How nuclear technology helps Sudanese women make the most of their land

By Nicole Jawerth

Nuclear science helps Sudanese women turn dry lands into vegetable fields.
(Photo: N. Jawerth/IAEA)

On the edge of Sudan under the blistering sun, women covered colourfully head-to-toe chatter away as they harvest lush green vegetables to feed their families, their neighbours and their wallets. Their fields thrive among long stretches of parched earth because nuclear science has helped them make the most of limited water supplies and optimize fertilizer use.

"We used to have nothing. We had little food, and we had to buy it at the market. We did not even know how vegetables were grown," said Fatima Ismail, a farmer from a small village in eastern Sudan where an IAEA-supported drip irrigation project has been ongoing since 2015.

These hundreds of women have been living constrained lives with few opportunities for change. They and their families, many of whom are refugees or internally displaced, had limited food resources and relied on their husbands' meagre income. The women did not have an option to grow their own food or leave their homes to work and earn a living.

Now, through small-scale farms and home gardens optimized using nuclear science and technology, the women, their families and entire villages benefit from access to all sorts of vegetables, from onions and eggplants to okra and leafy greens.

"Before this, my child suffered from malnutrition, and I had to take him to the doctor very often," said Haleema Ali Farage, a woman farmer participating in the project. "Now with more food and more nutrition from the vegetables, he has not gone to the doctor for months."

Science was the starting point of a new change for these women. Local scientists from the Agricultural Research Corporation (ARC) were trained and provided with technical support by experts from the IAEA, in partnership with the Food and Agriculture Organization of the United Nations (FAO). The scientists learned to use the soil moisture neutron probe technique to measure and determine moisture levels in their soil at Kassala Research Farm, to quantify the amount of water needed by the crops, and to optimize nitrogen fertilizer use (see The Science box). These studies then formed the basis for how much water and fertilizer to deliver through the watering system known as drip irrigation.

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Scientists carry out studies on the atoms in soil, water, fertilizer and crops to determine how to best grow crops and manage soil and water resources.
(Photo: N. Jawerth/IAEA)

Quick Facts

Drip irrigation uses 60% less water than surface irrigation. It improves onion crop yields by around 8000 kg/ha. This translates to over $3700 in additional income per hectare of crops.

Every drop counts

The low-cost drip irrigation system is easy to install and simple to use: it involves a giant raised tub of water that is controlled by an on–off valve, which, when switched on, uses gravity to draw the water mixed with fertilizer down into a series of tubes placed directly at the base of the plants. Using this method of combining water and fertilizer through drip irrigation is called 'fertigation'.

"Although not a new technology in itself, it is only when set up correctly and optimized using scientific data that drip irrigation can be effective with very little water waste," said Lee Heng, Head of the Soil and Water Management and Crop Nutrition Section of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. This fertigation method is promoted by the FAO for countries and regions where water is scarce and at a premium.

"What makes this drip irrigation system new and innovative is what has been released from ARC," said Rashid Sir El Khatim, Coordinator from the Talawiet Organization for Development. Pilot studies were conducted in fields around Kassala State, along the border with Eritrea. The ARC provides local NGOs like Talawiet with a complete package for setting up and using drip irrigation and fertilizer, optimized through the scientific work done with IAEA support. This area is often called the 'bread basket' of Sudan as the soil is rich with nutrients, and when combined with adequate water, has shown to be an excellent environment for growing food. However, water supplies are increasingly running short due to rising temperatures and climate change.

"Water, soil, temperature: it's all a complete package," said El Saddig Suliman Mohamed, ARC's Director General. "Without a proper irrigation system, you can't maximize yields, but on the other hand, without using fertilizer correctly the soil can't reach its full potential. So we have to look at the whole package."

The success of the IAEA pilot project in reducing water use by more than 60% while increasing food yields by more than 40% drew the attention of other organizations, such as the Sudanese Red Crescent Society (SRCS) and Talawiet. They have worked closely with IAEA-trained scientists from the ARC to set up and run more than 50 small-scale farms and home gardens for over 400 women. Following the success of these projects, the ARC, Talawiet and the SRCS are now working with their partners to establish more than 40 new drip irrigation systems for over a thousand women.

Women's empowerment for sustainable change

While the whole village benefits from these agricultural projects, women have been the primary focus because of the important role they play in family well-being. Women invest much more of their earnings in their children's education and health than men do: 90% of their income compared to 30–40% by men. This trend has the potential to break intergenerational cycles of poverty, according to the World Bank.

Small-scale farms and home gardens equipped with drip irrigation systems are helping to empower women in Sudan.
(Photo: N. Jawerth/IAEA)

"If women are empowered, they can share in the decision-making in the family and the community," said Sir El Khatim. "It helps to reduce poverty, and it makes future planning more effective. When women are empowered, the community is more empowered."

As the project continues, the women are eager to continue building on their success.

"We want to do more," said Fatima Ismail. "We want to expand the area and grow more and new types of vegetables. We want to help educate others to do this. We need another water tank, so all of our neighbours and all the women in the village get involved. We want everyone to have a chance. We are ready."

THE SCIENCE

Soil moisture neutron probe and nitrogen tracking

Scientists use a neutron probe to monitor moisture levels in soil at a research farm. The probe emits neutrons that collide with the hydrogen atoms of water in the soil. This slows down the neutrons. The change in neutron speed is detected by the probe and provides a reading that corresponds to the moisture level in the soil. The higher the number of hydrogen atoms, the more neutrons are slowed down, and the number of slow neutrons, which can be measured, serves as an indication of the level of moisture.

Nitrogen is a key component of soil and fertilizers. As nitrogen atoms interact with the atoms in soil, fertilizer and water, they change into forms taken up by plants, released in the air or absorbed further into the ground. Using fertilizers labelled with nitrogen-15 (15N) stable isotopes — atoms with extra or missing neutrons — scientists can track the isotopes to determine how effectively the crops are responding to and taking up the fertilizer. This can help increase crop yield and optimize fertilizer use.