IAEA Technical Cooperation Programme

Water and the Environment

The IAEA's technical cooperation programme helps Member States to achieve their development priorities while monitoring and protecting the air, earth and oceans.

Eight Millennium Development Goals (MDGs) have been adopted by the international community as a foundation for global development activities. These goals aim to make significant steps to combat poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women. Water and environment MDGs focus on halving by 2015 the proportion of people without access to safe drinking water and basic sanitation and on ensuring environmental sustainability. Meeting the targets on water and sanitation will contribute to the realization of other MDGs, including eradicating extreme poverty and hunger, promoting gender equality, reducing child and maternal mortality and providing universal primary education.

The International Atomic Energy Agency's Statute states that the IAEA shall seek to accelerate and enlarge the contribution of atomic energy for peace, health and prosperity throughout the world. The strategic goal of the IAEA's technical cooperation programme builds on this mandate, promoting tangible socioeconomic impact by contributing directly in a cost effective manner to the achievement of the major sustainable development priorities of each country.

In a world facing severe challenges to the environment and to water resource availability, nuclear technology can help manage and make the most of natural resources

Environmental degradation and a lack of clean water pose fundamental challenges to sustainable development. Socioeconomic advances cannot be sustained without clean air to breathe, safe water to drink, healthy soils for crops and livestock production and a clean and stable environment to support work and life.

Through its technical cooperation programme, the IAEA provides Member States with information and skills in the peaceful application of nuclear technologies to better understand and manage their water resources and their environment.

- More than one billion people in developing countries do not have access to safe drinking water.
- Water withdrawals for irrigation have increased by over 60 per cent since 1960. About 70 per cent of all available fresh water is used for

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irrigation in agriculture. Yet because of inefficient irrigation systems, particularly in developing countries, 60 per cent of this water is lost to evaporation or is returned to rivers and groundwater aquifers.[1]

- More than 2.2 million people, mostly in developing countries, die each year from diseases associated with poor water and sanitary conditions.[2]
- A WHO study shows that every US $1 invested in improved drinking water and sanitation services can yield economic benefits of US $4 to US $34 depending on the region.
- Freshwater ecosystems have been severely degraded: it is estimated that about half the world's wetlands have been lost, and more than 20 per cent of the world's 10 000 known freshwater species have become extinct, threatened or endangered.[3]
- Global atmospheric concentrations of CO2, CH4 and N2O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values, determined from ice cores spanning many thousands of years.[4]
- 2 billion tonnes of carbon dioxide (CO2) are absorbed by the oceans every year, making them one of the earth's key defences against global warming.

Managing groundwater

Water is a scarce and vital socioeconomic resource. The growing demand for water for both domestic and industrial purposes threatens the sustainability of groundwater, affecting agriculture, forestry, industry and drinking water. It is essential that water resources are managed strategically and sustainably.

Groundwater is the primary source of drinking water for half of the world's population. It is important that developing countries can protect and optimize what limited groundwater resources they have. Groundwater that has been contaminated due to land use activities affects public health and the environment. Industry is the greatest source of water pollution for developing countries. Rain runoff, especially flood water, is another major polluting agent because of the many different substances that it carries into freshwater systems.

IAEA technical cooperation projects promote the use of isotopic techniques to understand the source, extent and behaviour of water resources, as well as their vulnerability to pollution. Isotope hydrology also helps to identify the origin and extent of pollution or saline water intrusion, and provides valuable inputs for sustainable water resource management. IAEA projects support the development of comprehensive national and transboundary water resource plans

[1] UN WWAP, The United Nations World Water Development Report 2, 2006

[2] WHO/UNICEF/WSSCC, Global Water Supply and Sanitation Assessment 2000 Report, p.V.

[3] UN International Year of Freshwater Fact Sheet, 2003.

[4] IPCC Fourth Assessment Report: Climate Change 2007, Synthesis Report, p.37.

for domestic, livestock, fishery, irrigation and other water uses, and help Member States to develop regulations, procedures, standards, minimum requirements and guidelines for sustainable water management. Regional monitoring networks and databases on isotopes and the chemical constituents of surface water and groundwater can also help to improve water resource management. Additionally, radiation processing technology, in combination with other techniques offers improved environmental safety through effective treatment of wastewater, and supports the reuse of treated wastewater for urban irrigation and industrial purposes.

Supporting soil and agricultural water conservation

Soil erosion and land degradation are serious environmental concerns. Poor farming practices and inappropriate land uses have led to land degradation and accelerated erosion in many developing countries. The United Nations has highlighted soil degradation as one of the most significant environmental challenges to sustainable food production and supply of water in the 21st century.

IAEA technical cooperation projects apply nuclear technology to evaluate soil degradation and soil losses from erosion and to assess the effectiveness of soil and water conservation strategies in retaining water and applied nutrients for food production under both rainfed and irrigated agricultural systems.

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Monitoring and protecting the oceans

Marine pollution is a serious threat to marine creatures and habitats. Pesticides, toxic chemicals and heavy metals that can lead to mutation, disease and behavioural change enter the marine food web, and eventually end up in the human food chain. Trade in fish and seafood depends on a country's ability to determine the quality of foodstuffs.

IAEA technical cooperation projects help Member States to establish or improve analytical laboratories that can measure environmental radioactivity and pollutants in the oceans or in marketable foodstuffs. Other projects build national capacities to carry out marine environmental studies using nuclear analytical and radiotracer techniques that can track the movement of heavy metals and pollutants in the marine environment. By using such techniques, Member States can enhance their understanding of the earth's oceans, and their ability to manage and protect marine resources.

Data on radionuclides, isotopes and trace elements in the ocean can also help scientists to better predict weather and climate patterns and to develop methods to address major climate change issues. Natural radionuclides and isotopes can be used to study the ocean's ability to counteract the effects of climate change.

Identifying harmful algal blooms

In the ocean, harmful algal blooms (HABs), often referred to as red tides, can severely affect local and international trade. The IAEA is helping Member States to address HABs by finding quicker and more accurate means of detecting the presence of toxins in marine life. Early warning programmes provide important information about HABs to fishermen and consumers.

Managing air quality

Air contamination knows no borders. The increasing number of cars on the road and factories that pump particulates and other pollutants into the air, as well as energy generating activities that rely on the combustion of fossil fuels, are degrading the air quality of most major cities in developing countries. This raises the incidence of respiratory disease and contributes to global air pollution.

The IAEA helps Member States to fight air pollution and to reduce health risks to the public by studying and identifying the main sources of pollution. X ray and other nuclear analytical techniques can characterize and measure airborne particulates, helping policy makers create regulations that improve air quality and human health, and supporting national air quality management programmes.

Nuclear techniques can also be used for end of pipe treatment of pollutants: electron beam dry scrubbing, for example, can remove up to 95% of the pollutants from airborne factory outputs, and also results in a by-product that can be used as an agricultural fertilizer.

In addition, the IAEA also helps Member States to build their national capacity to develop strategic energy plans and helps countries to identify a suitable and feasible national energy mix that may or may not include nuclear power. Nuclear power may be the most environmentally suitable option for a country, as this form of energy generation avoids as much in carbon emissions as does hydropower.

Improving crop growth

IAEA technical cooperation projects use nuclear technologies to support the transformation and optimization of land and crops through improved sustainable farming practices. Mutation breeding – the use of radiation to induce favourable genetic variations – enhances the potential of native plants to meet local needs, such as salt and drought tolerance. Soil moisture neutron probes support optimal irrigation scheduling. Isotopic techniques also identify soil-water-cropping practices and fertilizer technologies that improve soil fertility status and soil quality for more nutrient-rich and high-yielding crops. The use of better adapted crops in combination with more appropriate timing and placement of fertilizers can improve soil fertility and lead to higher land productivity. Optimal placement of fertilizers reduces waste, protects the environment and saves on fertilizer costs while still increasing plant production. Biofertilizers and growth promoters can be obtained by radiation processing of inexpensive, locally available, biodegradable and renewable natural polymers.

Monitoring agricultural pollutants

Isotopes are also used to study groundwater contamination from agricultural pollutants, most commonly due to the application of inorganic fertilizers and animal manure. Agricultural pollutants are redistributed by runoff and erosion and have serious on- and off-site impacts on soil and water quality, threatening groundwater supplies, surface water quality, human and livestock health, and the environment.

With IAEA support, Member States can apply nuclear techniques to gather information on soil erosion rates, and the source and distribution of agricultural pollutants. This supports the development of effective management practices to prevent, minimize and control groundwater pollution, and helps to ensure the conservation of natural and agricultural resources for food crop production and environmental sustainability.

Reducing pesticide residues

Without pesticides, it would be nearly impossible to produce the quantities of food required to feed the world's growing population. However, pesticides include many hazardous substances and must be applied in an efficient manner to protect crops and farm animals while

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leaving the lowest possible residues in food and the environment. It is therefore necessary not only to monitor pesticide residues in soil, water and farm produce but also to promote best farming practices including soil-water-crop management practices that minimize soil erosion, optimize soil water retention capacity and improve soil and crop health. When crops exceed maximum residue limits (MRLs), produce cannot be sold on the international market. It may be sold locally, affecting local human and animal health.

IAEA technical cooperation projects support pesticide residue monitoring in soil, water and farm produce through training opportunities, the promotion of good agricultural practices, and the provision of appropriate laboratory equipment. Projects also help Member States to predict pesticide mobility in soils and leaching to the surface and into groundwater.

Measuring changes and mitigating damage: supporting environmental remediation

A wide variety of resource extraction operations from mining to minerals processing can result in the contamination of soils, surface and groundwater.

IAEA technical cooperation projects strengthen the capability of institutions and authorities to provide optimal management of areas contaminated by resource extraction, including the extraction of uranium. Projects support activity planning and costing, decontamination, dismantling, remote handling, assessment and management of radioactive wastes and remediation of sites including reuse and redevelopment.

What the IAEA technical cooperation programme does

Training courses and workshops provided through the technical cooperation programme cover topics such as marine contamination analysis, the distribution of contaminants, soil fertility and crop nutrition, soil and water conservation, soil-water salinity management, the establishment of permanent regional monitoring station networks and equipment use and methods customized to regional needs. This approach helps build local expertise and strengthen networking by bringing together researchers and technicians from across the developing world.

Technical cooperation projects assist Member States with training in the safe use of nuclear technology for the preservation and management of the earth's water resources. Project topics vary from the optimization of soil-agricultural water management including irrigation technologies to the use of isotope hydrology to determine the contamination of aquifers, and from the reduction of soil degradation and erosion to the study of harmful algal blooms. Through such projects, Member States are also applying radiation processing technology for a cleaner environment, from tackling harmful pollutants in wastewater to development of non-toxic fertilizers and plant growth promoters.

Expert assistance makes available on-the-spot training in a developing country by a recognized expert. Expert missions may be of a few months' duration or may extend to a whole year. When complex equipment is supplied to a country, the project usually includes the visit of an expert to train the staff in the operational and technical aspects of the instrument.

Training fellowships prepare local personnel to take over the responsibilities of soil-water-crop management, air quality and water resource assessment, and freshwater/marine water environmental impact evaluation in Member States. Fellows are sent abroad for comprehensive training to a suitable institution for periods ranging from a few months to several years. Technical cooperation fellowships provide researchers from IAEA Member States with the opportunity to learn and customize nuclear technology methods for their own research. Because of this adaptability, the fellowship programme attracts not just marine radiochemists and radioecologists, but also geologists, biologists, environmental scientists, soil scientists and plant physiologists.

Conferences, symposia and seminars are designed for exchange of ideas between scientists from various countries.

Equipment and materials provided by the IAEA are used to establish or enhance sustainable environment, water resource assessment and land and agricultural water management for achieving interlinked MDGs on environmental sustainability and eradicating hunger without degrading land-water resources in Member States. Equipment and techniques used in nuclear and non-nuclear methods often must be adapted to conditions in national laboratories.

Partnerships

Technical cooperation projects involve collaboration between governments, IAEA partners and Member States, keeping in mind priority national developmental needs where the IAEA has a unique role to play, where nuclear technology has a comparative advantage or where the IAEA can add value to services from other development partners. The IAEA strives to establish partnerships and working relationships through consultations and interactions with United Nations system organizations and other potential partners. Collaborative work ensures the coordination and optimization of complementary activities and informs relevant UN organizations of the developmental impacts of the TC programme.

Assistance to the TC programme in the area of fresh and marine water, soil and water management for food production and water resources assessment is provided by the IAEA's laboratories in Seibersdorf,

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Monaco and Vienna. The Marine Environment Laboratories in Monaco are dedicated to marine research, focusing on using radioactive and stable isotopes as tracers to better understand processes in the oceans and seas, address pollution problems and promote international cooperation. The Joint FAO/IAEA Agriculture and Biotechnology Laboratories in Seibersdorf specialize in research, development and transfer of nuclear techniques in soil science, plant breeding, animal production and health, entomology and food contaminant control. The laboratories provide a broad range of specialized services and training of scientists from developing countries through individual fellowships and interregional and group training courses in various disciplines. They also provide guidance on the introduction of analytical quality control and assurance into counterpart laboratories, and training in the maintenance of laboratory equipment and instruments.

Many activities are carried out in partnership with international organizations, such as the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the International Maritime Organization (IMO), the Global Environment Fund (GEF), the Food and Agriculture Organization of the United Nations (FAO), the Consultative Group on International Agricultural Research (CGIAR), Alliance for a Green Revolution in Africa (AGRA), the Intergovernmental Oceanographic Commission and the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO) and the United Nations Industrial Development Organization (UNIDO).

For more information, please visit:

www.iaea.org/technicalcooperation

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