

Technical Cooperation Report for 2011

Report by the Director General



IAEA

International Atomic Energy Agency

Technical Cooperation Report for 2011

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PREFACE

The Board of Governors has requested the transmission to the General Conference of the attached Technical Cooperation Report for 2011, the draft of which was considered by the Board at its June 2012 session.

The Director General is also hereby reporting in fulfilment of the request contained in resolution GC(55)/RES/11 on “Strengthening of the Agency’s technical cooperation activities”.

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Summary

This year's Technical Cooperation (TC) Report is set out in three parts: A, Strengthening the Agency's Technical Cooperation Activities; B, TC Programme Resources and Delivery; and C, Programme Activities and Achievements in 2011: Regional Overview. The Annex provides examples of project activities and achievements in specific thematic areas.

This year, part A is divided into two sections. The first presents an overview of the Agency's technical cooperation activities in 2011 including the global development context, the specific needs of Member States, the Director General's 2011 focus on water, and TC activity in the aftermath of the accident at Fukushima Daiichi. The second section concentrates on efforts to build a more efficient and effective TC programme. Part A describes the global development context in which the TC programme operated in 2011, focusing on 'Save and Grow' and 'Climate-Smart Agriculture', sustainable approaches to food security, climate change and land and water management where Agency activities are already having an impact.

The Director General's emphasis in 2011 on IAEA efforts to support water management in Member States is also reflected in part A of this document. Around the world, TC projects are helping Member States to monitor and manage both freshwater and ocean resources. In Africa, transboundary water resources are being explored and mapped with Agency assistance, while in Asia and the Pacific, isotopic and chemical techniques are being used to assess trends in freshwater quality, and to evaluate groundwater and surface water resources. In Europe, environmental isotopes are being applied to assess the interaction of stream and groundwater in aquifers in the Danube Basin, while in Latin America, monitoring and early warning systems are helping to protect populations from seafood toxicity associated with harmful algal blooms.

The TC programme continues to support the development of human resource capacity in Member States, using a range of approaches that take into account the differing needs and priorities of Member

States according to geographical region and degree of technical advancement. Knowledge management and skills retention remain a high priority. Knowledge sharing between countries continues to be an essential mechanism to support the sustainability of nuclear science and technology, and fellowships and scientific visits not only build individual human capacity, but also strengthen links between countries. National third level educational programmes in Africa, workshops on intellectual property in Asia and the Pacific, and improved management skills in nuclear research and development institutions in Europe are all helping to establish and maintain capacities in nuclear science and technology.

Numerous initiatives were made in 2011 to improve the overall quality and relevance of the TC programme. Sixteen Country Programme Frameworks were signed, and by the end of the year, the IAEA had signed 24 United Nations Development Assistance Frameworks in total. Closer collaboration was achieved with the Agricultural Department of the United Nations Food and Agricultural Organization. Relations were established with National Cleaner Production Centres supported by the United Nations Industrial Development Organization in selected pilot countries in an effort to bring nuclear technologies that support cleaner industrial production processes and hence support green economies to industries. Closer to home, intensive training in results based management using the Logical Framework Approach was delivered over the past two years to improve the development of projects for the 2012–2013 TC cycle.

Part B of this document presents a summary of indicators, reviewing mobilization of resources for TC through the Technical Cooperation Fund (TCF), and presenting extrabudgetary and in-kind contributions. Programme delivery is expressed using both financial and non-financial indicators. Pledges to the TCF totalled €62.9 million (not including national participation costs (NPCs), assessed programme cost arrears (APCs) or miscellaneous income), or 89.3% of the €70 434 000 TCF target set for 2011. New extrabudgetary resources for 2011 came to €17.7 million, and in-kind contributions were €1.1 million. Implementation for the TC Fund reached 73.9%.

Part C of this document responds to the operative paragraphs of resolution GC(55)/RES/11, dealing with assistance to Member States in the peaceful, secure and regulated application of atomic energy and nuclear techniques in specific fields. This part highlights activities and achievements in technical cooperation in each of the regions in 2011.

Programme distribution in 2011 differed considerably between the regions. Human health accounted for the highest percentage of actuals¹ in the Africa region, followed by food and agriculture. In Asia and the Pacific, the highest percentage of actuals was in the area of nuclear safety, followed by radioisotope production and radiation technology. In Europe, the nuclear fuel

cycle took the lead, followed by nuclear safety, and in Latin America, the highest percentage of actuals was in the field of human health, followed by nuclear safety. Interregional projects focused most heavily on human capacity development and programme support, followed by nuclear safety.

Project examples are presented in the Annex according to thematic area, covering human health, agricultural productivity and food security, monitoring and managing water resources and the environment, industrial applications, energy planning and nuclear power, and radiation and waste safety and nuclear security.

¹ Terminology has changed with the implementation of the Agency-wide Information System for Programme Support (AIPS). Actuals are the equivalent of disbursements.

The Agency's Technical Cooperation Programme in Figures

(as at 31 December 2011)

2011 target for voluntary contributions to the Technical Cooperation Fund:

€70 434 000

Rate of Attainment (on pledges) at the end of 2011:

89.3%

New resources for the technical cooperation (TC) programme: **€81.8 million**

Technical Cooperation Fund²: **€63 million**

Extrabudgetary resources³: **€17.7 million**

In-kind contributions: **€1.1 million**

Programme implementation rate:

73.9%

TC 2011 year-end budget⁴ (TCF, extrabudgetary and in-kind contributions):

€105.3 million

123 countries/territories receiving support

16 Country Programme Frameworks (CPFs) signed in 2011

4634 national experts/meeting participants and other project personnel assignments

3051 participants in training courses

119 Revised Supplementary Agreements (as at 21 February 2012)

67 currently valid CPFs

1397 fellowships and scientific visits

3319 expert and lecturer assignments

205 training courses

² Including TCF payments, National Participation Costs (NPCs), assessed programme costs (APCs) and miscellaneous income.

³ Includes donor, government cost-sharing and UNDP resources. Please refer to Table A.5 of the Supplement to this report for details.

⁴ Year-end budget is the total value of all technical cooperation activities approved and funded for a given calendar year plus all approved assistance brought forward from previous years but not yet implemented.

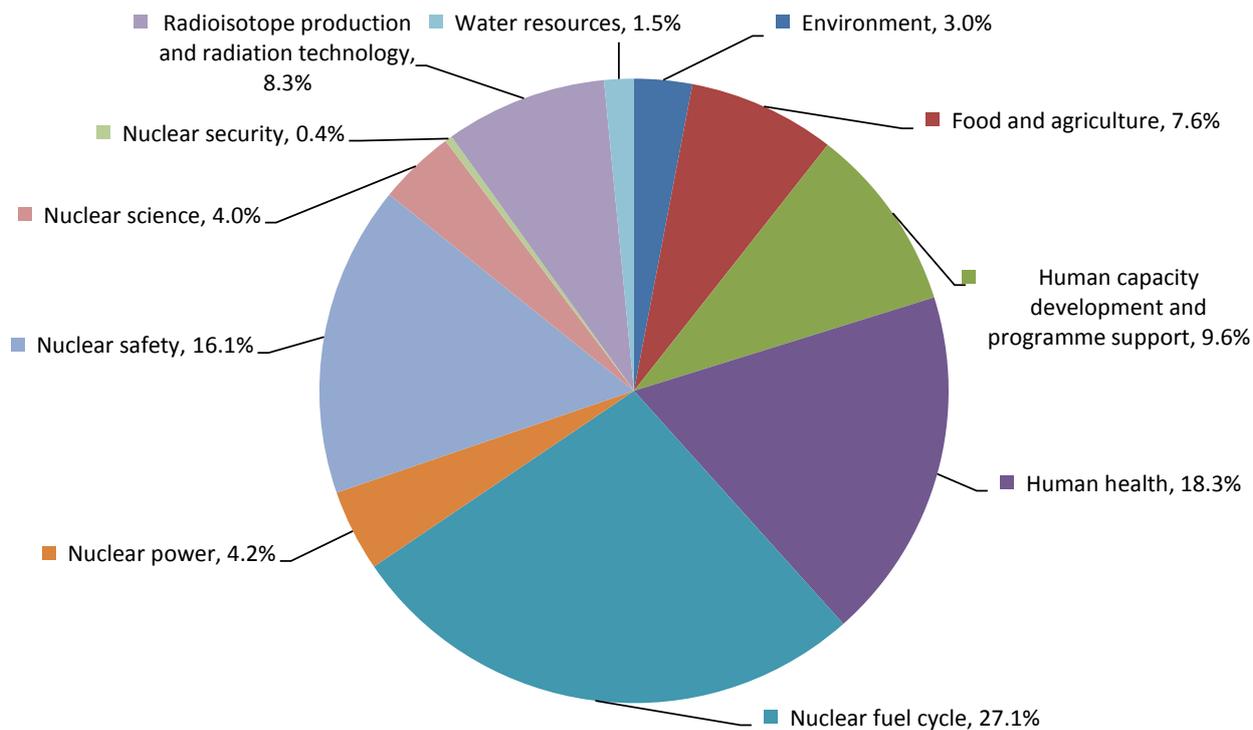


Figure 1: Actuals⁵ by technical field for 2011 (nuclear safety includes transport safety and safe management of radioactive waste; nuclear fuel cycle includes predisposal and disposal of nuclear fuel waste)⁶

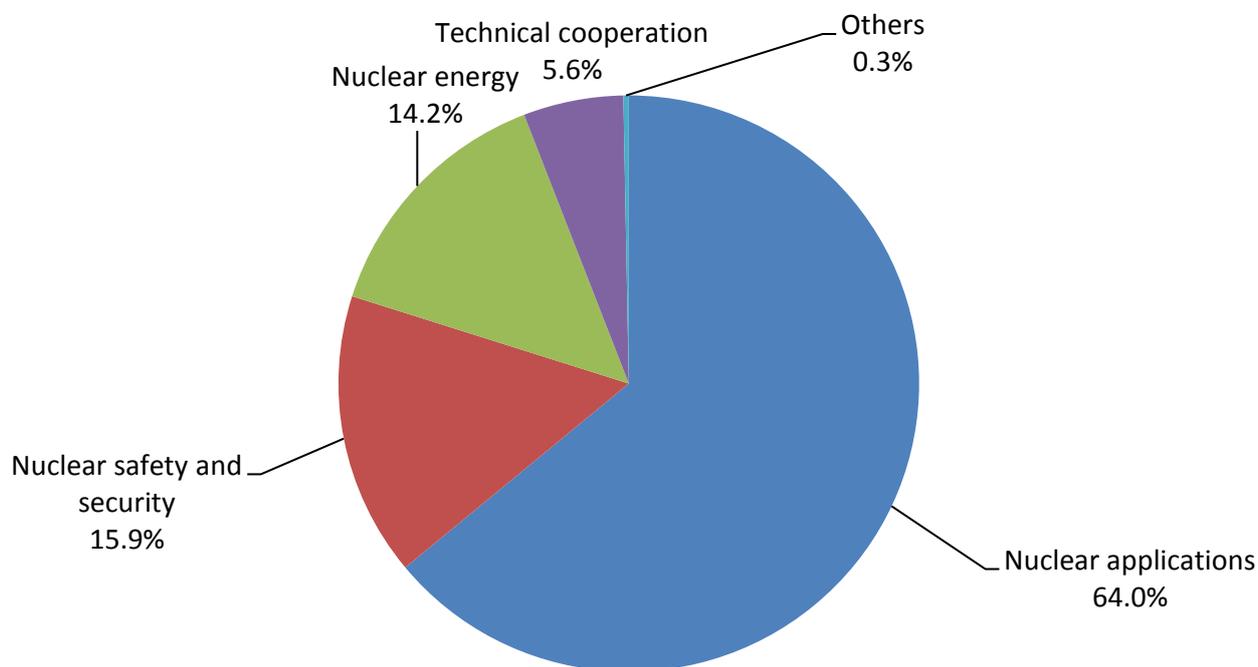


Figure 2: Support to the technical cooperation programme by Department of the primary Technical Officer for each project (shown as percentage of total number of projects).

⁵ Terminology has changed with the implementation of the Agency-wide Information System for Programme Support (AIPS). Actuals are the equivalent of disbursements.

⁶ Throughout this report, percentages in charts may not add up to 100% exactly due to rounding.

Technical Cooperation Report for 2011

Report by the Director General

This document responds to the request by the General Conference to the Director General to report on the implementation of resolution GC(55)/RES/11.

Part A of the document provides an overview of technical cooperation (TC) activities from 1 April 2011 to 31 March 2012, presents the context for the TC programme in 2011, focusing on capacity building in Member States, and offers a snapshot of efforts to improve programme effectiveness and quality.

Part B presents a summary of financial indicators and reviews the mobilization of resources for technical cooperation through the Technical Cooperation Fund, extrabudgetary resources and in-kind contributions. Part B also offers an overview of programme delivery, with both financial and non-financial indicators.

Part C responds to the operative paragraphs of resolution GC(55)/RES/11 by reporting on assistance to Member States in the peaceful, safe, secure and regulated application of atomic energy and nuclear techniques in specific fields. It presents regional activities and achievements in technical cooperation in 2011.

The Annex offers examples of project activities in the specific areas of human health, agricultural productivity and food security, water resource management, environmental monitoring and protection, industrial applications, energy planning and nuclear power, and nuclear safety and security.



Strengthening the Agency's Technical Cooperation Activities⁷

Technical cooperation in 2011: An overview

Global developments in 2011: the role of the TC programme⁸

In 2011, the Agency's increasing visibility within the UN system as an organization with technical capacities relevant to some aspects of development enabled it to expand its role in contributing to the global development agenda through its technical cooperation (TC) programme. Nuclear technologies, applications and techniques have certain comparative advantages for contributing to sustainable development within the framework of the United Nations Millennium Development Goals (MDGs), the Programme of Action for the Least Developed Countries for the Decade 2011–2020 adopted at the Fourth United Nations Conference for the Least Developed Countries held in Istanbul in May 2011, and the concept of a 'green economy' (i.e. an economy that is low carbon, resource efficient and socially inclusive).

During 2011, two concepts encompassing the interlinked challenges of climate change, food insecurity, and sustainable land and water management rose to greater prominence. 'Save and grow' denotes producing more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital⁹, while 'climate-smart agriculture' refers to agriculture that sustainably increases productivity and resilience (adaptation), reduces or removes greenhouse gases

(mitigation), and enhances the achievement of national food security and development goals¹⁰.

Spearheaded by the Food and Agriculture Organization of the United Nations (FAO) and addressing the immediate needs of least developed countries (LDCs) and developing nations, these concepts have become important global constructs. The TC programme has already been making significant contributions to both, as the Agency possesses comparative advantages with respect to nuclear research, technology and knowledge transfer capabilities that are relevant to these areas. For example, nuclear and isotopic techniques are used to improve agricultural water use efficiency, water quality, and nitrogen fertilizer usage. When combined with biotechnology for breeding drought and pest resistant seed, plant and crop varieties, nuclear technology plays a unique role in providing solutions to sustainable crop production intensification (SCPI). In addition, the Agency's support for fertigation techniques (the application of fertilizer through drip irrigation systems as an efficient way of controlling water and nutrients in the root zone) is encouraging wider adoption of improved water management practices for SCPI. With these and other related applications, the TC programme is contributing to the transformation of agricultural practices, supporting the attainment of sustainable food security in the face of climate change without damage to the natural resource base.

The Agency's input to the production of more and better quality food with enhanced nutritional value, while simultaneously protecting the environment and managing soil and water effectively, is important in reducing hunger and malnutrition, and in the improvement of human health and disease resistance.

⁷ This section responds to operative paragraph 25 of resolution GC(55)/RES/11 on strengthening TC activities through the development of effective programmes and well defined outcomes; and to operative paragraph 32 on Secretariat and Member State consultations on the support for and implementation of activities under national and regional projects and regional cooperation agreements.

⁸ This section responds to operative paragraph 1 of resolution GC(55)/RES/11 on facilitating and enhancing the transfer of nuclear technology and know-how among Member States; and to operative paragraph 28 on contributing to the implementation of the principles expressed in the Istanbul Declaration and the Programme of Action for the Least Developed Countries for the Decade 2011–2020, and to the attainment of the MDGs.

⁹ FAO, *Save and Grow: A Policymaker's Guide to the Sustainable Intensification of Smallholder Crop Production* (Rome, Italy, 2011).

¹⁰ FAO, *"Climate-Smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation* (Rome, Italy, 2010).

The TC programme contributes substantially to global health initiatives in the fields of communicable and non-communicable diseases, and nutrition. These fields are of particular importance in LDCs and developing nations that lack essential health services, and adequate access to sanitation, and suffer nutritional deficits. With regard to non-communicable diseases, such as cancer, the Agency has unrivalled experience in the delivery of radiotherapy, diagnostic imaging and nuclear medicine procedures, and provides assistance in all relevant aspects (i.e. planning, training, implementation, radiation protection, safety, security etc.) in partnership with the WHO/IAEA Joint Programme on Cancer Control. Using stable isotope techniques, the Agency is also helping Member States to address nutrition and HIV/AIDS in infant and young child feeding, and micronutrient deficiencies. The techniques can also be used to monitor changes in body composition during nutritional interventions, which can provide important information for optimizing the care and treatment of people living with HIV/AIDS, and which is of particular relevance in the context of increased access to antiretroviral (ARV) treatment.

The TC programme is driven by the priority needs of Member States, with the overarching goal of contributing to their socio-economic development. While all Member States are eligible for technical cooperation assistance, the Agency devotes particular attention to the needs of developing countries. LDCs in particular face specific challenges when participating in the TC programme, such as weak planning capabilities, problems with programme formulation and implementation, the possibility of talent flight, and challenges related to their nuclear and radiation safety infrastructure and security. Agency assistance through the TC programme concentrates on helping Member States develop technical, managerial and institutional skills in nuclear science and technology, taking into account specific country needs and absorptive capacities. With appropriately targeted support, all countries participating in the TC programme can

apply nuclear technologies safely and peacefully as they work towards important development objectives such as greater food productivity, better nutrition and health services, efficient management of groundwater resources, improved energy development planning, quality control in industrial development, and a cleaner and safer environment.

Responding by region: how the TC programme is tailored to Member State needs¹¹

The TC programme is delivered in four geographical regions: Africa, Asia and the Pacific, Europe, and Latin America. Each region has different needs and development priorities, as is evident in the thematic programme distribution across the regions. In 2011, human health accounted for the highest percentage of actuals in the Africa region at 28.1%, followed by food and agriculture at 18.1%. In Asia and the Pacific, actuals in the area of nuclear safety were most significant at 21.4%, followed by radioisotope production and radiation technology at 18.4%. In Europe, nuclear fuel cycle had the highest proportion at 53.2%, followed by nuclear safety at 15.9%. Finally, in Latin America, the highest percentage of actuals was in the field of human health, at 25.8%, followed by nuclear safety at 15.3%.

In 2011, Agency assistance to Africa through the TC programme aimed to help Member States harness nuclear science and technology to address priority needs in the areas of national and regional socio-economic significance. The TC programme supported projects to increase food productivity, improve health services, better manage groundwater resources, strengthen energy development planning, enhance quality control in industrial development, and promote a cleaner and safer environment. Special emphasis was placed on human resource training to help Member States develop technical, managerial and institutional capacities in nuclear science and technology and to ensure the long term sustainability of peaceful nuclear applications. The TC programme also emphasized

¹¹ This section responds to operative paragraph 8 of resolution GC(55)/RES/11 on strengthening TC activities and continuously enhancing the effectiveness and efficiency of the TC programme; and to operative paragraph 28 on contributing to the implementation of the principles expressed in the Istanbul Declaration and the Programme of Action for the Least Developed Countries for the Decade 2011–2020, and to the attainment of the MDGs.

the crucial importance of nuclear, radiation, transport and waste safety, and nuclear security, and vigorously supported Member State efforts at the national and regional level to build and strengthen safety and security.

The degree of development in the highly populated Asia and the Pacific region varies widely, and capacities in nuclear science and technology differ significantly from country to country. Although the region is developing fast, it still faces many serious challenges in the areas of food and energy security, environmental protection, health care, and the availability of water and other essential natural resources. During 2011, the TC programme in Asia and the Pacific continued strengthening the technical and institutional capacities of national and regional institutions and resource centres for increased and sustained application of nuclear techniques in human health, agriculture and food, environmental protection and energy, the top priority areas in the region. Special emphasis was given to improving nuclear and radiation safety and security.

Member States in Europe participated in numerous TC projects on the peaceful application of nuclear techniques in support of regional socio-economic priorities such as human health, agriculture and livestock production, optimization of industrial processes, environmental protection and cultural heritage preservation. The outcomes achieved in 2011 were diverse and included the consolidation of quality systems in radiotherapy and nuclear medicine, the harmonization of selected radioanalytical data across the region, and the production of new improved varieties of food crops. The regional approach is an effective way to transfer knowledge — for example, by coordinating expert services, workshops and training courses, and by providing technical support for radiation technology quality control methods and procedures.

In Latin America in 2011, special emphasis was placed on promoting technical excellence, leadership and cooperation in Member States, particularly in

preparation for trilateral cooperation arrangements between two Member States and the Agency within regional projects planned for the 2012–2013 TC programme. There is a renewed interest in the region in promoting strategic alliances and partnerships to multiply the benefits of technical cooperation in Member States.

Water Matters: Making a Difference with Nuclear Techniques

The Director General selected water as a key focus area for 2011 and as the subject of the Scientific Forum. More than one billion people in developing countries do not have access to safe drinking water, and over two million people, mostly in developing countries, die each year from diseases associated with poor water and sanitary conditions. Access to safe water for human consumption, agriculture and industry is a critical development challenge. In a world facing water constraints, nuclear technology can help manage natural resources in a more effective and sustainable manner. The announcement in March 2012 of the achievement of the MDG target of halving the number of people without sustainable access to safe drinking water has struck a note of hope. The World Health Organization (WHO) warns, however, that ‘only 61% of the people in sub-Saharan Africa have access to improved water supply sources compared with 90% or more in Latin America and the Caribbean, Northern Africa, and large parts of Asia. Over 40% of all people globally who lack access to drinking water live in sub-Saharan Africa.’¹²

Water resource management is thus a high priority for Member States in Africa. The focus is on transboundary water resource projects, notably those dealing with transboundary river basins and aquifers, and is driven by natural and human impacts on water resources, especially the impact of climate change. The Agency, in partnership with other UN agencies and Member States, has developed several regional projects to address ongoing and emerging issues, notably projects RAF/8/041, ‘Formulation of an Action Programme for the Integrated Management of the Shared Nubian

¹² http://www.who.int/mediacentre/news/releases/2012/drinking_water_20120306/en/

Aquifer (UNDP/GEF)', and RAF/8/042, 'Adding the Groundwater Dimension in the Nile River Basin', which has been co-supported by the Global Environment Facility with funding of \$1 million.

In 2011, Member States in Asia and the Pacific prioritized the application of environmental isotope and chemical techniques to assess trends in water quality, evaluate groundwater and surface water resources, as well as support water resource conservation. The research units of the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) in China, India, Indonesia, Pakistan and the Philippines are playing a leading role in related activities, and are proving to be a useful mechanism to strengthen and continue effective regional cooperation. Project RAS/8/108, 'Assessing Trends in Freshwater Quality Using Environmental Isotopes and Chemical Techniques for Improved Resource Management', has enhanced national capacities to use such techniques. Under the project, thirteen RCA Member States sampled and analysed a variety of water resources, resulting in the establishment of an isotope and chemical database of surface water, groundwater and precipitation. These data will be included in the Agency's Isotope Hydrology Information System (ISOHIS), which is accessible to Member States that are planning and conducting hydrological studies. Project findings have influenced water management policy decisions in Bangladesh, the Philippines and Thailand.

In Europe, regional project RER/8/016, 'Using Environmental Isotopes for Evaluation of Streamwater/Groundwater Interactions in Selected Aquifers in the Danube Basin', aimed to assess streamwater/groundwater mixing processes in river bank filtration zones in selected areas in Croatia, Hungary, Romania and Serbia. The status of available equipment in each country was reviewed, details of the field monitoring and sampling plans for each country were consolidated, and training was provided in isotope hydrology fieldwork. To ensure a harmonized approach in the participating Member States and to improve the quality of analyses, intercomparison exercises were introduced and appropriate testing equipment, calibration materials and samples were provided.

In Latin America, emphasis was placed on the marine environment, including the reconstruction of pollution history and early detection of harmful algal blooms (HABs), as well as on water resource management in general. Under project RLA/7/014, 'Designing and Implementing Systems for Early Warning and Evaluation of the Toxicity of Harmful Algal Blooms in the Caribbean Region, Applying Advanced Nuclear Techniques, Radioecotoxicological Evaluations and Bioassays (ARCAL CXVI)', counterparts in 14 countries in Latin America and the Caribbean were trained in the taxonomy of toxic species in seafood relevant to the region. Training on field sampling and laboratory processing of toxic benthic microalgae as well as extraction of biotoxins has also been completed. A manual for field sampling and monitoring of harmful microalgae was produced under the project by the Intergovernmental Oceanographic Commission (IOC) in collaboration with the Agency and the projects counterparts. It is available on the IOC-UNESCO web page at <http://ioc-unesco.org/hab/>.

Water matters: mapping water in Africa

Prior to 2005, only 13% of Madagascar's rural population had access to potable water. Few hydrogeological surveys had been made, and groundwater information was particularly lacking in the provinces of Fianarantsoa and Tulear, where mostly traditional wells were dug. The Government of Madagascar has made a considerable effort to increase access to water by initiating several borehole drilling programmes. Under project MAG/8/006, 'Use of Isotope Techniques in Studies for the National Programme of Borehole Drilling in the Provinces of Fianarantsoa and Tuliar', the Agency has helped Madagascar build a corps of professionals qualified in various groundwater geology fields.

A laboratory has been equipped, which is now able to carry out isotopic work to support implementation of the national programme of borehole drilling. The improved national capacity supports the development of a sustainable potable water supply in the country.

In Mauritania, the supply of potable water is a national priority for economic and social development. The first TC project in isotope hydrology started in 2007 to characterize and manage the Trarza aquifer, located in the Mauritanian coastal basin, which includes the capital, Nouakchott. Under project MAU/8/002, 'Use of Isotope Hydrology Techniques for the Study of the Trarza's Aquifer and discontinued Aquifers in Southern Mauritania', surface and groundwater samples have been collected and analysed from more than 100 sampling points. The results show different groups of water layers: namely layers with direct infiltration of rainwater, recharge by surface water, and more confined aquifers that are influenced less or not at all by surface water.

The project provided field equipment and data analysis resources, and project staff were trained in field work, laboratory-based isotopic and chemical analyses, and data interpretation. The hydrogeological system in the study area was described, and the characteristics of the aquifer system are being revealed, contributing to the goal of achieving a safe drinking water supply.

Under project ETH/8/010, 'Assessment of Groundwater Resources in Selected River Basins', the Government of Ethiopia has increased its understanding of coupled regional groundwater and surface water systems to anticipate and mitigate the impacts of droughts and floods, to maintain and enhance ecosystem services, and to reduce the risk of resource overexploitation. Under the project, a review of all previous studies in the area was carried out, a water point inventory was taken, and field sampling was carried out. Chemical and stable isotope analysis was used to decipher the flow regime and recharge conditions. The project strengthened the capacity of the hydrology laboratory at the University of Addis Ababa, which will now be able to meet the growing national need for updated data on the available groundwater resources to plan for the development and management of the national water sector.

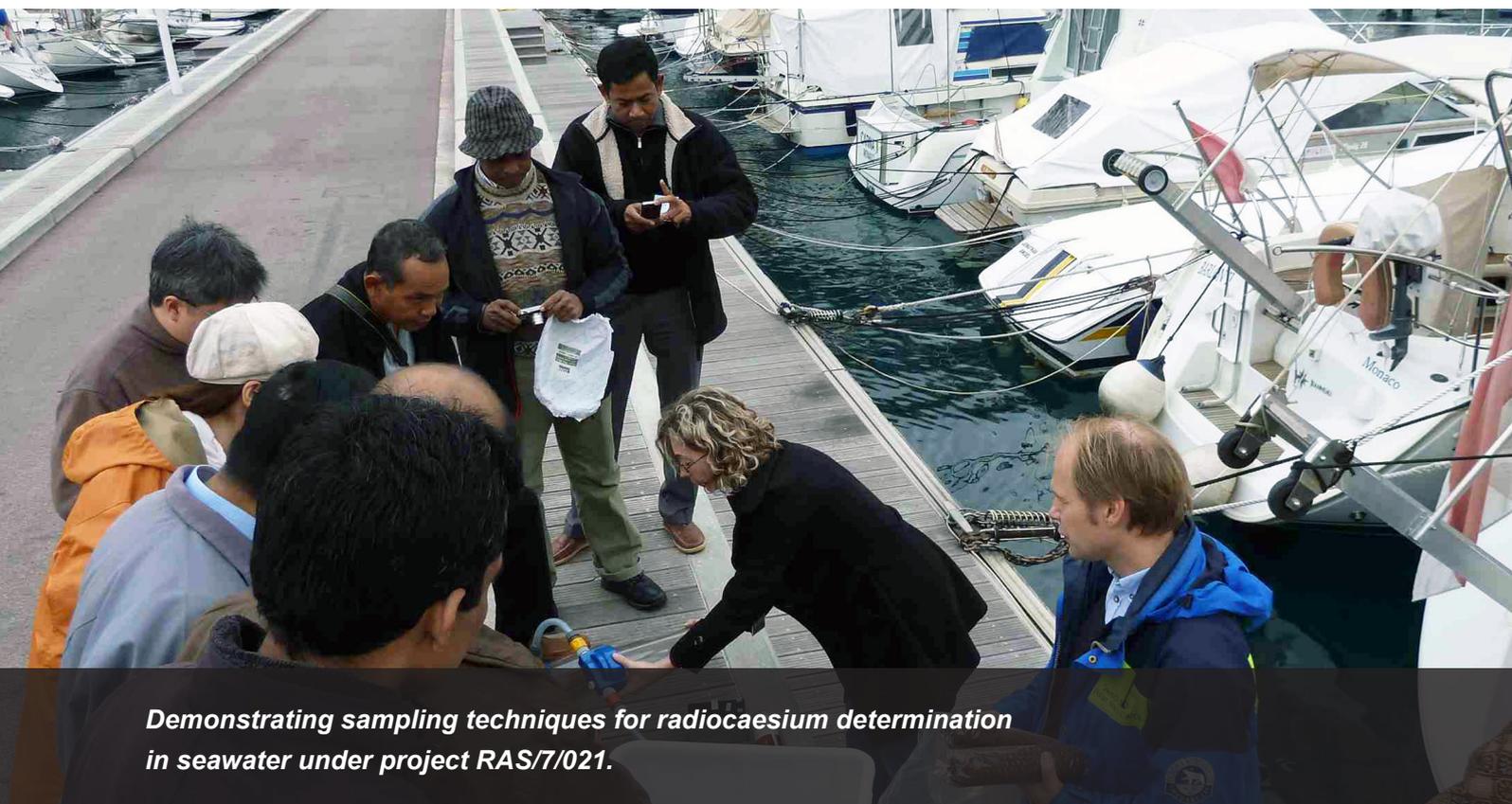
Mauritius faces an acute shortage of drinking water. More than 50% of the domestic supply comes from groundwater, which is threatened by seawater intrusion and pollution as a result of economic activities. Through project MAR/8/009, 'Assessing Groundwater Contamination Using Isotope Techniques (Phase II)', the Agency has enhanced national analytical capacities to monitor groundwater quality, thus enhancing water safety and supporting optimum use of available water resources. As a result of the project, a monitoring programme for groundwater quality has been established, and contamination risks have been identified.

After Fukushima: TC support to Member States

The Fukushima Daiichi nuclear accident has increased Member State concerns about nuclear safety. The Agency's ongoing TC projects and activities in the field of safety complement other Agency actions undertaken under the umbrella of the IAEA Action Plan on Nuclear Safety (GOV/2011/59-GC(55)/14).

the USA are supporting this project, which aims to harmonize the measurement of various radioisotopes to ensure a comparable and verifiable impact assessment across the Pacific Ocean.

The project builds on the achievements of the previous project RAS/7/016, 'Establishing a Benchmark for Assessing the Radiological Impact of Nuclear Power Activities on the Marine Environment in the Asia-



Demonstrating sampling techniques for radiocaesium determination in seawater under project RAS/7/021.

The accident raised concerns about the impact on the marine environment and possible consequences for communities and economies. RCA project RAS/7/021, 'Marine Benchmark Study on the Possible Impact of the Fukushima Radioactive Releases in the Asia-Pacific Region', was approved by the Board of Governors in June 2011 as a new project in the Agency's TC programme for 2011. Extrabudgetary contributions received from Australia, Japan, New Zealand and

Pacific Region'. The project RAS/7/016 provides pre-Fukushima baseline data, against which data collected under the new project can be measured. As well as the RCA Member States, seven other countries from the region are participating in RAS/7/021, including three non-Member States (Cook Islands, Fiji and Solomon Islands). Further information on the project can be found at <http://www.iaea.org/newscenter/news/2011/temarine.html>.

Developing human resources and building capacities¹³

Nuclear science and technology can provide important data for decision makers, and unique solutions to specific development challenges, but the lack of skilled and trained staff is a real constraint in many Member States. Even in countries with more advanced capacity, or a longer nuclear history, the sustainability of human resource advances cannot be taken for granted. The development and enhancement of human capital is therefore a high priority in the TC programme. A spirit of engagement and innovation must be fostered in new generations of nuclear scientists and technicians, founded on a solid nuclear education, well equipped training centres, and strategic programming. Knowledge management, professional development and networking also ensure the sustainability of nuclear capacity.

The Agency's training programmes in 2011 faced some challenges due to difficulties in placing candidates from some countries in traditional host institutions. As a result, the Agency organized training events in Vienna and made arrangements with potential host institutions in other technologically advanced countries. This will be further consolidated in the future to help countries build human capacities and make optimal use of the peaceful application of nuclear techniques.

Sharing knowledge between countries

Many countries in the Asia and the Pacific region still lack sufficient trained human resources and capacities for training. A lack of succession plans and the shortage of young specialized professionals threaten sustainability in areas that are key to the successful use of nuclear science and technology in socio-economic development. With this in mind, in 2011 there was a particular focus on human resource development and knowledge management, the main vehicles for the transfer of technology by the Agency to the region. Agency support in the form of fellowship and scientific visits, training of scientists and technicians,

and mentorship by Agency experts and consultants was provided through national and regional projects, including projects under the RCA and the Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA). The regional designated centres recognized by RCA and ARASIA continued to play a very important role in these efforts, as well as in the dissemination of know-how and good practice. Particular attention was given to new Member States (Bahrain, Cambodia and Nepal) as well as the countries in the region classified as LDCs, which have a pressing need for human resource capacity building.

Throughout 2011, some 250 technicians and scientists from ARASIA Member States were trained in the fields of human health, food and agriculture, marine environment, nuclear analytical techniques, quality assurance and quality control in nuclear analytical techniques, naturally occurring radioactive material (NORM), and energy planning. Regional cooperation under the RCA continued to be effective, as the 17 RCA signatories have long experience in cooperating with each other. In an effort to improve the RCA programme, the group conducted a review of its programme development mechanism in 2011. Technical cooperation among developing countries, or South-South cooperation, has proved to be an effective mechanism for mutual support in the region. As was the case in 2010, most experts recruited under RCA projects in 2011 were from within the region. The 2012–2013 RCA programme was developed after rigorous consultation among the RCA members, and is based on the RCA Strategic Priorities for 2012–2017.

Capacities in the Europe region in different aspects of nuclear physics education and training were developed in 2011 through a series of workshops under project RER/0/028, 'Improving Educational and Training Capabilities in Nuclear Science and Applications'. Topics included establishing connections with end users, outreach and promotion of nuclear physics, education curricula in medical physics, career opportunities for

¹³ This section responds to operative paragraph 4 of resolution GC(55)/RES/11 on identifying regional resource centres or other qualified institutes; and to operative paragraph 18 on ensuring that the components of TC projects are readily available and meet international quality standards.

professionals in nuclear science, and approaching external sources of research activities funding (e.g. the EU's Seventh Framework Programme for Research and Technological Development, and Horizon 2020). The project contributed to the development of collaborative relations and links between nuclear physics teaching institutions and research laboratories, in particular in the subregion of the Balkans and Southeast Europe.

Supporting future nuclear leadership

Agency support to the World Nuclear University (WNU) in 2011 enabled fourteen participants to take part in the 7th annual WNU Summer Institute, a six week leadership development programme held at Christ Church college, Oxford, UK, that provides cutting-edge presentations on the full range of topics relevant to the future of nuclear technology.

In Latin America, the development of human resources in the field of nuclear applications is crucial if Member States in the region are to benefit from the enormous potential of nuclear technology. The Regional Strategic Profile for Latin America and the Caribbean (2007–2013) highlights a deficit in trained human resources in the region in the fields of human health, agriculture and energy. In 2011, several initiatives were undertaken in the region under national and regional projects in order to build capacity and facilitate knowledge sharing, as well as to promote the establishment of networks, especially at regional level.

Ensuring sustainable nuclear capacity: developing management skills, managing knowledge and promoting sustainability

In December 2011, Nigeria formally launched a national educational programme in nuclear science and nuclear engineering at Masters' degree level under project NIR/4/009, 'Developing Capacities in Pre-Project Activities for Nuclear Power Projects'. The educational programme will be run by a consortium

of four national universities and the Nigeria Atomic Energy Commission (NAEC), which coordinates and finances the programme. Over 50 participants attended the inauguration ceremony, including deans and professors of nuclear engineering and science from the postgraduate schools of four national universities (Universities of Zaria, Ile-Ife, Port-Harcourt and Maiduguri), NAEC staff, the Director of the National Universities Commission and selected students. Three professors from Texas A&M University and Georgia Institute of Technology, and representatives of the Agency were also present.

Promoting sustainability was the focus of two important workshops held in China and the Philippines on innovation, technology transfer and successful technology licensing in research and development institutions, organized jointly by the Agency and the World Intellectual Property Organization (WIPO). Both events were attended by a large number of scientists and decision-makers, who debated the issue of intellectual property as a means for innovation, promotion and successful technology transfer of research results from R&D institutions. The workshops provided information and practical training on legal and organizational infrastructure issues (including institutional policies), explained licensing procedures and how to use licensing as a means for technology transfer, and enhanced networking among R&D institutions and potential end users in the technology transfer process. These topics are very important for enhancing the sustainability of R&D institutions and increasing the impact of technology on socio-economic development.

Management skills and networks among nuclear research and development institutions were developed in the Europe region under project RER/0/031, 'Strengthening Sustainability of Nuclear Research and Development Institutes in the Modern Science and Technology Environment'. Most researchers in nuclear research and development institutions have never received managerial training. Project activities

therefore focused on two main areas: increasing capacities in writing competitive research project proposals, communicating with stakeholders and improving presentation skills; and increasing capacities in negotiating technology licensing and protecting intellectual property rights in cooperation with WIPO. As a result of the training, some participants developed concrete project proposals, one of which won an EU research grant of €1 million.

Supporting gender equality: women in the TC programme

Women participate in the TC programme as counterparts, experts and trainees, and as end users and beneficiaries of TC projects. In line with the Agency's gender equality policy, TC activities strive to mainstream gender and to further gender equality throughout the TC programme. In 2011, 3562 women from all regions participated in the TC programme.



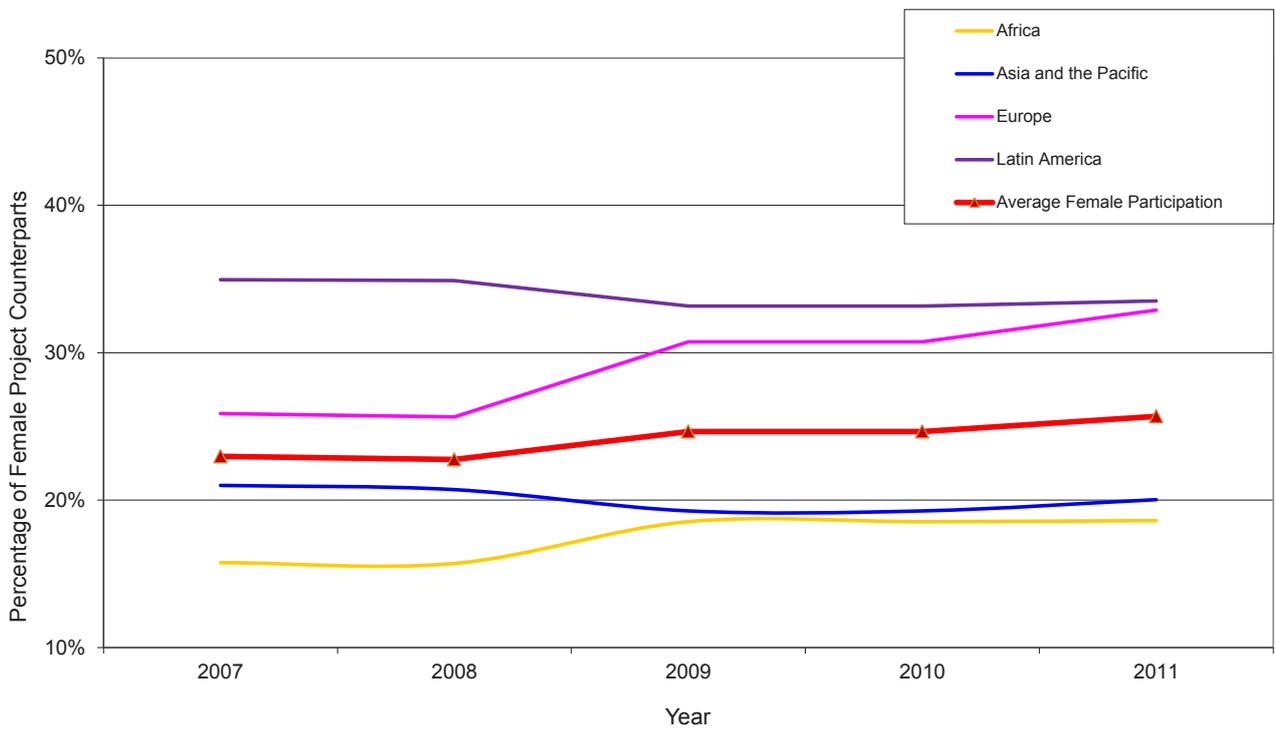


Figure 3: Female project counterparts by region.

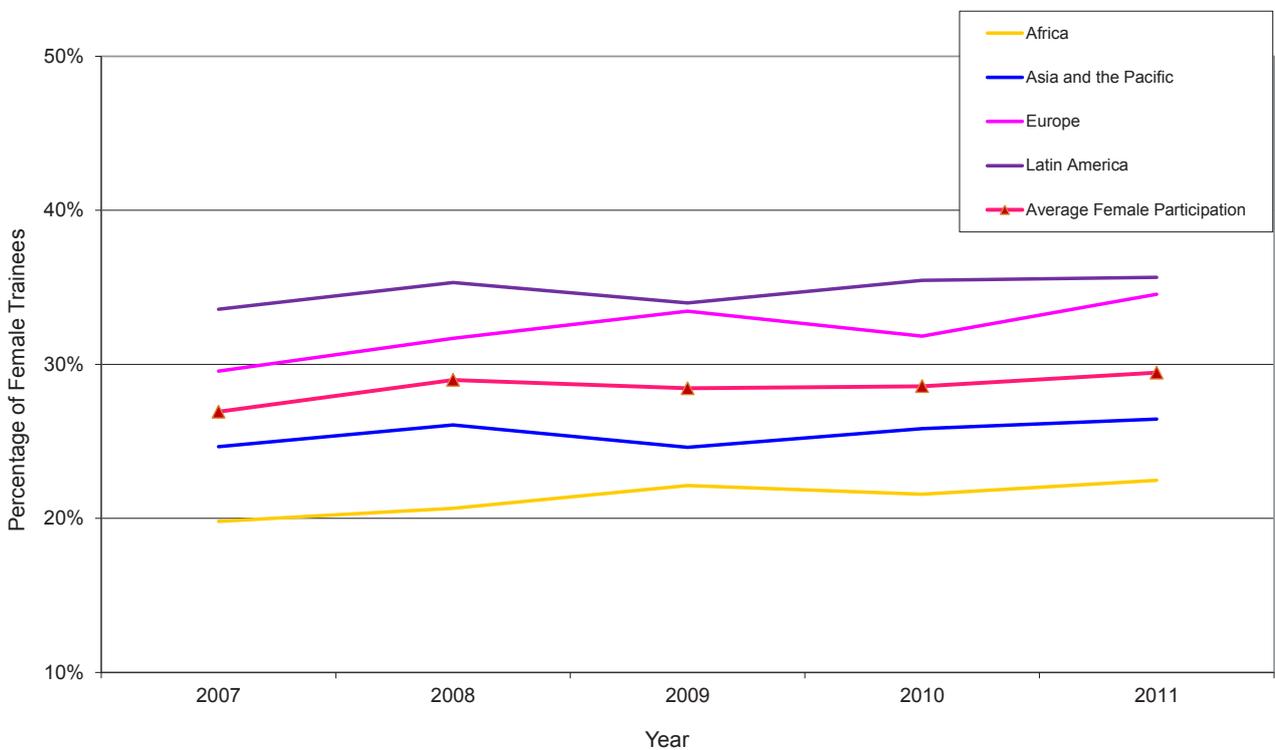


Figure 4: Female participation in training as fellows, scientific visitors, training course participants, national experts, meeting participants, and other project personnel, 2007–2011.

Building a more efficient, more effective technical cooperation programme¹⁴

About the TC programme

The TC programme aims to support Member States in the peaceful and safe use of nuclear applications. The programme is managed and coordinated under Major Programme 6 (Management of Technical Cooperation for Development). Other Major Programmes provide substantive expertise in non-power nuclear applications, nuclear energy, infrastructure development, nuclear safety and security, and safeguards. The TC programme is designed to meet the changing needs of Member States in a flexible and responsive manner, primarily in the areas of development, energy and nuclear safety. Compliance with safety standards and safeguards, as well as observance of security guidelines are integrated into all TC activities.

TC activities are programmed according to the needs of four geographical regions — Africa, Asia and the Pacific, Europe and Latin America — and take into consideration existing capacities and different operational conditions. The programme builds on the capacities of Member States in the same region by facilitating cooperation between them. For example, technically advanced countries in a region can provide expertise for projects in less advanced countries.

Technical cooperation support is provided through national, regional and interregional projects, developed at the country level with reference to the Country Programme Framework (CPF) where available, national development plans, and United Nations Development Assistance Framework (UNDAF). Regional projects take into account national development objectives but are developed according to regional development priorities established by regional cooperative agreements, strategies and frameworks. Interregional

projects deliver support across national and regional boundaries, and address the needs of several Member States in different regions. Interregional projects are categorized as transregional, global, capacity building or as joint activities with an international entity.

Country Programme Frameworks and Revised Supplementary Agreements

Country Programme Frameworks define mutually agreed priority development needs and interests that can be supported through TC activities. CPFs reflect national development plans, country specific analyses and lessons learned from past cooperation, and seek linkages with the UNDAFs. This ensures that the application of nuclear techniques is integrated with existing development initiatives and plans of the Member State. Sixteen CPFs were signed in 2011.¹⁵

Revised Supplementary Agreements (RSAs) govern the provision of technical assistance by the Agency, and are required under the Statute and The Revised Guiding Principles and General Operating Rules to Govern the Provision of Technical Assistance by the Agency (contained in document INFCIRC/267). They must be concluded by Member States participating in the TC programme. As at 19 February 2012, 119 Member States had signed an RSA¹⁶.

CPFs signed in 2011

Afghanistan	Guatemala
Algeria	Nicaragua
Armenia	Niger
Bulgaria	Slovenia
Burkina Faso	Thailand
Cambodia	United Arab Emirates
Dem. Republic of the Congo	United Rep of Tanzania
Gabon	Vietnam

¹⁴ This section responds to operative paragraph 8 of resolution GC(55)/RES/11 on strengthening TC activities and continuously enhancing the effectiveness and efficiency of the TC programme.

¹⁵ Total CPF signatures are calculated according to the year in which the Member State signs the document.

¹⁶ This paragraph responds to operative paragraph 16 of resolution GC(55)/RES/11 on adhering to the Statute and document INFCIRC/267; and to operative paragraph 17 on the importance of Revised Supplementary Agreements (RSAs).

Maximizing programme impact: improving interaction with the United Nations system and building partnerships¹⁷

The Agency participates in the harmonized programme cycle of the United Nations Development Group (UNDG) Executive Committee agencies where possible, strengthening its engagement in UNDAF joint programming in order to achieve better national development outcomes and to leverage synergies among UN organizations. By the end of 2011, 24 UNDAFs had been signed by the Agency. The Agency is also collaborating with or reaching out to a number of UN organizations in specific areas where nuclear technologies can add value.

The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture addresses the challenge of land degradation and desertification through projects in the area of soil and water management, and crop nutrition improvement. In 2011, in an effort to link TC soil and water management projects with the national and regional efforts of the United Nations Convention to Combat Desertification (UNCCD), contacts were established with the UNCCD offices in New York and Bonn, and follow-up visits to link activities will be undertaken in 2012.

The Agency's Department of Technical Cooperation collaborates closely with the FAO's Agriculture and Consumer Protection Department and the Joint FAO/IAEA Division to identify joint TC activities at the country level. The joint activities include work on assessing the impact of mutation breeding, and the creation of technology packages for food security in Asia, particularly in the area of climate proofing rice production systems. Outreach and partnership efforts with the International Rice Research Institute, as well as with regional and national FAO offices and national agricultural research and extension services are ongoing. The Agency also aims to link existing TC soil and water management projects to the FAO's Global

Soil Partnership, and to develop new initiatives in this area.

In an effort to bring nuclear technologies that support cleaner industrial production processes and hence support green economies to industries, the Agency has established relations with National Cleaner Production Centres supported by the United Nations Industrial Development Organization (UNIDO) in selected pilot countries. Initial efforts are under way with wastewater producing industries, particularly textile and dyeing industries in Cambodia and Vietnam, to assess the viability of electron beam technology and radiotracers as supplementary wastewater treatments. The viability of nuclear techniques in flue gas treatment in coal fired power plants and the treatment of persistent organic pollutants are also being explored as areas of further interest.

Looking back and moving forward: finalizing the 2012–2013 TC programme

Preparations for the 2012–2013 TC programme cycle were continued in 2011. Building on the project design training workshops that were delivered in 2010, the final stage of preparations for the new cycle included further training events to strengthen project design capacity and results based management in Member States, streamlining the language and approach used. A specially designed training package for TC programme planning and design, using the logical framework approach (LFA), has been developed, as have orientation materials for Agency staff.

In order to pursue continuous improvement in the TC programme, the Secretariat developed a two-step mechanism to assess the quality of projects submitted for the 2012–2013 TC cycle. The first step consisted of a self-review of all project designs submitted by the individual project teams themselves, supported by the Programme Cycle Management Framework (PCMF) IT platform. The second step was a quality review by the

¹⁷ This section responds to operative paragraph 8 of resolution GC(55)/RES/11 on enhancing the effectiveness and efficiency of the TC programme; to operative paragraph 21 on playing a more proactive role in seeking resources to implement footnote-a/ projects; and to operative paragraph 26 on consultations and interactions with interested States, the UN system, multilateral financial institutions, regional development bodies and other relevant intergovernmental and non-governmental bodies.

Secretariat of a 10% sample of the projects submitted. Lessons from the 2009–2011 TC programme cycle were used to develop the review methodology, and projects were assessed for compliance with TC project criteria¹⁸, and with the LFA. The review findings noted incomplete compliance in both areas.

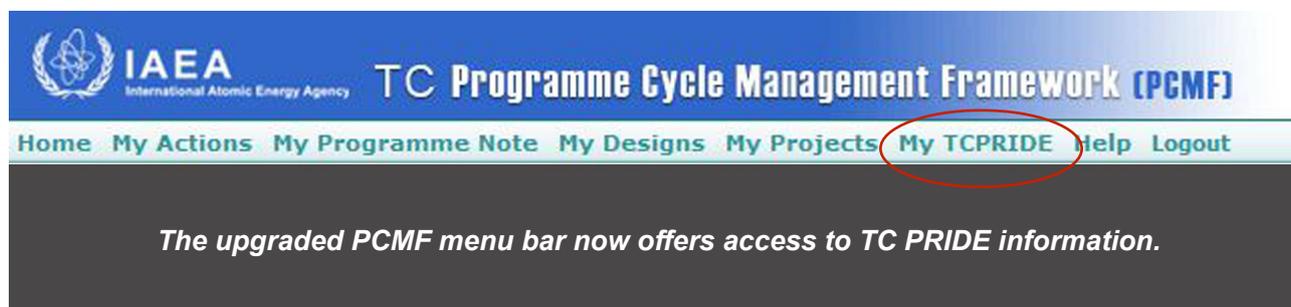
Regarding the LFA, a number of areas for improvement, both operational and strategic, were identified in the review report. For example, LFA trainings/workshops for counterparts, as well as for Programme Management Officers (PMOs) and Technical Officers (TOs), should be strengthened, and training should be implemented as early as possible in the TC cycle. Potential counterparts should participate in LFA trainings/workshops. Compliance with TC project criteria should be supported by standards, checklists, and other systematic instruments in order to verify and document compliance as part of the appraisal and approval process.

At the strategic level, the key lessons from the review process showed that consideration should be given to moving towards bigger and better projects, and that

a differentiation in LFA treatment should be made between large, complex projects and small, simple ones. The findings of the review process will further consolidate the basis for systematic TC institutional learning and continual improvement. Areas for improvement, as well as additional lessons learned from the review process, have been incorporated into the guidelines for the preparation of the 2014–2015 TC programme cycle.¹⁹

Learning and improving: implementation of OIOS recommendations²⁰

Internal coordination between the Office of Internal Oversight Services (OIOS) and the Department of Technical Cooperation has been streamlined and strengthened, and throughout 2011 major efforts were made to review and implement key OIOS recommendations. As at 31 January 2012, 148 of the outstanding 161 recommendations arising from TC programme evaluations had been implemented and closed, with the remaining 13 in progress.



¹⁸ TC quality criteria includes project relevance, Member State ownership and commitment, sustainability, effectiveness and efficiency.

¹⁹ This paragraph responds to operative paragraph 9 of resolution GC(55)/RES/11 on rationalizing the number of TC projects in order to increase programme efficiency and create synergies among projects.

²⁰ This section responds to operative paragraph 14 of resolution GC(55)/RES/11 on strengthening TC activities and enhancing programmes, with due account, and in consultation with Member States and the Secretariat, of the recommendations of OIOS and the External Auditor.

²¹ This section responds to operative paragraph 10 of resolution GC(55)/RES/11 on the use of the InTouch communication platform and improving this tool; and to operative paragraph 33 on continuing to implement the Programme Cycle Management Framework.

Transparency and efficiency: online tools for technical cooperation²¹

The online tools developed to support efficiency, transparency and traceability in the TC programme are upgraded on an ongoing basis to ensure that they meet the needs of Member States and the Secretariat. InTouch, the online communication platform for the TC community, is now fully operational, supporting nominations for fellowships, scientific visits, training courses and meetings, as well as the submission of expert and lecturer profiles. The PCMF IT platform has been extended to include the information

formerly contained on the Technical Cooperation Project Information Dissemination Environment (TC PRIDE) website. TC PRIDE is being phased out as a separate site, as the technology it uses is obsolete. The merger of the PCMF IT platform and TC PRIDE now provides in a single website a full view of TC projects from concept submission through to project closure, including historic data.



Outreach in 2011: exhibition at the 55th General Conference.



TC Programme Resources and Delivery

Financial overview

Resources for the technical cooperation programme²²

At the end of 2011, €62.9 million²³ or 89.3% of the €70 434 000 target had been pledged for the 2011 Technical Cooperation Fund (TCF). The rate of attainment on payments, based on the figure of €60.5 million received by 31 December 2011, was 86.0%, reflecting unpaid pledges of €2.4 million. Subsequently, €2.0 million were received in early January 2012 and €0.35 million in February 2012. Total TCF resources including National Participation Costs (NPCs), assessed programme cost (APC) arrears and miscellaneous income amounted to €63.0 million, higher than the 2010 figure of €60.6 million (equivalent to \$79.7 million). New extrabudgetary resources for 2011 came to €17.7 million and in-kind contributions were €1.1 million.

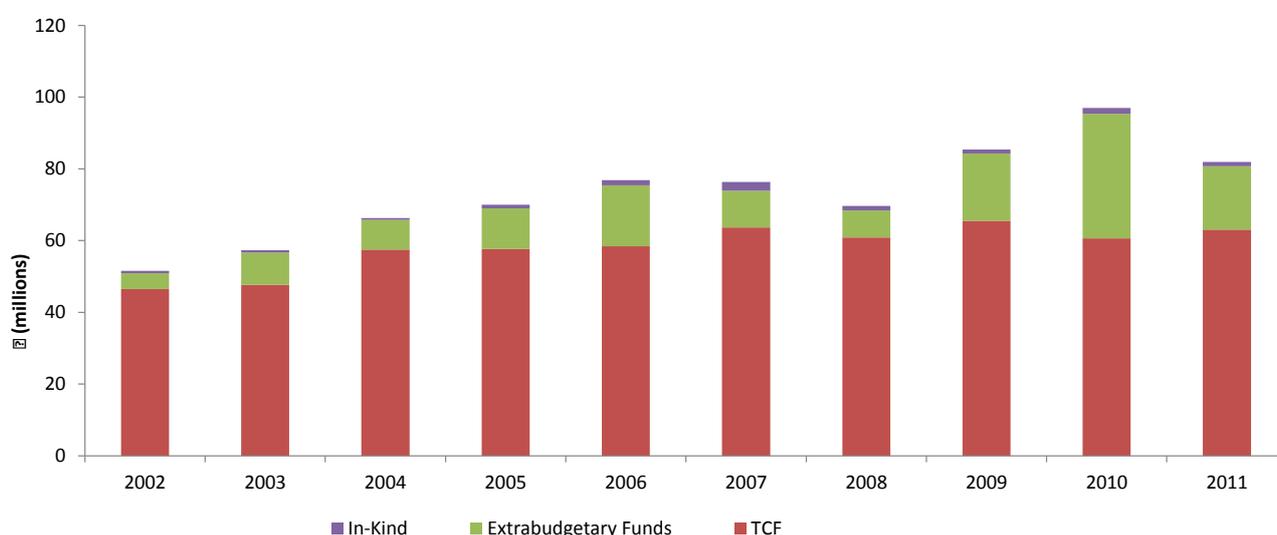


Figure 5: Trends in technical cooperation programme resources, 2007–2011

Table 1: TC Programme resources in 2011	
2011 target for voluntary contributions to the Technical Cooperation Fund	€70.4 million
Technical Cooperation Fund (TCF)	€63.0 million
Extrabudgetary resources ²⁴	€17.7 million
In-kind contributions	€1.1 million
Total new resources for the TC programme	€81.8 million

²² This section responds to operative paragraph 5 of resolution GC(55)/RES/11 on timely payment of TCF contributions; and to operative paragraph 6 on NPCs, and payment of APC arrears.

²³ Not including National Participation Costs (NPCs), assessed programme costs (APCs) or miscellaneous income.

²⁴ Please refer to Table A.5 of the Supplement to this report for details.

Table 2: Payment of National Participation Costs (NPCs) and assessed programme cost (APC) arrears

	Received in 2011	Outstanding payments
NPCs	€0.2 million	€0.2 million
APCs	€0.3 million	€1.4 million

The rate of attainment on pledges, as on 31 December 2011, was 89.3% for 2011, as compared with 92.3% for 2010. The trend shows a clear decrease, especially for 2010 and 2011.

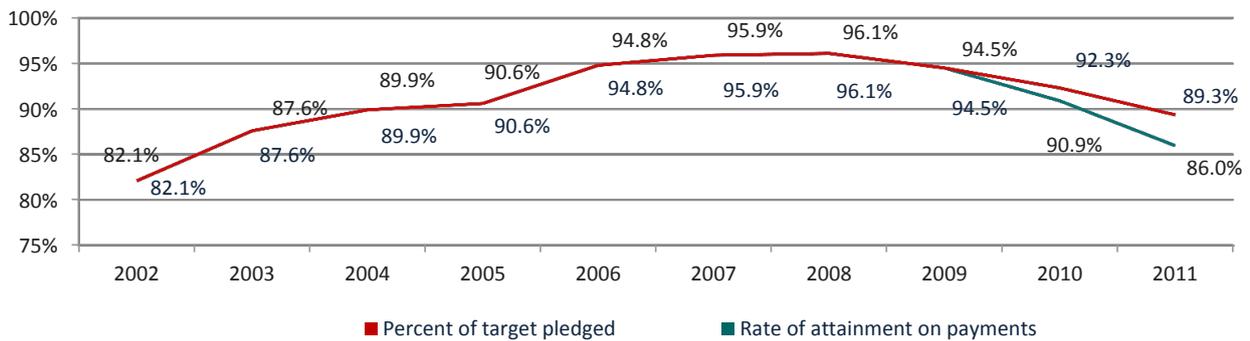


Figure 6: Rate of attainment trends, 2002–2011.

Extrabudgetary and in-kind contributions²⁵

Extrabudgetary contributions from all sources in 2011 (donor countries, international and bilateral organizations, government cost sharing) accounted for €17.7 million, with €4.6 million received from the USA, €3.4 million of which the USA designated for the Peaceful Uses Initiative. The European Commission contributed €2.9 million. In-kind contributions accounted for €1.1 million in 2011.

Table 3: Extrabudgetary contributions to TC programme by donors, 2011 (in Euros)

Argentina	14 580	Spain	150 400
Australia	72 489	Sweden	330 321
Czech Republic	101 862	United States of America	4 650 501
Japan	550 725	AFRA Fund	19 975
Korea, Republic of	30 440	European Commission	2 891 250
Malaysia	14 590	International Organization for Chemical Sciences in Development (IOCD)	7 280
New Zealand	45 148		

²⁵ This section responds to operative paragraph 21 of resolution GC(55)/RES/11 on playing a more proactive role in seeking resources to implement footnote-a/ projects; and to operative paragraph 23 on extrabudgetary contributions, including the Peaceful Uses Initiative.

Table 4: Government cost sharing, 2011 (in Euros)

Azerbaijan	1 142 050	Latvia	40 000
Botswana	145 600	Morocco	264 828
Chile	7 000	Mauritius	35 050
Colombia	382 590	Montenegro	36 450
Croatia	94 474	Pakistan	73 100
Czech Republic	23 286	Peru	2 595 897
Ethiopia	929 130	Turkey	70 200
Gabon	1 060 120	United Arab Emirates	139 800
Ghana	1 927	Uruguay	428 148
Guatemala	270 375	United Republic of Tanzania	138 750
Hungary	55 050	Uzbekistan	122 956
Jordan	51 620	Zimbabwe	756 020

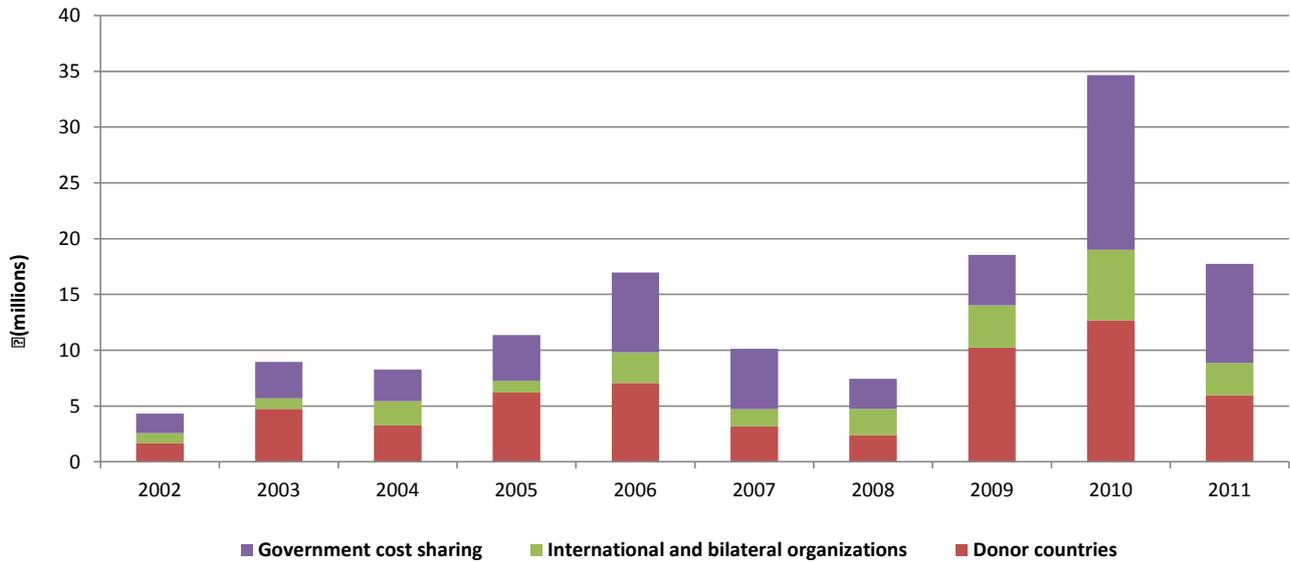


Figure 7: Trends in extrabudgetary contributions 2002–2011, by donor type.

Delivering the technical cooperation programme

Financial implementation

TC programme delivery can be expressed in both financial and non-financial terms. Financial delivery is expressed in terms of actuals and encumbrances²⁶. Non-financial delivery (i.e. outputs) can be expressed numerically in terms of, for example, experts deployed or training courses conducted.

Implementation for the TCF, measured against the budget for 2011 as on 31 December 2011, reached 73.9%, the same as the rate attained in 2010 for the TCF (Table 5).

Indicator	2010	2011
Budget allotment at year end	€78 436 278	€86 526 047 ²⁷
Encumbrances + actuals	€58 000 389	€63 914 291
Implementation rate	73.9%	73.9%

Unallocated balance

At the end of 2011, the unallocated balance²⁸ was €4.2 million. Of this total, some €3.9 million were unpaid TCF pledges, of which some €2.35 million were received early in 2012. In 2011, €1.3 million were received as advance payments for the 2012 TCF. Some €1.4 million of cash is held in currencies which are difficult to use in the implementation of the TC programme. The decrease in the unallocated balance in 2011 compared to 2010 is a result of the decision to use the total unallocated balance for 2010 to support projects in the 2012–2013 TC programme cycle, as indicated in document GOV/2011/58, Table I.

Description	2010	2011
Total unallocated balance	22 621 798	4 166 749
Pledges not yet paid	(3 568 837)	(3 939 638)
Advance payment for TCF for following year	Not reported in 2010	1 314 084
Non-convertible currencies that cannot be utilized	(12 657)	(12 579)
Currencies that are difficult to convert and can only be used slowly	(1 550 205)	(1 421 069)
Resources that can be used for the TC programme	17 490 099	107 547

²⁶ Terminology has changed with the implementation of the Agency-wide Information System for Programme Support (AIPS). Encumbrances are the equivalent of obligations, and actuals are the equivalent of disbursements.

²⁷ Includes carryover from the previous year.

²⁸ Total funds not allocated to TC projects.

Human resources²⁹

Human resource indicators are a means to show non-financial delivery of the TC programme. The launch of the Agency's new enterprise resource planning system delayed the start of programme implementation at the beginning of 2011. In addition, the lower number of assignments, meetings and fellowships may reflect programme status during the last year of the unique three year 2009–2011 TC programme, although there is no statistical basis to measure this against.

Indicator	2010	2011	Increase/ (decrease)
Expert and lecturer assignments	3545	3319	(226)
National experts/meeting participants and other project personnel ³⁰	5309	4634	(675)
Fellowships and scientific visitors in the field	1838	1397	(441)
Training course participants	2962	3051	89
Training courses	222	205	(17)

At the end of 2011, there were 681 active projects and an additional 80 in the process of being closed. During 2011, 244 projects were closed, one of which was a cancellation.

Programme Reserve projects³¹

One Programme Reserve project was implemented in 2011 at the request of Lesotho. Two other Programme Reserve projects were also requested, but were not implemented, and were terminated at the end of 2011 in line with guidance for Programme Reserve projects.

Project	Disbursement end 2011	Unliquidated obligation end 2011	Total
LES/9/001: Support for the Development of a Regulatory Infrastructure and Control of Radiation Sources (Lesotho)	€5 138.27	€10 300.61	€15 438.88

²⁹ This section responds to operative paragraph 18 of resolution GC(55)/RES/11 on ensuring that the components of TC projects are readily available and meet international quality standards.

³⁰ National experts are now counted as meeting participants. The 2010 figures have been adjusted to reflect this change and to enable comparisons to be drawn with the 2011 figures.

³¹ Programme reserve projects are funded by the programme reserve, an amount set aside within the TCF by the Board each year for financing assistance of an urgent nature requested after the Board has approved the TC programme.

Programme Activities and Achievements in 2011: Regional Overview³²

Africa

2011 Africa overview

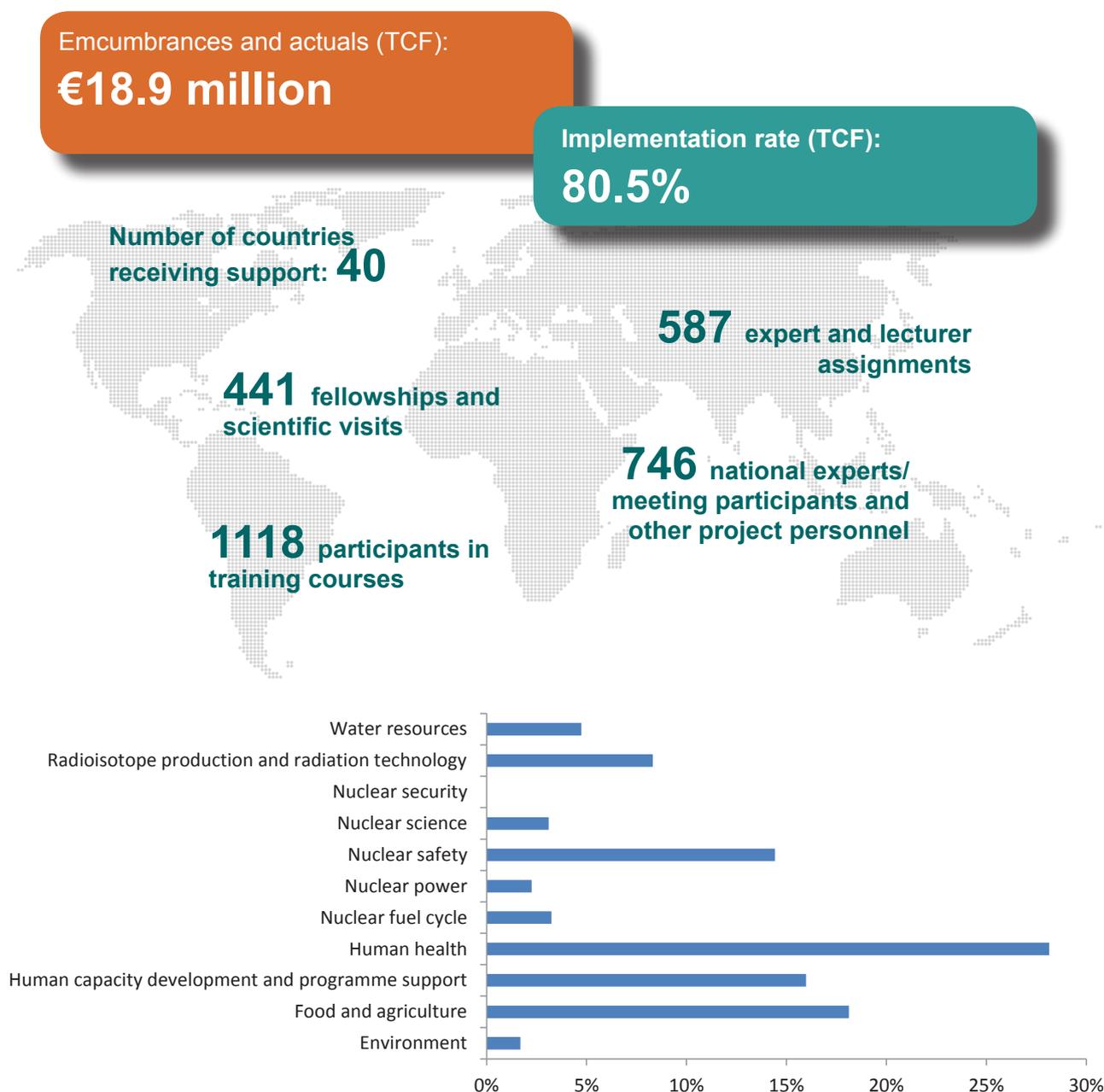


Figure 8: Actuals in the Africa region in 2011 by technical field.

³² This section responds to operative paragraph 1 of resolution GC(55)/RES/11 on facilitating and enhancing the transfer of nuclear technology and know-how among Member States; to operative paragraph 18 on ensuring that the components of TC projects are readily available and meet international quality standards; to operative paragraph 25 on strengthening TC activities through the development of effective programmes and well defined outcomes; to operative paragraph 27 on helping Member States to obtain information on (a) the role of nuclear power in mitigating greenhouse gas emissions and (b) the role of radiation and nuclear technology in mitigating polluting gases, managing agricultural and industrial wastes, and improving water security; to operative paragraph 31 on promoting activities supporting the self-reliance, sustainability and further relevance of national nuclear and other entities in Member States, particularly in developing countries; and to operative paragraph 32 on Secretariat and Member State consultations on the support for and implementation of activities under national and regional projects and regional cooperation agreements.

In 2011, Member States in the Africa region were very active in developing CPFs, which were signed for Algeria, Burkina Faso, Democratic Republic of the Congo, Gabon, Niger and the United Republic of Tanzania. Efforts also continued to link CPFs to UNDAFs. The Agency was involved in the UNDAF process in several Member States (Angola, Botswana, Central African Republic, Egypt, Gabon, Ghana, Malawi, Mozambique, Namibia, South Africa, Tunisia, United Republic of Tanzania, Zambia and Zimbabwe). The UNDAFs for Gabon and Zambia were signed in 2011.

Major efforts were made in 2011 to help Member States develop their national and regional programmes for the 2012–2013 cycle. Extensive upstream work was carried out through a range of activities and channels, including policy consultations with national authorities, meetings with National Liaison Officers (NLOs) and prospective counterparts in the region and at Agency Headquarters, and pre-project assistance missions. Two regional training courses on project planning and design were organized in Algeria and Ghana for national project counterparts from French-speaking and English-speaking countries. The courses, which aimed to improve Member States' capacity in the design and management of TC projects, were attended by 133 participants from 40 Member States. The courses focused on the use of the logical framework approach.

The African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology (AFRA) continued to be the primary mechanism for technical cooperation among developing countries and for enhancing regional cooperation. Eleven AFRA projects have been initiated for the 2012–2013 TC cycle, addressing the regional programme needs and priorities defined in the AFRA Regional Strategic Cooperative Framework for 2008–2013. The non-AFRA regional programme takes into consideration emerging trends and new challenges in Africa, and was designed to complement the AFRA

programme, avoiding duplication and ensuring programmatic synergies where possible.

Following a recommendation by AFRA, an external assessment of the AFRA Regional Strategic Cooperative Framework for 2008–2013 was conducted, and as a follow-up, AFRA has requested the Secretariat to organize a task force meeting for the formulation of the new AFRA Regional Strategic Cooperative Framework for 2014–2018. Other regional activities included setting up additional regional designated centres and implementing key human resources development activities.

Under AFRA's fellowship programme, nine candidates from Benin, Democratic Republic of the Congo, Mali, Nigeria, Sierra Leone, South Africa, Uganda and the United Republic of Tanzania were awarded fellowships in 2011 to undertake a two-year Masters programme in nuclear science and technology at the School of Nuclear and Allied Sciences, University of Ghana, and at the Nuclear Engineering Department, Alexandria University, Egypt. The AFRA fellowship programme will contribute significantly to the development of a new generation of scientists who will foster nuclear science and technology for African development.

Three regional designated centres have been appointed by AFRA in Algeria, Ghana and Morocco for training and education in radiation protection. The centres will support the development of radiation protection capacities in African Member States that comply with the requirements of the International Basic Safety Standards. Three AFRA regional designated centres for the control of communicable diseases have been appointed in Cameroon (malaria), Kenya (malaria) and South Africa (tuberculosis). Two AFRA regional designated centres for stable isotopes in human nutrition were also appointed in Botswana and Morocco.³³

³³ This paragraph responds to operative paragraph 4 of resolution GC(55)/RES/11 on identifying regional resource centres or other qualified institutes.



Work is continuing on the development of a strategic framework for the future management of the Nubian Aquifer under project RAF/8/041, 'Formulation of an Action Programme for the Integrated Management of the Shared Nubian Aquifer (UNDP/GEF)', with a review of the existing legal framework for use of this shared water resource, and the development of a 3D model simulating the Nubian Aquifer's response to significant drawdown. Nubian Sandstone Aquifer System country project leaders, experts, and representatives of the Agency and UNDP.

Asia and the Pacific³⁴

2011 Asia and the Pacific overview

Emcumbrances and actuals (TCF):

€14.7 million

Implementation rate (TCF):

71.9%

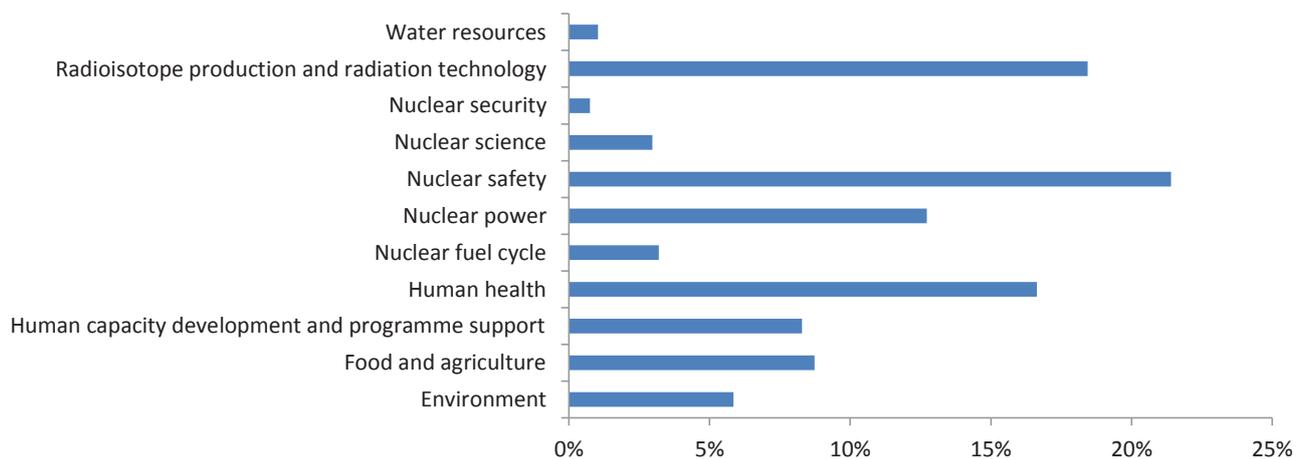


Figure 9: Actuals in the Asia and the Pacific region in 2011 by technical field.

³⁴ The Agency's technical cooperation with the Islamic Republic of Iran has continued in accordance with documents GOV/2007/7 and GOV/2008/47/Add.3, approved by the Board on 8 March 2007 and 27 November 2008 respectively, as well as with the mechanisms which the Secretariat has put in place to ensure that all Agency cooperation with the Islamic Republic of Iran is in compliance with UN Security Council resolutions 1737(2006), 1747(2007), 1803(2008) and 1929 (2010).

Bahrain, Cambodia and Nepal signed RSAs with the Agency in 2011 or early 2012, prior to starting their first national TC programmes. All Member States in the region with national TC programmes have now concluded RSAs with the Agency.

Efforts to develop CPFs in the Asia and the Pacific region continued throughout 2011. Five CPFs were signed for Afghanistan, Cambodia, Thailand, Vietnam and the United Arab Emirates, bringing the number of valid CPFs in the region to 23 in 2011. In addition, draft CPFs for Iraq, Israel, Qatar and Saudi Arabia were prepared and are currently under final review.

Attention was also devoted to developing partnerships with other UN organizations through the UNDAF process. Three UNDAFs for Bangladesh, Mongolia and the Philippines were signed by the Agency in 2011. The Agency has also been involved in the UNDAF development process in Cambodia, Indonesia, Myanmar, Saudi Arabia, Sri Lanka and Vietnam.

Intensive consultations to support the strategic planning and preparation of the region's TC programme for

2012–2013 were carried out using CPFs, the regional cooperative framework for the Asia and the Pacific region, and the strategic profiles of RCA and ARASIA. All national TC projects were developed with the close involvement of Member States, while regional TC projects were reviewed and prioritized by the Member States at meetings of National Liaison Officers held in June 2011.

Following the adoption of the RCA and ARASIA medium term strategies, the RCA and ARASIA strategic profiles for 2012–2017 were developed. Both strategic profiles identify priority areas for future regional cooperation between the relevant countries and the Agency through the TC programme.

Several Member States in Asia and the Pacific continue to show interest in nuclear power and some have taken steps towards constructing their first NPPs. Through national and regional TC projects, extensive support has been provided to help these countries establish the necessary national nuclear power infrastructure and to build related capacities in human resources. Human capacity building and nuclear safety and security



Signature of Afghanistan's Country Programme Framework.

were high priority areas in 2011. The accident at the Fukushima Daiichi NPP brought to the forefront new concerns and issues related to nuclear safety in general, and site selection in particular, and the Agency strove to ensure an immediate and effective response in addressing these matters.

Nuclear and radiation safety in all its aspects remains a priority for technical cooperation in the region. Assistance was provided through human resource development, review and evaluation missions, including Integrated Regulatory Review Service (IRRS) missions, and legislative help. In response to the request by the United Arab Emirates for an integrated review of its regulatory framework for nuclear safety and radiation protection, an IRRS mission consisting of ten experts was conducted in December 2011 under project UAE/9/008, 'Support for Development of National Nuclear Power Infrastructure for Electricity Generation in United Arab Emirates'. The scope of the mission covered the regulatory framework for all nuclear-related activities regulated by the Federal Authority for Nuclear Regulation (FANR).

Supported by the Agency, the Lebanese Atomic Energy Commission (LAEC) held an exhibition during the 55th regular session of the General Conference in 2011. The exhibition illustrated the technical capabilities of the LAEC and the impact it has had on national development, and highlighted the role of the TC programme in contributing to national development in Member States. The exhibition will also be shown in Lebanon to reach out to national stakeholders and the public at large in order to increase awareness of the role of nuclear science and technology in addressing national needs.



LAEC exhibition during the 55th regular session of the General Conference.

Europe

2011 Europe overview

Emcumbrances and actuals (TCF):

€14.9 million

Implementation rate (TCF):

78.4%

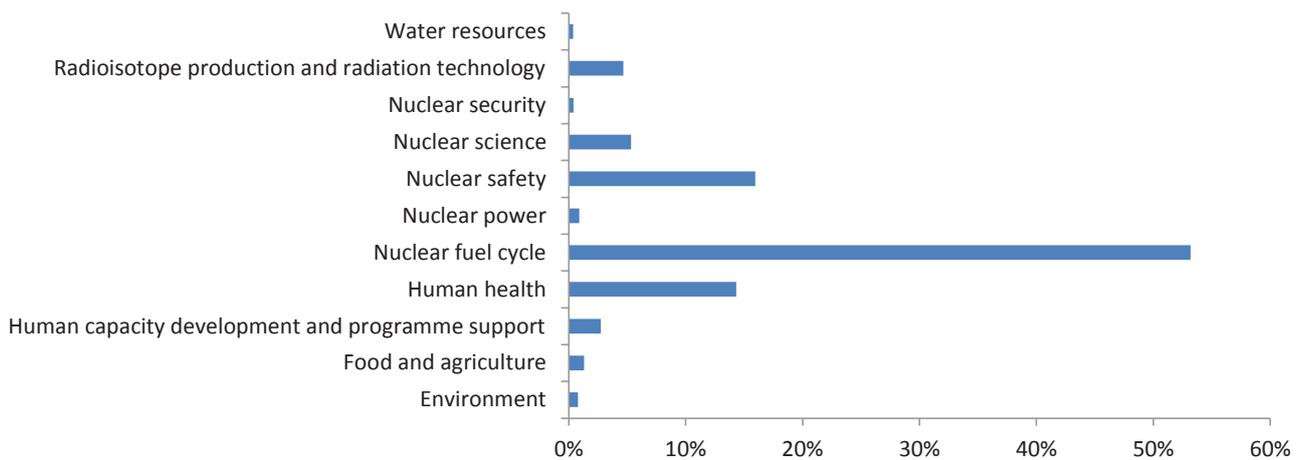


Figure 10: Actuals in the Europe region in 2011 by technical field.

In Europe in 2011, CPFs were completed and signed for Armenia, Bulgaria and Slovenia. Work continued on the renewal of CPFs for Albania, Azerbaijan, Croatia, Cyprus, Georgia, Latvia, Poland, Republic of Moldova, Tajikistan, The former Yugoslav Republic of Macedonia, Turkey, Ukraine and Uzbekistan.

The Agency participated in the UNDAF process for Albania, Azerbaijan, Georgia, Republic of Moldova, Montenegro, Tajikistan and Ukraine. It also shared information with other UN partners in the region at meetings of the United Nations system regional Directors in Europe and Central Asia, organized by the UNDP, as well as in the Europe and Central Asia Regional Coordination Mechanism meetings organized by the United Nations Economic Commission for Europe (UNECE). The key activities in this regard were carried out under the framework of regional project RER/0/032, 'Building Country and Regional Capacity,

and Assisting in Programme Planning and Monitoring'. The Agency, alongside other UN organizations, also signed the Programme of Cooperation 2012–2016 for Albania and the United Nations–Republic of Moldova Partnership Framework 2013–2017. In addition, the Agency signed memoranda of understanding with the United Nations Resident Coordinators and the United Nations Development Programme for operating One UN Coherence Funds for Albania and Montenegro.

In 2011, the TC programme for the 2012–2013 cycle was designed in line with TC quality criteria, following the results based approach. Several training workshops on the use of the logical framework approach were conducted for NLOs and project counterparts. Emphasis was also placed on designing a regional programme that strengthens regional cooperation in line with the core values and strategic objectives outlined in the Strategy for the Technical Cooperation



Signature of Bulgaria's Country Programme Framework (left) and Slovenia's Country Programme Framework (right).

Programme in the Europe Region that was adopted at the Europe Region National Liaison Officers Meeting, Vienna, Austria, in February 2010. The design process resulted in a programme for 2012–2013 with national and regional projects that reflect priorities identified in CPFs and the Europe regional profile³⁵ — safety, security and waste management; health; nuclear power; and industry. In addition, the programme shows strong synergy between national and regional activities, and incorporates significant government cost sharing for national programmes.

ΕΛΛΗΝΙΚΗ ΕΠΙΤΡΟΠΗ ΑΤΟΜΙΚΗΣ ΕΝΕΡΓΕΙΑΣ GREEK ATOMIC ENERGY COMMISSION



A postgraduate educational course on radiation protection and the safety of radiation sources was held in Aghia Paraskevi, Greece, in early 2012, under regional project RER/9/101, 'Building Competence through Education and Training in Support of Radiation Protection Infrastructures'. The course has provided 14 young professionals with a sound basis in radiation protection and the safety of radiation sources.

³⁵ Please see paragraph 5 of the Strategy for the Technical Cooperation Programme in the Europe Region (<http://www.iaea.org/technicalcooperation/Regions/Europe/TCP-Strategy.pdf>).

Latin America

2011 Latin America overview

Emcumbrances and actuals (TCF):

€12.9 million

Implementation rate (TCF):

64.8%

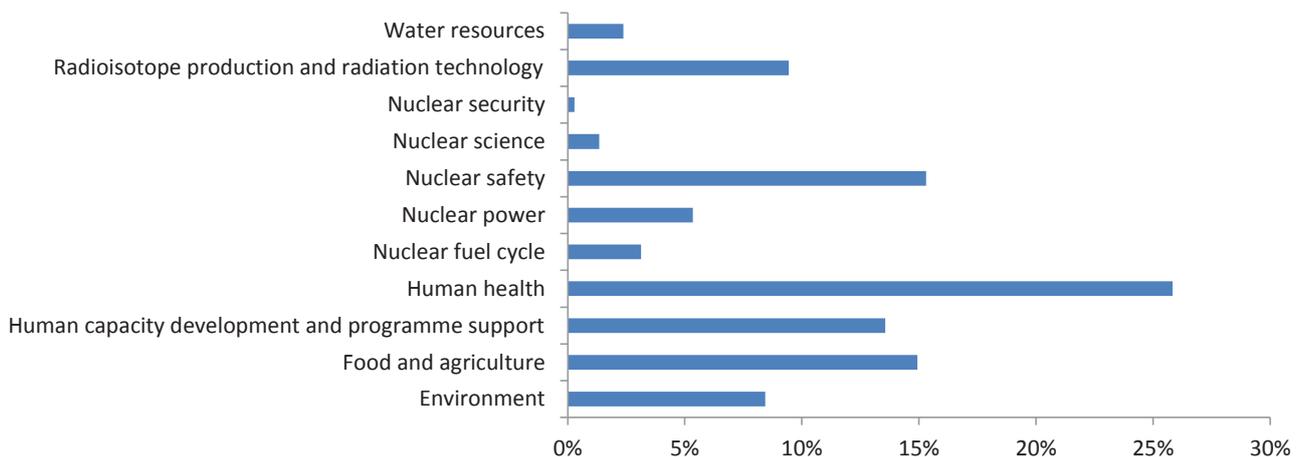
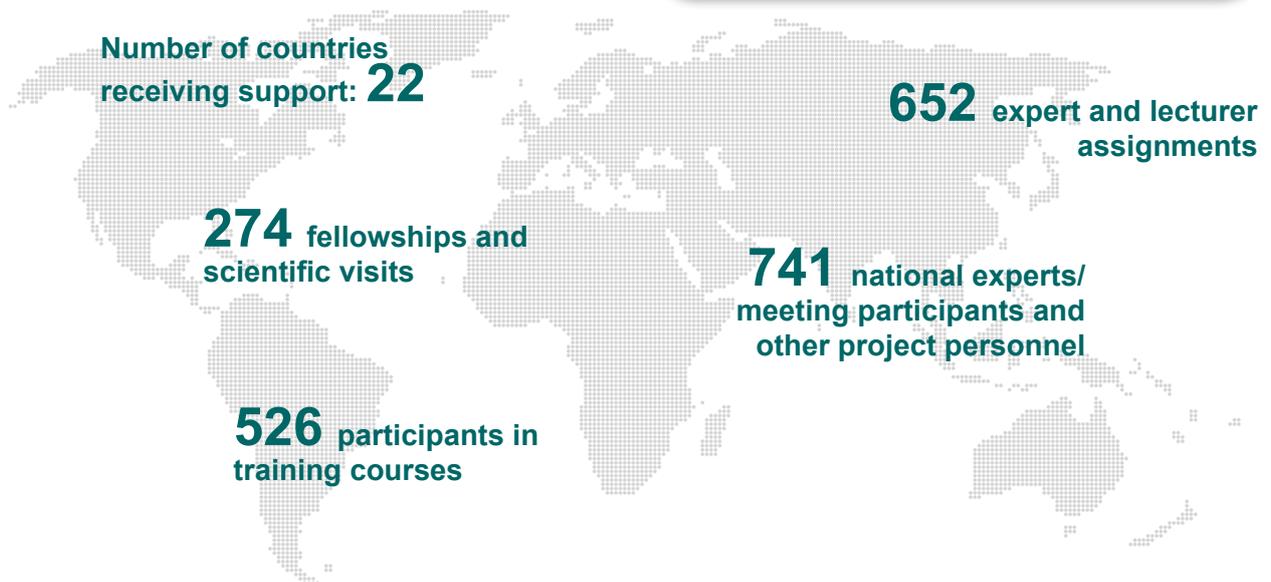


Figure 11: Actuals in the Latin America region in 2011 by technical field.

Programme management in the Latin America region in 2011 focused on activities to conclude the 2009–2011 TC programme, while simultaneously formulating the new programme for 2012–2013. The 2012–2013 programme reflects Member State priorities in the areas of human health and nutrition, food and agriculture,

and safety and security, within a framework of strategic actions to promote alliances and partnerships.

Member States in Latin America carried out extensive strategic planning activities in 2011, including the preparation of CPFs, under regional project RLA/0/043,

‘Strengthening the National Nuclear Sector and the Application of Nuclear Science and Technology for Development through Training and Facilitation of Strategic Activities’. Two new CPFs were signed with Guatemala and Nicaragua. At a meeting with new National Liaison Officers and Assistants from Latin America held in July 2011 in Vienna, over forty stakeholders were trained on TC procedures and the use of management tools.

In 2011, new joint activities were carried out with the Pan American Health Organization (PAHO) to expand regional capabilities in radiation medicine services and radiation safety in partnership with the Caribbean Community. A five year plan includes mapping available capabilities in radiation treatment and regulatory infrastructures to identify gaps and determine areas for improvements in and access to radiation medicine services in accordance with the International Basic Safety Standards. Other joint initiatives with PAHO sought to increase quality in medical applications, strengthen the regulatory capabilities of Ministries of Health in the region, and increase the availability of nuclear applications in medicine. Partnerships with UN system organizations were enhanced through the signature of three UNDAFs with the Dominican Republic, Jamaica and Panama. By bringing national programmes into greater harmony with the UN system, Member States in the region benefit from closer collaboration in key areas such as water resource management, conservation, food security, and safety. Funds were received from the US Nuclear Regulatory Commission to support regional regulatory

authorities, thereby helping to strengthen nuclear safety mechanisms and implementation strategies.

The Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL) plays an important role in defining priorities and promoting the peaceful uses of atomic energy in the region. Jamaica joined the Agreement in 2011, bringing the total number of Agreement members to 21 out of the 22 Member States in the region. ARCAL’s Regional Strategic Profile was reviewed in 2011 to include strategic performance indicators and to closely harmonize it with Agency goals and objectives as reflected in the Agency’s Medium Term Strategy 2012–2017.

Twelve ARCAL regional projects have been designed for the 2012–2013 TC programme, six of which are in the fields of agriculture and food security. An ARCAL special project for Haiti was also approved as part of the 2012–2013 TC programme. The project seeks to rebuild and sustain key human resource capacities in nuclear science and technology for the sustainable development and welfare of Haiti. The project strategy builds on trilateral cooperation between more advanced ARCAL institutions and Haitian counterparts. The 2012–2013 ARCAL programme also includes a communications project that aims to raise awareness among end users and policy-makers of the benefits and impact of nuclear applications, while also increasing the visibility of the Agreement.



Meeting for new National Liaison Officers and Assistants from Latin America, Vienna, 4-8 July 2011.

Interregional projects

Interregional projects address the common needs of Member States in different regions. They are categorized as transregional, global, capacity building or joint activities. In 2011, encumbrances and actuals under interregional projects totalled €1.59 million.

Currently, there are 19 active interregional projects in areas that include human capacity building, sharing of best practices, the utilization and operation of the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) research centre, the sterile insect technique, nuclear reactor technology evaluation, wheat stem rust (Ug99), uranium exploration, quality in nuclear medicine, and projects in the marine environment.

The interregional project INT/4/142, ‘Promoting Technology Development and Application of Future Nuclear Energy Systems in Developing Countries’, was implemented in cooperation with the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). The interregional project encouraged dialogue among developing countries and between developing countries and countries with mature nuclear technologies on future nuclear energy systems. Through a series of workshops, the project helped build national knowledge about innovative nuclear reactor and fuel cycle issues, and helped support informed decisions in countries considering nuclear power.

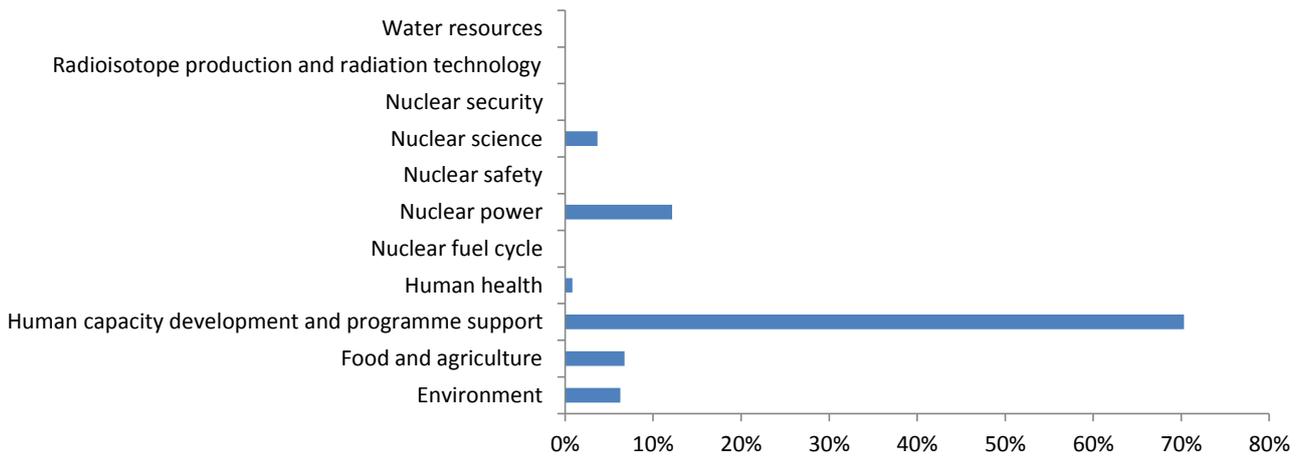


Figure 12: Actuals through interregional projects in 2011 by technical field.

Table 9: Active interregional projects

INT/7/016	Receptor Binding Assay for Harmful Algal Toxins	2005
INT/1/055	Support for Human Capacity Building in the Utilization and Operation of the Synchrotron-light for Experimental Science and Applications for the Middle East (SESAME)	2007
INT/0/083	Support for Human Capacity Building in Developing Member States	2009
INT/4/142	Promoting Technology Development and Application of Future Nuclear Energy Systems in Developing Countries	2009
INT/5/150	Responding to the Transboundary Threat of Wheat Black Stem Rust (Ug99)	2009
INT/6/054	Strengthening Medical Physics in Radiation Medicine	2009
INT/7/018	Supporting Capacity Building in Marine Environmental Protection	2009
INT/7/017	Providing Coordinated Support in the Use of Receptor Binding Assay to Address Impacts of Harmful Algal Toxins in Seafood	2009
INT/0/085	Sharing Best Practices for the Design and Management of Technical Cooperation Projects	2010
INT/0/086	Building Human Capacity for the Construction, Operation and Use of SESAME	2012
INT/0/087	Supporting Human Capacity Building in Developing Member States (Phase II)	2012
INT/2/013	Supporting Nuclear Power Infrastructure Capacity Building in Member States Introducing and Expanding Nuclear Power	2012
INT/2/014	Supporting Member States to Evaluate Nuclear Reactor Technology for Near-Term Deployment	2012
INT/2/015	Supporting Uranium Exploration, Resource Augmentation and Production Using Advanced Techniques	2012
INT/9/176	Strengthening Cradle-to-Grave Control of Radioactive Sources in the Mediterranean Region	2012
INT/9/174	Connecting Networks for Enhanced Communication and Training	2012
INT/5/152	Supporting Mutation Breeding Impact Assessment	2012
INT/5/151	Sharing Knowledge on the Use of the Sterile Insect and Related Techniques for Integrated Area-Wide Management of Insect Pests	2012
INT/6/056	Supporting Quality Management Audits in Nuclear Medicine Practices (QUANUM)	2012

List of frequently used abbreviations

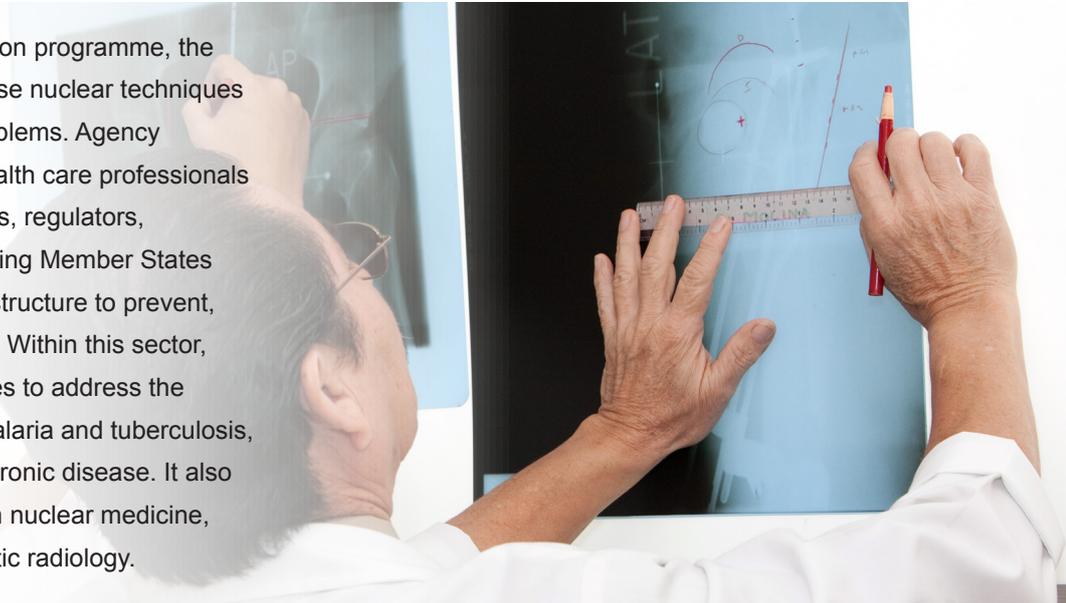
AFRA	African Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology	PAHO	Pan American Health Organization
Agency	International Atomic Energy Agency	PCMF	Programme Cycle Management Framework
APCs	assessed programme costs	PET	positron emission tomography
ARASIA	Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology	QA	quality assurance
ARCAL	Co-operation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean	QC	quality control
CPF	Country Programme Framework	RBA	receptor binding assay
FAO	Food and Agriculture Organization of the United Nations	RCA	Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology
HAB	harmful algal bloom	RSA	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the International Atomic Energy Agency
IAEA	International Atomic Energy Agency	SIT	sterile insect technique
LDC	least developed country	TC	technical cooperation
MDG	United Nations Millennium Development Goal	TCF	Technical Cooperation Fund
NLO	National Liaison Officer	TSA	thematic safety area
NPCs	National Participation Costs	UNDAF	United Nations Development Assistance Framework
NPP	nuclear power plant	UNESCO	United Nations Educational, Scientific and Cultural Organization
OLADE	Latin American Energy Organization	WHO	World Health Organization



Annex. Achievements in 2011: Project Examples by Thematic Sector

Human health

Through the technical cooperation programme, the Agency helps Member States use nuclear techniques to address important health problems. Agency services support the work of health care professionals and technologists, policy makers, regulators, universities and patients, providing Member States with specialized skills and infrastructure to prevent, detect and cure major illnesses. Within this sector, the Agency helps Member States to address the challenges posed by cancer, malaria and tuberculosis, malnutrition and obesity, and chronic disease. It also supports quality management in nuclear medicine, radiation oncology and diagnostic radiology.



Regional highlights

The TC programme in the Asia and the Pacific region focused on improving the quality of and accessibility to health care services for many countries in the region throughout 2011. Activities included strengthening nuclear medicine and diagnostic techniques for the detection and treatment or palliation of cancer as well as the diagnosis of cardiovascular diseases. Working with the Programme of Action for Cancer Therapy (PACT), assistance was provided to Member States in formulating comprehensive strategic national cancer control plans. Attention was also dedicated to building partnerships between health care institutions and partners in development.

In Latin America, TC projects in the field of nuclear medicine are helping Member States to set up nuclear medicine capabilities in hospitals and laboratories. Agency projects are also providing training through medical physics programmes to ensure that trained staff are available to provide quality diagnostic imaging and nuclear medicine services in their home countries in a safe and secure manner. Other TC projects are providing assistance and training to Member States in

the region that wish to use nuclear techniques to address nutritional issues. Nuclear science and technology are used to monitor and evaluate the effectiveness of nutritional intervention programmes, supporting the review of national policies and helping to set nutrition guidelines that are tailored to local conditions and needs.

Expanding radiotherapy services

In Kenya, three radiation therapy technologists and two course coordinators have been trained in Cape Town, South Africa, under project KEN/6/019, 'Expanding Radiotherapy Services and Establishing a Training Programme for Radiation Therapy Technologists (RTTs)'. The team has now started Kenya's first RTT training programme, which covers diagnostic, nuclear medicine, radiotherapy and ultrasound. Fourteen candidates are currently enrolled in the programme.

In Zimbabwe, a single energy linear accelerator has been procured under project ZIM/6/015, 'Strengthening Existing Training Programmes for Radiation Oncologists, Medical Physicists and Therapy Technicians'. The Government of Zimbabwe

provided US\$ 1 million in extrabudgetary funds. The equipment will benefit patients at the Department of Radiology in the Parirenyatwa Group of Hospitals in Harare. The TC programme is supporting a training programme in radiation oncology through improved teaching facilities and further training for scientists and professionals.

Zambia's Cancer Disease Hospital in Lusaka has state-of-the-art equipment, including a linear accelerator, a high dose rate brachytherapy unit, and a cobalt-60 machine. Project ZAM/6/012, 'Improving the Quality of Cancer Treatment', has contributed to improving the quality of newly trained staff in medical physics and oncology, as well as training nursing staff in oncology. Through the project, an overall improvement in the quality of services provided and number of patients treated by the Radiotherapy Oncology Centre, Lusaka, has been achieved.

Several years of Agency assistance have resulted in important upgrades to the radiotherapy facilities in Mongolia. Qualified radiotherapists and medical physicists are now available, and a quality assurance (QA) system was established and implemented in 2011. TC projects have made an important contribution to increasing the knowledge and skills of radiation oncologists, medical physicists and radiotherapists.

A radiotherapy centre has been established in the oncological dispensary in Ganja, East province of Azerbaijan, under project AZB/6/002, 'Upgrading Radiation Oncology in the National Oncology Centre', with the government sharing the cost of major equipment items. Two radiotherapists, a medical physicist and a technician have received extensive training both in the National Oncology Centre and in hospitals in the Czech Republic. A modern cobalt-60 radiotherapy unit has been provided and the quality of radiotherapy treatment has also been improved with a modern treatment planning system and the introduction of new radiotherapy protocols and a quality assurance/quality control (QA/QC) programme.

Seven fellowships and two Quality Assurance Team for Radiation Oncology (QUATRO) audits have been provided to Slovakia under project SLR/6/002,

'Upgrading Radiotherapy Services', which have improved the ability of the National Cancer Institute to offer training to other radiotherapy provider services in Slovakia that intend to move from classical radiotherapy to modern image guided radiation therapy and intensity modulated radiation therapy techniques. Counterparts were supplied with additional tools for clinical quality assurance.

Nuclear medicine

In 2011, under project ALG/6/016, 'Improving Clinical Nuclear Medicine and Radiotherapy Procedures', training and expert services were provided to the Department of Nuclear Medicine at the Bab El Oued Teaching Hospital in Algiers to prepare the team of the Nuclear Medicine Department for the implementation of positron emission tomography/computed tomography (PET/CT). The new technology requires additional training in physiological images which are needed to improve diagnostic quality in nuclear medicine investigations. The Department is an AFRA regional designated centre in clinical nuclear medicine.

The first nuclear medicine facility in Burkina Faso has been established at the Yalgado Ouédraogo Teaching Hospital in Ouagadougou under project BKF/6/002, 'Establishment of a Nuclear Medicine Centre'. The introduction of nuclear medicine techniques in the country improves the national health system, in particular the management of major health problems like cancer, coronary and artery diseases, paediatric diseases, metabolic diseases and infections. The Agency provided long and medium term staff training, expert services and equipment. Clinical operations started in January 2012 and TC assistance is continuing in 2012–2013 to support the consolidation of nuclear medicine services in the country.

In Vietnam, projects VIE/6/023, 'Establishment of National Cyclotron Facilities and Centres for Medical and Research', and VIE/6/024, 'Establishing National Cyclotron Facilities and Centres for Medical Applications and Research', have helped to enhance national capacities, particularly in the diagnostic and therapeutic applications of nuclear medicine, , and

to expand research applications. This has enhanced the country's R&D capability and enabled medical research workers to undertake additional activities.

Among other achievements, the guidelines developed for the optimum and efficient use of PET and PET/CT scanners under the project RAS/6/049, 'Strengthening Clinical Applications of PET in RCA Member States', are being used by the Member States in the region, in particular as reference for professionals in nuclear medicine and end users of PET scanning.

The Agency has been developing clinical medical physics capacities through education and training in ARASIA Member States under projects RAS/6/052, 'Upgrading Medical Physics Services in the ARASIA Member States through Education and Training', and RAS/6/054, 'Upgrading Medical Physics Services in ARASIA State Parties Through Education and Training (Phase II)'. Seventeen physicists attended the Master of Science medical physics programme established at the University of Jordan in 2007 to qualify for clinical training in medical physics in a hospital setting. Clinical training was provided in parallel through regional training courses and short term fellowships.

In Afghanistan, building human resources capacity in the field of nuclear medicine and radiation therapy remains the focus of TC support under projects AFG/6/011, 'Establishing a Nuclear Medicine Service at the Indira Gandhi Institute of Child Health', and AFG/6/012, 'Establishment of a Radiation Oncology Centre in the Medical University of Kabul'. Thirteen fellows have received long term fellowships in radiation oncology, technology and medical physics in various countries, including Egypt, Islamic Republic of Iran, Turkey and the United Kingdom, and a further ten fellowships are planned. The achievement is significant, given the prevailing safety and security conditions in the country and the difficulties of placing scientists and clinicians from Afghanistan.

Medical physics equipment was supplied and several training activities, including fellowships, scientific visits and participation in international training activities, were organized in Bosnia and Herzegovina under project BOH/6/012, 'Establishing a Medical Radiation

Physics Centre'. Activities were initiated based on the recommendations from a QUATRO mission, which was strongly supported by the government.

Quality

Quality Assurance in Nuclear Medicine (QUANUM) supports internal and external clinical audits of nuclear medicine, and encourages the adoption of a culture of review in the institutions. QUANUM is patient centred and outcome based. External evaluations of radiation oncology are provided through Quality Assurance Team for Radiation Oncology (QUATRO) missions, emphasizing quality improvement through the comprehensive review of radiotherapy procedures, structures and processes.

Two QUANUM audits were conducted in 2011 under project RER/6/017, 'Improving Clinical Practice in Nuclear Medicine (Phase II)', and four regional training courses were carried out. A training workshop for QUANUM auditors was organized to prepare a regional group of auditors in nuclear medicine.

In Croatia, the upgrade of QA/QC programmes is a long term objective. Pilot projects have been introduced in the University Hospitals in Osijek and Rijeka, which can later be expanded to cover the rest of the country. Ten scientific visits and fellowships were organized under project CRO/6/008, 'Upgrading the Quality Assurance and Quality Control Programmes in Radiotherapy', and quality assurance and control equipment was also supplied.

In Latin America, the TC programme supports quality audits in nuclear medicine, diagnostic radiology and radiation oncology through a combination of tools and guidance for self-auditing. External audits can also be carried out upon request. Valuable cooperation has been provided in connection with the carrying out of audits and organization of training courses through the effective partnerships maintained with the PAHO, the Research Centre for Energy, Environment and Technology (CIEMAT), the Latin American Association for Radiation Oncology (ALATRO), the European

Society for Therapeutic Radiology and Oncology (ESTRO), the Latin America Association of Societies of Nuclear Medicine and Biology (ALASBIMN) and the Latin American Medical Physics Association (ALFIM).

These strategic partnerships have facilitated the implementation of many regional activities, reduced their costs and provided participants with a deeper understanding, and a more comprehensive view of human health issues in the Latin America region. This has made TC projects far more effective and relevant for the Member States of the region. Activities were carried out in 2011 under projects RLA/0/039, 'Creating a Latin America Network for Collaboration and Education in Nuclear Medicine (ARCAL CXX)', RLA/6/059, 'Implementation and Evaluation of Intervention

Programmes to Prevent and Control Childhood Obesity in Latin America (ARCAL XCI)', RLA/6/061, 'Training and Updating Knowledge in Medical Physics (ARCAL CVII)', RLA/6/063 'Improving Management of Cardiac Diseases and Cancer Patients by Strengthening Nuclear Medicine Techniques in Latin America and Caribbean Region (ARCAL CIX)', RLA/6/064, 'Using Nuclear Techniques to Address the Double Burden of Malnutrition in Latin America and the Caribbean (ARCAL CX)', RLA/6/065, 'Strengthening Quality Assurance in Nuclear Medicine (ARCAL CXI)', RLA/6/067, 'Establishing a Subregional Plan for Cancer Prevention and Integral Cancer Care in Central America and the Dominican Republic (ARCAL XCIII)', and RLA/6/068, 'Improving Quality Assurance in Radiotherapy in the Latin America Region (ARCAL CXIV)'.



“Developing and Implementing a Quality Management System for Positron Emission Tomography and Advanced Nuclear Medicine Modalities” (ARG/6/010).

Agricultural productivity and food security

The Agency, in partnership with the FAO, helps Member States improve food security. Efforts focus on improving yield and quality by enhancing the diversification and adaptability of crops. Technical cooperation projects also help Member States to reduce pesticide use and to decrease the crop losses caused by pests and diseases, as well as to overcome phytosanitary barriers to trade.

The Agency also helps Member States to improve livestock productivity. Projects concentrate on the efficient use of locally available feed resources, on improved reproductive techniques and breeding programmes for indigenous and advanced animal breeds, as well as on improving diagnostic capacities and prophylactic strategies for the control of important transboundary animal diseases, including zoonoses.



Regional highlights

The application of nuclear technology for crop improvement and soil management to mitigate the effects of climate change, pest control using the sterile insect technique (SIT), and ionizing techniques for food preservation remained important areas of concentration in Asia and the Pacific during 2011. TC support in the area of livestock reproduction and health is strengthening Member States' capabilities for the surveillance of diseases and the production of vaccines.

The agricultural sector in countries of Eastern and Central Europe and Central Asia remains fragile, principally due to external economic and ecological factors, such as climatic variability and droughts. Throughout 2011, the TC programme continued to support Member State efforts to enhance agricultural productivity by transferring technologies that improve crop yields and quality, as well as by facilitating the eradication of fruit pests through the enlargement and consolidation of fruit fly free and low prevalence areas by means of SIT.

Livestock is an important part of the agricultural sector in the Europe region. The Agency's capacity building

activities in the application of nuclear techniques for early and rapid diagnosis of transboundary animal diseases, such as avian influenza (AI) and foot-and-mouth disease (FMD) aim to drastically reduce disease propagation, thereby protecting human health and generating positive socio-economic impacts.

In Latin America, regional projects were implemented to help Member States enhance soil conservation and environmental protection, with a view to increasing food production in drought-affected areas through the development and dissemination of drought-tolerant advanced mutant lines of different food crops. TC projects also supported the establishment of a diagnosis and assessment system for evaluating the impact of pesticide contamination including persistent organic compounds in food (including fish and molluscs) and environmental compartments. A network of Latin American national laboratories and centres of excellence was established with the introduction of harmonized procedures to determine food contaminants, and efforts continued to establish and maintain areas that are free of the fruit fly or where prevalence is low through the appropriate use of environmentally friendly technologies, such as SIT.

The better understanding of good agricultural practices achieved through field studies under these projects has led to a reduction in fertilizer use while enhancing soil fertility and quality and increasing the income of many small farmers. Induced crop mutation has led to the development of crops such as beans, rice, wheat, banana, tomato and soya bean that can be grown in arid and saline lands. In the field of marine contamination, counterparts have been trained on sample collection, processing and analysis of organic elements and detection of heavy metals, and regional capabilities for aquatic biomonitoring have increased. Laboratories in the region have extended the scope of their ISO 17025 accreditation for food control, implementing and validating analytical techniques for the monitoring of residues. The analytical capabilities of the laboratories are well recognized by regional stakeholders, and the laboratories are now receiving requests for technical advice and dialogue on policy issues. Feedback to stakeholders on the environmental cost of pesticide use has resulted in changes to management practices, adding value to the food production chain for several participating countries. Fruit and vegetables are now being exported to countries with stringent phytosanitary

requirements, and technical capacities in SIT have been developed in all participating countries.

Animal production and health

In Kenya, project KEN/5/027, ‘Assessment of Local Feed Resources for Enhancing Fertility and Productivity of Smallholder Dairy Cattle’, was very well received by local farmers. It was confirmed that local feed resources could improve livestock health. Productivity and reproducibility data indicated positive increases as more farmers reported successful insemination of their dairy cattle.

In Zambia, project ZAM/5/025, ‘Development of Feeding Strategies for Smallholder Dairy Animals in Njolwe and Palabana Dairy Tenant Schemes’, enhanced national capacities in animal production. It is expected that this strengthened capacity will improve household food security and income generation for small scale farmers, as sustainable feeding and breeding strategies based on increased use of locally available resources are developed.

In Eritrea, seasonal migrations of livestock are quite common, but allow the easy spread of serious



Field work in Panama, using trained dogs to identify fruit infested with fruit fly.

transboundary animal diseases. Project ERI/5/006, ‘Controlling Major Epizootic Diseases and Other Mycoplasma Infections of Livestock’, aimed to improve control of transboundary animal diseases and to continue the eradication of tuberculosis and brucellosis. The Agency supported human resources development with three local training courses, and enhanced the laboratory infrastructure for dealing with animal diseases. By the end of the project, regular animal disease surveillance was being conducted for major transboundary and endemic diseases such as bovine tuberculosis, brucellosis, FMD, and Rift Valley fever. The National Veterinary Laboratory is now conducting regular diagnosis of transboundary animal diseases using diagnostic reagents, chemicals, and sample collection containers supplied by the Agency. A total of 5800 samples have been processed.

In Uganda, project UGA/5/030, ‘Improving Diagnostic Capacity in Animal Diseases (Phase II)’, has supported the establishment of a molecular diagnostic laboratory with the capacity to carry out real time polymerase chain reaction and isothermal testing. As a result, Uganda is now serving as a fellowship training portal for Africa.

As a result of project RER/5/015, ‘Supporting Early Warning and Surveillance of Avian Influenza Infection in Wild and Domestic Birds and Assessing Genetic Markers for Bird Resistance’, several Member States in the Europe region now have the capacity to discriminate between low- and high-pathogenic AI viruses and report occurrences to the World Organisation for Animal Health (OIE) on a regular basis.

In early 2011, specialists trained under project BUL/5/012, ‘Developing and Validating Molecular Nuclear Technologies for Rapid Diagnostics of Foot and Mouth Disease and Genotyping of Indigenous Cattle Breeds’, were able to detect the presence of the foot-and-mouth disease virus (FMDV) in wild boars within 24 hours of receipt of the sample. The early and rapid response by the Bulgarian counterpart laboratory was of great benefit to the competent authority in the country, enabling the rapid enforcement of control measures areas.

Botswana has significantly improved its capabilities to deal with animal diseases under project BOT/5/005, ‘Improving Diagnosis of Animal Diseases’, by increasing its use of nuclear molecular technologies for the diagnosis and control of transboundary animal diseases. A laboratory was established under the project to carry out nuclear and nuclear-related serological and molecular diagnostic procedures in a timely manner. A laboratory information management system was set up to provide rapid support to animal disease control programmes, and disease diagnosis quality assurance management is now carried out routinely. Botswana has also enhanced its reporting to national authorities and the OIE.

Following Agency support to combat the outbreak of FMD in Mongolia in 2010 under the ongoing project MON/5/017, ‘Supporting the Sustainable Production and Supply of Vaccines and Diagnostic Kits for Transboundary Animal Diseases’, the spread of FMD was contained and the foci eliminated. Medium and long term plans to solve the problem of FMD and other animal diseases in Mongolia are currently being developed, with the aim of helping the country to enhance capacities for rapid diagnosis and the production of vaccines to control animal diseases. The Agency is supporting Mongolia in the development of a pilot facility to produce irradiated vaccines. Additionally, cooperation with FAO, OIE and Mongolia’s neighbouring countries is being pursued in order to establish a regional network mechanism to control transboundary animal diseases.

Crop mutation

In Namibia, the Agency has successfully trained six breeders in various aspects of mutation breeding and soil plant management techniques to develop sustainable, high yielding and drought-resistant crops under project NAM/5/009, ‘Using Mutation Breeding and Integrated Soil Plant Management Techniques to Develop Sustainable, High Yielding and Drought Resistant Crops’. Considerable attention has focused on mutant trials for cowpea, pearl millet and sorghum.

Regional project RER/5/013, ‘Evaluation of Natural and Mutant Genetic Diversity in Cereals Using Nuclear



Field trials in Yemen. Credit: Yemeni National Counterpart.

and Molecular Techniques’, has had a considerable impact on agricultural production and food quality in the Europe region. The project has supported the release of cereal, vegetable and legume varieties with higher yields, improved quality and better adaptability, such as the ‘F1 Orange Beauty’ hybrid pepper with increased beta-carotene registered for release in the Russian Federation in 2011. Also in Europe, national crop enhancement projects in Kazakhstan and Ukraine are supporting the production of new varieties of wheat and cotton that are adapted to the challenging climatic condition of several Central Asian countries.

The Agency has been assisting ARASIA Member States for several years in training staff in conducting mutation induction for plant breeding under project RAS/5/048, ‘Mutation Induction and Supportive Breeding and Biotechnologies for Improving Crop Productivity’. National activities focus on strategic crops such as wheat and barley, aiming to obtain higher yielding varieties with desired traits such as disease resistance and drought tolerance. Trials have been carried out over the past five years at both national and regional levels at research stations and in farmers’ fields, and achievements have been made in the development and selection of advanced mutant lines for breeding.

RCA project RAS/5/045, ‘Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production using Mutation Techniques and Biotechnology’, achieved significant results with the release of a total of 39 mutant varieties in economic crops and several hundred more being under evaluation or included in improved breeding programmes. Following closure of the regional project, efforts have continued through national programmes, and training materials developed under the project are being utilized by the participating countries. In addition, the project has contributed to the establishment of the Asian Association of Mutagenesis in Crop Plants, which supports networking among plant breeders in the region.

In Sudan, a new variety of tomato, developed under project SUD/5/030, ‘Increasing Productivity of Selected Crops using Nuclear Related Techniques’, is now being produced by the Agricultural Research Corporation (ARC) under the Ministry of Agriculture and Forestry. Other new varieties of wheat and banana are in development, and large scale production of one banana variety is being explored.

In Mauritius, project MAR/5/018, ‘Improvement of Banana and Tomato Varieties through the Use

of Nuclear Techniques for Mutation Induction and Biotechnology’, reflects the economic importance of banana in the country. Local production of the fruit, however, is constrained by severe wind damage due to both cyclonic and anti-cyclonic conditions. Tomato is also a major food crop for Mauritius, but the crop is particularly sensitive to climatic changes, especially extreme temperatures, drought and cyclonic conditions. Project MAR/5/018 aimed to develop dwarf varieties of banana that would be resistant to wind damage, and heat-tolerant varieties of tomatoes. By the end of the project, some advanced mutant lines of banana and tomato had been generated and selected for further screening, and genetic characterizations had been initiated. A follow up project started in January 2012, concentrating on developing the selected mutant lines, field and on-farm trials and reinforcing laboratory facilities in plant tissue and molecular genetics.

Most local communities in Africa cannot afford micronutrient supplements, and their food security is often at risk. Biofortification, the enrichment of nutritional properties of edible crops, can be achieved through the combination of agronomy and plant breeding. In South Africa, project SAF/5/010, ‘Development of new Maize and Sorghum Germplasm with Enhanced Nutritional Content’, addressed deficiencies in essential vitamins and minerals in maize and sorghum through training of human resources and the provision of the necessary equipment and consumables for the implementation of the project. With Agency assistance, the project counterpart developed six mutants of sorghum with improved grain quality traits. This has led to the development of four business concepts (sorghum based beverages, sorghum based functional/health foods, food security products and animal feed products) at the counterpart, Council for Scientific and Industrial Research (CSIR), in conjunction with Pannar, a private plant breeding institution.

Sterile insect technique (SIT)

In 2011, the releases of sterile flies under project RER/5/014, ‘Suppressing the Mediterranean Fruit Fly by Integrating the Sterile Insect Technique (SIT) on an Area-Wide Basis in Neretva Valley’, were extended to

1250 hectares of mandarin plantations in the Neretva River Valley of Croatia and Bosnia and Herzegovina. As in previous years, surveys showed a significant decrease of fruit infestation in the area where the releases took place, and contributed significantly to reduced pesticide use. The production of quality fruits that meet the export requirements of the European Union, and the preservation of the valley’s natural wetlands, have generated clear benefits for consumers, the trade industry and the environment.

In 2011, weekly releases of sterile male tsetse flies were implemented in two pilot areas in Senegal under project SEN/5/031, ‘Implementing the Pre-Operational Phase to Create a Zone Free of *Glossina palpalis gambiensis* Using the Sterile Insect Technique’. The flies originated from a colony maintained at the International Centre of Research and Development for Livestock in Subhumid Zones (CIRDES) in Burkina Faso. The release is part of an integrated pest management campaign to eradicate an isolated population of this tsetse species in Senegal. Fly suppression activities were also initiated in the most northern part of the project area, and operational aerial releases of sterile males will begin in mid-2012.

A number of milestones have been achieved in Sudan under project SUD/5/032, ‘Investigating the Use of the Sterile Insect Technique for Controlling Mosquitoes in Northern Sudan’. Essential baseline data have been collected in the target areas, Dongola and Merowe, and a sampling strategy has been developed to select survey locations and mapping breeding sites. The Agency has also helped with the establishment of a molecular biology laboratory and the training of staff.

Cruciferous vegetables in Myanmar are severely affected by the diamondback moth (DBM). Under project MYA/5/014, ‘Support for a Feasibility Study on Using the Sterile Insect Technique against the Diamond Back Moth’, a fact-finding mission conducted a feasibility study on the use of SIT for the control of the DBM. Equipment for mass rearing, materials for DBM monitoring and laboratory consumables were procured, and three fellowships and two scientific visits were awarded to staff of the counterpart institute, laying the groundwork for further investigation of the possibilities to combat the DBM in Myanmar. A core

group of personnel has been trained, and SIT capacity in the counterpart institute has been developed.

Following an outbreak of dengue fever, a potentially deadly disease transmitted through the bites of female mosquitos, during the 2011 monsoon in Pakistan, the country quickly needed to marshal multi-disciplinary expertise in fields such as epidemiology, public health, entomology, insect pest control, and field sampling and quality assurance. In response to a request from Pakistan, the Agency brought together at short notice national and international experts from very diverse fields for a workshop on the integrated control of the *Aedes aegypti* mosquito, the carrier of the dengue virus. At the five-day workshop in November 2011, the experts shared their experience and discussed an action plan for combatting and containing dengue in Pakistan as part of an area-wide integrated vector management approach. Two priorities were identified: collection of essential baseline data through field sampling, and

training for local and national health authorities. With Agency support, two training courses will be held in Pakistan in 2012, which will focus on basic surveillance and disease epidemiology, as well as on the biology and ecology of dengue vectors in the country. The aim is to strengthen Pakistan's capacity to implement surveillance networks before the next monsoon season.

Laboratory quality/dosimetry

In Serbia, dosimetry equipment and appropriate training has been provided to the Vinča Institute under project SRB/5/002, 'Implementing Alanine EPR Dosimetry in the Vinča Institute of the Nuclear Sciences Radiation Unit'. Serbia needs a dosimetry service to support the industrial applications of ionizing radiation (such as the sterilization of medical supplies and long-term food preservation), and the medical applications of radiation (radiotherapy, irradiation of blood for transfusion and dose rate monitoring in diagnostic X-rays).



In Africa, regional project RAF/0/027, ‘Consumer Safety and Trade Development through Competent Nuclear Testing and Metrology Laboratories’, addresses the lack of quality practices in laboratories and the shortage of internationally accepted accreditation capacity in Africa, which are significant impediments to trade. The project aims to transfer best practices and international know-how based on standards of the International Organization for Standardization (ISO) in order to support improved laboratory quality management, analytical skills, processes and method validation. Under the project, 17 national and regional training courses have been delivered, and expertise has been provided to national laboratories that seek accreditation. The project facilitated an intercomparison exercise of African secondary standards dosimetry laboratories (SSDLs). The results of the exercise are at the disposal of Member States for harmonization purposes.

Food safety

RCA project RAS/5/046, ‘Novel Applications of Food Irradiation Technology for Improving Socioeconomic Development’, has built national capacities in the use of food irradiation technologies. Nine protocols for quarantine treatment have been developed for economically important fruit crops. The participating countries have reported increased trade, with the volume increasing from 400 tonnes in 2007 to over 4000 tonnes in 2010. The project has created interest in the applications of food irradiation technology in the Asia and the Pacific region, and food irradiation facilities in the region have increased from 103 in 2007 to over 150 by 2010. Several countries have invested in electron beam technology and are conducting preliminary trials and dosimetry studies using this technology.

Under project LEB/5/014, ‘Upgrading the Environmental and Food Analysis Laboratory at the National Council for Scientific Research’, the Agency has helped the Lebanese Atomic Energy Commission to establish a food and environmental laboratory capable of performing analysis of residues, pollutants and contaminants in air, water and food. In 2011, the Agency further assisted Lebanon through training and the provision of a stable isotope analyser that

can trace carbon and hydrogen isotopes in food and environmental samples to address food provenance and origin (food traceability). The laboratory already offers analytical services to more than 1500 Lebanese farmers, who can now demonstrate to both local and export markets that their fruits and vegetables are safe. Trust between farmers and traders has notably improved.

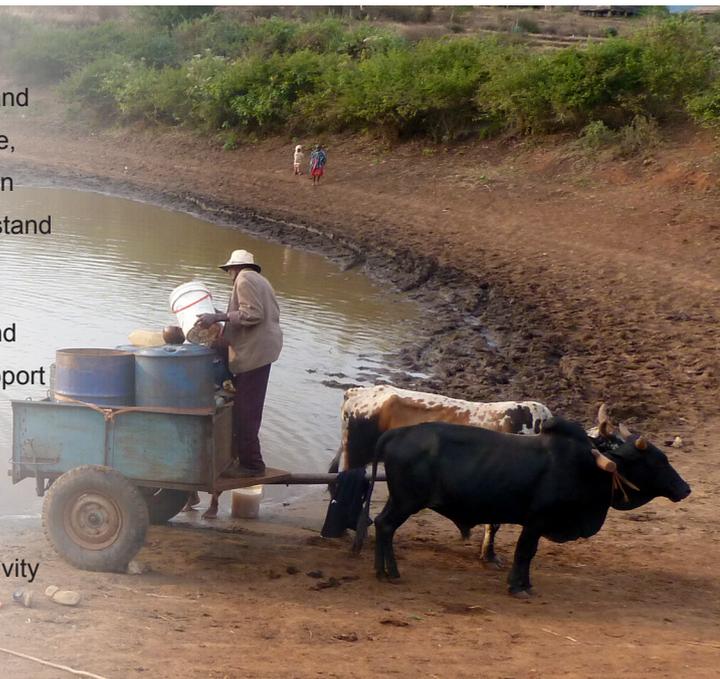
A regional project in Latin America, RLA/5/053, ‘Implementing a Diagnosis System to Assess the Impact of Pesticide Contamination in Food and Environmental Compartments at a Catchment Scale in the Latin American and Caribbean (LAC) Region (ARCAL CII)’, has strengthened the capacities of 13 analytical laboratories to improve risk management by implementing methodologies for pesticides residue detection. Impact assessments in several catchment areas are effective indicators of the degree of application of good agricultural practices (GAPs).

Monitoring and managing water resources and the environment

The Agency's technical cooperation programme helps Member States to achieve their development priorities while monitoring and protecting the air, earth and oceans. Through the TC programme, the Agency provides Member States with information and skills in the peaceful application of nuclear technologies to better understand and manage their environment.

TC projects promote the use of isotopic techniques to understand the source, extent and behaviour of water resources, and to support the development of comprehensive national and transboundary water resource plans for sustainable water management.

TC projects also help Member States to establish or improve analytical laboratories that can measure environmental radioactivity and pollutants in the oceans, and support the ability of Member States to manage and protect marine resources.



Regional highlights

Member States in the Asia and the Pacific region are becoming increasingly interested in environmental management and protection, especially as a result of urban air pollution and the radioactive waste generated from the peaceful application of nuclear techniques. In 2011, Member States were provided with assistance to develop capabilities for monitoring and assessing air pollution in urban zones.

Managing groundwater

Under project PHI/8/025, 'Isotope Applications in Improving Water Resource Management and Protection', the Philippine Nuclear Research Institute was equipped with a tritium enrichment system, an isotope ratio mass spectrometer, a flow meter, publications on isotope analytical techniques, and training and expert advice. Sampling and field measurements were conducted in nine municipalities, and physical-chemical data and tritium data were established for water sources in the provinces. The project was instrumental in establishing collaboration with the National Water Resources Board (NWRB) which requested isotopic investigations to serve as the basis for improving water utilization policies.

An exhibition on 'Water Resources Management in Thailand' was displayed in the Vienna International Centre on the occasion of the 55th regular session of the General Conference. Project THA/8/015, 'Use of Isotope Hydrology for Groundwater Resources Management', has made a substantial impact on integrated water resource management in Thailand, and has contributed to the country's socio-economic development. A national database of isotopic data on groundwater has been established, which provides a useful data source for further isotopic hydrology studies in the country.

Soil and agricultural water management

Under project KEN/5/030, 'Assessing Nutrient and Moisture Use in Major Cropping Systems', the efficiency with which the pigeon pea is able to use available water under dry land conditions in pigeon pea-maize cropping systems and its role in improving soil fertility were evaluated. The project was carried out by the Kenya Agricultural Research Institute (KARI). Small scale drip irrigation technology was used to improve water and nutrient use efficiencies and a soil moisture neutron probe determined soil water content during the growing season. In areas where drip

irrigation was applied, pigeon pea yields were 6 to 10 times higher per hectare (ha) than in rain-fed and hand-watered areas. The high yields achieved contribute a reliable source of protein which will improve the health of children in Kenya. The income of farmers will also increase, as the current market rate of \$1/kg of pigeon pea will provide \$2500–3200/ha.

Due to high gradient slopes, the soils in the Seychelles have very low organic matter content and low water retention capacity. Generally infertile, they cannot sustain long-term crop cultivation without the application of fertilizers. Through project SEY/5/004, ‘Developing Improved Nutrient Management Practices Using Nuclear and Related Techniques for Enhancing Sustainable Agricultural Productivity’, the Agency is helping to develop capacity for integrated irrigation and nutrient management practices for selected crops in targeted areas. Laboratory infrastructure and human resource capacity have been enhanced to use isotopic

techniques to characterize the physical properties of the main soil groups and to establish the main soil water balances in the country.

A five-year project, RLA/5/051, ‘Using Environmental Radionuclides as Indicators of Land Degradation in Latin American, Caribbean and Antarctic Ecosystems (ARCAL C)’, has succeeded in building capacity, introducing new nuclear technologies to the counterparts, and establishing a twinning mechanism that promoted South–South cooperation. A total of 36 scientists and technicians from universities and governmental organizations were trained on the use of fallout radionuclides (FRN) for estimating soil erosion and assessing the effectiveness of soil conservation measures. Inter-institutional collaboration has been instituted between regional and national research institutions involved in nuclear applications, agricultural and environmental management, soil protection as well as policy making, and partnerships



Exhibition on water resource management in Thailand.

were developed with UN agencies (e.g. the United Nations Environment Programme (UNEP) in Cuba), the private sector (e.g. the forestry sector in Chile, farmers in Argentina) and other research centres (e.g. Fluminense Federal University in Brazil). Good quality FRN analytical capacity is now available in 8 of the 14 participating countries, which will enable pilot investigations in the study areas in those Member States.

The project supported an historic expedition to the Antarctic in December 2011, with the collaboration of the Chilean Antarctic Institute, the Brazilian Air Force, the Southern University of Chile and the Agency. The expedition was carried out by a member of the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture and two Chilean scientists from the Southern University of Chile. The mission aimed to assess the impact of climate change on soil quality and soil degradation in polar ecosystems using natural tracers, such as stable isotopes and fallout radionuclides. With every effort made to minimize the impact on the fragile ecosystem, around 150 samples, each weighing between 50g and 400g, were taken, sieved, separated, dried and packed. In addition, 27 cylinders of undisturbed soil were collected for burial at sites in Antarctica, Patagonia and Valdivia in South

Central Chile. The data will enable the modelling of future trends of the effects of climate change.

Pollution

Environmental protection and pollution monitoring is a high priority for Croatia. Nuclear analytical techniques can be used for aerosol analysis, allowing elemental analysis of fine particle fractions. Supported by a government contribution, equipment and training was provided to the laboratory of the Institute for Medical Research and Occupational Health under project CRO/8/008, 'Upgrading Nuclear Analysis Techniques for Air Pollution Monitoring'. This comprised a fully integrated energy dispersive X-ray fluorescence spectrometer, detectors for ion beam analysis and a scattering chamber for a new beam line at the Ruđer Bošković Institute (RBI) Tandatron accelerator, which is dedicated to particle-induced X-ray emission/Rutherford backscattering (PIXE/RBS) analysis of air particulate matter. Staff from the laboratory received training through three fellowships for on-the-job training in similar laboratories.

Marine pollution

RCA project RAS/7/019, 'Harmonizing Nuclear and Isotopic Techniques for Marine Pollution Management



Water and sediment samplings in Bangladesh, under project RAS/7/019, 'Harmonizing Nuclear and Isotopic Techniques for Marine Pollution Management at the Regional Level'.



Sampling and field work conducted in the Philippines under project RAS/7/019, 'Harmonizing Nuclear and Isotopic Techniques for Marine Pollution Management at the Regional Level'.

at the Regional Level (RCA)', has helped to enhance national capacities for effectively addressing land-based sources and the fate of pollutants in coastal environments in Asia and the Pacific. Nuclear and isotopic techniques were harmonized in the region, and a guideline document and training syllabuses were adopted by all participating Member States, which supported harmonization for the effective applications of isotopic and nuclear analytical techniques in the RCA Member States. The intercomparison exercise improved QA/QC at national laboratories and provided a mechanism for the assessment of current analytical capabilities in each Member State. It has been reported that participation in the RCA project catalysed government support for effective implementation of national activities, with most participating Member States obtaining additional funding to conduct their activities.

Project RLA/7/012, 'Use of Nuclear Techniques to Address the Management Problems of Coastal Zones in the Caribbean Region', has increased scientific understanding of the creation and enhancement of environmental monitoring programmes to improve coastal zone management in the Caribbean. Laboratories with capabilities for field investigations and a critical mass of capable scientific and technical staff now can support the continuing efforts to ensure

the sustainability of the Caribbean region. Six regional training activities and workshops were conducted on the use of lead-210, and hands-on training through fellowships in laboratories was also provided, with a total of 75 persons being trained. Also, regional training courses have been carried out to support counterpart capacities in sampling, the use of new techniques, quality assurance, and the quantification of organic contaminants in marine sediments. A total of 23 fellows received training in areas such as alpha and gamma spectrometry, geochronology, the analysis of heavy metals and organic matter, data interpretation and data quality.

The data on levels of heavy metal and organic contents in sediments which were measured systematically for the first time basin-wide in the Caribbean provide the baseline data that are important for monitoring changes in the future. To ensure data storage and reference for future generations, a regional Caribbean Sediment Database, called CARISED, hosted by the Institute of Marine and Coastal Research (INVEMAR), Colombia, has been created. This database contains about 20 000 data entries from surface sediments and about 2000 data entries from sediment cores. CARISED will be open to the public as of 2015.

There have been other tangible project impacts in the participating countries. For example, Jamaica has

modified its environmental policy as a result of the detection of Endosulfan, a persistent organic pollutant, in Kingston Harbour. In Colombia, INVEMAR has established a section dedicated to the use of nuclear technologies and is collaborating with the Ministry of the Environment and Sustainable Development on the definition of parameters for the quality of marine water and coastal zones. Guatemala is using the project results as baseline data for the control of products entering the country through the port, to support compliance with regulations for ballast and bilge waters discharged from ships. The participating countries are using the project results to comply with international agreements such as the Cartagena and Stockholm Conventions. Cuba and Colombia have produced new national guidelines on the quality of sediments, a monitoring programme is now being implemented in the Dominican Republic, and a marine research laboratory is being established in Panama.

Decommissioning and waste

In Europe, the decommissioning of nuclear facilities is a very important area of the Agency's technical cooperation activities. Regional project RER/3/009, 'Supporting Planning for the Decommissioning of Nuclear Power Plants and Research Reactors (Phase II)', aimed to assist Member States in developing adequate strategies and plans for decommissioning, to facilitate information exchange, and to increase the competence of experts involved in decommissioning. As a result of the project, decommissioning capacities in the region have increased, and countries can more effectively plan and implement safe, timely and cost-effective decommissioning of nuclear power plants (NPPs) and research reactors.

The Agency supported independent reviews of decommissioning plans and procedures in Georgia under project GEO/3/004, 'Decommissioning the Reactor Site at the Andronikashvili Institute of Physics'. Project outputs included recommendations to the counterpart, regulators and other national stakeholders, drafting of detailed decommissioning plans, radiological monitoring of affected areas, and finally dismantling, conditioning and removal of contaminated outdoor piping to a temporary storage

site partially refurbished for that purpose. The second phase of decommissioning the IRT-M research reactor at the site of the Andronikashvili Institute of Physics was successfully completed, and as a result, the level of radiological hazards near the capital Tbilisi and the adjacent Georgian military highway and trans-Caucasian railway was reduced.

Under project IRQ/3/002, 'Decommissioning and Remediation of the Former Nuclear Facilities and Sites in Iraq', the Agency provided assistance to the Iraqi Ministry of Science and Technology in order to support the ongoing decommissioning programme of Iraq's nuclear facilities. Fellowship training and site visits were organized, focusing on areas such as decommissioning, waste management, radiation protection, database management, and inspection in order to improve current Iraqi capacity for the implementation of these tasks and to enhance the counterpart's experience and skills. Iraq is continuing its efforts for the preparation and approval of a national policy and strategy for waste management with Agency support and advice. Iraq also plans to continue its decommissioning programme of five new facilities/sites including the IRT 5000 and Tammuz 2 research reactors during the next phase of the project.

Industrial applications

Nuclear science and technology can be used in a wide range of industrial applications. A range of safe, tested nuclear techniques can be used to measure pollution levels, identify and measure material properties, sterilize and disinfect, and change chemical, physical and biological properties. The Agency builds Member State capacities in radiation technologies through training and the establishment or upgrading of nuclear centres, and ensures strong quality assurance and quality controls.



Regional highlights

Several Member States in the Asia and the Pacific region are very interested in the application of nuclear technologies. The Agency's technical cooperation activities in the region focused on the production of radioisotopes and radiopharmaceuticals, the development of new materials for industry and non-destructive testing. Radiation technology is playing an increasing role in health care applications, such as the production of medical items from synthetic and natural polymer materials.

Radiation technology in the Latin America region is applied across a range of different sectors. In 2011, the TC programme focused on upgrading and establishing QA/QC programmes in existing irradiation facilities. Efforts concentrated on harmonizing protocols, developing health care products, supporting radiosterilization and food preservation, and on increasing human and technological capacities for the application of radiation processing technology. In the field of non-destructive testing, activities have centred on harmonizing the qualification and certification of personnel and facilities among different countries. In the area of radiopharmacy, capacity has been strengthened in several national centres to produce radionuclides and radiopharmaceuticals for clinical application in accordance with high-quality standards.

Radiopharmaceutical production

The Agency assists the Atomic Energy Commission of Syria to strengthen its technical capacities in the area of production of cyclotron- and generator-based radiopharmaceuticals under project SYR/4/011, 'Developing Therapeutic Radiopharmaceuticals'. Existing radiopharmaceutical facilities and capacities have been expanded to include production of therapeutic radiopharmaceuticals based on an yttrium-90 generator. This increases the range of radiopharmaceuticals produced, which will have a positive impact on the health sector in Syria, and also in the region through the export of radiopharmaceuticals.

Agency assistance has enabled the Radioisotope Production Division (RIPD) of the Institute of Nuclear Science and Technology, Bangladesh Atomic Energy Commission, to develop and supply good quality radiopharmaceuticals to all 18 public and private medical institutions in Bangladesh in an effective and reliable manner. Through TC projects, RIPD has installed a current good manufacturing practice (cGMP) compliant technetium-99m generator plant with a capacity to produce 50 generator batches per week, in order to meet the growing demand for technetium-99m in the country. To meet the high demand for technetium-99m generators in 2011, RIPD produced 597 technetium-99m generators (strength 10–15 GBq) by November 2011, the highest number of generators

produced in a single year at RIPD, and fully covering national demand. RIPD routinely produces iodine-131 for diagnosis and treatment of thyroid-related diseases. Through project BGD/2/011, 'Capacity Building for the Manufacture of Cold Kits for Tc-99m Radiopharmaceuticals', RIPD has established a cGMP compliant clean room facility for technetium-99m kit production, which has been ISO certified by a German certifying body. The costs were fully covered by users (medical institutions) to the amount of \$36 000, a testimony to RIPD's customer satisfaction levels.

Cuba is ensuring a reliable supply of therapeutic radionuclides, especially yttrium-90, through project CUB/2/015, 'Producing Therapeutic Radiopharmaceuticals for Clinical Applications for the Treatment of Cancer Conditions and Rheumatoid Arthritis'. The therapeutic radionuclides are used for

the treatment of some types of cancer, including non-Hodgkin's lymphoma, neuroendocrine tumours, and palliation of metastatic bone pain and rheumatoid arthritis. The project is also supporting the development of validated criteria for the safe application of the new therapeutic agents in patients. An electrochemical generator, a remotely controlled automatic module for separating the parent radionuclide strontium-90 from the daughter radionuclide yttrium-90, is currently being used to prepare a number of important therapeutic radiopharmaceuticals for cancer treatment. The Isotope Centre (CENTIS) has received temporary approval from the Cuban regulatory authorities to use the yttrium-90 obtained from the electrochemical generator in investigational human studies with new therapeutic radiopharmaceuticals. These studies will allow the introduction of new therapeutic approaches for the treatment of various cancers including non-Hodgkin's lymphoma, neuroendocrine tumours and metastatic bone lesions.



Cuba's Isotope Centre (CENTIS).

Industrial applications: quality assurance

In Brazil, project BRA/2/017, 'Implementing a Quality Assurance and Quality Control Training Network for In-House Preparation of Radiopharmaceuticals in Nuclear Medicine Centres', aims to increase national capacity for the production of radiotracers (in addition to the widely used fluorodeoxyglucose) and to improve production standards. This will increase the number of oncological diseases that can be studied, and the number

their accreditation for gamma spectrometry techniques through the project.

In Latin America, under project RLA/8/046, 'Establishing Quality Control for Industrial Irradiation Processes (ARCAL CXVIII)', several countries have participated in intercomparisons of high radiation dose measurements to establish QA/QC system procedures for irradiation processes, and to harmonize protocols for industrial dosimetry, in order to guarantee a secure processing of materials utilized in the fields of human



Meetings and training events on quality assurance under project BRA/2/017.

of patients that will benefit from early diagnosis. Seventeen professionals from nine radiopharmacy and PET/CT centres in Belo Horizonte, Porto Alegre, Recife, Rio de Janeiro and São Paulo have been trained through the project.

The Agency continues to assist ARASIA Member States in the establishment of quality assurance and quality control systems at nuclear analytical laboratories. Project RAS/2/014, 'Implementing a Quality Assurance System for Nuclear Analytical Techniques in ARASIA State Parties', has contributed towards building human capacity and has created awareness among laboratory staff and managers about the importance of QA/QC systems. Two institutions, the Lebanese Atomic Energy Commission and the Jordanian Atomic Energy Commission, have obtained

health, food, environment and materials development. The harmonized protocols will help to promote the correct application of radiation technology, improving the reliability of good manufacturing processes for various products, and thus improving the competitiveness of products in the region.

Research reactors

Four subregional research reactor networks or coalitions have been established or strengthened under project RER/4/032, 'Enhancing the Sustainability of Research Reactors and Their Safe Operation Through Regional Cooperation, Networking and Coalitions'. The networks are the Eastern European Research Reactor Initiative (EERR), the Eurasia Research Reactor Coalition (EARRC), the Baltic Research Reactor Network (BRRN) and the Mediterranean Research Reactor Network (MRRN). The coalitions bring together countries with research reactors and countries without such facilities, allowing countries without research reactors to benefit from research reactor services. The project contributes to Agency efforts to improve operational safety and regulatory supervision of research reactors. The Agency has helped Member States to establish a Regional Advisory Safety Committee for Research Reactors, which will improve networking and regional cooperation to address important research reactor safety issues. Regional projects in Africa and Latin America are also supporting the Caribbean Research Reactor Coalition and the Central African Research Reactor Network.

Other industrial applications

Project ETH/8/011, 'Strengthening Non-Destructive Testing Capacity', has supported Ethiopia's national efforts to build its non-destructive testing (NDT) capabilities and to promote the use of NDT for industrial applications through the provision of equipment and training. The national capability established through the project has strengthened NDT services in various industrial enterprises. Increased awareness among stakeholders and government authorities has led to a growth in market demand for NDT services. The project will be sustained through income generation activities.

In Poland, project POL/0/010, 'Developing an Advanced Industrial Gamma Scanning System with Wireless Data Acquisition', has supported the development of a wireless gamma scanning system for investigations and diagnostics of industrial installations at the Institute of Nuclear Chemistry and Technology.

Following a fellowship and the procurement of some equipment components, a system is now in place, which enables diagnostics of columns, reactors and other facilities, and improves technological parameters and safety by reducing energy consumption and preventing environmental contamination.

In an effort to improve industrial productivity, RCA project RAS/8/111, 'Diagnosing Industrial Multiphase Systems by Process Visualization using Radiotracers and Sealed Sources', has enhanced national capacities in the diagnosis of industrial multiphase systems through process visualization using radiotracers and sealed sources. Quality criteria for the effective application of radiotracer and sealed source technologies as well as regional protocols for quality criteria were developed by the participating Member States as standard reference materials. These include protocols for: oilfield interwell radiotracer tests; gamma ray scanning for industrial process columns; leak detection of heat exchangers using radiotracers; and maintenance and calibration of data acquisition systems for radiotracer and sealed source applications. A number of promotional materials were also prepared.

In the Philippines, project PHI/5/030, 'Upgrading the Gamma Irradiation Facility', has contributed to upgrading the country's cobalt-60 irradiation facility and has played an instrumental role in the development of a semi-commercial irradiation service for radiation sterilization, microbial decontamination and food irradiation. A core group of personnel has been trained in irradiator operation and maintenance, quality management and process control, enhancing the counterpart institute's R&D capabilities. The project was particularly helpful in assisting the plant quarantine officers to acquire knowledge and skills needed for the proper application of irradiation. As a result, the officers are now able to manage quarantine pests, facilitate the development and implementation of irradiation research projects and ensure quarantine security in the trade of Philippine mangoes to the USA. Through this and other related TC projects, an adequate knowledge base and infrastructure have been provided to the counterpart institute to use irradiation as a quarantine treatment.

The analytical capabilities of the National Conservation Centre in the former Yugoslav Republic of Macedonia have been upgraded under project MAK/2/005, 'Establishing Nuclear Techniques for the Analysis and Preservation of National Cultural Heritage Objects'. Faster, non-destructive analytical capabilities for the characterization of cultural heritage objects have been introduced, and the Centre has also introduced non-destructive methods for the preservation of wooden artefacts and treatment of biodegraded wooden objects by anoxia.

In Hungary, project HUN/8/008, 'Implementation of a Pilot Plant and Upgrading the Laboratory for Treatment of Water and Wastewater Using Radiation Processing Technology', has contributed to the upgrade of an analytical laboratory and the commissioning of a pilot plant for treatment of wastewater and effluents. The project aimed to establish a demonstration facility to study the degradation of pollutants and the inactivation of microorganisms, as well as to demonstrate the effectiveness of the techniques to industrial partners. Human capacity and equipment gained through the

project has allowed the institution to start cooperating with the Budapest Sewage Works.

Excellent results have been achieved in Cuba through project CUB/8/023, 'Obtaining Hydrogel Membranes for Biomedical Applications with the Aid of Gamma Radiation'. Burn patients in Cuba will soon benefit from the use of hydrogel membranes in treatment, which will speed up their healing time and avoid contamination of the wound. As a result of the project, these membranes, based on polyvinylpyrrolidone (PVP), are now being locally produced and validated at a pilot scale, using national technology and resources. The membranes, produced by the National Centre for Animal and Plant Health (CENSA) and by the Centre for Technology Applications and Nuclear Development (CEADEN), are currently under clinical trials to attain official authorization for their use in the national health system. Membranes sold in the international market cost at least \$20, but producing them locally will cost around \$2. The treatment will cut the length of patient stays in hospitals, enabling the healing of more patients at a lower cost.

Energy planning and nuclear power

Although the United Nations Millennium Development Goals (MDGs) do not include sustainable energy development as a standalone goal, without increased investment in the energy sector, and major improvements in energy services in developing countries, it will not be possible to meet the MDGs. The Agency helps developing countries to build energy planning capabilities, and supports countries that are exploring the establishment of, or already have, a nuclear power programme.

When a country is considering the introduction of nuclear power into its national energy mix, the Agency advises that it take a comprehensive Milestones approach, integrating the relevant work of its governmental, industrial and educational institutions.

Regional highlights

Energy planning in many African countries is still inadequate, and a concerted and systematic effort is required to assist them in strengthening their capabilities for effective and robust energy planning. The increasing complexity of energy planning, which must take into account social and environmental aspects in addition to technical and economic factors, necessitates the use of sophisticated mathematical modelling techniques. Energy models developed by the Agency have proven to be very useful for addressing energy issues in many countries throughout the region. They are constantly being improved and enhanced to make them more effective for use by developing countries.

The renewed interest in nuclear power for electricity generation, and consequently in uranium mining and milling, shown by several Asian countries received significant attention from the Agency in 2011. Among the factors that have contributed to increased interest in nuclear power for electricity generation in the region are international obligations to reduce carbon dioxide emissions, the need to mitigate the effects of climate change, and the increasing price of fossil fuels, as

well as higher demand for electricity as a result of fast growing economies.

Energy production and energy supply are priority issues in Latin America and the Caribbean. The Agency foresees that primary energy demand will grow by up to 260% in Latin America by 2030. The electricity generated by NPPs is expected to grow by between 260% and 550% in the next 20 years. The region also faces other challenges: currently, about 7% of the Latin American and Caribbean population, or 31 million, do not have access to electricity. The region is committed to achieving a higher degree of energy production and energy independence while respecting the environment by promoting sustainable energy development.³⁶ The Agency supports this ambition by contributing to the sustainable energy development of Member States through different regional projects that principally focus on assessing regional energy needs, developing alternative strategies for energy supply, and ensuring the peaceful, safe and secure use of nuclear energy.

Energy planning³⁷

In Africa, regional project RAF/0/028, ‘Strengthening Planning Capabilities for Sustainable Energy

³⁶ International Energy Agency, World Energy Outlook 2011. (Paris: International Energy Agency, 2011). This publication can be ordered at: <http://www.worldenergyoutlook.org>.

³⁷ This section responds to operative paragraph 30 of resolution GC(55)/RES/11 on examining the specific characteristics and problems of the developing countries and least developed countries (LDCs) with respect to the peaceful applications of nuclear energy.

Development (AFRA VI-1)', aims to enhance the capabilities of AFRA Member States to elaborate national energy strategies for sustainable development. Altogether, 421 candidates from the region have participated in training courses. As a result, the capabilities of AFRA Member States to elaborate national energy strategies for sustainable development have been enhanced. The project activities have supported six specific objectives: institutional capability for energy planning has been strengthened and sustained; human resources development programmes in the field of energy planning have been established in the participating countries; country-specific studies on sustainable energy development have been conducted; comparative assessment studies of electricity supply options that rely on interconnected grids and related sustainable energy strategies have been facilitated; integration among the national bodies responsible for energy and development policy has been strengthened; and regional cooperation and networking for energy planning has been improved.

In Malawi, project MLW/0/003, 'Strengthening National Capabilities in Energy Planning', helped to develop and establish national infrastructures for effective and robust energy planning. The project addressed the country's inadequate energy planning practices and procedures, as well as the lack of suitable analytical tools and training to deal with the challenges involved in developing the energy sector. On-the-job training was also provided to the project core team. The energy planning capacity building focused on energy demand assessment and energy supply option analysis. A report on energy demand and another on energy supply were finalized and will be issued as government publications. The reports will provide a foundation for a policy dialogue between various stakeholders in the energy sector. The project has strengthened Malawi's national capacity to develop a medium to long term energy plan.

In Latin America, regional project RLA/0/040, 'Building Capacity for the Development of Sustainable Energy (Phase II)', supports the assessment of energy needs and the development of alternative strategies for the energy supply system, and strengthens national capabilities in the energy sector. Twenty-one Member States in Latin America and the Caribbean are currently involved in TC projects related to energy planning. Nineteen countries are participating in a regional project,³⁸ while two other countries are carrying out energy planning-related projects at the national level.³⁹ A key focus of the regional project RLA/0/040 has been the provision of training in how to perform energy demand studies using the Model for Analysis of the Energy Demand (MAED) and how to assess the optimal energy supply system to meet a country's demand using the Model for Energy Supply Strategy Alternatives and their General Environmental Impacts (MESSAGE). Innovative educational strategies were adopted to reach more people during the training courses and to improve the coordination of the project. The computer-based platform CAPEV of the project partner, the Latin American Energy Organization (OLADE), was used to deliver e-learning courses, and to conduct virtual meetings. The e-training material developed by the Agency is being used in conjunction with CAPEV to provide daily online support for when counterparts are taking the e-training courses. As a result of the project, an energy planning community has emerged in Latin America and the Caribbean, and strong cooperation in this area is taking place among the countries of the region.

Support to newcomers⁴⁰

The Agency has contributed to the development of the necessary nuclear power infrastructure in countries embarking on nuclear power programmes in the Asia and the Pacific region through regional project RAS/0/053, 'Providing Decision Support for Nuclear

³⁸ Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and the Bolivarian Republic of Venezuela.

³⁹ Haiti and Jamaica.

⁴⁰ This section responds to operative paragraph 30 of resolution GC(55)/RES/11 on examining the specific characteristics and problems of the developing countries and LDCs with respect to the peaceful applications of nuclear energy.

Power Planning and Development'. Following the Milestones approach, several countries from the region have participated in regional events, hand-on workshops and mentoring programmes dealing with critical issues such as defining sound financial structures, legal frameworks, regulatory and safety infrastructures, management systems, stakeholder involvement, public information strategies, human resource development, technology assessment and siting evaluation. An important outcome of the project has been the networking and horizontal cooperation between countries embarking on nuclear power for the first time. Advanced nuclear power countries in the region such as China, Japan and the Republic of Korea have shared their experience and know-how with newcomers in order to ensure the successful launching of their nuclear power programmes.

In Europe, regional project RER/0/029, 'Supporting the Introduction of Nuclear Energy (Phase II)', has enhanced, through various workshops and training courses, the technical and managerial capabilities for the proper preparation and introduction of nuclear energy programmes in the participating countries.

In Belarus, the Agency is carrying out a project on human resource development for a new nuclear power programme: BYE/0/006, 'Developing Human Resources and a Training System for the Nuclear Power Programme'. The project covers workforce planning, improving the educational system to support the country's nuclear power programme, implementing a training system for the future owners/operators of the country's first NPP, and building up the capacity of technical support organizations.

The regional project RLA/0/038, 'Supporting the Introduction of Nuclear Energy (ARCAL XCV)', aims to strengthen the national and regional infrastructures of interested Member States in Latin America and the Caribbean for planning and developing nuclear power programmes, and to ensure that Member States fully understand the range of issues and activities that must be addressed before implementing a nuclear power project. In 2011, a two-week training course was organized in Brazil on the Agency Safety Guide Establishing the Safety Infrastructure for a Nuclear Power Programme

(IAEA Safety Standards Series No. SSG-16, Vienna, 2011). Application of this Safety Guide will help Latin American and Caribbean countries to achieve a high level of safety and security during the entire lifetime of an NPP, including associated waste management and decommissioning.

Supporting nuclear power infrastructure

The Second Regional Conference on Energy and Nuclear Power in Africa was held in Cape Town, South Africa, from 30 to 31 May 2011. The Conference was attended by 148 participants, including high-ranking officials, invited speakers, and project coordinators from 29 African countries participating in the regional projects RAF/0/028, 'Strengthening Planning Capabilities for Sustainable Energy Development (AFRA VI-1)', and RAF/0/033, 'Increasing Awareness at Decision Making Level about the Requirements and Challenges Related to the Feasibility of a Nuclear Power Programme'. The Conference focused on several major inter-related topics through presentations, technical sessions and panel discussions: (a) analysing factors relevant to the challenges for energy development in Africa; (b) sharing international experience on the subject among national and regional energy organizations, and (c) further discussing the viability of nuclear energy in Africa. This was followed by a thematic breakout session during which issues pertaining to energy planning and regional approaches, legal and regulatory frameworks, workforce and human resources, and the financing of NPPs were discussed in depth.

Agency assistance in Asia and the Pacific in 2011 focused on the self-evaluation of national nuclear power infrastructure. Integrated Nuclear Infrastructure Review (INIR) missions were carried out in Bangladesh and the United Arab Emirates, and both Governments are taking steps to address the findings and to strengthen their national nuclear power infrastructure.

In order to channel Agency assistance in a coordinated and cohesive manner, integrated master plans (IMPs) for establishing the necessary national nuclear infrastructure have been initiated for Member States embarking on nuclear power, based on Agency guidelines and the local situation. Vietnam has adopted

an IMP for 2011–2015 and a draft IMP for Malaysia has been prepared. An IMP for Bangladesh was initiated as a cooperative undertaking between relevant national stakeholders and the Agency under the TC programme.

Following its decision to embark on nuclear power as a sustainable source of electricity and fresh water, the United Arab Emirates has, through the TC mechanism, sought advice and assistance from the Agency on nuclear power infrastructure building in all relevant areas, including legal, safety and security frameworks, as well as safeguards. Project UAE/9/008, ‘Supporting the Development of National Nuclear Power Infrastructure for Electricity Generation in United Arab Emirates’ has been instrumental in supporting an INIR mission and an IRRS mission, as well as several other national workshops and peer review missions. The INIR mission team concluded that the United Arab Emirates had reached Milestone 1, having made “a knowledgeable decision” regarding its nuclear power programme, and indeed had met all of the conditions for Phase 2 in each of the 19 issues, with the exception of one still under implementation. The mission team observed that the country’s nuclear power programme had in general progressed into Phase 3.

Expert advice and human resource development activities in a wide range of disciplines have been provided under project CPR/4/032, ‘Enhancing the Capabilities of National Institutions Supporting Nuclear Power Development’, which is reinforcing the technical foundations of China’s expanding nuclear power programme. The assistance provided dealt with nuclear safety and regulatory aspects, NPP operations and management, uranium exploration, waste management and education in the nuclear field. The project has promoted the sound development of a nuclear power programme and serves as an example of nuclear energy development for other countries in the region.

The IAEA assisted China in establishing a life extension system for operational NPPs through a plant life management (PLiM) programme and the acquisition of key technologies for long term operation of NPPs. Several training workshops were held under project CPR/4/029, ‘Developing and Implementing Plant

Life Management and Life Extension Programmes in Nuclear Power Plants’, covering various aspects of life extension, PLiM for long term operation, and management of ageing factors.

In Latin America, regional project RLA/4/021, ‘Cracking and Structural Integrity of Components in Light Water Reactors’, aims to ensure the safe and reliable operation of NPPs in the region and to prepare for possible lifetime extensions once these plants have reached the end of their planned service lifetime. The project supports an exchange programme of best practices in service life management, aimed to develop regional mechanisms for improving NPP performance and safety in Argentina, Brazil and Mexico. Group activities were organized in collaboration with, and using resources from, the Atucha NPP and Embalse NPP (Argentina), the Angra NPP (Brazil), and the Laguna Verde NPP (Mexico).

Providing legislative assistance

Under projects RAS/0/056, ‘Providing Legislative Assistance’, RAF/0/034, ‘Establishing a Legal Framework for the Safe, Secure and Peaceful Uses of Nuclear Energy’ and RLA/0/044, ‘Providing Legislative Assistance’ the IAEA continues to assist Member States in reviewing and drafting national legislation governing the safe and peaceful uses of nuclear energy. Apart from reviewing draft national nuclear laws as requested by Member States, participants from the Asia and the Pacific, Latin America and the Caribbean and Africa regions have been supported in attending the first two-week intensive training session of the Nuclear Law Institute (NLI), held in Vienna from 19 November to 3 December 2011 and attended by 84 representatives from 61 Member States. A new regional project for Europe in 2012, RER/9/105, ‘Establishing National Legal Frameworks’ will provide the framework for assisting Member States in reviewing and drafting national nuclear laws, as well as training opportunities such as the next session of the NLI.

The Nuclear Law Institute: providing Member States with comprehensive legislative assistance

Nuclear energy may pose special risks to the health and safety of persons and to the environment. At the same time, nuclear energy holds significant benefits in a variety of fields – from medicine and agriculture to electricity production and industry. Its dual nature, combined with the complexity of nuclear science, explains why, from the earliest days of its development to its most modern uses, nuclear energy has been considered to require special legal arrangements, in order to ensure that it is safely and securely managed.

In light of the increasing number and complexity of international instruments adopted in the areas of nuclear safety, security, safeguards and liability, and in order to better meet the demand from Member States for legislative assistance, specifically for training and for capacity building, the Office of Legal Affairs decided in 2011 to streamline its legislative assistance activities by establishing the NLI, in cooperation with the Department of Technical Cooperation. Following the positive feedback received with regard to the 2011 session, the Secretariat has decided to organize the NLI as an annual event.

By the end of the training session, participants should have acquired a solid understanding of all aspects of nuclear law and be able to draft, amend or review national nuclear legislation.

Drawing on modern teaching methods based on interaction and practice, the NLI provides a combination of 'impulse' lectures covering the fundamentals of nuclear law, facilitated small group (so-called TOP) sessions focusing on the implementation of the information from the lectures and a number of legislative drafting exercises.

The NLI addresses the following aspects of nuclear law: Nuclear safety (including transport of radioactive material); Nuclear security; Safeguards and non-proliferation; Nuclear trade; and Nuclear liability and insurance.

In addition, the following specific subjects are addressed in the context of the Special Sessions: Relationships between environmental law and nuclear law; Law of the sea; and Transparency of nuclear activities and public communication.



Nuclear, radiological and waste safety and nuclear security

Assistance in radiation protection and radiation safety is provided to Member States through dedicated regional projects covering the following thematic safety areas (TSAs): strengthening regulatory infrastructure (TSA-1); occupational exposure control (TSA-2); medical exposure control (TSA-3); protection of the public and the environment from radiation practices (TSA-4); nuclear and radiological emergencies (TSA-5); education and training (TSA-6); and transport safety (TSA-7).

Agency assistance provided through regional TC projects is also instrumental in strengthening the capacities of Member States for the prevention and detection of incidents involving nuclear and other radioactive material, as well as for the response to such incidents. These projects aim to support the implementation of relevant legal instruments with the ultimate goal of establishing sustainable security infrastructures and of strengthening aspects of nuclear security such as prevention capabilities at facilities housing nuclear and other radioactive material, and detection and response capabilities at borders and other checkpoints.

Training assists national authorities in developing and implementing physical protection principles and requirements covering systems engineering, facility analysis and coordination between the authorities in charge of nuclear security.

Regional highlights

In Africa, the TC programme continues to provide assistance to Member States in establishing and strengthening their regulatory infrastructure for radiation safety. With the expansion of radiotherapy services in the region, a comprehensive radiation safety infrastructure must be in place in every Member State for the regulatory control of existing facilities operated in the region. In accordance with their Revised Supplementary Agreements Concerning the Provision of Technical Assistance by the International Atomic Agency (RSAs) and their project and supply agreements (PSAs), Member States are required to apply Agency safety standards as a prerequisite for receiving TC assistance. Encouraging advances can be seen in the establishment of radiation safety infrastructure in the region, although progress varies from country to country.

Despite the promising development of national regulatory infrastructures in many African countries, one cross-cutting challenge is the critical shortage of trained staff for the establishment and development of regulatory functions. The TC programme in Africa focuses on human resource development in support of the establishment of a national legal and institutional framework, as well as to promote capacity building in the monitoring and control of hazards and radiological risks, and the enhancement of national emergency preparedness and response plans.

In Asia and the Pacific, assistance in radiation protection and radiation safety was provided through dedicated national and regional projects dealing with the seven thematic safety areas (see the box above), as well as by supporting education and training needs in radiation protection at the postgraduate level. Particular

emphasis has been placed on nuclear safety because a number of Member States in the region have expressed interest in embarking on nuclear power programmes. In addition, the Fukushima Daiichi nuclear accident triggered new concerns about nuclear safety, including public and civil society concern in some Member States that are investigating the feasibility of nuclear power programmes.

In the Europe region, strengthening nuclear safety further is also a top priority. Assistance is being provided through several regional projects such as RER/9/096, ‘Strengthening National Infrastructures for the Control of Radiation Sources (TSA-1), (Phase II)’, RER/9/101, ‘Building Competence Through Education and Training in Support of Radiation Protection Infrastructures’, and RER/9/099, ‘Strengthening the Effectiveness of Regulatory Authorities and Advanced Training in Nuclear Safety’, which are designed to help strengthen safety infrastructure in the participating Member States, with an emphasis on capacity building.

In 2011, the strengthening of national capabilities for radiation protection and radiological safety was a priority in the TC programme for Latin America, especially with regard to supporting regulatory activities and implementing new approaches to the education and training of exposed workers. Important goals were achieved under the project RLA/9/062, ‘Strengthening the National Infrastructure and Regulatory Framework for the Safe Management of Radioactive Waste in Latin American Member States (TSA4)’.

Strengthening regulatory infrastructure

Member States in Africa are enhancing the performance of their regulatory infrastructures with support from regional project RAF/9/038, ‘Promoting Self Assessment of Regulatory Infrastructures for Safety and Networking of Regulatory Bodies in Africa (AFRA)’, which involves the use of self-assessment methodologies and tools developed by the Agency. The project also provides comprehensive capacity building support that will lead to significant improvement in the performance of these countries’ regulatory bodies.

In 2011, the Agency sensitized Member States in Asia and the Pacific to the need to identify and

manage orphan sources, as well as to the methods used in searching for uncontrolled sources, under regional project RAS/9/054, ‘Strengthening National Regulatory Infrastructures’. The project also strengthened the capabilities of regulatory bodies and other entities to search for and handle orphan sources. National training courses were provided to help Qatar and Lebanon implement the Agency’s Regulatory Authority Information System (RAIS).

During 2011, activities under regional project RAS/9/059, ‘Strengthening Nuclear Regulatory Authorities in the Asia and the Pacific Region’, focused on addressing the participating Member States’ licensing processes and their national approaches towards the granting and authorization of licences for nuclear installations. The project also supported the sharing by Member States of practices and experiences for the review and assessment of relevant national documents in relation to the guidance contained in the Agency Safety Guide Licensing Process for Nuclear Installations (IAEA Safety Standards Series No. SSG-12, Vienna, 2010).

Project OMA/9/002, ‘Strengthening the National Regulatory Infrastructure for Radiation Safety and Occupational Exposure Control in Oman’, has been instrumental in starting the development of regulatory infrastructure for radiation safety by the country’s Ministry of Environment and Climate Affairs.

Under project HON/9/002, ‘Creating a Regulatory National Operative Authority for Protection and Radiological Security’, the Agency helped Honduras to evaluate safety and security conditions, including those relevant to operational procedures, with a view to preparing the licensing documentation for its first central storage facility for radioactive waste. With direct assistance from the Agency, 124 disused radioactive sources were removed from the facilities at which they had been housed and transferred to the central storage facility, thereby ensuring safety and avoiding potential risks to the population.

In Afghanistan, in view of the prevailing security situation, developing the regulatory infrastructure for radiation safety remains a challenge. Inspection and

monitoring equipment was provided under project AFG/9/002, ‘Establishing a National Regulatory Infrastructure for the Control of Radiation Sources’, and a national training course on radiation safety regulatory issues for nine Afghan fellowship trainees was organized in Istanbul, Turkey, in cooperation with the Turkish Atomic Energy Authority under projects AFG/9/002 and AFG/9/004, ‘Establishing National Technical Capabilities for Radiological Protection of Workers and Patients (Phase II)’.

Prior to 2010, the Islamic Republic of Mauritania had neither a legal framework nor a regulatory infrastructure in place to ensure adequate control of existing or planned facilities and activities using radiation sources. Project MAU/9/002, ‘Establishing a National Regulatory Infrastructure for Radiation Safety and Occupational Exposure Control Programmes’, was launched in order to address the urgent need to establish a regulatory authority and to develop and implement regulatory functions to put in place a national system of notification, authorization, inspection and enforcement for the control of radiation sources. With Agency assistance, the Islamic Republic of Mauritania has drafted a nuclear law, which was promulgated in early 2010 along with its enforcement decree. The Mauritanian Government subsequently created the National Radiation Protection and Nuclear Safety and Security Authority (ARSN). Through project MAU/9/002, the Agency is helping the country to train the ARSN’s newly recruited personnel in regulatory activities, as well as providing expert advisory missions for the launching of operational activities and equipping the regulatory infrastructure with radiation detection and monitoring tools.

Radiation protection

Assistance has been provided to Member States in Africa under regional project RAF/9/035, ‘Education and Training in Support of Radiation Protection Infrastructure’, to strengthen capacity building and train specialists in radiation protection at the postgraduate level, in order to help them develop the expertise and skills required for a sustainable national radiation protection infrastructure. A regional postgraduate educational course on radiation protection

was organized for the first time at the AFRA-accredited regional designated centre for training in radiation protection in Ghana.

Significant advances in radiation protection issues in Asia and the Pacific have been made under regional project RAS/9/042, ‘Sustainability of Regional Radiation Protection Infrastructure (RCA)’. A key achievement was the establishment of four regional networks covering regulatory infrastructure, occupational exposure control, medical exposure control, and radiation emergency preparedness. The networks are largely sustained by the participating Member States. Thus, activities to ensure network sustainability, including annual workshops and the launching of websites or newsletters, have been developed by the Member States themselves and require minimal support from the Agency.

Under regional project RAS/9/056, ‘Strengthening Capabilities for Protection of the Public and the Environment from Radiation Practices’, extensive training has been provided to enhance the public and environmental protection infrastructure in the participating countries, including environmental monitoring for public exposure control, assessment of effective dose, and the monitoring of imported and exported drinking water and foodstuffs.

Key activities in the characterization of the radiation status of selected rural areas in four administrative regions in Kazakhstan with higher radioactivity levels have been completed under project KAZ/9/011, ‘Supporting Radioecological Monitoring’. Preliminary studies have identified both natural and artificial radiation sources, associated in particular with uranium and thorium deposits, rocky territories with higher radioactivity, sites contaminated with radionuclides from historical nuclear tests, and areas with potential radon risk. Natural radiation sources contribute approximately 80% to the collective dose in granite dominated areas in central, northern and eastern Kazakhstan. Half of that amount comes from radon and its daughter products. The Agency provided assistance in the form of training, expert advice and equipment needed to enhance national capacity for

radon monitoring, including database development and mapping.

Regional project RER/9/097, ‘Strengthening National Capabilities for Radiological Protection of Workers and Occupational Exposure Control’, has supported staff training and compliance with occupational radiation protection requirements. Work is ongoing to ensure the self-sustainability of the Regional European and Central Asian ALARA⁴¹ Network (RECAN). This network aims to promote the harmonization of radiation protection policies and practices, with a special emphasis on the implementation of the ‘as low as reasonably achievable’ (ALARA) principle, both at regulatory and operational levels.

Under regional project RER/9/093, ‘Strengthening Radiological Protection of Patients and Medical Exposure Control’, Member States in the Europe region were assessed on their capabilities to meet regulatory requirements, their skill and competency development in patient protection, and their optimization procedures for medical exposures. Two training events covering radiation protection in digital radiology took place in 2011, and scientific visits familiarized participants with ways of reducing unnecessary radiological examinations.

Guidance in diagnostic radiology and mammography for Latin America has been issued and the first phase of the development of software for dose optimization in mammography has been concluded under regional project RLA/9/067, ‘Ensuring Radiological Protection of Patients during Medical Exposures (TSA3)’. Regional project RLA/9/065, ‘Supporting Radiation Protection Infrastructure Through Education and Training’, has contributed to the harmonization, recognition and authorization of training providers in radiation protection and safety in Latin America. Regarding the radiation protection of workers, assistance under regional project RLA/9/066, ‘Strengthening and Updating Technical Capabilities for the Protection of Health and Safety of Workers Occupationally Exposed to Ionizing Radiation (TSA2)’, focused on internal dosimetry and the

strengthening of a network on occupational radiation protection. Lastly, harmonized guides for inspection and authorization have been disseminated in the region under regional project RLA/9/064, ‘Strengthening National Regulatory Infrastructures for the Control of Radiation Sources (TSA1)’.

Emergency preparedness

The Agency is helping Lebanon to strengthen its radiation protection infrastructure through the introduction of an early warning system. Under project LEB/9/005, ‘Establishing a Radiation Early Warning Network System’, a centralized station and 10 remote stations are being installed, through which the Lebanese Atomic Energy Commission will be alerted to any above-normal levels of radioactivity in the country. The system will provide the information to emergency teams for proper response and rapid intervention.

In Europe, regional project RER/9/100, ‘Developing National Arrangements and Capabilities for Preparedness and Response to a Nuclear and Radiological Emergency’, is establishing national systems for emergency preparedness and response to nuclear and radiological emergencies using an integrated ‘all-hazards approach’. The needs of Member States have been identified through self-assessment, as well as by conducting five Emergency Preparedness Review (EPREV) missions. Over 115 representatives from 30 Member States have improved their capacities to develop national action plans. By the end of 2011, some 70% of participating countries had achieved good compliance with the requirements set out in Preparedness and Response for a Nuclear or Radiological Emergency (IAEA Safety Standards Series No. GS-R-2, Vienna, 2002). Fifty-six per cent already have national radiation emergency plans in place and four countries are working on drafting such plans.

Under regional project RLA/9/061, ‘Strengthening National Systems for Preparedness and Response to Nuclear and Radiological Emergencies (TSA5)’, assistance focused on the development of reference

⁴¹ As low as reasonably achievable.

hospitals capable of providing a medical response to radiation emergencies in Latin American Member States. Particular attention was paid to those countries where radiological accidents had occurred. To increase national capabilities, a large-scale exercise related to response to radiation emergencies was conducted in the Dominican Republic.

Under project SRL/9/009, ‘Developing National Capability to Respond to Radiological Emergencies’, Sri Lanka has been assisted in developing its national capabilities to respond to radiation emergencies. Expert advice has been provided on drafting a national radiation emergency plan and on designing a network of continuous radiation monitoring stations.

Supporting safety in nuclear power plants and research reactors

In common with a number of other countries in Asia and the Pacific, the Government of Vietnam is taking steps to strengthen its national nuclear regulatory infrastructure. Through projects VIE/9/011, ‘Improving the Capability for Site Characterization and Evaluation of New Nuclear Installations’, and VIE/9/013, ‘Strengthening the Technical Capacity of the Radiation and Nuclear Safety Regulatory Body’, comprehensive assistance has been provided for building up technical and systemic capacities in the country’s regulatory body, the Vietnam Agency for Radiation and Nuclear Safety (VARANS). Following a request by the Vietnamese Government, the Agency conducted a Site Safety Review Service (SSRS) mission to the country in August 2011, and assistance was provided to VARANS for reviewing and finalizing a draft circular on NPP site selection. The approval of this document is an important step in the process of strengthening Vietnam’s regulatory infrastructure in preparation for the construction of its first NPP.

With the help of safety-focused support from projects IRA/4/035, ‘Strengthening Owner’s Capabilities for Commissioning and Start-up of Bushehr Nuclear Power Plant’, and IRA/9/018, ‘Regulatory Infrastructure for Licensing and Control of Nuclear and Radiation Facilities in Iran’, which have provided advice based on international safety codes, standards and proven

practices, the light water reactor at the Bushehr NPP in the Islamic Republic of Iran achieved criticality on 8 May 2011 and was connected to the national grid in September 2011. The support provided by the TC programme under the above Board-approved TC projects to the Iranian utility counterpart and the national regulatory body helped to strengthen their capabilities for discharging their respective responsibilities in order to ensure the safe and reliable commissioning and start-up of the country’s first NPP unit.

Around 300 experts from 18 Member States attended workshops and a training course under regional project RER/9/095, ‘Strengthening Safety Assessment Capabilities’. The events provided participants with a friendly cooperation framework in which they could share ideas, skills and achievements. The work has taken stock of the Agency Safety Guide Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (IAEA Safety Standards Series No. SSG-3, Vienna, 2010). Member States exchanged information on low-power and shutdown conditions, as well as on internal and external hazards (a topic introduced in response to the Fukushima Daiichi nuclear accident). A workshop on the safety assessment of advanced-design (Gen III/III+/IV) reactors was held in Garching, Germany, from 29 November to 2 December 2011 as the final project event.

Some fifty Turkish experts have attended expert lectures under project TUR/9/017, ‘Enhancing the Turkish Atomic Energy Authority’s Capabilities for Regulatory Oversight of Construction, Commissioning and Operation of New Nuclear Power Plants’, which is fully funded by Turkey. Topics have included reactor design, regulatory issues, licensing procedures, and Agency safety standards.

Skills in on-site inspection and plant lifetime management have been upgraded in Armenia under project ARM/9/020, ‘Strengthening Nuclear and Radiation Infrastructure in Armenia’. Plant ageing issues were addressed in a workshop held for Armenian experts in Moscow by the Russian regulatory body, which serves as an example of inter-State support facilitated by the Agency through its TC programme.

In September 2011, a follow-up Site Safety Review Service (SSRS) mission that addressed seismic stability and other safety-relevant factors was carried out in Armenia for the country's planned new NPP. Funds were provided by the Russian Federation to support Armenia's safety-related national projects.

In Uzbekistan, a new instrumentation and control system has been delivered for the control and protection system of the WWR-SM research reactor at the Institute of Nuclear Physics in Tashkent under project UZB/9/005, 'Improving Operational Safety of the Research Reactor at the Institute of Nuclear Physics (Phase II)'. The WWR-SM reactor is one of the most heavily used research reactors in the world. It produces radioisotopes such as molybdenum-99, the 'raw material' isotope for technetium-99m generators that are in high demand in nuclear medicine imaging for early cancer diagnosis, cardiology, etc. Project UZB/9/005, which is being implemented as a combined effort of the Agency, the United States Department of

Energy and the European Commission, is helping to address several safety concerns to ensure the continued safe operation of the reactor throughout its expected lifetime.

Supporting nuclear security

With resources provided by the Agency's Nuclear Security Fund, ten regional and international courses in the field of nuclear security were delivered through various TC projects. These included regional project RAF/9/041, 'Developing Human Resources in Nuclear Security (AFRA)', which delivered one course on detection and response and two on physical protection; regional project RAS/9/060, 'Developing Human Resources in Nuclear Security', which delivered two courses on detection and response and one on physical protection; and regional project RER/9/102, 'Developing Human Resources in Nuclear Security', which delivered three courses on physical protection.



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