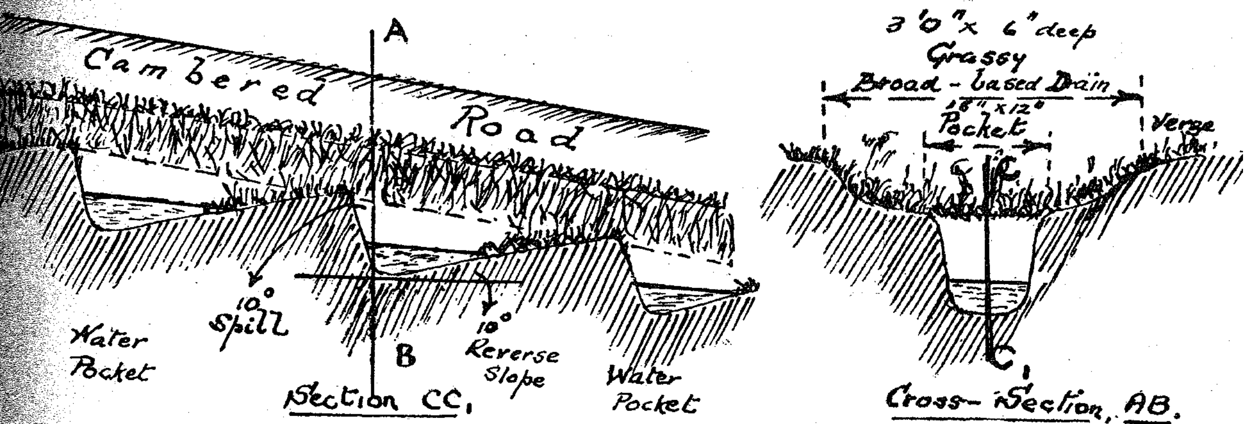
REVERSE-SLOPE DRAINS

By W. D. FREDRICK,
Superintendent, Bandirippuwa Estate.

Water Conservation

ALTHOUGH the principal limiting factor in the production of coconuts is water, the importance of water and moisture conservation is often not appreciated. In hilly and undulating country and particularly in areas subject to droughts or low rainfall, it is necessary to conserve or hold back water in the uplands whilst allowing free drainage in the lowlands. It is furthermore essential to control the water and to prevent or break down any accumulation of storm waters which would otherwise form into rivulets then into swift streams, developing thereafter into raging torrents which

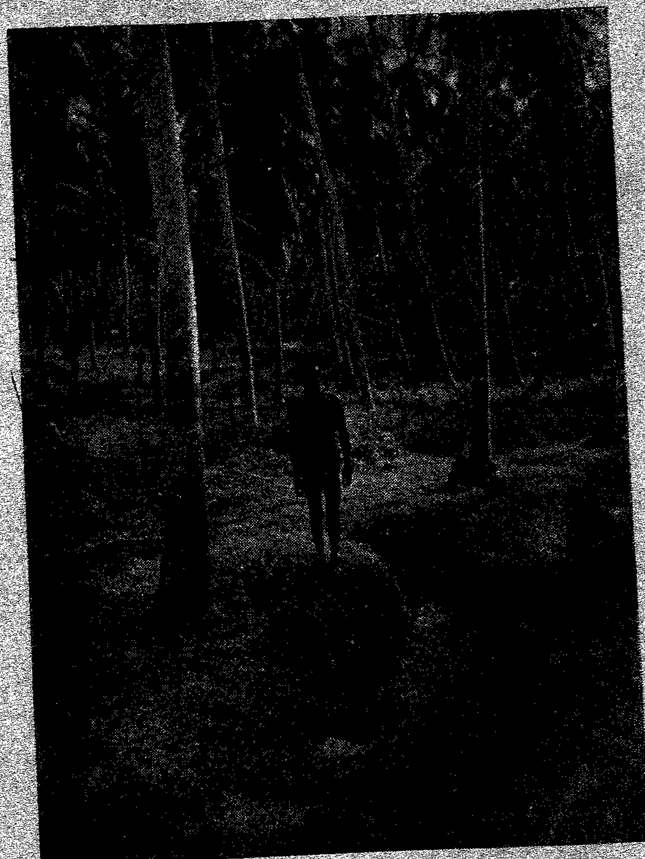


Reverse Slope Drain

cut deep into the hillsides and carve out gullies, ravines and gorges and in so doing undermine the palms and carry away thousands of tons of valuable soil to block the rivers and cause floods.

Soil conservation is also water conservation but to the coconut planter in Ceylon, it is perhaps of greater importance to conserve water than soil, because coconut palms are here mostly deep-rooting and the maintenance of subsoil moisture is a major problem of soil management.

Methods of soil and water conservation have been described in detail by Gorrie and by Perkins (*C.C.Q.* Vol. 1, No. 4), but no mention was made in their articles of the fact that,—during tropical down-pours,—estate roads, paths, and drains become the courses of swiftly running streams which are usually allowed to run away freely without passing through the soil as subterranean waters. The roadside drains gradually become deeper and deeper and the irregular erosion of their banks leads to their ultimate collapse. When these drains are blocked by coconuts, leaves and silt, or by the collapse of the banks, the road itself becomes the path of the torrent and later there may be heavy repair charges to bring it back again into serviceable condition.



Diversion Drain.

Reverse-slope Roadside Drains.

Reverse-slope Drains

The correct principle to follow is to check the swift movement of the water in roadside drains and also to prevent storm waters building up into a raging torrent towards the bottom of the hill. This can be done by the construction of reverse slope drains with diversion drains at regular intervals to lead off the water. It is essential also that the road shall be well cambered so that all rain water will run straight off into the drains and will not accumulate on the road.

Although it may demand a little more care and trouble, the establishment of this system is not expensive, neither in first cost nor in subsequent maintenance. The principle is that instead of the usual roadside drain, 18 inches by 18 inches in cross section, there is a series of water pockets, cascades, or steps so arranged that the rush of the water is checked by an opposing reverse slope and by grass and weeds which are purposely allowed to grow in the bottom of the pocket as shown in the diagram.

Method of Construction

After a new road has been traced, pegs to mark the position of the water pockets (or steps) are inserted at regular intervals, according to the gradient of the road. Thus a road on a downhill slope of more than 1 in 20 needs a peg to be inserted once in every 6 feet; a slope of less than 1 in 100 requires pegs to be set one in every 30 feet. A shallow drain is first scooped out on either side of the road, three feet wide and only six inches deep and where the pegs come a wedge of soil 12 inches deep 18 inches wide at top and say 6 feet long is removed. The step or spill is at an angle of about 10° to the vertical and the bottom of the pocket is a reverse slope or rise about 10° to the horizontal. The spoil, thus removed, is used to build up the camber of the road and later any accumulations of silt in the pockets can similarly be used to maintain and repair any minor damage to the road surface which may result from very severe storms. The water pockets are thus a series of steps each with a 1 foot drop into the next pocket.

Approximately every 30 yards or so on a steep slope and about every 60 yards on a mild slope, there is a barrier to obstruct the passage of water,—a diversion drain to turn the water into a contour trench or a large silt pit. Thus there is no build up or accumulation of storm water to erode the drains and there is no loss of water by run-off whatever. All the water is thus retained and has to pass through the soil on its way back to the sea. During storms of short duration, all the pockets are filled with water which seeps into the ground and so helps to carry the estate through a period of drought.

It will be appreciated that the cutting of the reverse slope drain is easier than cutting a simple drain as only half the amount of soil has to be removed and the drains do not have to be so large. Furthermore,a properly constructed reverse slope drain does not erode as there is no wear and tear. All that is necessary is the periodical removal of silt from the water pockets and occasional slashing to keep the weeds on the reverse slope under control.

Where the road is on the level (except in low-lying areas), the system is slightly different. On each side of the road there is again just a simple broad-based grass-filled drain, only 6 inches deep with a succession ot rectangular silt pits or water pockets, 2 feet long, 1½ feet wide, and 1½ feet deep. These pockets should be set at regular intervals, say 26 feet apart (if the palms are thus planted) with the pits midway between the rows of palms. Here again the idea is to check the rush of water, reduce its volume, and prevent any loss of water from the estate.

The Cost

This method of construction of water pockets is cheaper in first cost than cutting an ordinary drain as there is less soil to remove; it saves a lot of money in road maintenance and the maintenance of reverse slope drains is almost negligible. In the past road maintenance on Bandirippuwa was a big item owing to severe storm damage of frequent occurrence; in recent years soil and water conservation has improved the condition of the estate and the roads are now maintained in excellent condition at little cost.

The cost of constructing reverse-slope drains is 20 cents ($3\frac{1}{2}d$) a fathom (6 feet) and the maintenance cost is 3 cents a fathom annually. In addition, the condition of the palms will improve and the resulting crops will more than cover the cost of road and drain construction and maintenance.

Low-lying Areas

The system of drainage, described above, is only for roads on hilly and undulating land. Low-lying lands must of course be well drained. The main drains must be deep enough, large enough, and straight enough to allow the free flow of flood waters and the minor drains in alternate rows of palms must be deep enough, *i.e.* 3 feet deep, to drain the land effectively. If the storm waters cannot escape freely, the land becomes water-logged and quite useless for the cultivation of coconuts.

Remember then all water conservation work must begin at the top of the hill and storm waters must there be forced to pass through the soil. Conversely in low-lying areas, it is quite wrong to attempt to conserve water against periods of drought. Such lands must always be kept drained to a depth of 3 feet, even though the water-table may be higher.