*Tea Bull.* 8 (2), 3-8, 1988

# WATER CONSERVATION IN TEA LANDS

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Water is one of the environmental factors which limits crop production in tea lands during dry periods. It has to be made clear that the yield response of tea during a wet period is determined by the degree of stress it had undergone during the previous dry period. This implies that if the degree of drought stress is less, during a dry period, the yield response would be greater. Further, casualties in newly planted young tea is directly related to the amount of water stored in the soil. These facts serve to highlight the prime importance of conserving water in tea plantations.

The hydrologic cycle depicts the fate of rain water falling on tea lands (Fig. 1). When rain falls on tea lands, the tea canopy intercepts a part of it; a part of the water on the canopy evaporates directly into the atmosphere. The other part reaches the soil surface as 'through fall'. In the case of young tea which has a relatively small canopy, the canopy interception is low and as a consequence a higher amount of rain reaches the soil surface. Of the water reaching the soil surface, some enters (infiltrates) the soil and some may accumulate on the surface and puddle over as surface runoff and reaches the stream. Part of the water entering the soil evaporates into the atmosphere directly; some of the water gets stored in the soil while the rest may drain out into the deeper layers of the soil. Tea roots extract the water from the soil storage and some of this water is lost by transpiration into the atmosphere. Additional water can reach the ground either by runoff from adjacent fields or by capillary rise from the water table if it is close by to the soil volume under consideration.

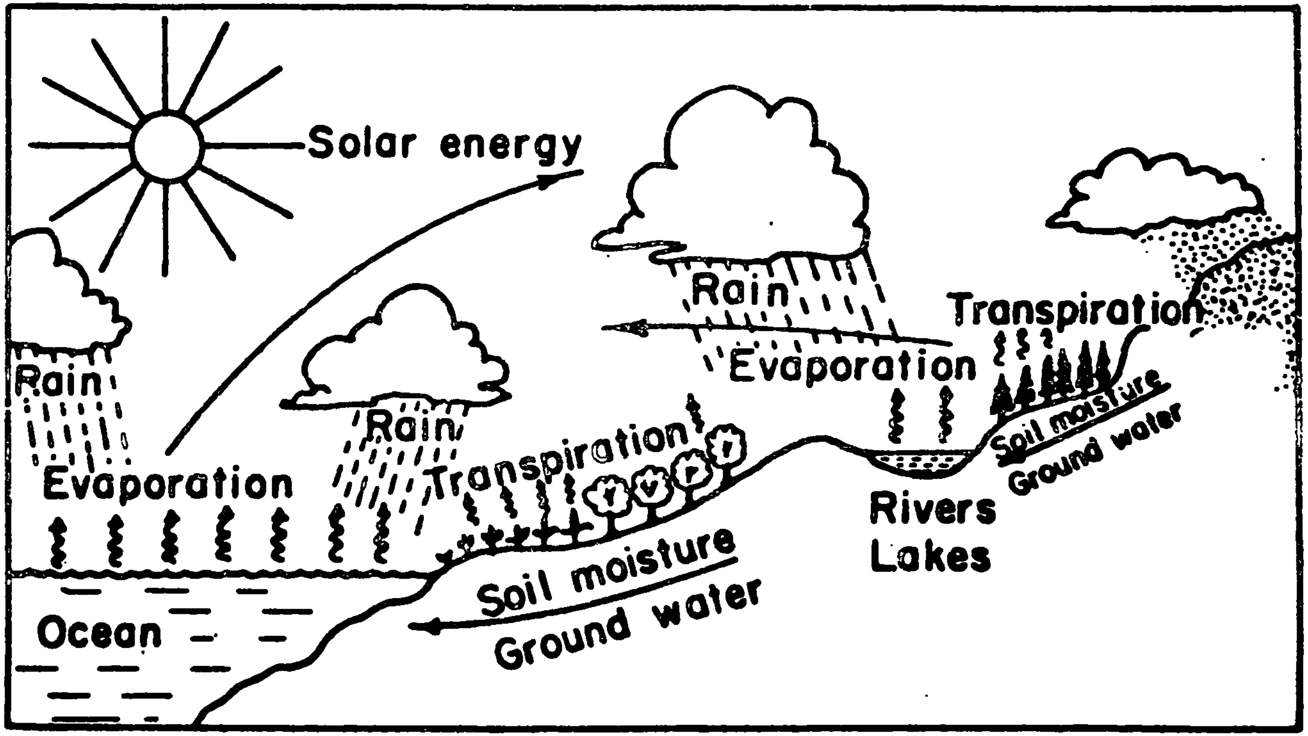


**Fig. 1 - The hydrologic cycle (schematic)**

Considering the water balance of the root zone of the tea plant in a given period of time, the difference between the amount of water entering ($W_{in}$) and the amount of water leaving ($W_{out}$) will be equal to the change in storage, i.e. $W_{in} - W_{out}$ = change in storage ($\Delta W$) (see Fig. 2).

In tea lands, $W_{in}$ is mainly by rainfall. However part of the rainfall reaches the soil surface and is known as effective rainfall ($RF_{EFT}$). Therefore

$$W_{in} = RF_{EFT}$$

At the same time, water may leave the root zone volume by evaporation (E), transpiration (T), net runoff (N) and drainage (D).

Therefore $$W_{out} = E + T + N + D$$

During dry periods N is zero and $W_{in}$ is zero

$$W_{in} = W_{out} = RF_{EFT} - E + T + N + D$$

$$W = 0 - (E + T + 0 + D)$$

In a young tea field when the soil is wet, the order of magnitude of E, T and D are almost same. However, in a mature tea field, where the canopy covers the ground, the magnitude of T is greater than E and D. Further, the magnitude of E, T and D is directly proportional to the storage water in the soil. This implies that higher the stored water in the root zone, higher will be the rates of E, T and D. For active growth of the tea plant, T should be greater. For T to be greater, storage water should be large. In other words, there should be more input i.e. more infiltration, and less E and D.

To have a higher rate of infiltration, the soil surface has to be well aggregated and porous. Organic residues and earthworm activities contribute to soil aggregation and thereby help towards a higher rate of infiltration. When sub-surface soil conditions restrict or prevent water infiltration and storage, deep forking to a certain extent helps to improve it.

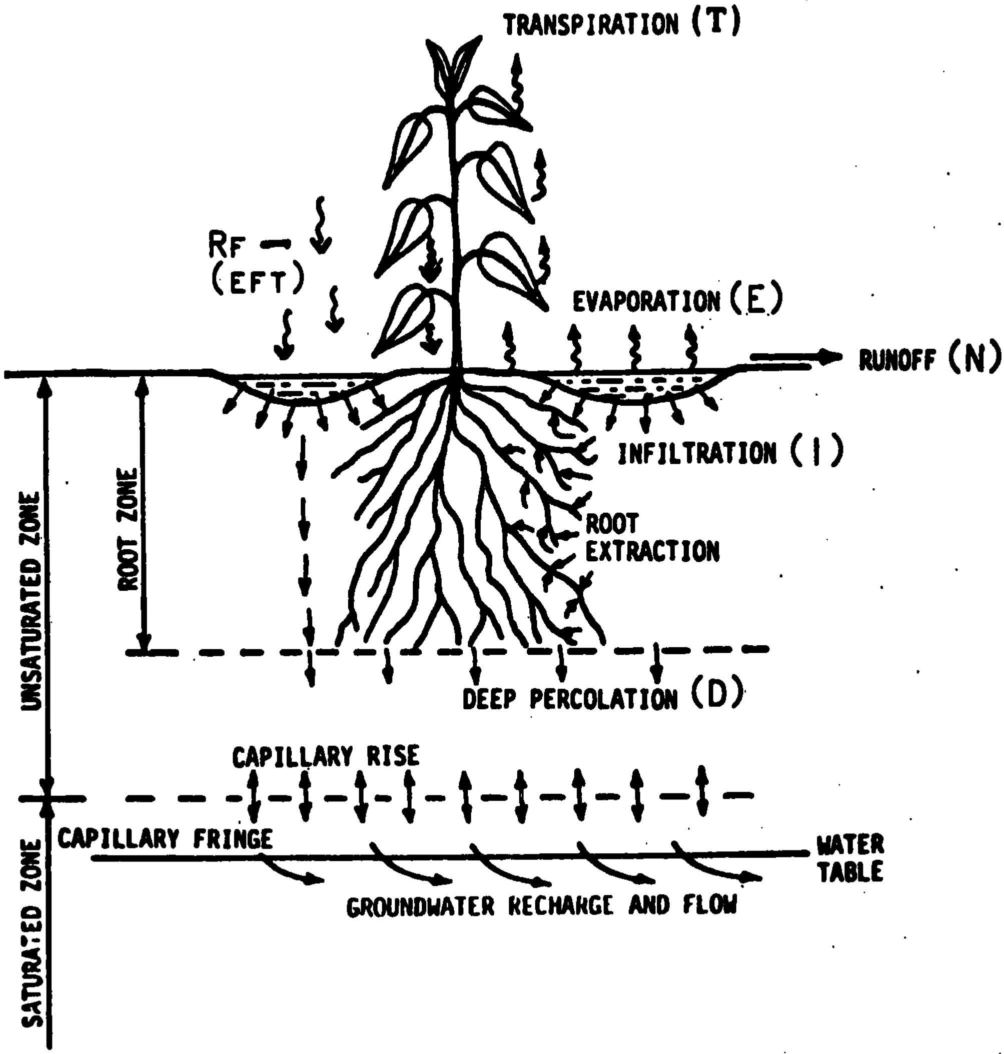


Fig. 2 - Water balance of root zone

Evaporation from the soil surface could be reduced by having a physical barrier between the soil surface and the atmosphere. A thick layer of mulch is considered as a good physical barrier. A mulch layer helps to reduce evaporation as well as growth of weeds, helps to improve the organic matter status of the soil and protects the soil surface from dispersion due to impact by rain drops. By protecting the soil against dispersion, a favourable surface structure is maintained which decreases surface scaling and therefore allows more rapid infiltration.

Another way to conserve soil water is to increase the storage capacity of the soil. Increasing the soil's organic matter content has been considered effective for increasing its storage capacity. It has been shown that plant available soil water increased by about 1.8 percentage units for each percentage unit increase in organic matter content for soils ranging in texture from sand to clay. To raise the soil organic matter content by one percentage unit to a 30 cm depth required adding about 45 tons $ha^{-1}$ of dry material. Smaller additions result in small increases in water retention, but may be practical if materials are grown *in situ*. Returning most or all residues from crops to the soil should maintain or gradually increase the soil organic matter content, thus increasing the water storage capacity over a long period. Drainage D cannot be reduced unless a physical barrier is placed below the root zone. This is not easily possible. However, by increasing the effective rooting depth, D also could be made use of by the plant.

## IMPLICATIONS FOR MANAGEMENT

To maximise yields under dryland tea production, where water is limited, management strategies should be aimed at maximizing the proportion of rainfall that passes through the crop as transpiration.

In addition to transpiration by tea, rainfall can be lost from the system through run-off, through deep percolation, interception and subsequent rapid evaporation from the tea canopy, and through transpiration by competing plants—weeds. It is therefore essential to control weeds at the end of the wet period which coincides with beginning of dry period. Weeds not only compete directly with the crop for water in the crop's root zone, but may be deep rooted and extract water which would be available to the plant in the latter part of the dry period.

In a compacted soil, forking can improve infiltration of water into the soil. Forking, therefore reduces run-off and hence soil erosion. Soil evaporation is another source of water loss during the dry period. Since the rate of water loss from a wet soil surface is similar to that from a free water surface or complete crop canopy, the rapid establishment of tea with greater ground cover will minimise soil evaporation. It is also well known that mulching with crop residues reduces soil evaporation. If any application of fertilizer is made at the tail end of the wet weather it may actually reduce the yield, because a luxurious vegetative growth induces excessive use of water at the beginning of the dry period leaving inadequate water for the rest of the dry period. Management strategies should endeavour to increase the total available water to the tea plant by building up the organic matter levels of the soil to that of adjacent forest covers over a period of time.