

Food and Agriculture

Objective

To enhance capabilities within Member States for alleviating constraints to sustainable food security by the application of nuclear techniques.

Sustainable Intensification of Crop Production Systems

Significant challenges in many parts of the world are the achievement of better soil, nutrient and water management practices to improve low crop yields and to reduce natural resource degradation, the selection and breeding of crops that give higher yields and nutritional value, and the control of insect pests that threaten livelihoods, food security and economic development. Agency support, involving the use of nuclear techniques, enabled Member States to address these challenges, both by conducting research that helped to identify and evaluate options for more productive and sustainable systems, and through technical cooperation projects for pilot testing and for extending these options to farming communities.

A CRP, aimed at increasing crop production by managing nutrients and water in rain fed, arid and semi-arid areas, assisted ten countries in the use of isotopes and neutron moisture probes for a reduction by up to 50% of recommended rates of fertilizer nitrogen without affecting crop yields. The efficiency of water use by crops was also increased by the same amount by changing management practices according to the pattern of rainfall during the growing season, resulting in better overall crop productivity and profitability and improved conservation of scarce water resources. A similar approach in a regional technical cooperation project involving nine European countries demonstrated the substantial agronomic and environmental benefits from using 'fertigation' (an irrigation technique that provides fertilizer nutrients to plants at the time of irrigation) compared with conventional methods of providing irrigation and fertilizers. Higher crop yields resulted, with an increase in the efficiency of water and fertilizer use and with minimal nitrate leaching to groundwater. Continuing this theme, 11 countries under an RCA technical cooperation project developed and tested new management

practices that restored soil fertility in rice based cropping systems.

Two important roles for the Agency in promoting economic development is increasing the availability and facilitating greater exchange between Member States of crop breeding lines possessing a variety of improved mutation induced traits. For example, genetic variability was induced in sorghum by gamma irradiation, and ten mutant lines showing promise for drought tolerance were identified as a result of cooperation between India and Indonesia. Subsequent field evaluation proved that the mutant lines could tolerate longer drought stress and produce higher grain and biomass yields for food and feeding livestock. New mutant wheat varieties with root systems that provide higher tolerance to water stress in drought-prone western China were developed through a CRP, which also led to chickpea mutant lines in South Africa that produced 30% more than the parent variety under drought conditions, and to the establishment of the first international consortium on plant root research (<http://www.crop-roots.org>).

Another important area of work for the Agency was reducing the constraints of disease and soil salinity in food production. A breeding programme using gamma irradiation of sesame seeds, a major oil seed crop, for mutation induction was initiated at the Department of Plant Research of the Egyptian Atomic Energy Authority. Three mutant varieties were developed with high yielding potential and disease and insect resistance. These varieties already occupy 13% of the total area under sesame cultivation in Egypt three years after they were released. Additionally, several mutants with resistance to the toxin causing Black Sigatoka disease in banana were reproduced at the Agency's Laboratories at Seibersdorf and are being field tested. Rice mutants with enhanced tolerance to saline soils were also field tested and integrated into national crop improvement programmes in Myanmar and Vietnam.

A Mutant Germplasm Repository has been set up to distribute germplasm to breeders in Member States. Mutations were developed in a CRP for wheat, rice, pea, barley, maize, pearl millet, soybeans and flax. They are undergoing extensive phenotypic characterization to form part of this repository. The Agency's regional technical cooperation projects in Asia and Africa were also used to exchange

mutant germplasm among Member States in order to improve food and oil crops, including neglected species.

The interest of commercial companies in the mass production of sterile insects is growing as the sterile insect technique (SIT) is more widely adopted for controlling insect pests of crops. Fresh vegetable exports have increased to over \$30 million per year in the Arava region between Israel and Jordan as a result of a successful Mediterranean Fruit Fly (medfly) suppression programme, and a private company has initiated the construction of a sterile fly mass rearing facility in Israel. Also, the success of a medfly suppression programme in South Africa in the grape exporting Hex River valley has triggered the start of similar programmes in several neighbouring valleys. As a consequence, the Government has now privatized the mass production of sterile medflies.

The Agency is also transferring SIT technology to Spain through a Memorandum of Understanding with the Territory and Housing Department of the Valencian Community for the transfer of medfly genetic sexing strains and related technologies. As a result of a successful pilot trial conducted in two areas, the Government of Valencia has started construction of a mass rearing and sterilization facility with an initial production capacity of 300–400 million sterile flies per week. This will be sufficient to cover major citrus production areas of the province.

Recognizing the importance of harmonizing international trapping procedures for fruit flies, the Agency published *Trapping Guidelines for Area-wide Fruit Fly Programmes*. Providing strategic guidance and direction to national and regional plant protection organizations, as well as the fruit industry, on implementing fruit fly surveys, the publication will support FAO and Agency Member States in obtaining international recognition of their fruit fly control and quarantine activities. In addition, the Agency developed an interactive 'Tephritid Worker Database' to provide information on fruit flies.

Sustainable Intensification of Livestock Production Systems

The Agency's efforts in the sustainable intensification of livestock production systems are directed at identifying and disseminating nuclear technologies and related guidelines and standards that lead to improvements in productivity and income generation from the domestic and international trade in livestock and livestock

products. Thus, two regional technical cooperation projects and a CRP on artificial insemination (AI) significantly improved the reproductive efficiency of cattle reared in smallholder farming systems in more than 20 Member States. Increases of 10–25% in milk production and of about 10% in meat production were achieved. The projects brought together technical and managerial staff of 25 laboratories in Africa and Asia, with local farmers, veterinarians and technicians, using diagnostic support in the form of radioimmunoassay technology.

Agency assistance, through a CRP and an RCA project, to improve animal nutrition led to the development of a new iodine-125 labelled protein and carbon-14 labelled polyethylene glycol based methods to measure the biological activity of tannins, predict the nutritional value of tannin-containing feeds and help to identify alternative local sources of animal feeds. Feeding blocks containing plant and herbal compounds increased the income of dairy farmers by 5% to 180% per cow per day, with an average increase of 38% in Bangladesh, India, Indonesia, Malaysia, Philippines, Thailand and Vietnam while income from beef cattle and small ruminants increased by up to 30% per animal (Fig. 1). Of the 47 feeds evaluated by 12 Member States, 39 showed potential as an alternative animal feed resource. China, Thailand and Vietnam introduced these novel feeding practices to more than 2450 farmers.

The development and implementation of guidelines, quality assurance procedures and reference standards for the diagnosis and surveillance of animal diseases contributed to the ability of Member States to deal with a number of major transboundary infections. Five Member States in Africa, Europe and Asia used these new surveillance guidelines in the last stages of their eradication campaigns and in the development of dossiers for recognizing freedom from rinderpest by the World Organisation for Animal Health, thereby improving their trade status. In the Global Rinderpest Eradication Programme, a number of countries in Africa were recognized as being free of infection or the disease.

Reagents for detecting antibodies against the non-structural proteins of foot and mouth disease virus, which allow countries to discriminate between vaccinated and field infected cases, were developed and validated through a CRP. Sustainable reagent kit production was established in the Islamic Republic of Iran and Thailand by the provision of reagents, guidelines and procedures.

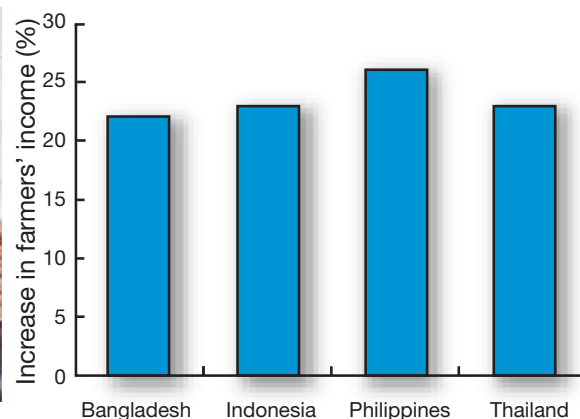


FIG. 1. Feeding blocks containing plant and herbal compounds to improve animal nutrition.

Quality assured procedures and implementation guidelines for enhancing the proficiency of veterinary diagnostic laboratories were developed and introduced into 30 countries through an inter-regional technical cooperation project. Ten of these countries are now approaching accreditation status under ISO 17025. This process was assisted by Austria, which granted a licence to import biological materials for the establishment of a serum reference bank at the FAO/IAEA Agriculture Laboratory at Seibersdorf.

An FAO-IAEA feasibility project for control of the Old World Screwworm (OWS) was started using funds from the Arab Organization for Agricultural Development. This project, which also includes a possible SIT component, is intended to provide training for countries affected by OWS, and carry out studies on OWS population genetics. Planning has also commenced for the establishment of the first small module of an OWS rearing facility to assess the technical feasibility of the SIT component.

Improving Food Quality and Safety

The development and application of guidelines and principles for the use of good agricultural practices throughout food chains is critical for

ensuring the safety of food supplies and for promoting the sustainability of the agricultural sector in developing countries. Agency activities focus on the use of nuclear and related analytical methods for ensuring compliance with maximum residue limits for pesticides and veterinary drugs, and integrated approaches to the application of agricultural countermeasures following a nuclear or radiological emergency. The Agency continues to provide information to Member States, through a number of publications, on the application of irradiation for sanitary and phytosanitary purposes.

A project on improving the reliability of pesticide residue sampling and the capabilities of food control laboratories to perform analyses according to international quality standards contributed to the elaboration of Codex Alimentarius maximum residue limits based on reliable acute intake estimates. In addition, a technical cooperation project implemented through regional workshops in Austria, Australia, Chile and South Africa assisted Member States in focusing resources on the analytical detection and control of veterinary drug hazards of concern for human health and the environment, thereby improving their knowledge for reducing technical barriers to trade. ■

Partnerships to Eradicate Insect Scourges

Ethiopia, in collaboration with major international partners including FAO, developed a "Concept Note" and a road map for joint international fund raising. The aim is to create a tsetse and trypanosomosis free zone, initially of 10 500 km², in the Ethiopian Southern Rift Valley. The OPEC Fund contributed towards equipment for the sterile fly mass rearing facility under construction. Together with others, the Agency assisted in securing funds from the United Nations Fund for International Partnerships and the USA for generating additional baseline information and for joint international fund raising efforts in support of priority areas for tsetse and trypanosomosis intervention.