*Tea Bull.*13(2), 26-38, 1993.

SOIL EROSION AND CONSERVATION IN NEW PLANTINGS

A. Kathiravetpillai

(Head, Agronomy Division, Tea Research Institute of Sri Lanka, Talawakele, Sri Lanka)

Soil Erosion

Soil erosion in tea land is caused mainly by the direct action of rain and moving water which displaces and transport soil particles. The direct beating action of rain on soil leads to breaking down of soil aggregates into fine particles which block the soil pores. This causes a reduction of the porosity of the surface soil and a gradual compaction resulting in a reduction of the infiltration of water into soil. As a consequence of reduced infiltration, the excess water during heavy storms flows over the soil surface. The runoff thus produced carries soil particles in suspension, causing soil erosion.

Soil loss due to erosion occurs to a great extent between the period of uprooting of old tea and replanting it with young tea and until the young tea establishes and adequately covers the soil. Soil is eroded from a field in a number of different ways:

1. Sheet erosion, where uniform and thin layers of soil are removed. Sheet erosion is not very

conspicuous but often the presence of exposed gravel on the surface is an indication of erosion of this type where the finer soil particles have been removed leaving behind the gravel.

2. When the runoff water collects in small channels or rills where water moves down rapidly on sloping land, carrying soil in suspension, it is termed rill erosion. Rill erosion is mostly evident when heavy storms are experienced on loose and shallow top soil, such as during land preparation and the early stages of the growth of young tea.

3. The formation of gullies or gully erosion is a more advanced stage of erosion where water flows rapidly down hill sides in deep and distinctly large channels with extensive scouring of the deeper layers of soil. Gullies are formed due to inadequate conservation methods being adopted in the drainage area and the improper construction of leader drains to carry away the excess water.

All these stages of erosion result in the gradual loss of valuable top soil with all its stored organic matter and nutrients. The subsoil will be exposed with time; plant roots will be restricted in growth due to the poor environment the subsoil provides. Moreover, applied fertilizers will be partly lost in the runoff water and the rest will

not be efficiently utilized by the plants. The result is a general degradation of soil condition leading to a decline in yield. As most of our tea lands are found on very undulating lands, conditions are most conducive for soil erosion. It is hence of paramount importance that proper soil conservation measures be adopted to arrest this loss of soil. Evidence of extensive soil erosion is seen in some of the old tea fields with a poor cover of tea, notably in the mid-country, where suitable soil conservation measures have not been adopted. Some of the causes of soil erosion in tea lands are:

1. Much of the seedling tea has been planted in steep areas where the speed of flowing water is high and water moving down the slope gains speed as it flows over long distances with increase in its carrying capacity for soil. Most seed tea fields do not carry any lateral drains or when present are cut at such steep gradient that water gushes down or are filled up with eroded soil from above and these are not cleaned up regularly. The sides of leader drains when present are not planted up with a grass leading to scouring.

2. The up and down planting adopted in seed tea helps soil loss which is seen to a marked degree in pruned fields when the soil is most exposed.

3. Most of the old seed tea is of low jat, not vigorous and hence does not cover the ground adequately.

4. The clean weeding adopted in plantations with the insidious weed scraper is a major cause of soil disturbance on tea lands. This leaves a loose layer of soil on the surface which can easily be washed off by the flowing water. Damage to surface roots and breakdown of soil structure are also caused by scraping the soil.

5. Often vacancies in tea fields are not planted up with a grass and as a result the bare patches remain exposed for a long time leading to soil loss and degradation of these patches.

During the various stages of replanting such as uprooting of old tea, deep forking, planting grass for soil reconditioning and the early stages of the growth of tea, the soil is exposed for considerable periods until the tea crop forms an adequate cover. Further, due to various cultivation practices the soil is frequently disturbed. Under these conditions the land is particularly vulnerable to erosion and special precautions should be taken to reduce soil losses. The planting of clonal tea on old tea (or rubber) land or on new land would give an ideal opportunity for the design and lay-out of effective soil conservation measures.

Principles of Soil Conservation

As soil erosion is caused by the direct action of rain and moving water on the surface soil there are three ways in which soil losses could be minimised. Firstly, it is necessary to intercept the falling rain drops to reduce its impact on the soil and maintain the soil in such a condition that it will absorb and transmit the water into deeper layers so that run-off losses are small. Secondly, the excess water or the run-off should be led out of the land gently and at non-erosive velocities. Thirdly, the disturbance of the surface soil should be avoided as far as possible.

Maintenance of the soil in a suitable condition to obtain maximum absorption of rain water is the first and most important aspect of soil conservation. It has been clearly established that the presence of vegetation, surface mulch and the addition of organic matter markedly improve the infiltration capacity of soils. On the other hand in exposed, bare soils the structure rapidly breaks down resulting in poor infiltration. The presence of a vegetation cover also helps in reducing erosion by forming an effective barrier against soil movement down the slope. The construction of lateral and leader drains at frequent intervals depending on the slope would help to minimise soil losses to a considerable extent.

Methods of Soil Conservation

The foregoing discussion dealt with some of the principles of soil erosion and conservation in relation to new plantings of clonal area. An understanding of the

problems of soil erosion and the factors that influence erosion is required in formulating suitable measures to conserve the soil. The main object of the replanting scheme is to increase yields by planting selected high yielding clones on suitable land. The adoption of proper methods of soil conservation is therefore clearly necessary to maintain and improve the productivity of these soils in order to achieve the desired yields.

1. Land Preparation

A considerable extent of soil disturbance occurs during uprooting, root removal and levelling. The loose layer of top soil left behind during these operations could easily be washed away during heavy storms. In order to reduce soil loss the following soil conservation measures should be undertaken:

a) Avoid land preparation during heavy rains.

b) Uprooting and clearing operations should should always commence from the uppermost sections of the field to prevent soil movement from upper to lower regions and possible reinfestation with pathogens.

c) The time between uprooting, levelling and planting of grass should be reduced as much as possible especially when large areas are undertaken for replanting.

d) If planting is undertaken in large areas, uproot old tea in small blocks and complete all operations up to planting of grass in each such block. If a large extent of about 8 ha (20 acres) is to be uprooted the delay in planting grass till the work in the entire area is completed may result in leaving a larger area of the land exposed for long periods.

e) In most areas after the forking out of roots, it is not necessary to thoroughly level the soil. If finely levelled it would increase the chances of soil erosion as the speed of water flow is high on such surfaces. A somewhat rugged surface would help to break the speed of water flow and minimize erosion.

2. Contour Drains and Terraces

On new land which did not carry tea previously as well as on land where old tea has been uprooted it is important that drains are cut before planting of the reconditioning grass. If drains are not cut early and the soil allowed to be exposed, the erosive power of water which is higher on longer slopes would wash off much of the soil. The presence of drains would considerably reduce soil loss. In the upcountry where a thorough job of root removal is done after deep forking, it may sometimes be difficult to cut drains prior to planting as the soil layers are loose and not compacted sufficiently. But in spite of some collapse of drains they should be cut

as soon as practicable and any collapsed drains should be cleaned and re-cut later.

a) Lateral drains or Contour drains

These should be cut on the contour at a gradient of 1 in 120 to slope gently towards the leader drains. These drains should be spaced 6 to 12 m (20 to 40 ft) apart; on mild slopes the distance may exceed 12 m (40 ft). The lateral drains should be 45 cm deep and 45 cm wide (18 in) and they should be of the "lock and spill" or "reverse slope", type or be provided with silt pits. The upper 'lips' of these drains should be planted with a grass like *Eragrostis curvula* (Weeping Love grass) at a spacing of about 15 cm (6 in). This would strengthen the sides of the drains and act as a barrier to soil erosion. The grass should be lopped periodically and used as a thatch. It is important that the grass is lopped prior to the onset of dry weather as otherwise it will compete unduly with the tea. Lateral drains should not be cut to open directly opposite each other into leader drains. They should be made to empty into leader drains at slightly different levels. This would help to protect and prevent the collapse of leader drains.

The lateral drains should be cleaned out regularly by de-silting them. If the drains are allowed to fill up, the effective storage capacity is reduced, causing water and soil to be carried away from the land during heavy rain. When cleaning out, the soil from the drain should always be put on the upper side from which it was washed down and never on the lower side of the drain.

b) Leader Drains

The improper construction of leader drains (nethi kanus) results in the formation of gullies in old tea fields and even in some new clearings. The function of the leader drains is to carry away the excess water received primarily from the lateral drains during heavy storms away from the land at non-erosive velocities that prevent the formation of gullies.

Leader drains should be sited on natural drainage lines. The size of the drains depends on the quantity of water discharged at peak rates of flow during heavy storms. They should be constructed in a stepwise manner with a reverse slope to reduce the flow velocity and prevent scouring. As the leader drains carry a large volume of water it is advisable to build the sides and pave the bottom with stones to stabilise the channels. The sides of the drains should be strengthened by planting a suitable grass such as *Paspalum dilatatum* or *Eragrostis curvula* which has a low spreading habit. Check dams should be built in the leader drains at frequent intervals to facilitate collection of silt carried in the run-off water.

c) Terraces

On steep lands where rocks are available contour terraces could be constructed to conserve the soil. The foundation of terraces should be made with large flat stones and they should slope towards the hill side. As in the case of lateral drains the distance between terraces would depend on the slope of the land. The construction of stone terraces helps in

reducing the rate and the distance of movement of runoff water by reducing the length of the slope.

3. Soil reconditioning or soil rehabilitation

The object of this practice is to improve the soil structure and fertility by the addition of organic matter and to reduce or eliminate the presence of pathogenic organisms. Reconditioning is done by planting a suitable grass. It is essential that the grass is planted early in the wet season and as soon as possible after uprooting the old tea and when the drains have been cut out so that the soil is not left exposed for long periods of time.

4. Contour planting

Another phase which is vulnerable to soil erosion is the time between uprooting the grass and until the new tea covers the ground sufficiently. It is essential that the period of exposure of the land is here again minimised though the amount of soil loss during this phase is less than that in the first phase. It is emphasized that holing should be done in blocks and planting should be completed in each block and then proceed to the next. In order to prevent the heaped earth after holing being washed down, it is preferable to heap it up above the hole so that it will be trapped in the hole.

The method of planting young tea should be on the contour as opposed to planting 'up and down' the slope on old tea land. The present planting system is in contour rows 120 cm (4 ft) apart and plants spaced 60 cm

(2 ft) apart in the row. The contour tea rows form an effective barrier against soil movement down the slope and with time the contour tea hedges would themselves form into small terraces.

5. Mulching and Cover Crops

In mature clonal tea fields the extent of soil erosion is relatively small due to the very thick cover of leaf canopy and the presence of a layer of leaf litter on the soil surface. In young tea, however, during the early stages of growth a large part of the land is exposed. There is enough evidence to show that soil loss is high during the first and second year after planting and is low in the third year when the tea has covered the ground.

It has been clearly demonstrated that the use of surface mulch and growing cover crops in between tea rows during the early years are beneficial in conserving the soil. All estates should adopt the practice of growing a grass in areas unsuitable for growing tea which would serve as pools from which loppings could be obtained periodically as thatching material for new clearings and infilled areas. Mulching reduces surface run-off, increases the rate of infiltration and prevent soil erosion, retains soil moisture during dry periods, provides nutrients and reduces weed growth. The coarser the grass like *Eragrostis*, the longer will it last without decay.

Growing cover crops such as *Crotolaria* spp., *Stylosanthus gracilis, Desmodium ovalifolium* in the inter-row spaces is beneficial in conserving soil if enough material for mulching is not available. I t appears very desirable to grow at least one

row of cover crops in between the tea rows. It should be emphasized, however, that the cover crops may compete with the young tea plants for water and nutrients. Experiments have indicated that in areas subject to long dry spells the presence of a thick stand of cover crops may compete severely with tea plants for moisture resulting in reduced growth and death of young tea. In order to minimize competition effects under these conditions the cover crops could be established in alternate rows and lopped almost to ground level at the onset of the drought and the loppings used to thatch the inter-row spaces of the tea.

6. Weed control

Due to the large extent of bare ground present during the early stages of growth of young tea there could be prolific weed growth in young tea plantations. Regular scraping of the soil to remove weeds breaks down the structure of the soil and leaves a loose layer of surface soil that could easily be washed away. While manual weeding is still the safest method of weed control in young tea, weeding should be carried out avoiding soil disturbance as far as possible.

This could be achieved by:

1. Avoid the use of weed scrapers;

2. Selective weeding so as to leave a certain proportion of desirable soft weeds such as *Oxalis* spp., *Drymaria cordata*, *Centella asiatica* and *Desmodium* spp. as a ground cover as they will not compete with the tea and in dry weather these weeds themselves would die;

3. Thatching the soil as soon as the young tea has been planted.

7. The use of vegetation for road and bare patches

The sites of drains, banks and roads when exposed are liable to be eroded continuously. All such areas should be strengthened by planting a grass or suitable vegetation to conserve the soil. It is a common practice to plant up road sides with grasses of low spreading habit such as *Paspalum dilatatum* while *Paspalum*, Mana and *Vetiveria zizaniodes* (Vetiver) could be planted along the edges of banks and drains. The African Weeping Love grass (*Eragrostis curvula)* has proved to be a versatile grass that could be used for all situations but care should be taken not to plant it too close to the tea. The advantage with *Eragrostis* is that it stands constant lopping and is too rough to be used as fodder.

Any areas or patches that are unsuitable for planting clonal tea due to shallow or gravelly soil or the presence of slab rock or boulders as well as vacancies that are to be infilled should never be exposed in this condition. All such areas should be planted up with grasses like Mana, Guatemala, *Eragrostis* or Vetiver in order to aid in soil conservation and these should be lopped periodically and the loppings used to thatch the young tea areas. If the grass planted in a vacancy that is to be infilled overgrows and tries to smother the surrounding tea, this could be prevented by trimming the leaves of the grass.