Coping with water scarcity in Vietnamese Highlands

The Challenge

Vietnam is the second largest coffee producer in the world, and the Tay Nguyen Central Highlands is the leading growing region for Robusta coffee. In recent years, drought and water shortages have been increasingly affecting the region and threatening coffee production of the smallholder farmers. As the availability of water during the growth season is the limiting factor in this region, reducing the water losses and increasing the water use efficiency of coffee plantations is a necessity. One way of achieving this objective is to reduce evaporation from the soil surface while ensuring that sufficient water is available for plant growth, i.e. for plant transpiration. However, quantifying these two components separately is not an easy task; this is where the isotopic signatures of hydrogen (\(^{2}\)H) and oxygen (\(^{18}\)O) in water can help.

The Project

Through an IAEA coordinated research project\(^1\), the Vietnam Institute for Water Resources Research set out to improve water use efficiency in coffee plantations at the Tay Nguyen Plateau in the Central Highlands of Vietnam by assessing the effects of surface soil cover with plant clippings on the loss of water by soil evaporation. By identifying the signatures of hydrogen and oxygen in atmospheric water vapour in coffee plantations, it was possible to separate the total water consumption into its individual components of soil evaporation and crop transpiration, thus providing data essential to determine the effective water requirement of coffee.

The project showed that, in a 10-12 year old coffee plantation, soil evaporation was highest (53%) during the maturation and canopy forming stages, lower (26%) during the bean development stage and lowest (17%) during the bud development and flowering stage. Although evaporation was lowest during the bud development and flowering stage, coffee plants need the most water during this stage, which also happens to occur during the dry season. Conserving water and minimizing water loss during this stage is therefore crucial to the production of good quality coffee in this region. The project showed that covering of the soil surface with old branches and leaves during this stage reduced evaporation to less than one third, from 17% to 5%, which enhanced the sprouting of new buds and stabilised soil structure on steep slopes.
The Technology

The variation in the signatures of isotopes (δ²H and δ¹⁸O) in the water vapour surrounding plants makes it possible to separate evapotranspiration into its individual components of soil evaporation and plant transpiration. Through this information, guidelines are provided to farmers that enable them to minimise the evaporation process in their efforts to optimise water use efficiency.

The Impact

The recurrent droughts in the Central Highlands of Vietnam compel farmers to transport water from far away to irrigate their coffee plantations. With a current water requirement of over 150 mm during the bud development and flowering stage in December to January and a total harvested area of 380,000 ha in Vietnam, a saving of ⅓ of water during these months can be achieved merely by covering the soil between trees with old branches and leaves, amounting to a saving of 66 million m³ of water. This finding has been helpful to local farmers whose livelihoods depend primarily on coffee production, and will provide a strong economic incentive to increase water use efficiency in coffee plantations.

For further information, please visit:
The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture
International Atomic Energy Agency, Wagramer Strasse 5, PO Box 100,
1400 Vienna, Austria
www-naweb.iaea.org/nafa/swmn

¹ D1.20.09 on “Managing irrigation water to enhance crop productivity under water-limiting conditions: a role for isotopic techniques” 2007-2012