IAEA BRIEF 2017/4

Environment

How Nuclear Techniques Help Address Environmental Challenges of Island States

SUMMARY

- Many island States face similar sustainable development challenges, such as limited natural resources, vulnerability to natural disasters and environmental shocks. Some islands are also remote, with small populations.
- The IAEA provides support in several areas of interest to island States, such as ocean acidification, coastal pollution, seafood safety, monitoring of marine ecosystems, groundwater management and soil conservation.
- The IAEA works with its Member States to design and carry out projects that directly address such challenges.

Coral reefs and the organisms they shelter are a vital source of food and revenue for island States. The IAEA supports Member States in using nuclear and isotopic techniques to protect and preserve the marine environment.

(Photo: P. Swarzenski/IAEA)

INTRODUCTION

Island States are influenced by the water that surrounds them, and their inhabitants depend extensively on the marine environment for their livelihood. They have limited terrestrial resources to meet the needs of their populations and many face serious challenges such as coastal erosion, rising sea levels, land and marine pollution, and ocean acidification.

Population increase affects the availability of arable land, places heavy demands on freshwater resources and may threaten biodiversity. Drought, decreased rainfall (or in some places excessive rainfall), loss of mangrove forests due to sea level rise, coral reef loss due to ocean warming and acidification, damage to terrestrial forests and environmental degradation are additional problems.

Nuclear technology offers solutions to many of these challenges. For example, nuclear and isotopic techniques can be used to identify patterns of water circulation and to support the management of freshwater resources, to improve soil health, and to enhance farming practices and improve livestock health in support of greater food production.

IAEA SUPPORT

The IAEA helps its Member States use nuclear technology for a broad range of applications — from generating electricity to increasing food production, from managing freshwater resources to ensuring seafood safety and protecting marine ecosystems

— as well as assisting them with the strengthening of regulatory control in the use of such technology. The IAEA provides Member States with training in the use of nuclear and isotopic techniques to detect environmental contaminants and to limit their impact on organisms and protect human health.

PUTTING NUCLEAR TECHNOLOGY TO WORK

The IAEA, through its technical cooperation programme, helps island States to strengthen capacity in the peaceful application of nuclear technologies. It does this using three key mechanisms:

- Training provided to scientists, technicians and others improves the knowledge and skills required to apply nuclear techniques in the laboratory and in the field. In addition to enhancing Member States' abilities to carry out sampling missions, monitoring and assessment, specific IAEA-related training strengthens capacity in relation to information systems, particularly data collection and storage, analysis and interpretation.

- Expertise is provided by sending leading experts to work with country counterparts (e.g. local scientists and policymakers) to address specific problems, typically by providing advice, training or by contributing to meetings and workshops.

- Equipment is often needed to support the peaceful application of nuclear techniques. With the right tools, trained staff with first-hand knowledge of local issues can apply their expertise.

ASSESSING THE IMPACT OF OCEAN ACIDIFICATION

The world's oceans make up around 70% of the earth's surface. They soak up carbon dioxide from the atmosphere, helping to mitigate the effects of climate change. However, this changes the chemical balance of the ocean through a process known as ocean acidification. The amount of carbon dioxide released into the atmosphere, primarily generated by burning fossil fuels, has now reached over 9 billion tonnes per year. Unless carbon emissions are reduced, ocean acidity is expected to increase by 150% by the end of the twenty-first century. This could have serious repercussions for marine ecosystems, as well as for people who depend on the ocean as a source of revenue and food.

The IAEA Environment Laboratories based in Monaco conduct research with radioactive isotopes such as calcium-45, which can be used as tracers to examine the growth rates in calcifying organisms such as corals, mussels, limpets and other molluscs, whose skeletons and shells are composed of calcium. Tracers are also used to determine how ocean acidification is affecting the eggs and juveniles of vertebrate fish species, such as finfish, and cephalopods, such as squid and cuttlefish.

In addition to conducting research, the Monaco laboratories host the Ocean Acidification International Coordination Centre (OA-ICC), which fosters scientific collaboration to provide sound data in support of fact-based understanding of the potential impacts of ocean acidification on the marine environment and coastal populations. The Monaco laboratories also build awareness of how conventional, nuclear and isotopic techniques can be used to understand the effect of changes in seawater chemistry on marine organisms and ecosystems, coupled with other human pressures such as overfishing, eutrophication and pollution.

TRACKING MARINE POLLUTANTS AND ENSURING SEAFOOD SAFETY

In addition to ocean acidification, our seas and their wildlife are facing a grave threat from the release of pollutants into the marine environment. This includes heavy metals, such as lead and mercury, and synthetic organic compounds, such as chlorinated pesticides, flame retardants and polychlorinated biphenyls (PCBs). Pollutants also include some of life's building blocks, such as nitrogen and phosphorous compounds that can fuel eutrophication and harmful algal blooms (HABs). These pollutants can enter our oceans through illegal

dumping of industrial waste, or through harder-to-control processes such as rainwater run-off and river pollution. In high concentrations, pollutants and biotoxins linked with HABs can jeopardize seafood safety, threaten human health, and limit the use of marine resources.

The IAEA Environment Laboratories use nuclear and isotopic techniques to trace the sources of pollutants on land and in the sea, helping to limit their impact on the environment and on populations. The IAEA helps Member States develop their expertise for monitoring contaminants in the environment and in seafood so that they can protect their populations rapidly and effectively in case of a pollution incident or a HAB outbreak. The research work carried out at the IAEA Environment Laboratories also provides insight into the transfer and accumulation of contaminants in marine organisms.

MANAGING SCARCE FRESHWATER RESOURCES

Many island States experience freshwater shortages. Limited capacity to store water for the dry season and torrential rains, coupled with easily eroded soils, can cause siltation of reservoirs, further decreasing storage capacity. Groundwater is the largest freshwater source available and is currently used to meet global domestic, industrial and agricultural demands. However, the challenge for island States is that seawater intrusion can damage or destroy available groundwater, posing a serious threat to water supplies and public health.

Isotope hydrology techniques provide unique information on water resources, as these techniques can identify the unique 'fingerprints' of water. This allows water to be tracked throughout the water cycle, and key information on the age, origin and renewal rate of groundwater, as well as its vulnerability to pollution, salt water intrusion and climate change, to be collected. Such data allow for targeted evaluations of water quality, and offer invaluable, objective

Scientists at the IAEA Environment Laboratories in Monaco use nuclear techniques to detect biotoxins from harmful algal blooms to limit their impact on the environment and on seafood safety.

(Photo: Sarah Couture/IAEA)

information to support sustainable water resource management.

In addition, nuclear technology can help these countries with limited land space to better manage their water resources through smart agriculture.

ENHANCING SOIL MANAGEMENT

Degraded land and eroding soils jeopardize people's lives and livelihoods. Sustainable land management policies in island States require data for accurate soil erosion assessments and to determine whether soil conservation practices are effective. Isotopic techniques can provide accurate data for

Staff from the IAEA Environment Laboratories train scientists from Member States on sampling techniques to determine the presence of pollutants in the ocean.
(Photo: Roberto Cassi/IAEA)

such assessments. Radionuclides can be used to characterize and quantify sediment movement, and to trace the origin of soil particles and their redistribution inside a watershed, an area or ridge of land that separates waters flowing to different rivers, basins, or seas. Such techniques can be used to identify erosion hot spots, providing important data for decisions to reverse land degradation and restore soils.

Soil erosion also has broader environmental consequences. Besides providing the medium for plant growth and food production, soil plays a key role in the supply of clean water and resilience to flood and drought. It is also the largest store of terrestrial carbon; its preservation contributes to climate change adaptation and mitigation.

The IAEA also helps to develop new crops that are resistant to saline soil, and to strengthen soil fertility using nuclear related technologies.

SAFE AND SECURE USE OF NUCLEAR TECHNOLOGY

The IAEA assists in the introduction of global safety standards and nuclear security guidance into national legislation and regulatory infrastructure in order to ensure the safe, secure and sustainable application of nuclear science and technology for socio-economic development.

RECOMMENDATIONS FOR CONSIDERATION

Island States are encouraged to:

- Examine how nuclear science and technology can contribute to addressing development and environment challenges.
- Participate in targeted IAEA activities that are designed to support the application of nuclear science and technology for socio-economic development.
- Collaborate with the IAEA in capacity building and training to have well-trained and knowledgeable national scientific personnel able to apply nuclear techniques for development.

IAEA Briefs are produced by the Office of Public Information and Communication
Editor: Aabha Dixit • Design and layout: Ritu Kenn
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