International Atomic Energy Agency

One of five key areas to sustainable development where progress is possible with the resources and technologies at our disposal today.

Improving Productivity in Agriculture

Despite progress made since the 1996 World Food Summit that set the goal of halving the number of undernourished people by the 2015, serious food insecurity persists in many parts of the world. Although more food is being produced worldwide than ever before, some 800 million people are still chronically malnourished. Improving agricultural productivity is a driving force for both economic and social development. When agriculture falters, income sources are lost, social ties are disrupted, and, as a result, societies become more mobile.

Up-to-date technologies, improved plant and animal stock, and better soil and water management practices not only combat food insecurity, they are also important to achieving sustainable agriculture practices essential to maintaining an appropriate balance between conservation and use of all the resources required to grow crops and raise livestock.

Through its programme in Food and Agriculture operated with the Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA) works to enhance capacities at national and international levels for identifying and alleviating constraints to sustainable food security by facilitating development and adoption of nuclear and related biotechnologies. With an annual budget of nearly $10 million, this programme helps Member States to improve productivity in agriculture, particularly through better water and soil management practices, efficient crop nutrition, and control of insect pests.

The Food and Agriculture Programme

- soil and water management and crop nutrition
- plant breeding and genetics
- animal production and health
- insect and pest control
- food quality and safety

Water Use and Soil Management

According to FAO estimates, as much as 40 per cent of the world's food is grown using irrigation, but large amounts of this water is lost to leakage in the irrigation system itself. Improper irrigation is also a major cause of soil salinity. Roughly one tenth of the world's irrigated land has been damaged by salt. With the threat of climate changes, more and more regions of the world are also at risk of drought and desertification. Improved irrigation practices will help conserve water and protect vulnerable land.

Stable and radioactive isotopes can be used as "tags" at the molecular level to monitor how plants use essential nutrients. Such techniques allow scientists to determine the exact nutrient and water requirements of crop in particular conditions, making it possible to find sustainable alternatives for that area.

The IAEA is using nuclear science to improve crop production techniques, particularly in regions where water is scarce. Through its Soil and Water Management and Crop Nutrition programme, the Agency develops and transfers techniques that use stable and radioactive isotopes to study crop growth and nutrient requirements to increase yields, while conserving water and preventing further degradation of marginal lands.

A five-year technical co-operation project in the West African Sahel countries (Burkina Faso, Mali, Niger, and Senegal) is now underway with three main strategies: sustainable agriculture intensification on the most suitable arable land; conversion of marginal lands to appropriate land uses, reducing and/or eliminating the extensive grazing of low-productivity rangelands; and restoration of degraded lands and ecosystems. Each country is developing

a national action plan tailored to their specific situation and needs. The IAEA is providing technical advice and assistance, as well as the equipment needed to use isotopic techniques for water and integrated nutrient management.

Through its technical co-operation programme, the IAEA provides training, expert services, equipment and other assistance to help Member States apply nuclear technology.

In 2001, $12.1 million was spent to support projects related to food and agriculture. In fact, almost 35 per cent of the total technical co-operation programme for Africa is spent on food and agriculture assistance.

In Mali, for example, one project is studying the interaction between various plants, climate and fertilization over a three-year period. Nitrogen fertilizers labelled with a stable isotope of nitrogen (^{15}N) will be used to help determine the optimal growing conditions for sustainable agricultural production in this dry-land area. Similarly in Senegal and Burkina Faso, local staff are being trained to use ^{15}N isotope techniques for field studies of nitrogen fixation in legumes and efficient use of fertilizer in cereals.

Micro-irrigation systems and fertigation — the application of fertilizers through an irrigation system — help to control water and nutrients in the root-zone, saving labour and equipment costs. Eight countries from the West Asia region (Iran, Jordan, Lebanon, Saudi Arabia, Syria, Turkey, United Arab Emirates and Yemen) participated in an IAEA regional project over a five-year period. Isotope techniques were used to identify improved water and fertilizer management practices. Tremendous savings of water and nitrogen fertilizer were observed when these methods were compared with the traditional method of applying water and nitrogen fertilizer to the field. A regional project in the Mediterranean also found fertigation to be a more effective technique for conserving both water and nitrogen fertilizer and increasing crop production than conventional irrigation practices.

Control of Insect Pests

Insect pests are another serious threat to productivity. They can devastate crop yields and transmit disease to both crops and livestock. Conservative estimates put losses of food production in the range of 25–35 per cent, even with use of pesticides. Moreover, there are concerns that reliance on pesticides to maintain yields not only has negative impacts on the environment, but may also lead to the insects developing resistance to the pesticides themselves. Through its Insect and Pest Control programme, the Agency is using nuclear science to develop environmentally friendly alternatives for pest control. One of the most successful techniques developed to date is the sterile insect technique (SIT).

SIT involves mass rearing insects and then sterilizing them using gamma radiation. These sterile insects are identical to those in the wild except that they cannot reproduce. The sterile insects are then released to compete with wild males for mating. Successive releases of sterile insects over time will gradually reduce, and eventually eradicate or control, the targeted insect population.

This technique has been successfully used to eradicate several insect pests of agricultural significance. One of the most significant is the Mediterranean fruit fly (Medfly), a serious threat to more than 250 species of fruit and vegetables. Thanks to successful implementation of SIT, the Medfly has now been eradicated from Mexico and Chile, and from parts of Guatemala and the United States. The programme is now being expanded into Argentina, Southern Peru, and the Middle East.

The tsetse fly, which spreads the parasite trypanosome that causes African sleeping sickness and the cattle disease Nagana, has turned several fertile African landscapes into uninhabited green areas. Because of the risks of the tsetse, large fractions of Africa's best land — particularly in river valleys and moist areas where the potential for mixed farming is good — lies uncultivated. Affecting as many as 500 000 people, the tsetse fly is responsible for economic losses estimated at more than $4 billion per year. As a result of the successful combination of SIT with conventional pest control methods, Zanzibar was declared tsetse-free in 1997. Building on this success, in 2001, the Organization of African Unity established the Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) to combat the tsetse in the 37-Sub-Saharan African countries with support from the World Health Organization, FAO, and the IAEA.

Improving productivity in agriculture in a sustainable manner is today a realistic target. Nuclear science offers proven techniques that can and are being used to improve productivity while conserving valuable resources needed for today and for the future.

More information is available on the Agency's WorldAtom website:
http://www.iaea.org/programmes/nafa/dx/index.html

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