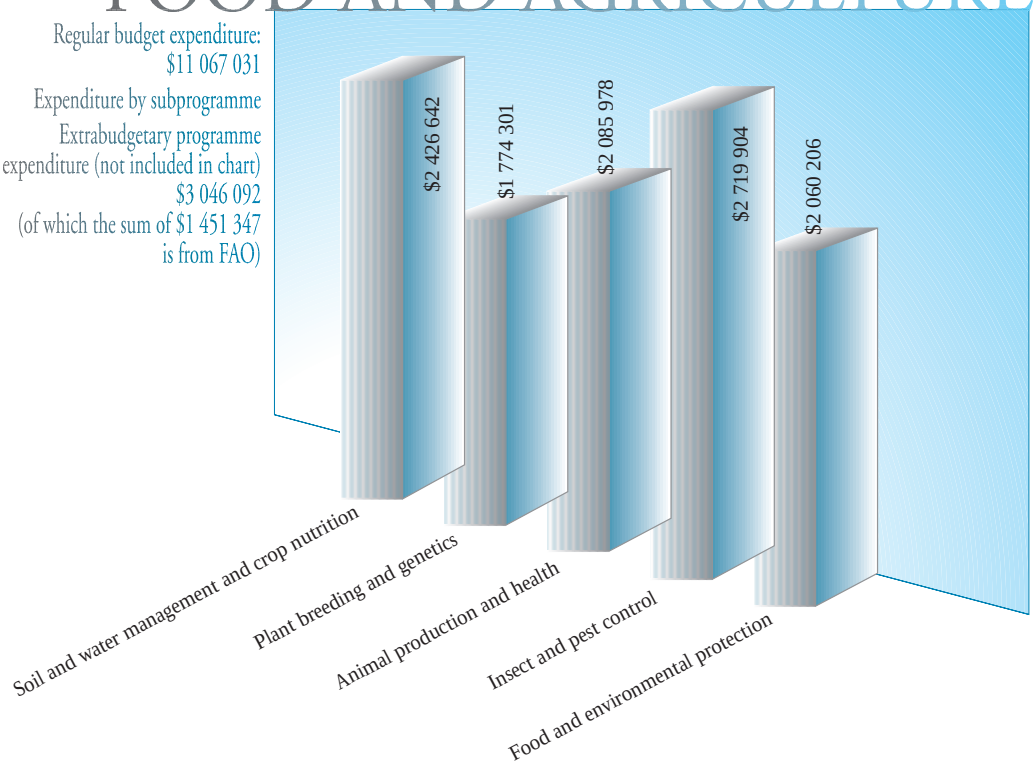
FOOD AND AGRICULTURE

Regular budget expenditure:
$11 067 031

Expenditure by subprogramme

Extrabudgetary programme expenditure (not included in chart)
$3 046 092
(of which the sum of $1 451 347 is from FAO)



Among the major achievements in the food and agriculture programme were the eradication of the tsetse fly from Zanzibar Island (United Republic of Tanzania) and the substantial progress made towards eradication of the Mediterranean fruit fly (medfly) in several Member States, both using the sterile insect technique (SIT). The R&D and quality assurance support provided by the Agency's Laboratories at Seibersdorf were critical to the success of these activities. Quality assurance was also a key component of research and technology transfer in other areas, contributing most notably to the development of sustainable soil and water management, animal production and health and food contaminant control strategies in Member States, as well as to efforts in plant breeding using mutation techniques. Construction commenced on a 250 m^2 extension to the existing laboratories at Seibersdorf for the FAO/IAEA Training and Reference Centre for Food and Pesticide Control. A comprehensive implementation plan was prepared to cover the major contaminants affecting international trade.

Soil and water management and crop nutrition

Adequate supplies of water and nutrients are two key inputs in sustainable crop production. The neutron moisture probe, an instrument developed more than 40 years ago for measuring soil water content, is finding expanding applications in the quest for more efficient use of scarce water resources. For example, studies conducted within the framework of a CRP have shown that the amount of irrigation water applied to wheat could be reduced by up to 30% compared with conventional practices without any loss of grain yield. Optimal use of water also prevented water tables from rising and promoted the efficient use of nitrogen fertilizer by avoiding nitrate leaching, which causes environmental degradation through groundwater

pollution and soil acidification. A modest reduction of 5% in fertilizer nitrogen losses would result in savings of $94 million in China and India, where 3.36 million tonnes of nitrogen are applied annually to 23 million hectares of wheat.

The feasibility of using saline groundwater in arid and semi-arid environments to irrigate salt tolerant plant species (including food crops, forage and fuel woods) is being tested in seven countries in a technical co-operation Model Project which was developed following a CRP on this subject. The proper management of saline irrigation water requires the monitoring of soil water and estimation of the water balance in order to avoid accumulation of salt in the soil profile. Some salt tolerant varieties/strains of kallar grass, acacia, eucalyptus, the *Atriplex* species, sesbania, the *Tamarix* species, rapeseed, barley and pistachio have been successfully grown.

The value of nitrogen fixing trees for rehabilitating and maintaining the fertility of tropical soils was also clearly demonstrated in a recently concluded CRP. Results from eight countries highlighted the importance of nitrogen-15 techniques in identifying species such as *Gliricidia*, *Acacia*, *Chamaecystisus* and *Leucaena*, which performed well in both nitrogen fixation and biomass production. From studies conducted in Malaysia and Nigeria, it was evident that management practices have a direct effect on nitrogen fixation. For example, frequently pruned trees showed more consistent nitrogen fixing abilities. The time, rate and method of adding prunings to soils were crucial in achieving synchrony between nutrient supply from decomposing residues and crop nutrient demand.

The role of legume green manures in enhancing crop production on degraded soils was investigated in a recently concluded CRP in Central America, where maize and beans have been the basic staples since the ancient Mayan civilization. Yields are very low because the crops are grown by peasant farmers on eroded hillsides with poor technology and little diversification. Isotope aided field experiments aimed at understanding and improving the traditional farming system were carried out in Costa Rica and Guatemala. It was demonstrated that some nitrogen fixing legume crops such as 'mucuna' and 'canavalia', grown as green manure, are important sources of nitrogen and organic matter in these degraded soils. If properly managed in a rotation, they can supply up to 80 kg of nitrogen per hectare, which is sufficient to obtain good yields of the maize or sorghum crops that follow.

The development of isotope based methods for estimating the contribution of organic materials applied to soils for plant nutrition is crucial in evaluating the benefit of residues as compared with mineral fertilizers. A novel concept developed at the Agency's Laboratories at Seibersdorf assesses this contribution indirectly by comparing the isotopic composition of plants grown in nitrogen-15 labelled soil with and without unlabelled residue addition. The advantage of this technique is that it does not depend on the production of labelled residues which, while permitting direct estimation of the contribution, is either too expensive or impractical with materials such as animal manure.

Plant breeding and genetics

Vegetatively propagated crops contribute significantly to the world food supply. While most are minor crops on a global scale, some are important for small scale farmers and the poor (e.g. yam). In a CRP on DNA fingerprinting techniques for the detection and characterization of genetic variation in vegetatively propagated crop plants, DNA profiling technologies were transferred and evaluated. The resulting maps that were generated for various species make it possible to exploit alternative life-cycles for vegetatively propagated plants. For example, mapping the genome of diploid species that are closely related to more important yam crops allows the tagging and isolation of critical genes for the improvement of yam.

Cassava is a traditional food crop in Africa, but its yield is severely affected by the African Cassava Mosaic Virus Disease (ACMVD). The cassava mutant ISU-W, developed under a previously completed CRP, was released as the new variety 'Tekbankye' in Ghana. The mutant features large sized starch granules in the tubers, improved cooking quality and tolerance to ACMVD. It is now being promoted to farmers in the region by distributing high quality planting material while epidemiological studies have begun to record the rate of plant re-infection.

In 1997, about 120 new accessions were registered in the FAO/IAEA database for officially released mutant

varieties. The total number has now grown to 1849 varieties of 164 plant species released in more than 50 countries. A new FAO/IAEA database was established on mutagenic treatments used to develop mutant varieties of cereals crops around the world during the past forty years.

Micropropagation of vegetatively propagated crops is one way of increasing food production through the rapid multiplication of plants with the desired yield potential and characteristics. This is also the best approach in shortening the extension cycle of newly released mutant varieties. To make this technology available to developing countries, research was undertaken at the Agency's Laboratories at Seibersdorf to develop low cost alternatives for tissue culture that use cheap and easily available media and simple laboratory equipment. The research demonstrated that it is possible to significantly reduce the cost of micropropagation. For example, it was found that white and light brown sugars produced in various developing countries are suitable substitutes for tissue grade sucrose in the micropropagation of banana and potato, and also that banana micropropagation could be carried out during the summer under natural light. The rate of micropropagation and quality of plants produced under these conditions were comparable with those obtained in growth chambers under artificial light and controlled conditions.

Mutation induction coupled with the anther culture technique is an effective system for improving rice cultivars in a relatively short period of time. An efficient method was developed at the Seibersdorf Laboratories for anther culture in the japonica and indica types of rice which will speed up the breeding of genetically uniform generations of food and industrial crops.

Animal production and health

An FAO/IAEA symposium on animal disease control in the 21st century identified a number of innovative nuclear based technologies that will be vital in controlling and eradicating the major diseases affecting livestock in the developing world. For example, using radioisotope markers within molecular engineering can provide more sensitive and speedy diagnosis and more effective and safe vaccines. They can also identify genes that can make animals more resistant to the disease itself. The challenge will be to transfer and use this technology in developing countries, and the symposium highlighted the need for effective veterinary services to maximize these technological advantages.

This was also an important year for the Global Rinderpest Eradication Programme (GREP). The ten year period of mass cattle vaccination in countries at risk from rinderpest ended in 1996. The process of intense disease surveillance to identify and remove the remaining pockets of disease has begun with the goal of completion by the year 2005. The Agency, in close partnership with FAO and other international, regional and national organizations, is providing essential support to this surveillance process. In addition to supporting diagnosis through immunoassay and molecular methods, the Agency developed a set of performance indicators that can be used by national authorities to ensure that rinderpest detection systems are in place and functioning well.

The FAO/IAEA External Quality Assurance Programme (EQAP) for animal disease diagnosis was considerably expanded, assessing the diagnostic proficiency of more than 60 national veterinary diagnostic laboratories for diseases of global importance (i.e. rinderpest, trypanosomosis and brucellosis). This led to requests for participation in the EQAP from many Member States. These developments were the basis for the Agency's contribution to the 1997 Office International des Epizooties (OIE) General Conference resolution requesting international organizations to develop a certification or accreditation scheme to assist national diagnostic laboratories in establishing common standards of quality assurance.

Poor nutrition and mismanagement are the critical factors constraining animal productivity. Considerable success was achieved recently in a number of Asian and African Member States through CRPs designed to use urea–molasses multinutrient blocks (UMBBs) to supplement ruminant diets. Developed by national scientists and produced at the village level using locally available feed resources, this approach is proving highly sustainable, with a very high benefit to cost ratio (for example, 8 to 1 in Indonesia).

Progesterone levels are an indicator of reproductive performance and productivity in animals. For the past ten years, FAO/IAEA radioimmunoassay (RIA) progesterone kits have provided Member States with an essential tool to conduct research in these areas. The

process of establishing a sustainable system for the regional production and distribution of progesterone RIA kits in Africa and Latin America was initiated in 1997. Bulk supply of critical reagents to key regional laboratories, a full cost recovery process and the routine operation of an external quality assurance programme will ensure that scientists in these regions can continue the research needed for increases in livestock productivity.

Insect and pest control

Considerable progress was made in establishing a medfly SIT project between Israel and Jordan to support horticultural development in the Arava Valley region. Aerial sterile male releases were initiated on the Israeli side of the border and are scheduled to begin in 1998 over the Aqaba area in Jordan.

On Madeira, mass rearing began of a medfly genetic sexing strain provided by the Agency's Laboratories at Seibersdorf. In addition to producing flies for pilot releases on Madeira, this facility is providing eight million sterile males weekly to the Israel–Jordan Arava Valley medfly SIT project. On Guimaras, in the Philippines, island wide aerial sterile fly releases were initiated following an aerial male annihilation campaign with methyl-eugenol baited filter blocks. The flies were released as part of an area wide integrated Oriental fruit fly control programme in support of commercial mango production on the island.

A successful project in Chile, culminating in the eradication of the medfly from that country, was expanded into southern Peru. Sterile flies from the Arica facility in Chile are being released over the southernmost valley of Peru, with eventual coverage expanding to all valleys of Tacna and Moquegua Departments. A similar agreement was signed in mid-1997 between the Governments of Chile and Argentina to strengthen an Agency supported medfly SIT Model Project in Argentina. In 1997, Mendoza Province in Argentina achieved the lowest medfly populations ever and negotiations were initiated to obtain fly-free status for commercial fruit production. In addition, sterile male releases were initiated in the Neuquen and Rio Negro Provinces of Patagonia, the main temperate fruit producing regions of Argentina, using genetically sexed flies provided by the Mendoza mass rearing facility.

A self-stocking system for tsetse production cages was developed that will enable cages to be stocked with the correct number of flies at the appropriate sex ratio without the need for handling the flies. There was also success in using freeze-dried blood as a diet for the in vitro feeding of adult flies and in establishing a colony of *Glossina pallidipes* from Ethiopia. Chromosomal inversions were induced in medflies. This is the first time that such inversions have been isolated and they will be used to improve the stability of genetic sexing strains. Also, a comprehensive study, in conjunction with a CRP on this topic, on the mating behaviour of medfly populations from many parts of the world demonstrated that there are no major differences in this behaviour. This is of major significance for the application of SIT against the medfly, making mass rearing and the release of genetic sexing strains in different parts of the world much easier. Finally, a generic model was developed that permits detailed economic feasibility assessments of alternative area wide options for controlling or eradicating medflies in different parts of the world.

Food and environmental protection

Food irradiation can ensure hygienic quality, reduce losses and facilitate wider trade in food and agricultural commodities. It is increasingly being accepted and is now commercially applied in over 30 countries. A CRP on irradiation as a quarantine treatment of mites, nematodes and insects other than fruit flies was concluded, generating valuable data on the use of irradiation against these pests in various food and agricultural commodities. For example, a minimum dose of 300 Gy resulted in the sterility of a number of species of insects and mites, thereby meeting quarantine requirements. However, plant parasitic nematodes were found to be resistant to irradiation, requiring a minimum dose of 4 kGy to render them non-infective. Irradiation for nematode control will thus have to be restricted to commodities that can withstand such a high dose, such as wood chips and pot soil.

A joint FAO/IAEA/WHO Study Group investigating the hygienic quality of food irradiated with doses above 10 kGy concluded that food was wholesome and nutritionally adequate regardless of the absorbed dose.

This conclusion could expand the application of food irradiation to cover the development of shelf-stable food through irradiation at doses above 10 kGy.

In the area of environmental protection, a CRP was completed on the development of procedures to stabilize acaricides in livestock dips. It was demonstrated that the addition of phosphate fertilizer can extend the effective life of some acaricides, making the dips more efficient and cost effective. Three simple field techniques were developed to monitor the concentration of pesticides in the field dips. Methods for the safe disposal of spent dip showed that some pesticide residues can be degraded by spreading the content thinly on the soil surface under sunny conditions. This information will help farmers and ranchers make more efficient use of their cattle dip treatments.