Global networking for improved radiological and nuclear emergency preparedness and response in food and agriculture

THE CHALLENGE

Radioactive release during a radiological or nuclear emergency can affect agriculture and food production. Response involves the timely identification of areas where produce grown cannot reach the consumer due to safety reasons. It is critical that the most up-to-date information on spatial and temporal distribution of radionuclides is available to decision-makers.

IAEA RESPONSE

Establishing a global network enhancing worldwide capabilities of competent authorities responsible for monitoring radionuclides in food, soil, water and agriculture is key to swift global and national response in an emergency. The network will encourage and facilitate collaborative operations, including the development of online data management and geo-visualization platforms; improve the effectiveness of sampling, analysis and mapping; develop optimised remediation planning, monitoring and evaluation strategies; and ensure proper and ongoing training of staff.

PROJECT ACTIVITIES

- **Develop modules** for training and train competent authorities in managing data on radionuclides in food and agriculture, including monitoring and use of monitoring data for remediation planning.
- **Exchange information** between Member States on sampling techniques and analytical measurements, data management and visualization and real-time monitoring.
- **Develop, expand or customize** data management and visualization strategies and tools.
- **Prepare guidelines** on participatory monitoring of data on radionuclides in food and agriculture for food producers and consumers.
- **Perform simulation exercises** covering different aspects of nuclear emergency response in food and agriculture.

DURATION

Three years

BENEFICIARY COUNTRIES

All IAEA and FAO Member States

EXPECTED RESULTS

Enhanced capabilities in Member States in addressing contamination of food producing areas during radiological and nuclear emergencies, and improved infrastructure and support to address challenges concerning contamination in these areas.

TOTAL ESTIMATED BUDGET

	Budget (EUR) with 7% PSC included
Year 1:	133 750
Year 2:	304 950
Year 3:	283 550
Total:	**722 250**

Improving agricultural practices to enhance resource use efficiency and reduce greenhouse gas emissions in intensively managed agricultural systems

THE CHALLENGE

Increased greenhouse gas emissions, which contribute to climate change and global warming, are having a profound impact on the sustainability of agricultural production systems. Yet, at the same time, agriculture itself is contributing to greenhouse gas production through intensive farming methods, as countries struggle to meet the food demands of rapidly rising populations. It is therefore important to find an integrated solution to reduce greenhouse gas emissions, making soils more resilient to climate change and increasing crop productivity at the same time.

IAEA RESPONSE

Using both nuclear and conventional techniques, the IAEA, together with the Food and Agriculture Organization of the United Nations (FAO), assists Member States to find integrated solutions. The project is designed to enhance nutrient use efficiency on farms while reducing greenhouse gas emissions through adaptation and mitigation practices and technologies. A specific focus of the project will be to quantify nitrous oxide (N_2O) and identify its exact sources using the ^{15}N isotopic technique, and the use of ^{13}C isotope to assess sources of carbon (C) sequestered in the soil.

PROJECT ACTIVITIES

- **Development, evaluation and validation** of methodologies and guidelines to measure N_2O, NH_3 and C-sequestration. Stable isotopes of ^{15}N and ^{13}C as well as conventional techniques will be used for quantifying greenhouse gases, nitrogen use efficiency and C sequestration. This also includes the provision of standard operating procedures, guidance and technical support.
- **Outreach and promotion.** This includes producing pamphlets for farmers on climate smart agricultural practices, and the publication of research results in popular media and in peer-reviewed journals. The objective is to improve the exchange of ideas, knowledge and experience, and to facilitate interaction.
- **Technical workshops and technology packages.** These will focus on the results of greenhouse gas measurements and C-sequestration under different land uses, as well as developing packages for reducing N_2O and NH_3 emissions and improving soil fertility, crop productivity and resource-use efficiency in intensively managed agricultural production systems.

DURATION

Five years

BENEFICIARY COUNTRIES

IAEA Member States in Asia and the Pacific

EXPECTED RESULTS

It is expected that better management of nitrogen used in agricultural processes will result in reduced greenhouse gas emissions. Equally, more efficient use of nitrogen offers scope for increased farm production and profitability. An improved environmental footprint will help grow the market appeal and reputation of the produce.

TOTAL ESTIMATED BUDGET

Year	*Budget (EUR) with 7% PSC included*
2016	444 050
2017	96 300
2018	58 850
2019	64 200
2020	101 650
Total	**765 050**

Creating Veterinary Laboratory preparedness among Member States in line with the global strategy for the control and eradication of peste des petits ruminants (PPR) using Nuclear and Nuclear-derived techniques

THE CHALLENGE

Peste des petits ruminants is a highly infectious transboundary animal disease that primarily affects sheep, goats and small wild ruminants in almost 70 countries in Africa, the Middle East and parts of Asia. With mortality and morbidity rates as high as 80%, the disease causes an estimated loss of US $1.5 to 2 billion annually. As sheep and goats contribute significantly to the cash income and nutrition of small farmers in many countries, control of the disease is an essential element in the fight for global food security and poverty alleviation.

IAEA RESPONSE

The 2015 Global Control and Eradication Strategy for peste des petits ruminants and other small ruminant diseases lays out the general principles, strategies and tools to be used, including nuclear and nuclear-derived diagnostic and monitoring techniques. The IAEA, together with the Food and Agriculture Organization of the United Nations, and national veterinary extension services, will collaborate under this strategy to help eliminate the disease. In particular, it will draw on the IAEA's laboratory experience in this area and its strong network of Member State laboratories. It is important to note that peste des petits ruminants is earmarked as an eradicable disease, the second after rinderpest.

PROJECT ACTIVITIES

- **Develop and refine** techniques for early and rapid diagnosis.
  The project will focus on the early and rapid immunological and molecular nuclear and nuclear derived diagnoses and control of peste des petits ruminants.
- **Optimization, validation, transfer, implementation and harmonization.**
  Appropriate nuclear and nuclear derived peste des petits ruminants diagnostic platforms will help Member States to survey infected or susceptible domestic animals and wildlife.
- **Development and evaluation** of peste des petits ruminants irradiated vaccines.
  Also, the standardization and harmonization of associated control reagents.

DURATION

Three years

BENEFICIARY COUNTRIES

IAEA Member States in Africa, Asia and the Middle East

EXPECTED RESULTS

Quality assured detection of the peste des petits ruminants virus and other small ruminant respiratory pathogens will be strengthened. Also, disease diagnostics and surveillance, post vaccination monitoring and confirmation of freedom from disease will be significantly improved.
Ultimately, peste des petits ruminants and respiratory disease burden will be reduced in the targeted countries through enhanced surveillance and early detection.

TOTAL ESTIMATED BUDGET

Year	*Budget (EUR) with 7% PSC included*
2016	508 250
2017	572 450
2018	476 150
Total	**1 556 850**

Enhance Agency's capacity to provide support to Member States to control Aedes mosquitoes as vectors of human pathogens, particularly the Zika virus, using integrated vector management approaches with a Sterile Insect Technique (SIT) component

THE CHALLENGE

Mosquitoes are bloodsucking insects that can carry pathogenic micro- organisms, causing diseases that may result in severe illness or death. The growing outbreak in Latin America and the Caribbean of a mosquito-borne disease caused by the Zika virus has resulted in the World Health Organization (WHO) declaring a global health emergency. With no vaccines or safe, inexpensive drugs yet available to control diseases such as Zika, Dengue and Chikungunya, the sterile insect technique (SIT) could play a decisive role in controlling populations of Aedes mosquitoes.

IAEA RESPONSE

The IAEA has been working to further develop different aspects of the SIT for some major disease vectors, including the *Aedes* mosquitoes. Responding to the Zika outbreak and requests from affected Member States for urgent assistance, the IAEA is developing and implementing an off-cycle regional project aimed at strengthening capacity in Latin America and the Caribbean to help control the spread of the virus using an integrated vector management approach with a SIT component.

PROJECT ACTIVITIES

- **Development of strains** required for SIT-based integrated vector management approach for Aedes mosquitoes. More than one Wolbachia-infected strain of each vector species needs to be developed for the combined SIT and incompatible insect technique in order to select the best ones after evaluation and quality control analysis.
- **Development of genetic sexing lines.** To separate males from females before releasing the sterile males.
- **Mosquito rearing efficiency, handling, shipping and air releasing.** Refine rearing protocols and equipment, optimize handling and shipping methods, and assess different air release strategies.
- **Introgression and quality control analysis** of strains to be sent to Member States. Several strains of *Aedes* mosquitoes need to be developed for Member States. Before transferring these strains to Member States, they need to be introgressed into the genomic background of different local target populations.
- **Technical backstopping** of the off-cycle regional project activities. This includes managing technical coordination meetings, regional training courses, carrying out technical advisory missions to Member States, providing specifications for mass-rearing and related equipment and materials for their procurement, and shipping specialized supplies and strains to Member States.

DURATION

Four years

BENEFICIARY COUNTRIES

All IAEA Member States

EXPECTED RESULTS

This project will result in the development and transfer to Member States, in particular those in Latin America and the Caribbean, of evaluated strains of *Aedes* mosquitoes. These strains will be used in integrated vector management approaches with a SIT component for the population control of mosquitoes transmitting Dengue, Chikungunya and, particularly, Zika.

TOTAL ESTIMATED BUDGET

Year	*Budget (EUR) with 7% PSC included*
2016	895 590
2017	640 930
2018	592 780
2019	592 780
Total	**2 722 080**

Mutation breeding R&D networking for fighting coffee leaf rust

THE CHALLENGE

Coffee is the second most traded commodity in the world after crude oil. But around the globe, a fungal disease that kills coffee plants by withering its leaves is decimating crops and seriously impacting coffee-dependent economies. Coffee leaf rust is not new, but as climate change brings the warmer and wetter conditions that nurture the disease, countries in Latin America are facing an unprecedented epidemic. Coffee yields have fallen drastically, and the livelihoods of millions of people are under threat.

IAEA RESPONSE

In partnership with Food and Agliculture Organization (FAO), the IAEA actively supports Member States in their efforts to prevent the spread of new and emerging plant diseases. Using nuclear techniques, scientists breed plant varieties that are disease resistant, or can tolerate severe or changing climatic conditions. For example, mutation breeding was used successfully to address black stem rust of wheat.

The project's objective is to establish a global R&D network, with its core in Latin America, based on coffee leaf rust mutation breeding and plant biotechnologies that can improve breeding efficiency.

PROJECT ACTIVITIES

- **Development of R&D network.** This will include identification of endemic disease hotspots for in-field screening and the detection of resistant mutants.
- **Development of technology packages.** The mutation induction in coffee will be optimized through R&D on in vitro and in vivo techniques for preparing requisite populations to mutagenize. This includes the organization of a technical workshop for the inception of the R&D network to decide on test material and field locations, R&D on high throughput and low cost screening techniques for the detection of mutant resistance alleles and R&D in mutation induction methods in coffee.
- **Transfer of material and optimization of screening methodologies.** A technical workshop will be organized on mutation induction R&D in coffee, the optimization of technology packages for the detection of mutant resistance alleles, and the optimization of in vitro and in vivo methods.
- **Characterization of mutants showing disease resistance.** This is to be carried out through field screening in identified endemic hotspots.
- **Validation of technology packages.** These will be used for the detection of mutant resistance alleles, in vitro techniques, initiation of mutation breeding in chosen coffee parent lines, and the preparation of protocols and guidelines.

DURATION

Four years

BENEFICIARY COUNTRIES

IAEA Member States in Latin America and the Caribbean

EXPECTED RESULTS

Long-term, the potential economic impact expected to be derived from the establishment of coffee leaf rust-resistant varieties for Latin America is above US $1 billion per year. Considering the time-to-yield of coffee plantations, this impact should be achievable within 10-12 years of project completion.

TOTAL ESTIMATED BUDGET

Year	*Budget (EUR) with 7% PSC included*
2016	218 120
2017	209 163
2018	209 163
2019	223 898
Total	**860 344**