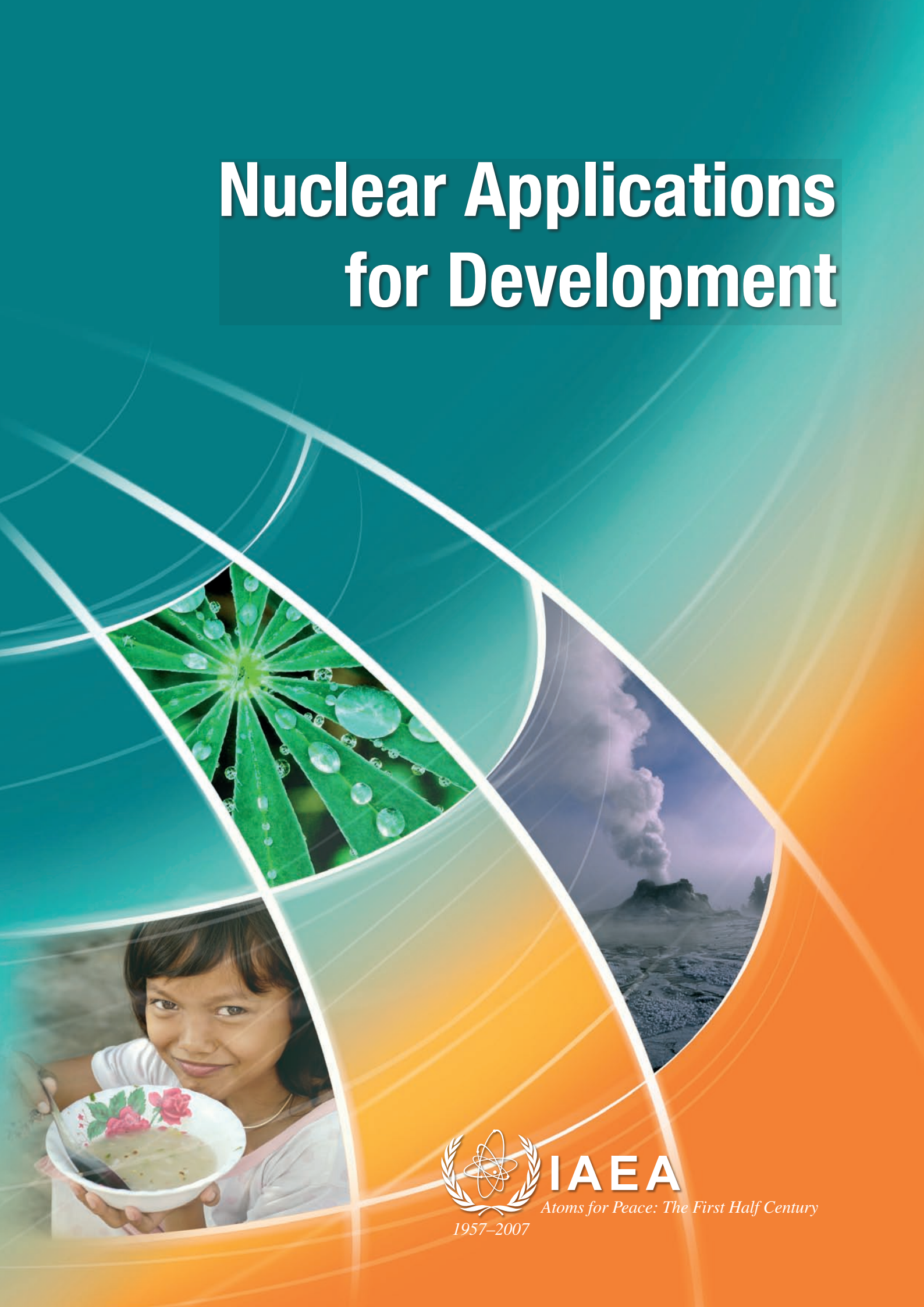
Nuclear Applications for Development



IAEA

Atoms for Peace: The First Half Century

1957–2007

Sometimes, key information lies in small details…

The ability to examine matter at the atomic level provides new insights into natural processes that underpin the well-being of our planet and all of its inhabitants.

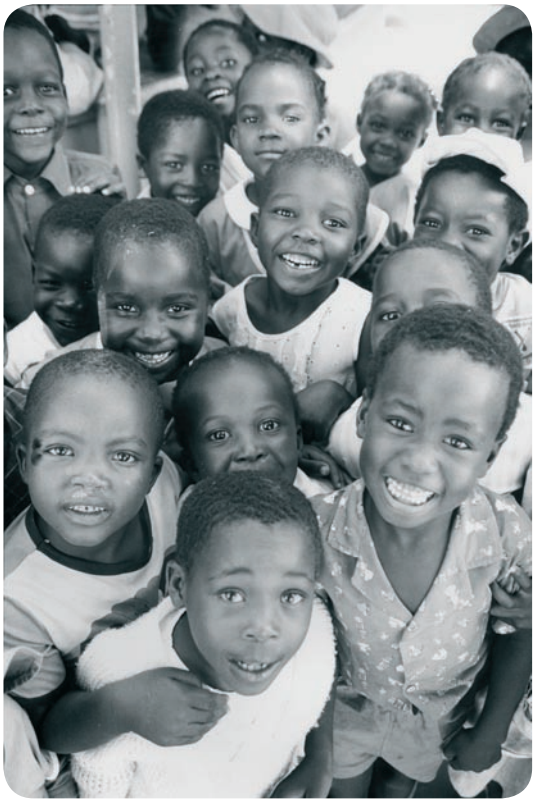
PATRICK FRISCHKNECHT/STILL PICTURES

A drop of water

Each molecule of water holds its own history and reveals clues about the long term viability of the river, lake or underground aquifer in which it is found.

A single seed

Every seed contains the genetic potential to produce a plant that is better adapted to the growing environment and can deliver greater nutritional value.



JORGEN SCHYTTE/STILL PICTURES

One healthy person

Every individual can make vital contributions to social and economic development… and has the right to benefit from equitable access to nuclear technologies that improve lives and support livelihoods.

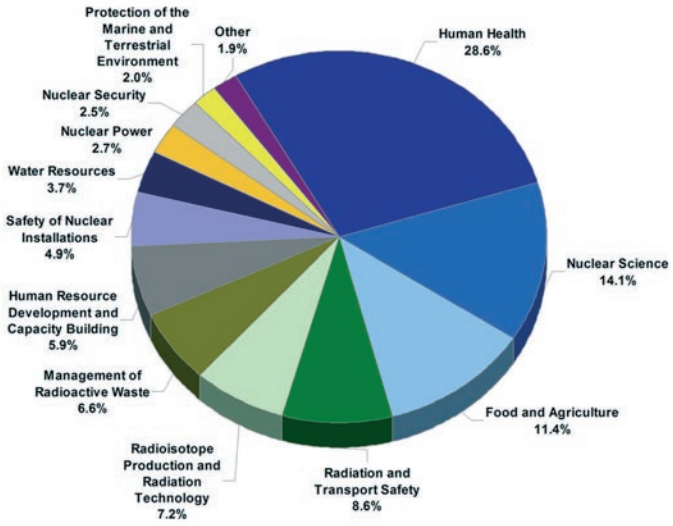
…and a little bit of support makes a world of difference.

Building capacity for the safe application of nuclear technologies produces tangible socioeconomic benefits to developing countries.

FRIEDRICH STARK/DAS FOTOARCHIV/STILL PICTURES

Identifying killer infections such as extrapulmonary tuberculosis and drug resistant strains of HIV/AIDS in sub-Saharan Africa • Monitoring malaria drug resistance in Myanmar • Teaching Jordanian farmers how to produce viable crops on salty soils • Investigating water resources deep beneath the Nubian Desert • Fighting acid rain in Poland • Creating an energy strategy for Latin America • Strengthening the security of nuclear sources in Kazakhstan

These are just some of examples of the practical ways in which the International Atomic Energy Agency (IAEA) fulfils its mandate to "accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world". And some of the reasons the IAEA's long history of global action was recognized through the Nobel Peace Prize in 2005.



This list of activities reflects the diverse needs of Member States. It also demonstrates the enormous potential of nuclear technology and the breadth of expertise that lie within three IAEA technical programmes: **Nuclear Sciences and Applications, Nuclear Energy**, and **Nuclear Safety and Security**.

More importantly, it speaks to the success of a determined effort to facilitate knowledge sharing and technology transfer through a cross-cutting mechanism known as the technical cooperation programme.

Each year, the technical cooperation programme disburses approximately US $90 million, all of which is acquired through voluntary contributions from Member States.

The programme concentrates on building capacity through training and education, expert advice, and equipment delivery. It is currently active in more than 110 countries across four geographic regions: Africa, Asia and the Pacific, Europe and Latin America.

But the concept of technical cooperation extends beyond training and technology transfer…

A shared vision for *self-reliance and long term sustainability*

The technical cooperation programme serves a very specific purpose. It lays the foundation for nuclear technology, upon which Member State institutions will build their own futures, according to their own needs.

Each technical cooperation project starts with an identified need – and spawns a strategic plan to ensure that the Member State acquires the capacity to be self-sufficient in implementing sustainable solutions. In this sense, technical cooperation is:

- A strategy to pool the resources (technical and non-technical) of organizations that share a commitment to addressing development needs.
- A process to support the development of local skills and expertise.
- A mechanism to encourage the generation of new knowledge and the application and dissemination of innovative solutions.

A shared investment

Disbursements for technical cooperation projects are linked to Member State investment. Governments requesting assistance must demonstrate that they can commit the resources needed to transform capacity into long term delivery of services or products. This includes:

- Budget allocations by governments over several years.
- Stable partnerships and contracts with end users.
- The ability to develop markets or customers for the products or services.
- The capacity to train replacement human resources.
- The expertise to maintain equipment and facilities.

In addition, governments and institutions must develop a strategic plan that covers two key areas:

- How nuclear technologies can best be applied to development priorities at the national level.
- How each nation can help rationalize products and services at the regional level to ensure that individual institutions remain viable.

Radiotherapy clinic – a classic example of technical cooperation

In 1997, cancer was the second leading cause of death in Yemen. Because treatment was unavailable, virtually every case became fatal.

The Government placed high priority on establishing a National Centre for Radiation Oncology and secured support to acquire the necessary equipment. It then turned to the IAEA for assistance in planning and executing each phase of development in a safe, secure manner:

- Design and construction of radiotherapy facilities.
- Acquisition, delivery and installation of a cobalt-60 radiotherapy machine.
- Fellowship training (2-3 years) for nine oncologists, all nationals of Yemen.
- Expert visits to provide interim treatment while oncologists completed training.

In March 2005, the new Centre delivered its first dose of radiotherapy and began providing services for screening, early detection and treatment. Although the Centre's capacity meets only a small portion of the actual need for cancer care, it will reduce mortality rates: more people will live longer and have a higher quality of life. This increases their ability to continue contributing to social and economic development.

an infrastructure that puts *safety first*

Safety is essential to the effective application of nuclear technologies. It is the first point of engagement between Member States and the technical cooperation programme – and it puts people first.

Repatriation, management and disposition of fresh and/or spent nuclear fuel from European research reactors • Strengthening operational safety management of Pakistan's Chashma nuclear power plant • Creating the regulatory infrastructure for licensing and control of nuclear facilities • Safe removal of spent fuel from Serbia's Vinča RA research reactor

In advance of transferring technologies that use radiation sources, the IAEA works with Member States to establish a network of experts with diverse knowledge and skills: Legislators and regulators, medical professionals, scientists, industry leaders, emergency response personnel, etc. Their collective safety objective is to protect people and the environment from the harmful effects of ionizing radiation.

Since 1994, the technical cooperation programme has helped more than 90 Member States build capacity in the five Thematic Safety Areas outlined in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS).

Thematic Safety Areas for Radiation Protection	
Legislative framework and regulatory infrastructure	• Draft radiation protection laws and regulations. • Establish an independent regulatory authority; empower it to manage notification and registration/authorization, conduct inspections and enforce legislation. • Create an inventory of all radiation sources and facilities.
Occupational exposure control	• Protect the health and safety of workers through individual and workplace monitoring and dose assessment.
Medical exposure control	• Control the exposure of patients undergoing diagnosis and/or treatment via radiology, nuclear medicine or radiotherapy.
Public and environmental exposure control	• Ensure the safety of all sources and material, including radioactive waste, to protect human health and avoid contamination of air, soil and water.
Emergency preparedness and response	• Train personnel, develop technical capabilities and allocate resources to mitigate the impact of a radiological emergency.

A life cycle commitment

Training professionals in the safety and security aspects of nuclear installations, radiation, transport and waste management is essential for a strong and sustainable global nuclear safety regime.

Regardless of what it is, where it comes from, what purpose it serves and what risks it represents, every radiation source must be accounted for from the moment it is acquired to the day it is retired – at which point rigorous standards for waste disposal must be strictly followed.

The technical cooperation programme is closely linked with the IAEA's Nuclear Safety and Security programme to ensure that Member States are fully prepared to shoulder responsibility for radiation sources found within their borders.

Development priorities *drive technical cooperation*

"Across the developing world, countries are tackling important challenges: the need to improve health care; to boost agricultural production and increase food security; and to enhance the management of natural resources. These challenges are often multidimensional; finding practical solutions requires effective collaboration, sufficient resources and strategies that will ensure the self-reliance of local institutions.

Nuclear technologies can provide effective solutions to many of these challenges – sometimes as a supplement to or in concert with other technologies. The IAEA is committed to building the capacity of its Member States to use nuclear technologies in ways that will support national, regional and interregional priorities for sustainable development."

Director General, Mohamed ElBaradei
International Atomic Energy Agency

JORGEN SCHYTTE/STILL PICTURES

ILAN MIZRAHI/IAEA

Increasing capacity to treat cancer through tele- and brachytherapy techniques in Madagascar • Controlling fruit pests across boundaries in the Palestinian Territories, Jordan and Israel • Identifying sources of pollution in Mongolia • Determining the movement of fluids in geothermal fields to ensure sustainable use in Central America

Improved nutrition for people living with HIV/AIDS

Out of the more than 40 million individuals living with HIV/AIDS around the world, nearly 30 million are in sub-Saharan Africa. The highest infection rates worldwide are in southern Africa, where the prevalence of HIV infection in adults exceeds 25% in most countries. This extremely high prevalence, combined with limited health care, food shortages and widespread undernutrition, highlight the current crisis in sub-Saharan Africa.

The importance of access to an adequate diet and of integrating nutrition into a comprehensive response to HIV/AIDS was recently reiterated by the WHO. There is an urgent need to evaluate locally appropriate, sustainable food based strategies to improve the nutritional status of people living with HIV/AIDS. The IAEA contributes to these efforts by supporting a regional project in Africa to evaluate the efficacy of nutritional interventions in individuals infected with HIV, based on changes in body composition (muscle mass) that are measured by the stable isotope technique.

Nuclear technologies contribute to UN Millennium Development Goals

Increasingly, Member States seek technical cooperation assistance to support their own targets in relation to the Millennium Development Goals (MDGs) set out by the United Nations.

The technical cooperation programme contributes to reducing child and maternal mortality, preventing the spread of communicable diseases, ensuring environmental sustainability, and building a global partnership for development.

Human health
a high priority

Socioeconomic development hinges on the contributions of a healthy population. In many parts of the world, persistent problems such as poor nutrition[1] and communicable diseases keep children away from school and adults out of the workforce. The rising incidence of cancer and cardiac diseases poses a new threat.

Strengthening quality assurance in radiation oncology • Improving nuclear medicine services by establishing positron emission tomography centres in Malaysia, Thailand and Vietnam • Improving the management of care for cardiac patients by strengthening nuclear medicine techniques for diagnosis of coronary artery disease in Cuba • Increasing human resource capacities in clinical, medical physics and nuclear medicine technology in the Libyan Arab Jamahiriya

Nuclear techniques provide unique capabilities in the prevention, diagnosis and treatment of disease. Radiotherapy, one of the earliest applications of radiation, remains a major cost effective means of treating cancer. Recent advances in diagnostic radiology and nuclear medicine improve early diagnosis and staging of cancer, thereby increasing the efficacy of treatment and the chance of cure. Nuclear medicine procedures in cardiology provide a very sound basis for managing cardiac patients. Applied to activities in nutritional and environmental health, nuclear techniques also support public health measures.

MASON MORFIT/THE MEDICAL FILE/STILL PICTURES

The ongoing battle against communicable diseases

Malaria, tuberculosis and HIV/AIDS: Despite decades of research, these diseases continue to devastate communities and drain national resources. Some 300 million people currently suffer from malaria, the world's largest disease burden. Tuberculosis will likely cause 30 million deaths this decade, most of them avoidable. In 2006, almost 40 million people were living with HIV (including 4.3 million new cases) and 2.9 million people died from AIDS[2].

MARK EDWARDS/STILL PICTURES

Nuclear techniques contribute to both basic research and patient care. They help to improve understanding of pathogens and can quickly identify drug resistant strains of malaria, tuberculosis and HIV. This knowledge is vital to pharmaceutical research and enables physicians to make more accurate diagnoses and prescribe more effective treatment plans. Identifying "killer" infections using nuclear medicine techniques, especially for extrapulmonary tuberculosis, is a new weapon in identifying patients at risk and treatment follow-up.

Rising needs in the management of cancer…

By 2015, it is estimated that 15 million new cases of cancer will be diagnosed each year; more than half will occur in developing countries. These regions are home to 85% of the world's population, yet they currently have only 2200 radiotherapy machines – less than one-third of the global figure. There is an urgent need to build capacity for diagnosis and treatment and to provide the necessary equipment. Over the years, the IAEA has overseen a large number of technical cooperation projects in the field of radiation treatment. Building on this experience, the IAEA launched the Programme of Action for Cancer Therapy (PACT) in 2004 to assist Member States in providing cancer treatment and care, and working in conjunction with WHO and other partners, to expand fundraising efforts with non-traditional donors.

Many technical cooperation projects are currently under way to start or strengthen nuclear medicine services for the early diagnosis of cancer: the Cuenca Cancer Institute of the SOLCA Society (Ecuador) is just one example. This Institute specializes in detecting bone metastasis, each year providing care to patients with advanced or terminal cancer. The addition of nuclear medicine services will facilitate the management of cancer by improving diagnostics and treatment.

[1] See ***Nutrition programmes enriched by partnership approach*** (page 12).
[2] UNAIDS/WHO AIDS Epidemic Update, December 2006.

Sustainable agriculture underpins *food security and the fight against hunger*

Eradicating hunger presents a multifaceted challenge. It is imperative to find ways to boost food production, but to do so without causing environmental damage. Moreover, efforts must be made to ensure that individuals have access to the right mix of foods to support a healthy diet.

Enhancing the quality and yield of rice mutants using nuclear and related techniques in Vietnam • Managing fruit fly pests in Central America and Panama using the sterile insect technique • Field evaluation and distribution of African crop varieties improved through mutation breeding and biotechnology techniques

Nuclear techniques contribute in key areas of agricultural production and consumption. They are useful in developing new plant and animal breeds and reducing the impact of pests (both in the field and in food processing). Isotopic 'tags' are used to monitor the evolution of nutrients in agroecosystems, to assess the availability of nutrients in soils, crop residues, fertilizers and foods, and to analyse whether the human body is absorbing nutrients effectively.

Additional land for farmers in arid regions

Salty soil is a worldwide phenomenon. In some regions it is natural; in others it is the end result of human activity. Irrigation scheduling and integrated soil-water-plant-nutrient management can play a major role in preventing the development of soil salinity.

Nuclear technologies support a novel approach that combines nature and nurture. Mutation breeding, based on a selection of native plants that meet local needs, is being used to enhance more than 100 plant species that show some salt tolerance. Neutron probes that measure soil moisture support optimal irrigation practices, and isotopic techniques allow to determine sustainable use of agricultural water and soil nutrient resources. Other isotopic and nuclear techniques monitor factors such as plant-soil-water interactions and species competition for soil moisture, as well as the nutritional value of harvested crops.

Transforming marginal land into productive farms does more than provide food and fodder. Increasing ground cover decreases soil erosion and desertification, boosts biodiversity, and creates environmental and economic gains. Mutation breeding is also proving effective in developing crops that thrive during drought.

Boosting farm production and improving food processing

Radiation techniques enhance plant breeding by stimulating the development of desirable traits (e.g. higher protein levels, disease and pest resistance, affinity to saline soils) without introducing genetic material from other organisms.

Irradiation of fresh and processed foods eliminates bacteria and pests, lengthening shelf-life and improving storage and transport possibilities, thereby improving food safety while creating trade opportunities between developing and developed countries.

Pest control boosts social and economic development

FAO estimates that Africa loses US $4.5 billion annually due to diseases transmitted by the tsetse fly. The sterile insect technique (SIT) uses gamma radiation to inhibit fertility in mass reared young male tsetse flies. These sterile males are then released systematically (by airplane) into the target region, where they mate with females but produce no offspring. Over time, the tsetse fly population is virtually eliminated, as is the need for extensive pesticide use. In Zanzibar, a ten year control programme that combined SIT with other techniques has increased food production while eliminating the incidence of tsetse fly transmitted disease in livestock. SIT is cited as a major contributor to the island's remarkable economic growth.

Managing water resources
to ensure quantity and quality of supply

Fresh water plays a vital role in human and economic development. Safe drinking water is fundamental to human health; irrigation boosts agricultural productivity and enhances food security; and virtually all industries require water for processing and production. In urban and rural areas alike, competing demands are depleting surface water sources.

R. FAIDUTTI, MALAYSIA/UN FAO

Management of drinking water resources in areas of scarcity across Europe • Studying artificial recharge of groundwater in Asia • Characterizing coastal aquifers in Ecuador to address increasing salinity and support integrated management • Promoting sustainable development and equitable utilization of the common water resources in the Nile Basin

M. MARZOT/UN FAO

As countries turn to alternate options such as underground aquifers, there is an urgent need to assess their long term viability and ensure they are managed in sustainable ways. Nuclear techniques reveal important clues about the origin, age and renewal rate of groundwater, as well as the risk of salt water intrusion or contamination. They are also used to assess dam leakage and the impact of climate change on water resources.

Increased reliance on groundwater sources leads to fundamental changes in water resource management – including the need to think beyond immediate demand and existing national borders. Isotope hydrology provides the information necessary to develop integrated water management strategies, including flow dynamics, water balances, recharge rates, and analysis of the sources and movement of pollutants.

Assessing the safety of village pumps

Arsenic contamination of groundwater has affected 59 of 64 districts in Bangladesh, leaving millions of people at risk of exposure and subsequent chronic health problems. Isotope hydrology techniques provide a rapid and relatively inexpensive way to identify how arsenic travels through groundwater systems, to characterize deeper aquifers and verify their safety as alternate sources of drinking water, and to mitigate the impacts of the arsenic poisoning of water.

Master plans for megacities

Exponential population growth and intense industrial activity in megacities put enormous pressure on local water resources. In Santiago, Chile, prolonged dry spells exacerbate the problem, leading to the increased use of groundwater resources to supplement available surface water. Applying an extensive set of tools (including hydrochemistry, stable isotopes and radiocarbon dating), several institutions collaborated to study recharge sources of the Santiago aquifer, identifying and quantifying – for the first time – the origins, volumes, differences in quality and fluxes of different groundwater types present in the aquifer. These data were synthesized to create a hydrological model, including vulnerability maps and recommendations for local water authorities.

Protection and preservation of *air, earth and oceans*

Experience demonstrates the pressing need to ensure that environmental concerns figure prominently in development plans. Nuclear techniques fulfil multiple roles in this area. Tracing the movement of radionuclides through various ecosystems makes it possible to map past changes, monitor current conditions, and predict future trends. Nuclear technologies can also serve as active agents for pollution monitoring, prevention and remediation.

COURTESY NATIONAL NUCLEAR RESEARCH INSTITUTE, MEXICO

PAUL SPRINGETT/STILL PICTURES

Environmental assessment of the Mediterranean Sea, covering both European and African coastal areas • Treating industrial wastewater with an electron beam machine in the Republic of Korea • Evaluation of airborne pollutants in Lebanon using nuclear and related analytical techniques • Use of nuclear techniques to address management issues of coastal zones in the Caribbean region • Safe management of residue from former mining and milling activities in Central Asia

Reducing emissions – at the source

Industrial dependence on fossil fuels is a key contributor to air pollution and to climate change. The problem is heightened in many developing countries, where economic factors make it necessary to use low-grade 'dirty' fuels such as coal. Demonstration projects in Brazil, China and Eastern Europe show that a process known as electron beam dry scrubbing (EBS) removes up to 95% of these pollutants from flue gases at coal fired boilers. It also creates a by-product that can be used as fertilizer. Saudi Arabia is now assessing the feasibility of EBS in oil fired boilers.

Increasing soil stability and productivity

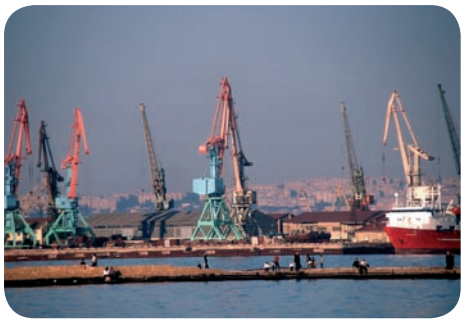
Soil erosion is a serious problem on the global scale. It often stems from inappropriate land use and poor farming practices that reduce plant cover, and results in reduced capacity to produce food and timber products and off-site environmental impacts. Tracking the distribution of radionuclides (e.g. caesium-137) in the landscape is one means of measuring soil redistribution and of assessing the suitability of various conservation practices and integrated land-water management strategies.

Tracking aquatic contamination

Situated over significant oil reserves, the Caspian Sea is economically important to the surrounding region. But it is also a repository for radionuclides that were dispersed during atmospheric bomb testing and following the Chernobyl nuclear power plant disaster. Recent changes in water levels prompted the Government of Azerbaijan to seek IAEA support to study radioactive contamination in the Caspian Sea. In 2006, scientists undertook a two week journey at sea to measure contamination, identify where it comes from, and map how it travels through the aquatic system. This information will be used to develop monitoring and remediation activities.

MARK EDWARDS/STILL PICTURES

EBS technologies clean flue gases from coal burning plants, thereby reducing the sulphur dioxide (SO2) and nitrogen oxide (NOx) emissions that previously caused significant environmental damage.



KNUT MUELLER/ DAS FOTOARCHIV/STILL PICTURES

Supporting long term growth through *sustainable energy planning*

Energy services are an essential requirement for daily life and are key to socioeconomic development. Governments in developing nations are demonstrating an increased commitment to enhancing the availability of affordable energy to their populations; the IAEA helps them in this endeavour through capacity building in energy analysis and planning.

Meeting increased energy demand involves a multitude of choices and challenges. Traditional energy supplies (such as wood biomass or agricultural waste) used predominantly in rural areas are known to have negative impacts on human health and to degrade the local environment. The fossil fuels that power mega-cities and industrial development are key contributors to climate change and poor air quality.

KANSAI ELECTRIC POWER CO.

In many developing countries, the task is further complicated by a lack of available indigenous energy resources, the desire to reduce dependence upon imported energy, and the need to increase the diversity of energy resources while reducing carbon emissions.

With so many factors to consider, developing and implementing an energy strategy is a long term process. The IAEA helps Member States build capacity in energy planning through comprehensive training in the use of analytical tools designed to calculate future energy needs, assess energy technologies and suggest optimal supply systems. Participants in training activities develop expertise in using computer modelling to formulate and evaluate (according to economic competitiveness, social consequences and environmental impacts) alternative scenarios. This enables them to map a strategy that uses clean and efficient energy technologies to achieve national and regional development goals.

Renewed interest in nuclear energy

The interplay of energy, economics and the impacts that certain forms of energy may have on the environment is prompting many countries to reconsider the nuclear power option in their energy plans.

A nuclear power plant (NPP) is major undertaking that requires careful planning, preparation and investment in a sustainable infrastructure that provides the necessary legal, regulatory, technological, human and industrial support. Experience shows that the lead time to begin operating a nuclear plant is at least 10–15 years.

During this time, the IAEA works with Member States to build capacity to ensure safety and security during installation and operation, to achieve optimal performance, and to effectively manage nuclear waste and decommissioning.

Establishing an energy infrastructure for Ghana, based on affordable, renewable sources • Mapping technology paths – both short and long term – to meet rapidly rising energy demand in Pakistan • Developing an integrated energy plan for several countries in Latin America • Improving self-reliance and capability to manage nuclear power plant projects in China • Assessing the feasibility of a nuclear power and water desalination plant in the United Arab Emirates

Tapping into renewable sources

Geothermal fields in El Salvador provide a viable option for electrical power generation. Together with the LAGEO, a private geothermal energy company, and national agencies of El Salvador, the IAEA is building local capacity in isotope techniques, fluid dynamics, and reservoir management. The aim is to facilitate exploitation and expansion of this resource while also ensuring minimal environmental impact. A complementary project supported by the Inter-American Development Bank aims to reduce levels of groundwater pollution and protect the geothermal zones.

ED RESCHKE/STILL PICTURES

Nuclear applications
Provide benefits to people, add value to products

Radiation technologies enhance human well-being and contribute to industrial development across many sectors. Effective application requires ready access to state of the art facilities and a steady supply of radioactive sources and products. The IAEA helps Member States establish facilities and strengthen expertise, with the end goal of meeting local demand through the supply of local products.

Domestic production of diagnostic radiopharmaceuticals using a cyclotron in Brazil, the Syrian Arab Republic and Thailand • Advanced non-destructive testing of structural integrity in components related to oil and gas industries in Malaysia • Treatment of industrial waste water using electron beams in the Republic of Korea • Strengthening institutional self-reliance and regional training capability in non-destructive testing in Africa

A look inside… *Radiographic non-destructive testing (NDT) probes beneath the surface of materials to pinpoint internal defects, making it a useful tool for quality control and assurance. It is increasingly used to measure corrosion, assess structural damage or locate deposits in a wide range of facilities and equipment such as oil pipelines and heavy machinery, making it an indispensable tool for maintaining the safety and infrastructures of industry in developing nations.*

Physical and chemical applications

Nuclear technologies are effective, non-invasive tools for examining the internal structures of materials ranging from glass, plastics and metals to large industrial components. They are equally useful for studying individual proteins and organs and systems that regulate human health. In recent years, Member States seeking to expand their national nuclear programmes have requested assistance in two key areas:

- *Radiopharmaceuticals are radioactive compounds used in nuclear medicine for the diagnosis or treatment of disease. Nuclear imaging techniques use radiation emitted by 'tracers' to examine physiological functions of internal organs or systems. In treatment applications, radiopharmaceuticals can target diseased tissue and relieve pain.*
- *Radiation processing is often a better alternative to chemical or other modification during industrial production and processing. It is broadly used to sterilize medical products and make food products safe, and can improve certain characteristics (e.g. strength or quality) of natural and synthetic materials. Radiation processing can also reduce the hazardous nature of industrial effluents.*

Research reactors and particle accelerators underpin national nuclear programmes

One of the primary functions of research reactors is irradiating material to produce the radioisotopes needed for the application of radiation technologies. Multidisciplinary in nature, they are also centres of innovation, productivity and capacity building for nuclear science and technology.

The IAEA helps Member States develop utilization strategies that maximize the potential of new or existing reactors. Special emphasis is currently directed toward converting reactors that rely on high enriched uranium (HEU) fuel to operate using low enriched uranium (LEU) fuel, thereby reducing proliferation and security concerns.

Particle accelerators provide complementary analytical capabilities in sectors such as health, environment, material science and forensics. They are often located in university settings and are a cornerstone of training and education in nuclear sciences.

Strengthening the synergy between *science and development*

SHEHZAD NOORANI/STILL PICTURES

"Radiation based technologies have been particularly useful in efforts to ensure water quality and improve food safety. But for these nuclear technologies to take hold across the developing world, two additional factors must be addressed.

First, capacity building programmes in nuclear science must be expanded so that each country, and especially the least developed countries, acquire a skilled labour force capable of dealing with the application of nuclear science and technology to real-life problems. Second, educational programmes must be expanded to help provide the public with the information that they need to have informed opinions about the benefits and risks associated with these technologies."

Mohamed H.A. Hassan, Executive Director
Academy of Sciences for the Developing World, TWAS

The main thrust of the technical cooperation programme is to build skills and expertise in order to realize the full potential of nuclear technologies. Experience shows that the combination of talented minds and advanced tools produces practical solutions. The three main elements of the programme support innovation at local, regional and inter-regional levels.

Training and education

The technical cooperation programme coordinates project related and practical 'on-the-job' training, through four primary modes:

- *Fellowships* support postgraduate, academic studies to develop scientific and technical expertise (usually up to 12 months);
- *Scientific visits* are geared toward individuals in management and administration (usually up to two weeks);
- *Training courses* provide opportunities for a larger number of participants to build skills in a particular area. They are often offered at the national or regional level and facilitate interaction amongst participants from different Member States.
- *Meetings* bring together small groups of peers to share expertise and experiences in relation to common issues.

In addition, a postgraduate course, entitled Radiation Protection and the Safety of Radiation Sources, is offered on a regular basis by universities in each UN region. It is delivered in Arabic, English, French, Russian and Spanish.

Expert advice

Member States often identify the need for skills in specific areas. The programme responds by engaging experts to lead hands-on training sessions, or by assisting in the organization of lectures, meetings and workshops. This approach enables projects to progress more quickly while also building long term sustainability. In recent years, the number of experts in developing countries has increased significantly.

Essential equipment

Technology transfer within a technical cooperation project is strategically linked to national development priorities and sustainable delivery of products and services. Member States must demonstrate an appropriate radiation protection infrastructure and are often asked to share the cost of equipment procurement.

This comprehensive approach ensures that recipient countries can conduct, validate and apply research, use the appropriate technologies, maintain equipment and facilities, and train additional staff. It also creates opportunities to establish strong relationships with regional and international networks of experts and peers.

Mutual support
amongst Member States

Technical cooperation is, first and foremost, a joint initiative of the Member States belonging to the IAEA. Every Member State plays an active role in advancing the application of nuclear technologies – often in ways that contribute to regional and interregional efforts to support sustainable development – and in building the global safety regime.

More than 80% of funding for the technical cooperation programme derives from voluntary contributions by Member States. All Member States are eligible for assistance; some choose to participate primarily as donors. Recent figures show a steady rise in cost-sharing for technical cooperation projects, either through extrabudgetary contributions from Member States or through donations from outside agencies. These contributions validate the programme strategy and support its expansion.

The success of the programme is evident in another telling trend. Technical cooperation has dramatically increased the number of nuclear experts within developing regions, across many different fields. These individuals and their institutions are now taking the lead role in designing and executing projects, including providing training and education and expert advice. Their scientific and technical expertise is significantly enhanced by local knowledge and cultural understanding.

A partnership approach to every project

Pooled resources make it possible to find solutions sooner; partner networks facilitate their rapid dissemination to other regions.

The technical cooperation programme provides a mutually beneficial mechanism for Member States seeking to apply nuclear technologies and organizations with available resources. It draws upon in house expertise to identify the necessary inputs and appropriate partners, and then utilizes well established links to national institutions to facilitate rapid and effective transfer of contributions.

Nuclear Expertise (Internal)	**Technical (External)**	**Non-technical**	**Financial**
Nuclear Energy Nuclear Safety and Security Nuclear Sciences and Applications	Universities Research institutes Private industry	UN Agencies Aid organisations Cooperation agencies NGOs	Development banks Foundations Funding agencies
TECHNICAL COOPERATION			

Partnerships improve outcomes *and strengthen impacts*

Development priorities reflect complex and wide-reaching issues. No single technology will deliver precisely the right solution; no individual stakeholder can provide the range of knowledge and expertise required to tackle the problem from every angle.

Nuclear technologies are often 'enablers' more than 'answers' – that is, in many instances they are most effective when coupled with conventional technologies and applied through targeted development programmes. The IAEA partnering strategy seeks to:

Engage the right mix of players…

Member States • UN agencies • Aid agencies • Non-governmental organizations • Development banks • Foundations • Private sector

To fulfil the right range of roles...

Advocacy • Policy dialogue • Mobilising funds • Operational delivery • Information and education • Technical expertise • Financial expertise

Each at the right time…

TC actively pursues both formal and informal partnerships, as determined by the project scope. Some partners are critical to project continuity; others can respond quickly to an immediate need.

And according to individual strengths.

Vital assistance comes in many forms. In-kind contributions – from equipment donations to delivery services – can be crucial to leveraging financial support

A partnership approach to nutrition programmes

Stable isotope techniques are important tools to assess the availability of micronutrients in foods and can be used in the development of food fortification strategies.

After studies revealed that 48% of Peruvian children were undernourished, the Government of Peru joined forces with the National Compensation and Social Development Fund (FONCODES), the WHO-sponsored Instituto de Investigacion Nutricional (IIN), and the Pan American Health Organization to establish a daily breakfast programme for 500 000 young children.

The IAEA's technical cooperation programme contributed to combating iron deficiency, one of the major nutritional problems faced by Peruvian children, by providing expertise in the use of stable isotope techniques to evaluate strategies to optimize the availability of iron in the fortified breakfast meal served at school.

Partners

The IAEA has a history of attracting partners that are well known for their commitment to supporting sustainable development by building local capacity.

Asian Development Bank (ADB) • European Bank for Reconstruction and Development (EBRD) • European Society for Therapeutic and Radiation Oncology (ESTRO) • European Commission • Food and Agriculture Organization of the United Nations (FAO) • United Nations Environment Programme (UNEP) • Global Environment Facility (GEF) • International Labour Organization (ILO) • International Fund for Agricultural Development (IFAD) • International Society of Radiation Oncology (ISRO) • African Union (AU) / Interafrican Bureau for Animal Resources (IBAR) • OPEC Fund for International Development • Joint UN Programme on Aids (UNAIDS) • US Agency for International Development (USAID) • The World Bank • World Health Organization (WHO)

The IAEA's technical cooperation programme

helps to transfer nuclear and related technologies for peaceful uses to countries throughout the world. The ***training and education, expert advice and equipment*** *provided by the programme are directed toward* ***supporting the development goals*** *of Member States.*

Programme

Spans vital development areas, including human health, agriculture and food, resource management and sustainable energy options. The programme operates at national, regional and interregional levels under a two-year cycle, undertaking more than 400 new projects each cycle.

Participants

All IAEA Member States are eligible for assistance; some choose to participate primarily as donor countries. In 2005, the programme was active in ~114 recipient countries, including 22 of the world's least developed countries. More than 80% of participating countries have no nuclear power capabilities; their interest lies in acquiring capacity to deploy proven nuclear techniques.

Projects

Building local capacity takes time and resources. The average project duration is four years; costs are typically shared by the programme and Member States, and sometimes supplemented by funds and in-kind donations from external organizations. This upfront investment serves the broader goal of ensuring the self-reliance and long term sustainability of national nuclear programmes. In 2005, the programme oversaw 882 projects: 667 national; 192 regional; 23 interregional.

Partners

Nuclear technologies often augment the capabilities of more conventional methods. For this reason, the programme actively seeks technical and non-technical partners from other UN agencies, non-governmental organizations, aid agencies, development banks, foundations and the private sector. Pooled resources make it possible to find solutions sooner; the resulting network facilitates their rapid dissemination to other regions.

A measure of success

In recent years, the programme has witnessed a significant increase in projects that involve technical cooperation between developing countries. Clearly, developing nations have acquired expertise to plan and execute projects that use nuclear technologies to address regional and interregional challenges.

Our expertise is nuclear technology
Our vision is to see it work for development

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Atoms for Peace: The First Half Century
1957–2007

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