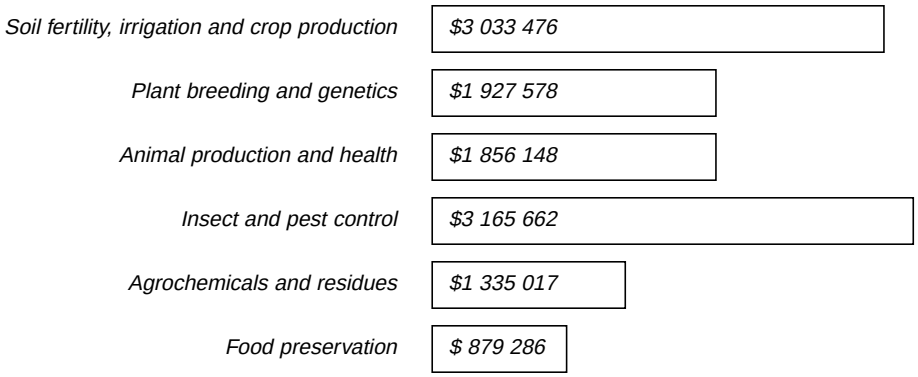
FOOD AND AGRICULTURE

Regular Budget expenditure: $12 197 167

Expenditure by subprogramme



Extrabudgetary programme resources utilized (not included in chart): $3 592 205 (of which the sum of $1 677 290 is from FAO)

The Agency's food and agriculture programme assists Member States in improving food security through sustainable and environmentally friendly agricultural development. It does so by enhancing their capacity to use nuclear methods across a wide range of commodities and agroecological zones, with emphasis on improving crop and livestock productivity, food safety and food quality. The programme is operated jointly with FAO and implemented by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, and by the FAO/IAEA Agriculture and Biotechnology Laboratory at Seibersdorf.

Restructuring within FAO resulted in the upgrading of joint activities to the status of a programme within FAO's Agriculture Department. This offered the opportunity for strengthening the complementarity and co-ordination of work with other FAO divisions and, together with the Agency's Programme Performance Assessment System (PPAS), provided focused strategy, objective and task setting within each subprogramme. In addition, it permitted the development of time-frames and milestones for the attainment of specific objectives.

A feature of the work in 1995 was the increasing involvement of modern biotechnologies, such as nuclear based molecular methods, in vitro culture techniques and monoclonal antibodies. The value of including these methods in sterile insect technique (SIT) approaches to integrated pest management, mutation plant breeding programmes and diagnostic tests for animal diseases is already clear from the successes achieved in Mediterranean fruit fly and rinderpest control and eradication activities. The continued transfer of these methods over the past year and their expanded role in training, analytical and research support activities at the Agency's Laboratory are helping to improve knowledge and the capacity in Member States to tackle important issues, and represent an important investment towards future achievements.

Soil Fertility, Irrigation and Crop Production

A major thrust was optimization of the use of plant nutrients and water for sustainable crop production, with one approach being the identification of crops to suit the soil

and environment. Under a recently completed CRP funded by the Swedish International Development Agency (SIDA), several genotypes of wheat were identified in Morocco and Tunisia using the neutron moisture meter technique. These genotypes were highly efficient in utilizing limited amounts of water. Two of these, 'Massa' and 'Sarif', also had high grain yields. In addition, several provenances of the gum arabic tree *Acacia senegal* were shown to grow well in Sudan, where water availability is limited. On the basis of these results, a provenance from the Qoz Ashgar Forest of southern Sudan is now being recommended for introduction into the gum belt for its rehabilitation.

In Kenya, 22 provenances of *Acacia*, *Prosopis* and *Casuarina* were screened for drought tolerance in a semi-arid site in Machakos. The results showed significant differences in water use efficiency and dry matter yield. For example, *Acacias* from the Middle East and neighbouring north eastern African countries had greater drought resistance than those from other regions of Africa, while provenances from Costa Rica and Senegal were the best for *Prosopis* and *Casuarina*. An interesting feature demonstrated in this programme was that carbon-13 isotope discrimination is closely correlated with water use efficiency and the dry matter yield of a crop. This technique can thus be used in future research for the rapid screening of crop and tree species for high water use efficiency and high yield.

Another CRP completed in 1995 identified the growth stages of maize, wheat and cotton that are more resistant to drought. It was shown that 'water stress' during certain growth stages of field crops may not necessarily result in significant yield reductions. For example, research in Brazil, Egypt and Romania showed that cutting down irrigation at the vegetative stage did not reduce the yield of maize. In China and Morocco, wheat produced the same yields even when irrigation was reduced at tillering or at maturity. These results have important implications for increasing the efficiency of water use in crop production, since by reserving water which would otherwise be used during the more drought resistant stages, optimum crop growth and yield can still be obtained with minimum water inputs.

Plant Breeding and Genetics

Significant results were achieved during 1995 in the use of radiation induced mutants for increasing crop production. In the Altiplano of Peru, small farmer fields are located at more than 3600 m above sea level. This is a very stress-prone area characterized by short vegetation periods, droughts and morning frosts. Agency supported efforts by the National University of Agriculture, La Molina, to improve barley, which is the main crop that is grown there, made use of mutation techniques. A high yielding, 'naked' grain and extremely early mutant was selected from gamma ray irradiated seeds. This mutant was officially released as a new barley variety in May 1995 and its use is foreseen in large scale commercial production. In addition to improved adaptability, this variety's naked grains are very well accepted by consumers for preparing the traditional foods of the Altiplano.

In China, work on radiation induced mutations has been supported for many years through various FAO/IAEA CRPs. With assistance provided in 1995 through a technical co-operation project, rice breeders from the China National Rice Research Institute and Zhejiang Agricultural University started to grow rice mutant varieties in five provinces along the Yangtze River — the main rice growing areas in China. In total, nearly 600 000 hectares of early season rice were cultivated with mutant varieties, which gave an increase in rice production of about 263 000 tonnes over the best varieties grown in certain provinces. The total gain to farmers was estimated at $50 million, calculated on the basis of the official price of rice on the international market.

African farmers will soon benefit from new mutants of sorghum, African rice and cassava which were developed through a recently completed FAO/IAEA CRP supported by the Government of Italy. For example, in Mali several stable mutants of sorghum were developed with long panicles and better grain and drought tolerance, along with white grain mutants of African rice (white grained varieties have a higher market value than the normal red grain types).

The use of in vitro culture techniques for the improvement of vegetatively propagated crops in combination with radiation induced mutations has proved to be of immense value for producing the desired variation and in enhancing the selection of mutants in a disease-free condition. In Ghana, cassava mutants were selected for improved cooking quality and production of the traditional native dish 'fufu'. These mutants have larger starch granules, higher tuber yields and greater resistance to diseases.

At an FAO/IAEA international symposium on the use of induced mutations and molecular techniques for crop

improvement, held in Vienna in June, there was confirmation that radiation induced mutations followed by the appropriate selection procedures have been instrumental in improving the performance of germplasm throughout the world, since by 1995 nearly 1800 mutant varieties had been officially released in 52 countries. In fact, mutant induction and the understanding of mutations at the molecular level and in biochemical terms are now the basis of much present day research in plant breeding and genetics. As supporting tools for conventional breeding, molecular techniques therefore have the potential to assist in increasing productivity, improving quality and developing new raw materials for industry.

Animal Production and Health

The results of a recently completed CRP involving 13 Latin American countries documented the benefits to milk production and growth of supplementing cattle diets with a variety of non-traditional sources of protein, such as leguminous trees, poultry manure and urea–molasses blocks; similar information was obtained in Asia and Africa. For example, village based systems were developed in Indonesia to produce urea–molasses blocks which were distributed to farmers and resulted in weight gains of up to 0.5 kg per week in fattening animals and two to three litres per week in dairy cows. Similar gains were made in Sudan through feeding a supplement derived from the residues of sorghum and groundnuts, while even greater improvements were made in Morocco through the supplementation of silage with fish waste and molasses.

Support was given to Member States in Africa and Asia for serological monitoring of mass vaccination campaigns against rinderpest using an FAO/IAEA immunoassay test for rinderpest antibodies. This testing has shown that vaccination cover has produced sufficiently high levels of immunity in the national herds of most countries to warrant cessation of mass vaccination. This will lead to annual savings of several hundred million dollars. These countries will now proceed along an agreed pathway towards international declaration of freedom from disease, which will involve surveillance backed up by immunoassay and molecular based diagnostic tests to identify and stamp out the remaining few areas where the virus has survived. The tests were transferred to national veterinary laboratories in 1995 to assist in the task of final eradication.

Trypanosomiasis control and eradication programmes were monitored in 14 African countries using an enzyme linked immunosorbent assay (ELISA) test developed by the International Livestock Research Institute and at the FAO/IAEA Laboratory at Seibersdorf. On the island of Zanzibar, United Republic of Tanzania, the use of this assay has been crucial in supporting the SIT based tsetse eradication project. The assay provides a sensitive indicator of the presence of trypanosomes in the blood of cattle in the sterile fly release area, and hence of the presence of tsetse flies which, at low density, cannot be detected by present trapping methods.

Pilot quality assurance programmes were initiated by the FAO/IAEA Laboratory at Seibersdorf in 1995 to monitor the reliability of the results obtained through the use of radioimmunoassay (RIA) and ELISA tests provided to Member States. A high level of competence was shown by most participating laboratories.

Insect and Pest Control

Substantial progress was made in the eradication of the tsetse fly from the island of Zanzibar. Activities within a CRP and research at the FAO/IAEA Laboratory at Seibersdorf to improve the sterile tsetse fly rearing system, as well as the completion of the second phase of the refurbishment of the Tanga mass rearing facility on the Tanzanian mainland, led to an increase in the fly colony from only 40 000 at the beginning of the year to over 400 000 at the end of 1995. In addition, the laboratory at Seibersdorf continued monthly shipments of pupae in support of the project. These intensified releases of sterile flies over the southern part of the island, where the highest tsetse fly populations are located, had the effect of drastically increasing the sterile to wild fly ratio to over 200:1. Most wild females trapped now show signs of induced sterility and the wild population is rapidly disappearing. Sterile fly releases are being extended to the central part of the island and, when refurbishment of the third insectary of the Tanga facility is completed, releases of sterile flies can be expected to cover the entire island.

An SIT Mediterranean fruit fly (medfly) eradication project in Chile culminated in the eradication of this pest from that country, with benefits to the economy estimated at $500 million per year. Although the southern and central regions of Chile were already free of fruit flies and the country had developed a very successful fruit export industry, its produce was still being restricted from certain markets because of a fear of outbreaks as a result of the presence of the medfly in the Arica region of

northern Chile. After a decade of unsuccessful attempts to eradicate the fly using insecticides in this region, the Chilean Agricultural Service requested technical support from FAO and the Agency to establish an SIT eradication programme. As a consequence, a medfly mass rearing facility with a production capacity of approximately 60 million sterile flies per week was completed in 1993, when sterile fly releases were initiated. No wild medflies have been detected in the Arica region since the first half of 1995. In addition, the pest has been suppressed in Tacna, the southernmost valley of Peru. Future collaboration within an expanded FAO/IAEA bi-national Chile–Peru project foresees enlarging the eradication and control activities to other fruit producing valleys in southern Peru.

The year also saw the introduction of genetic sexing strains into large mass rearing facilities for SIT control of the medfly. This represents significant progress in the use of these strains, which were developed at the FAO/IAEA Laboratory at Seibersdorf over the last ten years. The white pupal colour sexing strain was introduced into the eradication programme in Argentina, with large scale releases planned for early 1996. Support activities for a medfly SIT programme in Guatemala also gathered momentum with the supply of the temperature sensitive genetic sexing strain.

Agrochemicals and Residues

Assistance continued to be provided to regions where agriculture has been affected by radionuclide contamination from the Chernobyl accident. In Belarus, research has shown that rapeseed oil essentially free of caesium-137 can be produced on land contaminated to a level of 0.5–1.5 TBq/km^2. Some 10 000 hectares were sown with rapeseed in 1995 to produce oil for lubricant manufacture and it is intended to increase the area by three to four times in 1996. This will provide a valuable cash crop for areas where the production of food with acceptable levels of radionuclides is uncertain. In Ukraine, assistance was given to improve the facilities for monitoring radionuclide contamination at a milk canning factory.

Experimental protocols for studying the effects of pesticides in non-target organisms in tropical agroecosystems, developed at the FAO/IAEA Laboratory at Seibersdorf and the Swedish University of Agricultural Sciences and funded by SIDA, were validated through a CRP involving African research institutes. The focus of efforts was on the insecticides lindane and endosulfan which are the two most commonly used organochlorine compounds. Both were shown to dissipate much faster in hot, moist tropical environments than in temperate conditions and it was probably for this reason that there was no evidence of serious environmental impacts resulting from their use (e.g. on natural enemies of pests). Soil organic matter breakdown was reduced, but this was not likely to influence long term soil fertility. These results are highly relevant for pesticide regulatory authorities in the participating countries who normally must depend on information generated in Europe or North America which may not be appropriate to African conditions.

Food Preservation

Through a seminar convened by the International Consultative Group on Food Irradiation (ICGFI) and the Secretariat of the Association for Southeast Asian Nations (ASEAN), a unified position was recommended to individual ASEAN governments for consideration regarding the regulation of food irradiation and acceptance of this technology to overcome trade problems in the region.

Among the tasks of a workshop convened by the ICGFI, with the endorsement of the World Trade Organization, was clarification of the implications of the trade in irradiated food, the various provisions of the Agreements on the Application of Sanitary and Phytosanitary Measures (SPS) and the Technical Barriers to Trade (TBT), adopted during the GATT Uruguay Round. On the basis of earlier recommendations by the ICGFI, the United States Department of Agriculture announced in 1995 that it will issue a new regulation to take effect in 1996 permitting irradiation as a quarantine treatment of fresh fruits and vegetables against major fruit fly species without a restriction on host commodities. Such a regulation should facilitate wider international trade in irradiated fruits and vegetables.

Results from a recently completed CRP showed that if irradiation is combined with other processes (e.g. low pH, low water activity, and a modified atmosphere), the radiation dose can be reduced and significant improvements made to the safety and quality of treated products. In addition to individual food items (e.g. fruits, vegetables, meat, and seafood), composite foods such as sausages, kebab and prepared meals also benefited significantly from the combined treatment. In some instances, combined treatment resulted in shelf stable products which were not only highly palatable but had modest energy requirements for production, storage and distribution.