The Challenge

Agriculture is the most important economic sector in Ghana, with smallholder farms dominating the sector and accounting for about 80% of total agricultural output. During the rainy season peri-urban farmers around Accra and other major cities primarily grow vegetables that attract good prices and offer the prospect of improved livelihoods for these farmers. However, despite the demand, the production of vegetables is low during the dry season from November to March because of recurrent droughts and water shortages. Traditionally, peri-urban vegetable farmers use either water cans or sprinklers to irrigate their crops. While the former method is laborious and often results in patchy harvests, the latter requires large amounts of water that are all too often not available. Ghana is therefore faced with the challenge to develop efficient water management strategies that will facilitate the production particularly of vegetables during the dry season, while at the same time ensuring more sustainable incomes for its peri-urban farmers.

The Project

Through an IAEA technical cooperation project, the Biotechnology and Nuclear Agriculture Research Institute (BNARI) in Ghana compared water requirements of vegetable crops using drip irrigation versus traditional overhead sprinkler irrigation, both in terms of total water usage and of crop yields. The soil moisture neutron probe was used to facilitate the synchronisation of irrigation scheduling with the content of water in the soil.

The results showed that the same amount of water applied to cabbage through drip versus sprinkler irrigation delivered yields of 47 t/ha and 32 t/ha, respectively. To achieve the same yield with sprinkler irrigation, 60% of additional water had to be applied. Having established the superiority of drip irrigation in terms both of total crop yield and of yield per unit of water, the project investigated the optimal timing of manure applications in the production of cabbage using drip irrigation.

It was found that the provision of up to 12 tonnes of poultry manure, equivalent to about 150 kg of nitrogen/ha, increased the yield of cabbage by 9% when the manure was applied shortly before sowing rather than several times throughout the growing season. By adopting drip irrigation and using organic manure, rather than the 120 kg of chemical nitrogen fertiliser normally applied to cabbage, the total saving to farmers on the cost of water pumping and chemical nitrogen fertiliser was more than US $216/ha compared to sprinkler irrigation with chemical fertiliser.

The Technology

Drip irrigation technology increases water use efficiency by applying water directly to the immediate vicinity of the plant roots through a network of pipes and water emitters. This again results in a reduction both in soil water evaporation and in excess water draining away below the roots, so that much less irrigation water is needed. This technology can be easily adapted for use in large-scale fields allowing for automation of the irrigation
process, or for small-scale plots using low-cost materials such as buckets, drum kits, etc. It can also be easily adapted for the simultaneous application of water-soluble fertilisers, such as nitrogen.

The soil moisture neutron probe (SMNP) is an instrument that measures soil water content for crop production. During the measuring process, the probe emits neutrons that collide with hydrogen atoms in soil water. This collision slows down the speed of the neutrons. The change in the speed of the neutrons is detected by the probe and provides a reading that corresponds to the soil water content. The SMNP is currently the most suitable instrument to accurately measure soil moisture under saline conditions. It is also widely used to calibrate other moisture sensors for direct use in farmers’ fields.

**The Impact**

The 60% reduction in the water requirements of cabbage with drip irrigation on the 6400 ha of irrigated peri-urban vegetable growing regions of Ghana, compared to the currently used overhead sprinklers, is equivalent to a total water saving of 416,000 m³. Such a saving is substantial in the overall national efforts of Ghana to alleviate increasing water shortages.

The yield increase of 15 t of cabbage/ha with drip irrigation versus sprinkler irrigation, combined with savings of US $216/ha/year in water pumping and fertiliser costs when using poultry manure rather than chemical nitrogen fertiliser, provide a much-needed additional income to Ghana’s peri-urban farmers and enable a sustainable production of fresh vegetables for the urban population also during the dry season. As a result of these strong incentives, small-scale family-size drip irrigation technology has already been adopted by 130 peri-urban farmers in this early stage of the project.

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

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1 RAFS058 on “Enhancing the Productivity of High Value Crops and Income Generation with Small-Scale Irrigation Technologies”, 2009-2013