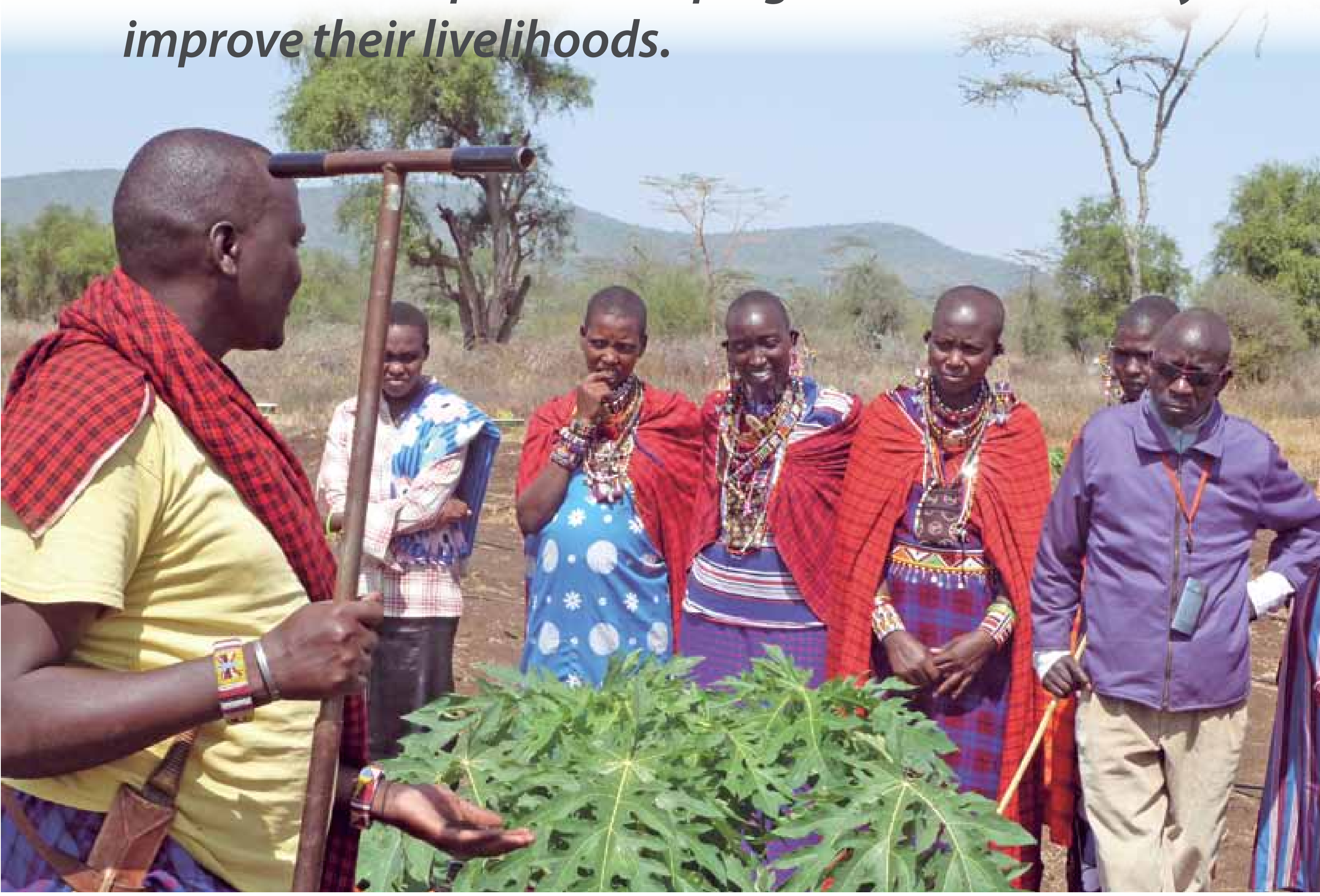
Farming when the Rains Fail

by Louise Potterton

Nuclear techniques are helping the Maasai in Kenya improve their livelihoods.



(P.Pavlicek/IAEA)

On a dusty, dry patch of land in south-east Kenya a lone Maasai man admires a thriving fruit and vegetable plot. Mangoes, papaya and spinach flourish under the searing heat of the African sun.

This is a rare sight here in Ng'atataek on the Tanzanian border, an arid region where rainfall is scarce and the little water available is usually reserved for the livestock.

But this Maasai community is fortunate. Thanks to financial support from AMREF, the African Medical and Research Foundation, they now have access to freshwater for irrigation via a borehole. By harvest time, they will have nutritious crops to eat and produce to sell at market.

This project is one of many across Africa that is operating within an IAEA Technical Cooperation project that supports the use of drip irrigation for high-value crops. With the help of nuclear technology, the system enables farmers to grow healthy crops using very little water in dry conditions.

Alex Ntasikoi, who has been trained by KARI in drip irrigation methodology, shows other members of his community how the system works.
(Photo: L. Potterton/IAEA)

It forms part of an on-going campaign, initiated by Kenya's Green Belt Movement, to improve the health and livelihoods of the Maasai people by encouraging them to move towards sustainable agriculture, while protecting the environment.

"The Maasai are by tradition pastoralists, depending on their livestock as a source of income and food," says David Mathenge from the Green Belt Movement, who oversees the project. "But times are changing. Populations are increasing and land for animals is becoming scarce. Also during the droughts livestock die, so the Maasai need to diversify."

Having access to a source of water was only part of the solution. The Maasai farmers needed to know how to use it efficiently and effectively. The Green Belt Movement approached the Kenyan Agricultural Research Institute (KARI) for assistance. Through its partnership project with the IAEA, KARI was able to help.

"We had a challenge on our hands. We needed recommendations on how best to use a small amount of water in a very dry area. We don't know how much water is needed for the plants and how much moisture there is in the soil and this is where the IAEA and its technology proved their value," adds David.

Nuclear techniques, such as the neutron probe that measures soil moisture levels, can provide the guidelines and advice the farmers need to be able to irrigate at the best times, using the right amount of water, without wastage.

"It would be very presumptuous to say that this would work without involving modern technology. Even the boreholes have low yields," David says. "If we go on irrigating using traditional methods without having a scientific basis, we might fail and could come into conflict with a community that still considers water to be more important to their livestock than to any other activity."

The Maasai site is one of nine projects that are being coordinated by the KARI under the IAEA's Technical Cooperation Programme to promote the use of small-scale drip irrigation, supported by nuclear science.

With drip irrigation, water is applied in droplets near the plant's root zone through small tubes called drip-lines. It is the most efficient form of irrigation, using up to 70 percent less water than other techniques, and can improve crop yields threefold.

This simple, low-cost set-up avoids over-watering, which can damage both the soil and the crops. Too much water can flush away vital nutrients and can increase the salinity level of the soil, which can curtail crop growth.

When plants receive too much water it can lead to runoff from the area where the crops are grown and eroded topsoil and applied fertilizers can find their way into neighbouring streams, rivers and lakes.

KARI's Irrigation Coordinator Isaya Sijali, says: "Nuclear techniques are very important and useful in agriculture. We can use the neutron probe, for example, to measure soil moisture levels and advise farmers on how much water to apply and when. These techniques can help them save water and money and get better crops while protecting the environment."

He decided to use these techniques to study the dynamics of water and nutrients at the site, since the community needed to know how to use their limited water and nutrient supplies to grow crops in a sustainable manner.

"The IAEA is directly helping these new farmers and many others will be able to benefit from this site and the findings we get from this project," says Sijali.

Experts from KARI visit the sites to explain how and why the nuclear techniques work and provide advice and guidelines based on the tests that have been carried out at their laboratories in Nairobi.

"Using isotopic techniques we can study the uptake of nitrogen, the most important element required by the plant, and advise the farmer on how to get the most benefit from the fertilizer that's been applied," Sijali adds.

In the Maasai community, Alex Ntasikoi, who has been trained by KARI in drip irrigation methodology, shows other members of his community how the system works.

"We've really seen the benefits of drip irrigation," he says. "The system is cheap and requires little water, which is very important in our region because we have so little of it. Also, the plants get less disease because the water goes into the roots and not on the leaves," Ntasikoi says.

But the real beneficiaries of this project are the Maasai women. The men can be away for up to a year in pursuit of grazing land for their livestock, while the women and children remain in the community.

"Drip irrigation is a new technology for us and since it's been introduced we can plant our own vegetables and don't have to depend on livestock alone," says Mary Kashu. "We can improve our children's nutrition and raise some income. We can use the money to pay school fees and to maintain the pump to get more water from the borehole."

The IAEA is currently implementing the drip irrigation project in 19 countries in Africa. Lee Heng, a water specialist who manages the project, says: "We hope that this project will empower the farmers to farm in an efficient, productive and sustainable manner."

She adds that agriculture is responsible for around 70% of freshwater use and for most of the world's groundwater depletion. However, on average, only 37% of this water is used efficiently, due to inappropriate irrigation technology and farming practices.

"As water becomes more and more scarce and growing populations demand more food, it is of paramount importance that we manage agricultural water better to grow more crops for every drop of water we use in both rain-fed and irrigated agriculture," says Lee.

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Seeing Through Soil

by Peter Kaiser

Nuclear technology helps farmers make the most of water

Irrigation consumes seven of every ten litres of fresh water used daily around the world. As global population rises, so too does the demand for food, which is satisfied by expanding cultivation and increasing irrigation. If irrigation efficiency can be boosted, much can be done to reduce farming's thirst for fresh water, and help preserve this irreplaceable resource.

(P.Pavlicek/IAEA)

One of the nuclear technologies employed in tackling water scarcity and saving water in agriculture is a "soil moisture probe", or "neutron probe", which is used to measure how much water is present in the soil surrounding the probe. Measurement across a farm plot provides the farmer invaluable insights into an otherwise invisible phenomenon: how much of the irrigation or rainwater is held in the soil and how much of that water is accessible and used by plants.

In the hands of a trained and licensed operator, a probe can literally see through soil to detect the faintest traces of water. The device is so sensitive it can even calculate how much water a plant consumes.

By flicking a switch, the operator can trigger a specially shielded, tiny radioactive source that emits a thin stream of neutrons. They travel at great speed through the soil. The passage of those neutrons that struck hydrogen atoms in water molecules is dramatically slowed. After the neutrons collide with other particles, they are reflected back towards the probe, which measures the speed of the returning neutrons. Water's braking effect on the neutrons is registered by a detector within the probe. Thus, the amount of returning, slower-moving neutrons counted by the detector indicates the soil's hydrogen content. The probe translates this data into an exact soil-water content measurement, which is expressed in millimetres of water. That data is exactly what the farmer needs to immediately plan irrigation and water storage strategies that make the most of water for irrigation.

The probe itself does not cause any radioactive contamination, nor are any radioactive traces left in the soil.

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