POTENTIAL EVAPOTRANSPIRATION & WATERSHED DEGREDATION

By

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Increasing degradation of St. Lucia's watershed areas represents one the most serious threats to sustainable social and economic growth. Paradoxically, this situation has created opportunities for increased levels of environmental awareness and in particular, the use and conservation of fresh water resources. There is an apparent decrease in available supplies in circumstances of increasing water demand and use. The reasons for decreasing water supplies are not clearly understood, but generally attributed to increases in pollution, shifts in land use, and climate change. However, to achieve sustainability, informed management decisions must be made on the basis of our ability to describe and quantify elements of the local water cycle, and understand how changes to them can affect the availability of water.

Evapotranspiration is one of the most important elements for quantifying available water since it generally constitutes the largest component of the terrestrial water cycle. It is however closely connected to, and limited by characteristics of our physical environment, and therefore, also an excellent indicator of impacts of environmental change on the local water regime.

The evolution and easy access to computers, Geographic Information Systems (GIS) and, artificial neural networks (ANN's) have opened the way for new opportunities, perspectives, in interpreting complex environmental patterns such as our fresh water resources. However, we need to urgently invest the time and resources needed to understand and reverse degradation of our watersheds, rivers, and natural resources in general, so as to secure our social and economic growth.

Evapotranspiration is generally defined as the discharge of water by the combined process of evaporation and transpiration to the atmosphere. Evaporation occurs when liquid water is changed to vapour from bodies of water and other surfaces, while transpiration occurs when water is lost from plants through the stomata and plant tissue. It involves complex processes, which are influenced by factors such as climate, topography, precipitation, soil moisture, plant-water requirements, and the nature of land cover. Potential evapotranspiration occurs when evapotranspiration is at its maximum, in conditions of unlimited moisture supply.

The main requirement for evapotranspiration to occur is an energy supply which provides the latent heat of vaporisation to change liquid water to water vapour. This energy input relates to the surface energy budget by way of net radiation, derived from the extra-terrestrial solar radiation balance. Net radiation is the result of this Earth-Atmopsphere budget and is the basic input to the surface energy balance.

Generally, it constitutes energy available for evaporation and is governed by site conditions such as land cover type.

The apportionment of net radiation into latent heat or sensible heat (the part that contributes to temperature) depends on the availability of water and the nature of land cover. In conditions of unlimited water the latent heat dominates, but when water becomes restricted or less available more energy is dissipated as sensible heat. Therefore, by maintaining land cover types, which reduces infiltration capacity for rainwater to enter the soil, we are actually making more water available for evaporation, instead of allowing it to enter the ground as storage where it will eventually contribute to sustaining streamflow.

The results of a recent study showed that St. Lucia receives enough net surface energy to potentially evaporate most of the rainfall that it receives. The study found that long-term mean annual potential evapotranspiration can be as much as 92% of mean annual rainfall, while wet and dry season evapotranspiration was found to be 67%, and 134% of mean annual rainfall, respectively. What this means to us as water resource and land managers in general, is that, we must seek land use changes that tend away from potential evapotranspiration conditions, and also plan for water storage in the wet season so as to supplement available water in the dry season.

This is precisely what has happened to Haiti. They in effect altered the balances of important natural systems beyond some critical threshold through drastic land-cover transformation. By destroying natural vegetation they have altered the surface energy balance towards greater evaporation, while at the same time reduced infiltration opportunities for water to enter the soil, where it can be stored and protected.

Once this critical threshold is reached, reforestation schemes do not work due to a lack of water for plant growth, given that evapotranspiration is at or near potential. Streamflow will be reduced or become seasonal, due to low infiltration capacity, and most of the water entering the soil will be consumed by the newly planted trees and evaporated back into the atmosphere. Additionally, Dry Lifezones will expand and extend drought-prone conditions due to local climatic changes, as experienced by coastal regions along with their associated deciduous and drought-resistant vegetation. We are well on our way to realizing the above situation in St. Lucia if we continue the current rate of watershed degradation and disruption of natural balances of surface solar energy, freshwater, vegetation, and climate. The time to act is now, tomorrow may be too late