Food and Agriculture

Objective

To contribute to the sustainable intensification of agricultural production and the improvement of global food security through capacity building and technology transfer to Member States. To increase the resilience of livelihoods to threats and crises that impact agriculture, including climate change, biothreats, food safety risks, and nuclear or radiological emergencies. To improve efficient agricultural and food systems for sustainable management and conservation of natural resources, and to enhance the conservation and application of plant and animal biodiversity.

Area-Wide Integrated Pest Management in the Niayes Region of Senegal

In 2018, the Agency, through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, provided instrumental support to the Government led effort to suppress the tsetse population in the Niayes region of Senegal. As part of a long term tsetse eradication campaign, the Agency supplied technical support for and strategic advice on executing the overall tsetse control programme, involving the use of area-wide integrated pest management including the sterile insect technique (SIT) (Fig. 1). It also maintained

FIG. 1. Release of sterile tsetse flies in Senegal's Niayes region as part of a tsetse fly suppression and eradication campaign.

a colony of the target species at its laboratories in Seibersdorf, sending a shipment of 4000 sterile male pupae to Senegal for release each week. The weekly shipments of male pupae were produced in Slovakia and irradiated at the Agency's laboratories before transport. During the year, the Agency also provided technical backstopping to scientists in Burkina Faso to assist with the production of the sterile males to be used in Senegal.

The campaign resulted in the suppression of the tsetse population throughout the Niayes region and a dramatic decline in the frequency of the deadly African animal trypanosomosis disease transmitted by it. With the suppression of the tsetse fly, farmers who had been rearing only local cattle breeds — with natural tolerance to trypanosomosis but low milk and meat production and inferior reproductive rates — began importing more productive cattle, leading to increased incomes and a higher return on investment. This in turn brought a tenfold increase in imports of cattle and a 50–60% decrease in the overall cost of imported cattle.

Sterile Insect Technique for Control of Mosquitoes

In 2018, the Agency made important R&D advances on the SIT package to control disease-transmitting mosquitoes such as *Aedes aegypti* and *A. albopictus*, the vectors for dengue, chikungunya, Zika and yellow fever. Key developments during the year included a new automated mosquito larval counter for consistent and standardized rearing of mosquito in immature stages, and cost effective mosquito larval diets and a new mass rearing cage to reduce rearing costs. These developments allowed the Agency to initiate technology transfer to Member States through pilot projects to supress vector populations. In this context, by helping to design pilot trials and providing equipment for insect rearing, the Agency supported the use of area-wide integrated pest management in field suppression trials of SIT at a small scale in China, Greece and Italy (*A. albopictus*) and in Mexico (*A. aegypti*), and in field validation of a drone device to release sterile male *Aedes* mosquitoes in Brazil. This crucial upstream R&D, carried out at the Insect Pest Control Laboratory in Seibersdorf, was conducted collaboratively with national research institutes. Capacity building and the development of technology packages for transfer to Member States are central to these R&D activities. In 2018, mass rearing equipment was shipped to eight Member States; traps and other laboratory equipment were provided to 14 Member States; and expert missions were conducted to 12 Member States.

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Many of the research outputs for *Aedes* species may also be useful for controlling *Anopheles* species, vectors for malaria. In 2018, R&D continued on *A. arabiensis*, focused on the development of a genetic sexing strain.

Small-Scale Drip Irrigation to Assist Farmers in Africa

As part of an initiative to expand the use of climate-smart soil and water management practices in Africa, the Agency introduced small-scale drip irrigation technology, guided by nuclear and related techniques, into impoverished rural areas of Mauritania and Zimbabwe in 2018. Through its Soil and Water Management and Crop Nutrition Laboratory in Seibersdorf, the Agency used stable isotope nitrogen-15 and neutron probes for measuring the moisture content of soil to determine the most effective use of fertilizer and water for enhanced subsistence agriculture in these arid areas. It then trained local experts and farmers in the use of the technology and in installing small-scale drip irrigation systems suited to local needs (Fig. 2). During the year, the initiative produced socioeconomic impacts for family farmers, particularly women, helping them not only to grow food in arid areas, but also to plant new types of vegetables, increase yields, improve the nutrition and health of their families and communities, and generate additional income. In Zimbabwe, increased

FIG. 2. Smallholder farmers in Mauritania, including women, have begun using small-scale drip irrigation to grow vegetables on arid land.

crop production allowed children to return to school and women to generate income from the sale of their produce. In Mauritania, more than 400 women and their families produced food for their own consumption and for selling, securing additional income for education and health. During the year, local authorities began scaling up the use of this technology by setting up more drip irrigation systems.

Diagnosis and Control of Disease Outbreaks

Food security and the livelihoods of livestock farmers in several Member States continued to be at risk from the continuous threats posed by animal infectious diseases, whose spread is exacerbated by climate change and the transboundary movement of animals and people. In 2018, the Agency, through its Veterinary Diagnostic Laboratory (VETLAB) Network, supported efforts to control outbreaks of African swine fever in Asia and Eastern Europe and peste des petits ruminants in Europe, the Middle East and Asia. Drawing on R&D carried out at the Animal Production and Health Laboratory in Seibersdorf, and continuous capacity building and transfer of technology, the VETLAB Network was able to share timely information among its technical networks regarding outbreaks of animal diseases, thus helping to control and contain them. It also provided technical support to strengthen the capabilities of Member State laboratories for the early detection, characterization, monitoring and control of animal diseases such as African swine fever in China, Hungary and Poland; peste des petits ruminants in Bulgaria; and Avian influenza in the Democratic Republic of the Congo (Fig. 3), Ghana, Lesotho, Mozambique, Myanmar and Namibia. The Agency conducted an interlaboratory test with the participation of 27 laboratories from 25 Member States worldwide aimed at verifying their proficiency and competence in diagnosing peste des petits ruminants through laboratory testing.

FIG. 3. In the Democratic Republic of the Congo, staff of the Central Veterinary Laboratory perform laboratory analysis for the characterization of Avian influenza during the 2018 outbreak.

Integrated Screening Techniques for Climate-Smart Agriculture

The Agency improved and tested integrated screening techniques in mutation breeding to support the development of climate-smart crop varieties adapted for climate change. In 2018, it developed and released two improved mutant varieties with tolerance to drought: the groundnut variety Tafra-1 in the Sudan, and the cowpea variety CBC5 in Zimbabwe.

During the year, the Agency's work on climate proofing of food crops, carried out through its Plant Breeding and Genetics Laboratory in Seibersdorf, yielded significant advances in heat and drought tolerance of rice and sorghum. For rice, pre-field screening protocols were developed for heat-tolerant mutants, and physiological screening protocols for tolerance to terminal drought stress were developed and used to confirm the improved performance of advanced mutant rice lines that showed better grain filling under drought stress imposed under greenhouse conditions. In sorghum, early maturity — an important secondary trait that facilitates drought avoidance — was explored in detail and an associated genomic region was identified; the genomic region will be explored further for the development of molecular marker(s). In this regard, the Agency put in place, for the first time, molecular marker and doubled haploid technologies that accelerate the pace of crop improvements to maintain resilience in the face of climate change and began sharing these technologies with Member States. As a result, one new CRP project was launched and another was designed in 2018. Both projects will focus on improving crop resistance to increasing frequencies and intensities of pests and diseases triggered by climate change.

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New Analytical Technologies for Supporting Food Authenticity and Food Traceability Systems

In 2018, the Agency concluded a five year CRP entitled 'Accessible Technologies for the Verification of Origin of Dairy Products as an Example Control System to Enhance Global Trade and Food Safety' that led to the development of innovative analytical methods for food authenticity and food traceability systems. The CRP successfully demonstrated the feasibility of using stable isotope and trace element (SITE) analysis combined with other nuclear and related techniques to establish the geographical origin and authenticity of both liquid and powdered milk. Achieving this important outcome involved the publication of 19 standard operating procedures and numerous scientific articles, including a standard operating procedure on the elemental analysis of milk powders using laser ablation inductively coupled plasma mass spectrometry in geographic sourcing. The dissemination effort helped those Member States involved in the CRP to become increasingly aware of the importance of SITE analysis and its wider applications in food authenticity and traceability based on production methods and geographical origin, as well as its potential to reduce barriers to trade and enhance consumer confidence. As a result, 13 Member States began increasing investments in their SITE capabilities in 2018. Furthermore, within the framework of the CRP, pilot studies were carried out in Slovenia and Singapore: Slovenia created and put in place the 'Selected Quality — Slovenia' protective mark for Slovenian milk and dairy products, using SITE as a 'fingerprinting' method for food authenticity and traceability, while Singapore, which imports all the milk products it consumes, used SITE profiling to verify the provenance of those imports.