

SPOTLIGHT

Technical Cooperation Programme to Build Countries' Capacities for Science-Based Sustainable Marine Management

By Marc Metian, Jana Friedrich, Pere Masque, Sam Dupont, Magali Zapata, Michel Warnau, and Carlos M. Alonso-Hernandez

INTRODUCTION

For more than 60 years, the International Atomic Energy Agency (IAEA) has promoted the peaceful use of nuclear science and technology for addressing major socioeconomic and sustainable development priorities at national, regional, and interregional levels. The Agency's Technical Cooperation (TC) Programme is the primary mechanism for transferring nuclear and related technologies to its Member States, helping them to address their priorities in a variety of areas such as health and nutrition, food and agriculture, water and the environment, industrial applications, and, of course, the safe and secure use of nuclear energy. Here, we briefly describe the types of TC Programme projects that promote the sustainable development of coastal countries and the mechanisms IAEA uses to identify and support the projects. We highlight two of these projects.

CAPACITY BUILDING EFFORT

With 178 Member States and over 2,500 staff, the IAEA is central to global governance in monitoring and assisting with the peaceful use of nuclear technology. The agency promotes nuclear technology R&D, offers services and equipment, and fosters scientific exchange among its Member States. Beyond nuclear energy, it supports various nuclear and nuclear-derived applications, including for marine science under the Atoms for Peace and Development agenda, aligned with UN Sustainable Development Goals (SDGs) 13, 14, and 17 (climate action, life below water, and partnerships).

The collaborative IAEA TC Programme involves Member States, the IAEA Secretariat, and strategic partners in designing peaceful uses of nuclear technologies. All Member States can participate and benefit from the Programme, either directly through specific projects or indirectly through global initiatives (Raffo-Caiado, 2018). Through consultation with national stakeholders, Country Programme Frameworks (CPFs) reflect national priorities and identify areas for cooperation between Member States and the TC Programme.

Managed by the Department of Technical Cooperation, the IAEA TC Programme's integrity is ensured by technical departments. The Monaco-based Marine Environment Laboratories play a pivotal role in marine science research and development, and in providing technical guidance to TC projects. With marine issues becoming increasingly important in CPFs, these laboratories focus on developing and transferring modern nuclear science and technology to assist Member States in addressing oceanic changes caused by human activities.

The TC Programme's planning process involves extensive consultations during a two-year dialogue that ensures projects meet IAEA quality criteria. Services provided by the TC Programme include human resource development and provision of expert advice and equipment as well as training, workshops, fellowships, and support of conferences for knowledge exchange. The Programme facilitates expert missions and scientific visits emphasizing South-South and triangular cooperation, and supplies equipment for institutional capacity building, aligning with Member States' requests and priorities.

RESULTS

Since 2000, more than 50 marine TC projects have been implemented on topics such as marine toxins; ocean acidification; seafood; and organic, inorganic, and radioactive contaminants in marine ecosystems.

Among these projects, emerging areas of technology transfer, such as those regarding marine microplastics and blue carbon, have grown significantly to align with the needs of Member States. The flagship initiative NUClear TEChnology for Controlling Plastic Pollution (NUTEC Plastics) was launched in 2021 by IAEA Director General Rafael Grossi to address the global challenge of plastic pollution on two main topics: plastic recycling and marine microplastic monitoring. Marine microplastic pollution is complex, with significant monitoring challenges and unequal global capacity. By equipping laboratories worldwide with the necessary technology and expertise, NUTEC Plastics aims to enhance the understanding and mitigation of plastic pollution's impact on marine ecosystems.

Since its inception, NUTEC Plastics has developed a global network of laboratories, supported by teams that specialize in microplastics research. As of June 2024, 99 laboratories were part of this network (Figure 1), with more expected to join. To date, 132 individuals have been trained, and two harmonized protocols for sampling and analysis on sandy beaches and in surface waters have been developed and endorsed by experts from participating Member States. Additionally, most participating laboratories have received equipment that includes almost 80 sampling kits and spectroscopy systems for monitoring and characterizing microplastic pollution.

The second emerging area of technology transfer involves sharing capacity with IAEA Member States on the assessment of carbon sequestration by coastal vegetated ecosystems (blue carbon), a key mechanism for effective climate change mitigation. Enhancing Member States' capabilities through technical training, analyses, and advice enables them to contribute significantly to the UN 2030 Climate Agenda, fostering sustainable development and environmental protection. The first TC project on blue carbon was initiated in 2020 alongside research conducted at the IAEA Marine Environment Laboratories on this topic. By 2024, seven national, regional, and interregional TC projects were ongoing, and three were in preparation. To date, 40 countries are already using or establishing atomic and nuclear techniques for assessing carbon content and sequestration rates in blue carbon ecosystems, thanks to cooperation with the IAEA.

LESSONS LEARNED

The IAEA's marine nuclear application capacity building efforts are designed to enhance Member States' abilities to protect the marine environment, foster technical cooperation, support research, share knowledge, and ensure sustainable resource use, all within a framework of environmental safety and sustainability. Examples of successful efforts have occurred in seafood safety in Africa (IAEA, n.d.) and in

NUclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics)

Marine Microplastic Monitoring and Assessment



ON JUNE 2024

99 member states involved through **24** technical cooperation projects related partially or fully to this initiative
132 people trained and **6** million euros invested for the implementation of this initiative

FIGURE 1. The marine component of the International Atomic Energy Agency (IAEA) initiative called NUTEC (Nuclear TEChnology for Controlling Plastic Pollution) Plastics. Through the IAEA's NUTEC Plastics initiative (begun in 2021), 99 countries are now participating in marine microplastics monitoring and impact assessment (data as of June 2024).

the creation of the Research Network of Marine-Coastal Stressors in Latin America and the Caribbean (REMARCO; <https://www.iaea.org/services/networks/remarker>).

Project successes hinge on constructive interaction among three key stakeholders: the country, the specific institution involved, and the IAEA team. Commitment and ownership by the country, crucial for sustaining post-project activities, can consist of establishing institutional knowledge management strategies and multi-institutional agreements as well as engaging international partners.

TC Programme challenges include limited funding and an increasing number of Member States' requests along with competing priorities (e.g., nuclear safety and security vs. human health vs. food and agriculture vs. environment) that arise with multiplication of the number of projects. Additional resource mobilization and government cost sharing must be considered for addressing these challenges, as improving Member States' capacities to make science-based ocean management choices is essential.

CONCLUSION

Science and technology are key for socioeconomic growth. Many developing countries lack the means to advance science and technology. The IAEA supports its Member States through the Technical Cooperation Programme and in acquiring the necessary expertise and infrastructure to address sustainable marine development. The IAEA's efforts have significantly improved marine management by enhancing the monitoring and analysis of marine pollution, including microplastics, and by building global laboratory networks and capacity. This has led to better understanding and effective mitigation strategies as pollution and climate change increasingly affect marine ecosystems.

REFERENCES

IAEA (International Atomic Energy Agency). n.d. Strengthening regional capacities in monitoring marine pollution and assessing related risks in Africa. IAEA, 2 pp., https://www.iaea.org/sites/default/files/18/10/raf7015_success_story_2018.pdf.
Raffo-Caiado, A. 2018. IAEA's Technical Cooperation Programme—Nuclear Technology Contributing to Development. Pp 157–165 in *International Cooperation for Enhancing Nuclear Safety, Security, Safeguards and Non-proliferation—60 Years of IAEA and EURATOM*. L. Maiani, S. Abousahl, and W. Plastino, eds. Springer Proceedings in Physics, vol. 206. Springer, Berlin, Heidelberg, https://doi.org/10.1007/978-3-662-57366-2_24.

ACKNOWLEDGMENTS

The IAEA is grateful to the Government of the Principality of Monaco for the support provided to its Marine Environment Laboratories.

AUTHORS

Marc Metian (m.metian@iaea.org) and **Jana Friedrich**, IAEA Marine Environment Laboratories, Department of Nuclear Sciences and Applications, International Atomic Energy Agency (IAEA), Principality of Monaco. **Pere Masque**, School of Natural Sciences, Centre for Marine Ecosystems Research, Edith Cowan University, Joondalup, WA, Australia. **Sam Dupont**, IAEA Marine Environment Laboratories, Department of Nuclear Sciences and Applications, IAEA, Principality of Monaco, and University of Gothenburg, Fiskebäckskil, Sweden. **Magali Zapata** and **Michel Warnaar**, Department of Technical Cooperation, IAEA, Vienna, Austria. **Carlos M. Alonso-Hernandez**, IAEA Marine Environment Laboratories, Department of Nuclear Sciences and Applications, IAEA, Principality of Monaco.

ARTICLE DOI: <https://doi.org/10.5670/oceanog.2025.129>