IAEA

Nuclear Technology for a **SUSTAINABLE FUTURE**

water

energy

food

ocean

health

EVERY DAY, MILLIONS OF PEOPLE THROUGHOUT THE WORLD BENEFIT FROM THE USE OF NUCLEAR TECHNOLOGY

Nuclear Technology for a **SUSTAINABLE FUTURE**

Foreword by the **IAEA** Director General

Sustainable development requires international cooperation and the effective use of technology.

The IAEA helps its Member States to use nuclear technology for a broad range of applications, from generating electricity to increasing food production, from fighting cancer to managing fresh water resources and protecting the world's seas and oceans.

Despite the Fukushima Daiichi accident in March 2011, nuclear power will remain an important option for many countries. Use of nuclear power will continue to grow in the next few decades, although growth will be slower than was anticipated before the accident.

The factors contributing to the continuing interest in nuclear power include increasing global demand for energy, as well as concerns about climate change, volatile fossil fuel prices and security of energy supply. It will be difficult for the world to achieve the twin goals of ensuring sustainable energy supplies and curbing greenhouse gases without nuclear power. It is up to each country to choose its optimal energy mix. The IAEA helps countries which opt for nuclear power to use it safely and securely.

Every day, millions of people throughout the world benefit from the use of nuclear technology. The IAEA helps to make these benefits available to developing countries through its extensive Technical Cooperation programme. For instance, we provide assistance in areas such as human health (through our Programme of Action for Cancer Therapy), animal health (we were active partners in the successful global campaign to eradicate the deadly cattle disease rinderpest), food, water and the environment.

The IAEA contributes to the development of global policies to address the energy, food, water and environmental challenges the world faces. We look forward to helping to make Rio+20 a success.

This brochure provides an overview of the many ways in which nuclear technology is contributing to building the future we want. I hope you will find it useful.

Yukiya Amano
Director General
International Atomic Energy Agency

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Nuclear Technology for a **SUSTAINABLE FUTURE**

INTRODUCTION

Nuclear technologies are used daily to find and protect sustainable sources of fresh water, produce energy and food, while providing researchers the tools to study the ocean's past and predict its future. The IAEA helps its 154 member countries safely employ these technologies to ensure peace, health and prosperity throughout the world.

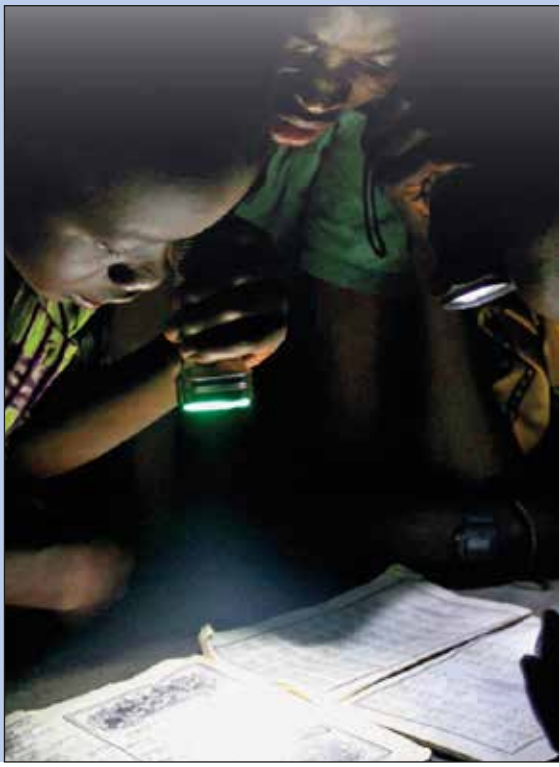
- *Population growth, accelerating economic development, and changing lifestyles demand ever more resources.* Resource overuse has begun to compromise "natural services" such as biodiversity, clean air, fresh water and arable land; a trend that threatens the sustainability of development. "Natural services" are inextricably interlinked. Decisions related to the management of a single resource impacts others.

  Yet, today at the national level, future land, water and energy policies are usually planned by separately operating institutions. An integrated system is needed to bring decision-makers together to address the complex challenge of designing development policies for an uncertain future. Integrated solutions can resiliently adapt to a changing climate and the natural resource constraints that could exacerbate existing inequalities.

  To help Member State governments achieve greater adaptability, the IAEA has developed a new methodology for modelling these complex interactions called **CLEWS** (Climate, Land-use, Energy and Water Strategies) that allows simultaneous and cohesive analysis of all these areas.

- *Increased access to sufficient, safe water* is made possible through nuclear techniques that map ground water resources more affordably and more quickly than any other means, and thus improve water managers' ability to sustain this irreplaceable resource. Nuclear techniques enhance the efficiency of agricultural irrigation, which uses 70% of all freshwater resources.

- *Access to affordable energy* directly improves human welfare; current projections foresee electricity demand increasing by 60 to 100% between today and 2030. Low carbon sources of energy, such as nuclear energy, minimize the greenhouse gases emitted in energy generation and mitigate the negative impact of climatic disruption on development. The IAEA helps countries using or introducing nuclear power to do so safely, securely, economically and sustainably. Its safety standards, assistance and reviews increase safety for the benefit of human health and the environment. The IAEA also verifies that nuclear energy is only used for peaceful purposes, directly contributing to international peace and security.



Young scientists come from IAEA Member States around the world to expand their knowledge through on-the-job training at MEL's advanced research facilities. Support for them is provided through IAEA Coordinated Research Projects, Internships and Technical Cooperation Fellowships.

Nineteen African countries are now part of the IAEA´s technical cooperation project that aims to promote drip irrigation for high-value crops.

- *Access to sustainable sources of food* will remain a preeminent challenge in the decades to come. Based upon current practice and consumption, agricultural production will have to increase by about 70% by 2050 to meet demand. Nuclear techniques are used in developing countries to increase production sustainably by breeding improved crops, enhancing livestock reproduction and nutrition, as well as controlling animal and plant pests and diseases. Post-harvest losses can be reduced and safety increased with nuclear technology. Soil can be evaluated with nuclear techniques to conserve and improve soil productivity and water management.

- *To better understand and protect oceans,* nuclear techniques are used to monitor the ocean's shifting chemical balance caused by ocean acidification that can stunt and endanger coral and microorganisms' growth. This chemical shift can limit the habitats and disrupt the food chain for the species that supply up to a third of all protein consumed by humans. Nuclear techniques are also powerful tools used to acquire an accurate picture of the ocean's distant past. With an improved understanding of past climates, predictions about this enormous, life-sustaining realm's future will be more accurate.

- *Health for millions of patients relies upon the safe and effective diagnosis and treatment of disease.* Nuclear techniques provide precise diagnostic information that is of vital importance in detecting and curing both infectious and non-communicable diseases such as cancer. Radiopharmaceuticals are used to treat disease and to enable diagnostic imaging. Radiotherapy also employs focused radiation beams that are essential in curing diseases. In the developing world, infectious and non-communicable diseases, as well as malnutrition, create a socio-economic burden that threatens sustainability. The safe, well-coordinated use of nuclear techniques to detect, diagnose and treat disease and to combat malnutrition contributes to improved health and social stability throughout the world.

Cancer deaths in the developing world are expected to surpass the collective toll of the three illnesses targeted by the Millennium Development Goals — HIV/AIDS, Tuberculosis and Malaria — in 2017, according to the World Health Organization.

A SAFE OPERATING SPACE FOR HUMANITY

Humans have become a major shaping force of the environment. This force that is fuelled by the growing demand for goods and services overexploits natural resources and ultimately leads to the degradation of natural ecosystems. Climate change amplifies the negative impact of our resource overuse. Measures, such as irrigation, desalination or the production of biofuels, that are designed to help mitigate and adapt to these climatic changes, are in themselves resource-intensive.

Current demand and resource use projections indicate that inclusive and sustainable development in the future is threatened. The United Nations Sustainable Development Conference, Rio+20, may launch a process to better define a safe and more equitable operating space for humanity that defines how we can preserve the environmental services upon which future generations depend, as well as offering socio-economic opportunity for all.

Solutions for sustainability

The linkages among the agricultural, water, energy and environmental sectors offer opportunities to apply nuclear technologies that provide solutions to these complex inter-related challenges. Cross-sectoral planning increases the effectiveness with which resources are employed, providing an essential benefit that supports sustainability. For instance, appropriate planning, development and monitoring can ensure that crops are bred to deliver as much nutrition as possible while using as little water and land as possible. Or, careful analysis can identify linked constraints in food and bioenergy production as a result of water or land resource limitations.

A leading priority in low income countries' is to find the means to enhance water, energy and food security, while contending with low resource productivity, in particular low agricultural yields, natural resource degradation, rapid population growth and weak institutional capacity. To help Member States develop integrated solutions for sustainable development challenges, the IAEA has created a tool that models these complex interactions called CLEWS (Climate, Land-use, Energy and Water Strategies).

CLEWS allows planners to conduct a simultaneous and cohesive analysis of these systems.

Access to enough fresh, safe water is of paramount importance to ensure sustainable development. The IAEA helps Member States develop science-based information and technical skills to improve their understanding and management of water resources. By tracking the isotopes of water, scientists can quickly obtain valuable information that may otherwise require decades of hydrological data collection to gather. Working with partners in government and the United Nations system, the IAEA has been a pioneer in developing isotope hydrology as a powerful and effective scientific approach for managing water resources.

WATER

Today, one billion people have no access to safe drinking water, and only about 15% of the world's population enjoy relative abundance. Unsafe water, carrying preventable, water-borne diseases, kills nearly five million people annually. Most victims of unsafe water are children. Rising populations, more irrigated agriculture and increasing industrial growth together deplete and degrade freshwater supplies faster than these can be replenished. In addition, river flows have become more variable and vulnerable in a warmer climate (due to increased glacial melt and changes in precipitation patterns). These concurrent trends are driving the need to optimize water use and management practices.

Water's fingerprints

Through its technical cooperation projects, the IAEA works with Member States to tackle water pollution and scarcity issues. For instance, to be able to depend upon fresh water supplies in the future, Member States must be able to accurately measure the available water resources. Water contains varying concentrations of naturally-occurring isotopes that can be measured with nuclear techniques. The measurements identify a specific water sample's origin precisely, quickly, easily and cost-effectively. The isotopic composition of water serves as a 'fingerprint' that allows researchers to track where water travels from its origin, what happens to water along its course and how quickly it is being replenished. Isotope tracking also helps researchers detect sources of pollution and salt water intrusion, and identify the effects of climate change.

IAEA water resource projects are in operation in Africa, Asia, Europe and Latin America, addressing a variety of groundwater and surface water resource challenges. For example, a study conducted by the IAEA in Bangladesh — where naturally-occurring arsenic poisoning created a major public health crisis — uncovered the source of contamination and provided information about where to find safe drinking water.

Reliance on aquifers

More than half the world's population relies on water pumped from aquifers, many of which traverse national boundaries. Nuclear methods rapidly and reliably map transboundary aquifers, producing the data needed to plan how to share the water sustainably, rationally and equitably. The IAEA is studying several major underground aquifers, such as the Nubian Sandstone Aquifer System in Africa and the Guarani aquifer in South America. These projects support better groundwater resource management, which is the basis for sustainable socio-economic development, as well as the preservation of biodiversity and land resources.

How much water is available?

The IAEA's Water Availability Enhancement Project (IWAVE) strengthens Member States' national capacity to conduct water resource assessments by identifying gaps in hydrological data and formulating strategies to close them. These comprehensive assessments include evaluations of water quality, water quantity, and water use, as well as resource vulnerability and sustainability. This information will complement other international, regional, and national initiatives to provide decision makers reliable tools to better manage national water resources. IWAVE pilot studies are under way in Costa Rica, Oman and the Philippines.

Cooperation is the key to sustainable water supplies

Developing countries receive training and technical analytical support in nuclear technology through the IAEA hydrology projects, as well as expert services and equipment. The IAEA Isotope Hydrology Laboratory offers analytical support and services to ensure high-quality isotope measurements worldwide, and helps Member States establish their own laboratories. The IAEA's newsletters, atlases, on-line applications, training programmes, e-learning, and isotope information help water resource managers make effective decisions. To strengthen the impact and broaden the reach of its programmes, the IAEA works together with other organizations, such as the World Bank, United Nations Environment Programme, Organization of American States and United States Geological Survey to facilitate programmes and transfer knowledge.
The IAEA is also a member of UN Water, an inter-agency group that brings together 30 United Nations organizations collaborating on effective fresh water management.

ENERGY

Development that relieves poverty relies upon access to energy. *Sustainable* development relies upon access to clean, sufficient and affordable energy. Globally, about 1.3 billion people, have no access to electricity, and are deprived of the opportunities that energy enables in education, agriculture, business, industry, and healthcare. Half of the world's population has no access to clean cooking fuels, relying instead on biomass such as wood, dung and agricultural residue, as well as coal, to fuel cook stoves and to heat their homes. The WHO estimates that diseases caused by the resulting indoor air pollution kill two million people annually.

Energy choices

Expanding energy access requires systematic planning to find the optimal combination of sources that deliver energy that is affordable, while conserving resources and protecting the environment. For the rural poor, off-grid renewable energy may offer the greatest promise. For the urban poor and growing mega-cities, the energy mix must include large, centralized electricity generation facilities to meet large-scale, centralized electricity demand.

The IAEA is the sole UN agency involved in overall capacity building in energy system analysis. It offers a comprehensive menu of support to assist developing countries plan for their future energy needs. Under the IAEA energy planning approach, all energy options are treated equally. Together with national planners, the IAEA develops and transfers tailored planning models and data that consider all of the economic, environmental, and social aspects of sustainable development. The IAEA trains local experts and establishes local capacity to chart national energy paths for sustainable development.

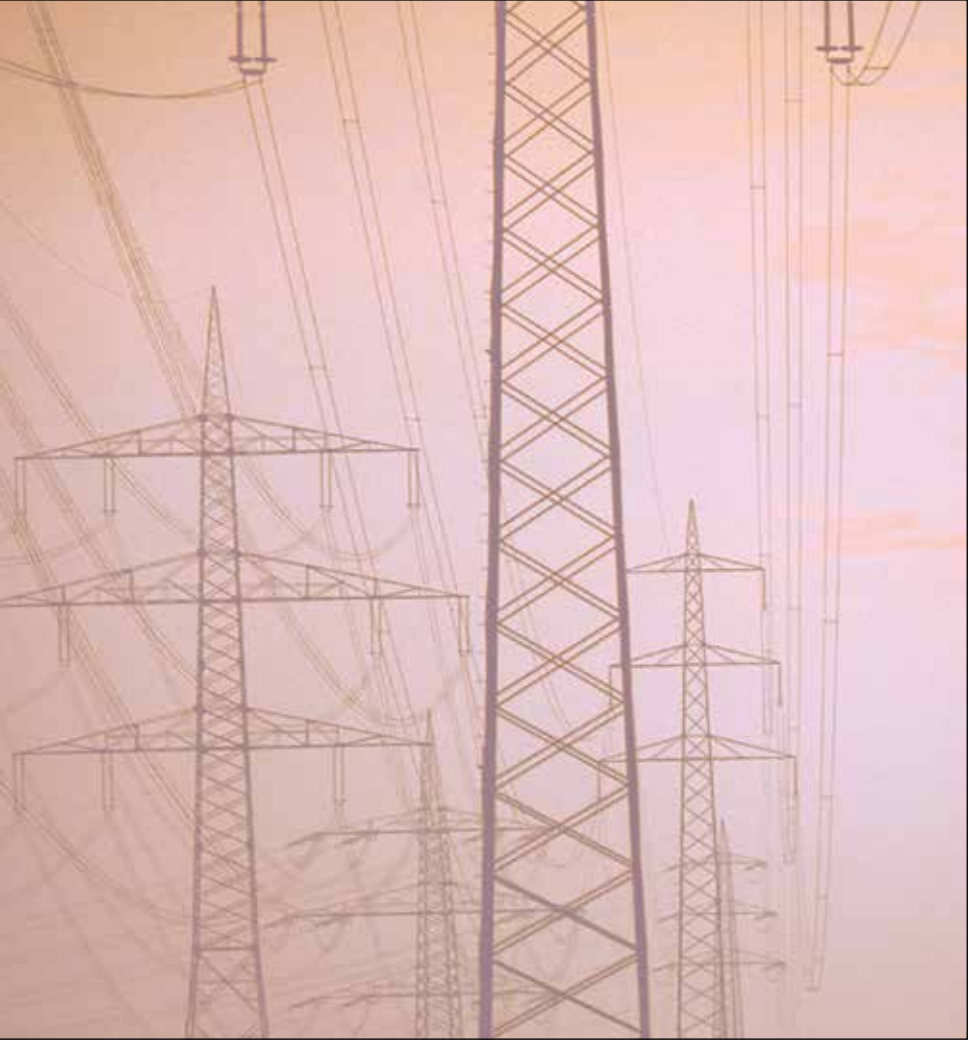
The IAEA is a founding member of UN-Energy, a network that promotes coherence within the United Nations family of organizations in the energy field and develops engagement between the United Nations and other key external stakeholders

Using nuclear power safely

To be a viable contributor to sustainable development, nuclear power must be safe: accidents must be prevented and avoided; the emergency response must ensure that any radioactive release is minimized and swiftly stopped to prevent public exposure. The IAEA's safety standards, safety training, direct assistance and safety peer reviews help ensure that the highest safety levels are in place.

After the Fukushima-Daiichi nuclear power plant accident the IAEA's Member States approved an Action Plan on Nuclear Safety. The Action Plan focuses a global effort to strengthen nuclear safety worldwide. Under the Action Plan, all countries with nuclear power programs agreed to promptly undertake nuclear power plant 'stress tests'. The IAEA's peer reviews are being strengthened by incorporating lessons learned from the accident and by ensuring that these reviews appropriately address regulatory effectiveness, operational safety, design safety, and emergency preparedness and response.

Essential to all human activities, energy fuels social and economic development. Energy is the engine for the production of goods and services across all economic sectors: agriculture, industry, transportation, commerce, public administration, among many others. Lack of energy is a contributing factor in individual, community, national and regional poverty. In contrast, access to energy opens many new opportunities; and meeting the United Nations Millennium Development Goals cannot be accomplished without access to affordable energy services.



Using nuclear power economically and sustainably

Nuclear power is not a panacea. It is a good investment if the benefits exceed the risks, costs less than available alternatives, pays for itself, and results in profitable operation.

Ensuring profitability requires good planning, infrastructure and operation. For countries that choose to introduce nuclear power, the IAEA provides guidance and assistance in developing the necessary legislative and regulatory framework, human resources, nuclear safety, stakeholder involvement, emergency planning, environmental protection, non-proliferation safeguards and nuclear waste management.

When a nation includes nuclear power in its energy mix, it reduces harmful air pollution and greenhouse gas emissions, expands electricity supplies, increases the national stock of technological and human capital and broadens the resource base by putting uranium to productive use.

Due to its environmental risk, radioactive waste requires special attention. The IAEA, as the only UN organization involved in radioactive waste management, establishes safety standards and provides technical and related guidance for the implementation of waste management in accordance with those safety standards.

Using nuclear power securely

As with safety, nuclear power must be secured against malicious acts such as sabotage, theft or attacks to be a viable contributor to sustainable development. The IAEA develops security guidelines and provides training, direct assistance and peer reviews to ensure that security is maintained at the highest possible levels.

Using nuclear power peacefully

Sustainable development depends upon international peace and security, which the IAEA helps to maintain by verifying that nuclear power is used for peaceful purposes only. This is essential because, unlike other energy forms, nuclear energy can be misused to pursue military purposes and develop nuclear weapons.

Over the past five decades, the international community has put in place a number of international legal mechanisms to help stem the spread of nuclear weapons. These include the Treaty on the Non-Proliferation of Nuclear Weapons and the IAEA safeguards system. The IAEA applies safeguards, a set of technical measures through which it independently verifies that nuclear material is not diverted from peaceful uses. The IAEA plays an important verification role, demonstrating to States that nuclear non-proliferation commitments are being respected.

The IAEA delivers training, technical assistance and equipment to States, and provides international guidance on improving nuclear security.

FOOD SECURITY AND SUSTAINABLE AGRICULTURE

As the effects of a changing climate become more evident, many countries are burdened by longer drought periods, flood-triggered soil erosion, encroaching saline water, and the devastation wrought by extreme weather. All of these factors can severely constrain food production and sustainable development. Nuclear techniques are used to increase crop and soil productivity, efficiently manage water resources, improve livestock health and productivity and reduce the use of fertilizers.

Healthier livestock

Healthy and productive livestock help ensure food security. Nuclear techniques are used to improve livestock growth, reproductive efficiency and disease resistance. For instance, radioimmunoassay methods help diagnose diseases and monitor the effectiveness of disease control and eradication programmes. This methodology is essential in stopping the spread of trans-boundary animal diseases, such as rinderpest, which was recently completely eradicated worldwide.

Defence against insect pests

Nuclear techniques can be used as part of an integrated approach to control insect pests that destroy crops and spread disease. Diseases and pests destroy more than a third of crops before and after harvesting. Insect pests can be controlled using the sterile insect technique (SIT). In SIT, an environmentally friendly alternative to insecticides, male, laboratory-raised insects, are sterilized with gamma radiation. When they are released into the wild and mate, no offspring are produced. Over time, insect populations shrink and are eventually fully suppressed, reducing the need for pesticides. SIT has been used to eradicate the medfly, a threat to some 250 species of fruit and vegetables, from Chile and Mexico, as well as from parts of Guatemala and the United States.

Reducing pollutants

By suppressing insect pest populations with SIT, pesticide use worldwide had been reduced by 600 000 litres annually. At the same time, the technique has improved incomes for 18 000 producers, since these pesticide-free products, grown in developing countries, satisfy international food safety requirements, thereby increasing the access of rural agricultural communities to valuable export markets. For example, the use of SIT in Guatemala reduced the fruit fly population, which helped double earnings from the agricultural export of tomatoes, bell peppers and papaya, while providing badly needed new jobs. Since 2006, the insect pest control programme has generated benefits to farmers of more than $100 million and created thousands of rural jobs.

Plant breeding

For instance, when seeds are briefly exposed to radiation, subtle genetic changes in plants occur, speeding up a natural process that would otherwise take many years. The IAEA utilizes this technique to help Member States swiftly develop commercial crops that are more resistant to disease or drought. A wide range of improved crop varieties, such as rice, wheat, banana, potato, yam and soya bean, have been developed. These varieties are now planted for instance on 15% of Vietnam's rice production area, where they have been adopted as part of a national programme to "eradicate hunger and alleviate poverty", focussing on the central highland region, an economically poor area where agricultural production is low. These techniques expand the range of productive land and increase the global food supply.

Services to ensure food security

Through a joint programme, the Food and Agriculture Organization and the IAEA collaborate to support global food security and contribute to combatting poverty. IAEA services increase Member States' capacity to adapt to climate change by offering needs assessments, technical advice, training, coordinated research projects, equipment, networking, technical publications and public information.

PROTECTING THE OCEANS

The IAEA's Environment Laboratories in Monaco help Member States apply nuclear techniques to detect pollutants in coastal zones and the deep ocean, analyse their impacts on marine organisms and human health, and better understand key marine heat and carbon cycling processes.

Ocean acidification

The oceans absorb 2 billion tonnes of carbon dioxide every year, and act as a powerful buffer that mitigates the effects of global warming. The IAEA Environmental Laboratories study ocean acidification and climate change's other effects on oceans and marine ecosystems. Ocean acidification occurs as oceans absorb the rising quantities of carbon dioxide in the atmosphere. When dissolved, the carbon dioxide forms carbonic acid, creating a more acidic environment, which can threaten marine ecosystems. Corals and other marine organisms, particularly those with shells, are at particular risk. The IAEA is using radiotracers to track the effects of this acidification on ocean chemistry and marine life. This knowledge is needed to be able to act effectively to protect the oceans that are the primary source of food for more than 3.5 billion people.

To support international efforts to mitigate ocean acidification, the IAEA, together with UNESCO and 155 scientists, drafted and signed the 2009 Monaco Declaration, which calls for substantial reductions in CO_2 emissions to avoid widespread damage to marine ecosystems caused by ocean acidification. The IAEA is an active member of UN Oceans, which is an effective, inter-agency coordination mechanism on ocean and coastal issues within the United Nations.

Understanding climate change

The IAEA contributes to basic climate science by using nuclear techniques to learn more about past climates. The isotopic "natural archives" preserved in marine sediments, ice cores, corals and polar ice offer a wealth of information. The isotope record provides precise data about the environmental conditions on Earth over the past millennia. Information about the ocean's temperature, salinity, acidity, humidity, biodiversity, and circulation in the ancient past helps scientists verify the accuracy of current ocean and climate models and helps orient future model development. These models are needed to predict the ocean's "health" and the weather in future.

Preventing marine pollution

The IAEA has worked with several regional organizations to improve their capacity to use nuclear techniques to monitor and assess marine pollutants, like heavy metals and pesticides. Projects to enhance the capability of Black Sea and Caribbean countries to assess and monitor coastal pollution problems have been successfully completed. In the Caribbean and the Philippines, nuclear techniques have been validated as reliable, swift, cost-effective tools that detect toxins produced by harmful algal blooms in marine foods.

Measuring marine radioactive pollution

The IAEA's Environment Laboratories have provided essential scientific and analytical support for a landmark study of radioactive and non-radioactive pollutant levels in all principal seas. They have undertaken worldwide radioactivity baseline studies of the Antarctic, Arctic, Atlantic, Indian, North and South Pacific Oceans, and the Far Eastern, Mediterranean, and Black Seas. Regional studies have been conducted in the Gulf, as well as the Caspian, Irish, and Kara Seas, in addition to the New Caledonia, Mururoa and Fangataufa Atolls. The baselines levels are essential for identifying changes to the radioactivity levels in the marine environment.

Following the Fukushima Daiichi nuclear accident, radioactively contaminated cooling water was discharged into the sea, raising concern about the radioactivity's harmful effects on marine life and on seafood destined for human and animal consumption. Japan initiated an intense programme to monitor both coastal and off-shore levels of seawater contamination at the discharge area, as well as at distances 10 and 30 kilometers from the reactors. The IAEA is now undertaking a long-term marine study of the Pacific through an IAEA regional cooperation project.

The IAEA Marine Environment Laboratory in Monaco is the only marine laboratory in the UN system, supporting efforts to protect the world's oceans and seas.

HUMAN HEALTH

In developing countries, malnutrition, communicable and non-communicable diseases, particularly cancer, threaten health and cut short productive lives. Health problems and diseases can be detected and treated using nuclear techniques.

Fighting non-communicable diseases

Non-communicable diseases, such as cardiovascular diseases, cancer, diabetes and chronic lung disease, are a significant barrier to sustainable development. The WHO estimates that the costly, long term health-care needed to treat these diseases consumes family savings in low and middle-income countries and drives about 100 million people into poverty every year. More than 36 million people are killed each year by these diseases, and nearly 80% of these deaths occur in low- and middle-income countries. A quarter of the victims die early, before their sixtieth birthday, often robbing families of a breadwinner.

For over 40 years, the IAEA has helped its Member States to build sustainable capacity in the use of radiation medicine and has assisted more than 110 low and middle-income countries to manage cancer and non-communicable diseases. For instance, with the assistance of the IAEA, Mauritania's first radiotherapy centre was inaugurated in 2010, and, cancer patients are receiving treatment in their home country. Another IAEA project in Yemen has helped to establish the necessary infrastructure for the country's first nuclear medicine centre, by building the necessary human capacity, training staff and providing essential equipment, such as a double-head gamma camera. The Nuclear Medicine Centre at Al-Thawra Hospital was opened in early 2008 and can provide services

to many of the 23 000 patients per year requiring cancer, renal and cardiology diagnosis, and serves as a national training centre in Yemen.

Fighting cancer in the developing world

Today, most new cancer cases are diagnosed in the developing world where access to cancer diagnosis and treatment is very limited. According to the WHO, more than two-thirds of new cases and cancer deaths — almost eight million people worldwide per year — occur in low and middle income countries. Cancer is spreading in these countries at an epidemic rate. Cancer, which often affects the most productive working-age members of society, could become a major impediment to socio-economic development in low and middle income countries.

Radiotherapy: a cancer-fighter's essential tool

The WHO considers radiation therapy to be "fundamental to the optimum management of cancer patients", which alone, or in combination with surgery or chemotherapy, is recommended for more than half of cancer patients. Radiotherapy is attractive for developing countries, because it is a highly cost-effective option for cancer treatment.

In 2004, the IAEA established the Programme of Action for Cancer Therapy (PACT) to help fight cancer in its developing Member States comprehensively and effectively, through partnerships and resource mobilization. PACT builds upon the IAEA's expertise in radiation medicine technology to enable low and middle income countries to introduce, expand and improve their cancer care services and workforce. PACT also conducts missions to evaluate Member States' readiness to implement cancer control programmes and offer recommendations on developing cancer control capacity.

Global alliance

The WHO/IAEA Joint Programme on Cancer Control is a global alliance of NGOs, foundations, public and multilateral organisations and private industry that works to increase awareness, build technical and public policy capacity and develop alternative fundraising mechanisms to help establish much needed national cancer control programmes in developing countries. With the support of the WHO/IAEA Joint Programme, countries such as Ghana now have established a national cancer control plan, and are implementing infrastructure improvements and developing the needed workforce, which all are helping to improve the health of the population in the country.

Improving nutrition

Malnutrition has devastating humanitarian and economic consequences, contributing to developmental problems and weakened immune systems, and to subsequent long term impacts on the economy. One out of every ten children born in developing countries will die before their fifth birthday as a result of malnutrition. According to the World Bank, investing in infant and young child nutrition can save one million lives each year, and can help 260 million more children and their mothers have a healthier future. Given its comparatively low cost, investing in children's improved nutrition is one of the most effective interventions to advance sustainability.

The IAEA's nutrition programme, in cooperation with WHO and UNICEF, uses nuclear techniques to monitor a wide variety of nutritional problems. To improve breastfeeding practices, manage healthy growth and address micro-nutrient deficiencies, the IAEA helps Member States develop effective, evidence-based interventions to combat malnutrition using stable isotope and other nuclear techniques. These methods are non-radioactive and non-invasive procedures. For the first time, this method is being used in fifteen African countries to collect a large data set on human milk intake and the prevalence of exclusive breastfeeding. Nuclear techniques are also used for neonatal screening for sickle cell disease, hypothyroidism and cystic fibrosis, as well as childhood cancers.

CANADA — The Linola mutant series of linseed is similar to traditional sunflower oil and therefore suitable for human consumption. Linola accounts for about 10% of all flax/linseed grown in Canada, a major flax producer.

GHANA — Cassava variety 'Tek Bankye', with improved cooking quality, released to wide acclaim. Trials underway to produce higher-yielding, disease resistant cassava, with improved starch content.

SUDAN — Banana variety 'Albeely' producing up to 100% higher yields and improved quality.

VIETNAM — Since the mid-1990s eight mutant rice varieties were released, with high quality, increased yield and tolerance to soil salinity. Since 2000, the area cultivated with mutant rice varieties reached 2.5 million hectares in southern Vietnam.

CAPACITY BUILDING

At the heart of the IAEA's activities is building local capacity through technology transfer. Working with its Member States, the IAEA's role is to make sure that this technology is used safely and effectively, and can also be locally sustained. This means providing training to develop local expertise and ensuring that any needed infrastructure is in place before technology is transferred.

The IAEA helps Member States develop scientific and technical capacities in water management, soil management, agriculture, energy planning, nuclear engineering, and environmental and climate research to enhance sustainability nationally and regionally. As a result, many developing countries are using state-of-the-art nuclear science and technology to solve chronic developmental challenges, such as ensuring public health, providing sufficient energy, food and fresh water, as well as preserving a safe environment. The IAEA's services include expert needs assessments, technical advice, training, equipment procurement, networking, technical publications and public information, which are delivered through coordinated research projects and the technical cooperation programme.

The IAEA helps countries that choose to introduce nuclear power to make the necessary long-term plans, to develop the necessary infrastructure and to continuously improve safety and efficiency, and provides guidance on each of the milestones that a country must meet when preparing for nuclear power. These milestones distil lessons from past experience, helping countries that choose to introduce nuclear power today to do so safely, securely and sustainably. The IAEA helps countries to assess their progress against the milestones and provides training and assistance to strengthen their programmes and speed their progress.

Over the past five decades, the IAEA and its Member States have built a sound foundation of institutions and personnel in many developing countries that now provide an important regional resource — in terms of capabilities and expertise. Today, developing countries are better positioned to use nuclear science and technology to improve public health, provide sufficient food, energy and water; and sustain a safe environment.

By advancing the peaceful uses of nuclear technologies, the IAEA helps its Member States address basic human development needs, while building the future we want.

Throughout the world, nuclear applications in medicine, industry, agriculture and environmental research are helping to save lives, boost productivity, increase food output, provide energy and protect oceans and fresh water reserves. The IAEA provides guidance and practical assistance to countries that are interested in using nuclear science and technology to support sustainable development.

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