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Priority setting in technical cooperation: expanding the demand for knowledge-based development

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The Technical Cooperation Programme of the International Atomic Energy Agency (IAEA) has the capacity to link scientific research and technical innovation to national, regional and global development priorities. The programme therefore provides a unique case study for science and technology-based organizations seeking to move from technology-driven to demand-based technical cooperation. This chapter examines the evolution of the programme over the last 40 years. It describes a sequence of conceptual changes within the programme in order to address the gap between science and development by fostering demand-led research, promoting technical solutions for national development priorities. The programme is also promoting cooperation between national scientific and technical institutions to encourage self-reliance and sustainability.

1 Introduction

The Technical Cooperation Programme of the International Atomic Energy Agency (IAEA) was conceived in the 1960s to close the technical capacity gap between industrialized and developing countries by promoting the transfer of technology and expertise. This technology-driven cooperation was expected to build and strengthen scientific and technical capacities in the ‘recipient’ countries. In some cases this approach was successful, but in many others it soon became apparent that the results of projects were unsustainable. The technical solutions and expertise ‘transferred’ from the North were often inappropriate or insufficiently adapted to the conditions in the South.

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More recently, the setup of the Technical Cooperation Programme was reconsidered. Key concepts and tools were identified to underscore the importance of strong government commitment, of greater ownership of technologies by Member States and of sustainability of project outcomes for the success of projects and programmes. Thus, in 1997 a process was set in motion to redirect the programme – from supplying nuclear technology for its own sake, to building national capacities to meet priority needs through the application of nuclear science and technology (NS&T). This transformation of the programme's conceptual underpinning is still in progress.

This redirection required that the Programme's secretariat had to work differently. It had to create an understanding of the development constraints and opportunities that could best be addressed by applying NS&T, and to focus on supporting national nuclear agencies that wished to become more self-reliant. This redirection process provides the unifying purpose for strengthening cooperation among these agencies.

The Programme recognizes that for some years, the United Nations institutions have also been renewing their focus on institutional development and capacity building in Member States in the South. The emphasis on institutional self-reliance and sustainability implies a gradual but systematic transfer of UN management and technical responsibilities to qualified national institutions in developing countries and new regional cooperation models. This shift signifies important changes in the collaboration between developing Member States and UN organizations. It also implies a leadership role for the UN in promoting ownership and technical-managerial self-reliance, and a gradual evolution in relationships from 'donor–recipient' to genuine partnerships in science and development – a knowledge-based strategy for development. The Programme is now vigorously pursuing this vision.

2 'Atoms for Peace': the origins of the Technical Cooperation Programme

The idea for the Technical Cooperation Programme was originally envisioned by President Dwight D. Eisenhower in his 'Atoms for Peace' speech in 1953, in which he emphasized the need to control the proliferation of fissile material while ensuring equal benefits and access to the power of nuclear science and technology.

The IAEA's objective is 'to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world'. The Statutes continue with the pledge to 'ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose'.[2]

Under the Non-Proliferation of Nuclear Weapons Treaty (NPT), the Programme functions in both a political and technical environment and thus must fulfil its external

[2] IAEA Statute, Article II (www.iaea.org/About/statute_text.html).

role in accordance with the NPT. The Treaty brings into balance the IAEA's two main activities, the verification of peaceful uses of nuclear science and technology (also known as 'safeguards'), and their promotion for human development through the Programme. Until recently, the Member States have supported and maintained this balance between safeguards activities and technical cooperation programmes, thus helping to ensure relatively predictable funding for the Programme. It is important to note that these activities were carried out through two separate but coordinated programmes. The IAEA's Regular Programme of verification, inspection and regulatory activities, technical information exchange and coordinated research activities was financed from an obligatory assessment from all Member States. The Technical Cooperation Programme is voluntarily funded by Member States. The Regular Programme provides the management framework for the Technical Cooperation Programme, so that the latter does not have 'overheads' or administrative costs.

Article III of the IAEA Statute states that the Agency is authorized 'to encourage and assist research on, and development and practical application of, atomic energy for peaceful purposes', and to foster the exchange of scientific and technical information, as well as of scientists. The IAEA's research activities are designed to contribute to this mandate, by stimulating and coordinating research in selected nuclear fields by scientists in Member States. The research programme incorporates the concept of a lead laboratory, often in a developed country, but always representing advanced knowledge and technical competency to act as mentor for participating laboratories that are less advanced. Although laboratories in industrialized countries often function in a mentoring capacity, the research agenda, problems addressed and expected outcomes are expected to be driven by developing country laboratories.

The IAEA supports research mainly through coordinated research projects (CRPs) that bring together research institutes in developing and developed countries to collaborate on topics of mutual interest. These projects encourage the acquisition and dissemination of new knowledge and technology generated through the use of nuclear and isotopic technologies in the various fields covered by IAEA's mandate. The CRPs also provide an important foundation for the Programme because contract holders are often or later become the Programme's counterparts. The complementarity between the nuclear sciences (research) and nuclear-based technologies (applications) creates opportunities for IAEA to advance developments in key areas such as natural resources management and environmental monitoring, diagnostics of communicable diseases, human nutrition and micronutrient deficiencies, pest management, and energy production, including geothermal energy.

3 The first 40 years: transferring technology and expertise

In 1958 the Agency began its technical 'assistance' by offering a number of fellowships, and later by supplying equipment and experts. In the early years, the Programme supported just over 40 countries and disbursed less than US$2 million each year. By 2004, there were projects in 103 countries and an annual budget of over US$70 million.

Between 1958 and 2002 the emphasis was on human resources development. The IAEA trained more than 27,000 fellows. Throughout this period, the Agency planned and delivered project outputs worth more than US$1.2 billion in 103 Member States, while building technical competencies and scientific expertise in fields such as energy, safety, agriculture, industry, medicine, water and environmental protection.

Since the Rio Conference on Sustainable Development in 1992, the Programme has also supported national efforts to achieve key targets of Agenda 21, including human health, biotechnologies, atmosphere, land and agriculture, oceans and seas, freshwater, chemicals and waste, and energy and transport. Between 1993 and 2002, the IAEA supported 813 projects, valued at over US$210 million and involving 1853 national and regional scientific-technical institutions, 5787 scientists and technicians participating in 381 training events and training an additional 3082 fellows. This contribution to achieving Agenda 21 continues to grow.

4 Meeting national priority development needs and ensuring sustainability

The first major shift for the Technical Cooperation Programme occurred in the early 1990s, when 11 ‘model projects’ were formulated to demonstrate how nuclear applications could respond to specific development needs. These projects were to reflect an indispensable role for the nuclear technology involved, have significant economic or social impacts, and produce sustainable benefits through strong government commitment. This ‘model project’ approach was endorsed by the Board of Governors in 1997, and became the core element of the initial strategy for redirecting technical cooperation towards meeting specific development priorities.

The present phase of the technical cooperation strategy began in 2002 with the introduction of mechanisms that function as priority setting tools. They include three major elements: the central criterion, country programme frameworks and thematic planning.

The *central criterion* establishes standards for project sustainability that require strong government commitment. Each project must meet a clearly defined national need, and produce significant economic and social impacts through the production of measurable benefits for end users. This commitment from national authorities helps confirm and validate the success of a technical application and ensure that the benefits are sustainable.

The process of preparing *country programme frameworks* (CPFs) involves a dialogue between the IAEA and the Member States to focus the technical cooperation on a few priority areas that can make significant contributions to achieving national objectives.

The process is also used to help realize partnerships between national scientific and technical institutions and development authorities. Equally important is the role the CPFs play in assessing technical competence and capabilities and linking the relevant scientific-technical institutions to national development authorities and policy makers. The CPFs provide a useful framework for the formulation of the biennial project requests submitted by Member States to the IAEA.

Thematic planning, with the participation of experts from Member States, includes identifying best practices for successfully and sustainably applying nuclear technologies to development problems. Thematic planning also involves comparing nuclear techniques with conventional or emerging techniques, ascertaining the necessary preconditions to ensure the impact of outcomes in a particular thematic area, and identifying possible partners already working in that area. In addition, thematic planning influences the IAEA's coordinated research projects and provides a link between research activities and technical applications. One benefit of this process is that it provides opportunities for advancing and adapting nuclear science and technology to meet new or emerging needs, such as analytical tools for monitoring the HIV/AIDS pandemic and assessing vaccine trials, isotopic studies for coastal zone and river basin management, and analytical modelling for air quality management.

Priority setting for the Technical Cooperation Programme recognizes that the conditions and requirements in Member States determine the relevance of the IAEA's activities. The three elements provide a reasonable means of assessing and ordering information on conditions and requirements in Member States, and provide essential feedback for strategic direction. Thus, this approach provides a mechanism for the IAEA to periodically realign priorities with new requirements, time frames and opportunities, as well as justification for reallocating human resources as required by new priorities.

5 The role of nuclear science and technology in national development

The IAEA's focus on sharing safe and secure nuclear technologies in peaceful applications is given purpose through programmes that put advanced science to work to meet the needs of Member States, and facilitate collaboration in areas such as human health, agricultural productivity, water resources management and environmental restoration. Regional cooperation agreements play a vital role in fostering collaboration and expanding and sustaining its impact. These are formal intergovernmental agreements covering research, development and training, and provide opportunities for cooperation among national counterpart organizations.[3] The agreements work through regional

3 There are four regional cooperation agreements: (1) the African Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology among African Member States (AFRA); (2) the Regional Cooperation Agreement for the Promotion of Nuclear Science and Technology in Latin America and the Caribbean (ARCAL); (3) the Regional Cooperation

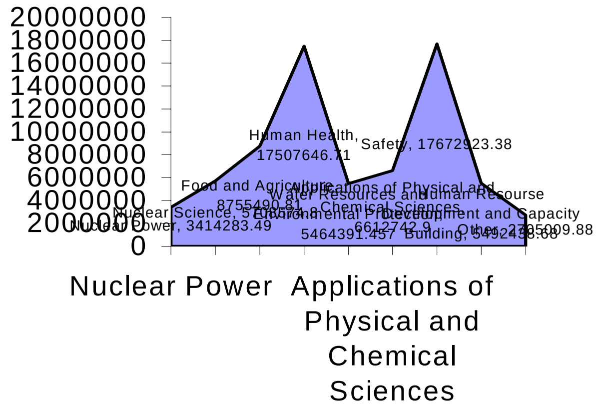
resource units or other national centres of excellence, usually national nuclear science and technology institutions with comparative advantages in the region. They exercise a leadership role in specific thematic areas and provide technical and management services to other institutions in the region for a nominal fee.

The basic functions of the regional resource units are to provide analytical support to other members and supply experts as needed. The units also deliver standards or reagent kits to other countries and provide ‘hands-on’ training for IAEA trainees. They host regional training events and meetings, develop manuals and handbooks, and carry out IAEA contracts.

There is a strong association between nuclear science and technology and sustainable development. Many applications produce analytical outcomes that are knowledge based. At the World Summit on Sustainable Development in Johannesburg in 2002, the IAEA reported that over US$500 million worth of technical cooperation had been undertaken since 1992, with more than 800 projects valued at more than US$200 million specifically supporting the priorities of Agenda 21 such as human health, agriculture and food security, and water resources and environmental protection (see figure 1).

Examples of how nuclear science and technology contribute to national development can be found in every region. The following paragraphs offer some examples to illustrate the nature and scope of the benefits.

Agreement (RCA) for East Asia and the Pacific; and (4) the Cooperative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA).



Human health: cancer diagnosis and therapy, variety of disease diagnosis, identification of drug resistant strains, sterilization, nutrition studies.
Agriculture and food security: development of new plant varieties, preservation of agricultural produce, control and eradication of pests.
Water resources and environmental protection: mapping of underground aquifers, water pollution, dam safety, environmental monitoring, management and remediation of contaminated areas.

Figure 1. Main areas of technical cooperation in nuclear applications in 2004; total disbursements US$73.3 million.

Human health

As can be seen from figure 1, human health is the largest area of IAEA technical cooperation, with an emphasis on radiotherapy as a valuable tool in the treatment of cancer. Building competencies and institutional capacity is becoming increasingly important as life expectancy and the incidence of cancer increase. The IAEA seeks to build up indigenous capabilities by training practitioners, improving the quality of equipment, and increasing the quality and effectiveness of treatment. One initiative, ‘Management of the most common cancers in Africa’, is promoting regional self-reliance by utilizing indigenous expertise in specialized teams that audit radiotherapy practices at national facilities. The initiative also aims to ensure the quality of therapy by applying management and control practices used by the regional designated centres under the African Regional Cooperative Agreement (AFRA).

At present eight regional centres are operational in Africa, all of which follow a process of pre-selection, auditing and appointment by AFRA representatives. They provide support in the fields of radiation oncology (Morocco and South Africa), non-destructive testing techniques (South Africa and Tunisia), radioactive waste management (South Africa), instrumentation (Egypt), radiation processing (Egypt), and mutation breeding and biotechnology (South Africa). The centres have been steadily increasing their contributions by hosting training events, providing expert services, and training African fellows. The IAEA is working with AFRA representatives to extend collaboration, particularly in promotional activities to help make full use of regional expertise and capacities. The IAEA periodically convenes project coordination meetings to review the portfolios of the centres, confirm regional priorities, discuss problems and possible solutions and procedures, as well as to identify new project activities that can be performed by the regional centres.

In many developing countries, particularly in Asia, micronutrient deficiencies can result in major public health problems. Despite the efforts of governments to eliminate micronutrient malnutrition, progress is still slow and patchy because of the lack of effective nutritional interventions. For many years, the IAEA and its Member States have contributed expertise and knowledge in research and technical cooperation to exploit applications of nuclear and related isotopic techniques as tools to solve nutritional problems prevalent in developing countries. The IAEA recently began an important collaboration with the Asian Development Bank (ADB) and five national analytical laboratories in Asia to evaluate and monitor ADB-sponsored food fortification intervention programmes and to develop rice mutants with low phytic acid from high-yield varieties. The management strategy calls for close collaboration between national laboratories and the regional food industry to produce bioavailability studies that will improve the formulation of processed foods by increasing iron, iodine and other essential micronutrients.

Agriculture and food security

In the area of *agriculture*, one example of South-South collaboration is the induced mutation plant breeding programmes that aim to produce crop varieties with improved yields, and the ability to tolerate specific environments. One such application in Pakistan involves an interregional demonstration project to support more productive use of saline groundwater and wastelands. Globally, some 77 million hectares are unproductive or marginally productive due to high salinity, and the problem is increasing. The basic technology package was developed through partnerships between the Pakistan Atomic Energy Commission and four national agricultural research institutes. For countries with large areas of saline lands, the applied techniques can be expanded at relatively low cost and thereby increase soil fertility, land value and, in some areas, reverse the process of desertification. The government of Pakistan is leading this project, providing IAEA with expertise to support seven participating countries. As a demonstration of its commitment, the government of Egypt recently allocated US$2 million to expand its programme to new regions of the country. To facilitate this collaboration, the IAEA has recently signed a partnership agreement with the International Center for Bio-saline Agriculture in the United Arab Emirates to promote the sustainable utilization of saline groundwater.

The African tsetse fly causes widespread economic damage and constitutes an ecological barrier to mixed farming and sustainable agricultural production. Its bite causes African sleeping sickness in both humans and animals. The sterile insect technique (SIT) uses radiation to sterilize healthy male flies that are released into the environment. They successfully compete with wild males for mates but being sterile cannot reproduce, which suppresses and eventually eradicates the tsetse population. The technical package sponsored by the IAEA for tsetse area-wide control activities was developed as a joint collaboration with the Tanga Tsetse Research Station in Tanzania. The SIT package has eradicated the pest from the island of Zanzibar, and its use is now being extended under the mandate of the Pan-African Tsetse and Trypanosomiasis Campaign (PATTEC) of the African Union. The campaign is supported by the United Nations Fund – the organization set up by philanthropist Ted Turner to administer his donation of US$1 billion to foster UN system cooperation.

Another application of SIT involves the Mediterranean fruit fly (medfly) in a transnational project between Israel, Jordan and the Palestinian Authority. The project has effectively suppressed this pest in the Arava region and the Lower Jordan valley, allowing the export of vegetables to medfly-free countries without quarantine restrictions, with considerable economic benefit. The project has been expanded to cover Gaza, Israel's western Negev region, and fruit-producing areas in eastern Egypt. In this case, the fact that the scientific cooperation has succeeded even during civil unrest underscores the contribution of scientific cooperation to peace, security and international development.

Water resources and environmental protection

The management of *water resources* is a special area for knowledge-based cooperation because water is a shared resource that is held in a global trust. In every region, national nuclear institutions are applying techniques in isotope hydrology that are widely recognized as essential tools for understanding the entire water cycle and enabling sustainable water management. Most water projects are regional where scientists in developing countries are trained in isotope hydrology to map underwater aquifers, estimate groundwater resources, and combat the risk of pollution. In Africa, over 50% of IAEA expert assignments are carried out by local scientists and technicians, while in Asia and Latin America the figures are 60% and 70%, respectively.

In Ethiopia, for example, technical experts from South Africa trained counterparts in the use of isotope hydrology and helped tap a new groundwater field at Akaki, which now provides more than 40% of Addis Ababa's water supply. The expertise to implement this study benefited from the technical and scientific collaboration of seven North African countries in a regional groundwater management project. This expertise, along with related scientific and technical knowledge in Egypt, Kenya, Sudan, Tanzania and Uganda, provides the backbone of technical skills for a new initiative, 'Sustainable development and equitable utilization of the common Nile basin water resources', a capacity building activity linked to the Nile Basin Initiative, supported by the Global Environment Facility (GEF) and the World Bank.

Due to the technical requirements and the transboundary nature of natural resource management, partnerships between scientific and development authorities are essential. In South America, the Agency has formed partnerships with the Organization of American States, the World Bank and the GEF to support the governments of Argentina, Brazil, Paraguay and Uruguay to protect and manage the Guarani aquifer. National authorities are carrying out groundwater assessments and are sharing the data through a technical coordination committee that is also developing system-wide modelling techniques for groundwater management. The Guarani, the largest groundwater aquifer in South America, contains enough freshwater, if protected in a sustainable manner, to supply the needs of over 300 million people.

The area of *environmental protection* is a relatively new and innovative area of cross-border collaboration among Member States. The Agency's Marine Environment Laboratory in Monaco has given priority to the use of nuclear techniques for sustainable coastal zone management. One of the most serious and visible problems facing coastal waters is related to a phenomenon known as 'red tide' or harmful algal blooms. The toxin produced by the algae causes paralytic shellfish poisoning, a condition that is deadly to aquatic animals and humans. Working with the Philippine Nuclear Research Institute and the Intergovernmental Oceanographic Commission, the Agency has developed a receptor-binding assay that is quick, sensitive and effective in determining seafood safety.

6 Looking to the future

The focus of Technical Cooperation Programme on sustainability and institutional self-reliance has set in motion a major shift toward increasing technical partnerships with national institutions that can play a leading role within regions with broader responsibility for technical cooperation involving mature nuclear technologies. For the IAEA this approach represents a different future for technical cooperation and a new model for organizing scientific research and technical applications that requires closer collaboration between the scientific and development communities. It also requires an evolution in relationships between more and less advanced institutions. It promises an alternative to the conventional model for technical cooperation that fosters peace, security and prosperity by strengthening the scientific and technological base for development.

Greater investments must be made in establishing and maintaining national scientific and technical infrastructures. Technical, scientific and managerial roles and responsibilities should be entrusted to qualified national and regional institutions. Scientific-development collaboration at the regional and sub-regional levels should be systematically promoted to enable lasting solutions to national development, and to set in motion scientific discovery and technological innovation. Establishing scientific-technical competencies at the national level, *as well as* institutional capabilities should be the focus. International cooperation should be transformed from over-reliance on technology transfer to knowledge transfer as the fundamental requirement for national development. New regional cooperation mechanisms for development should be encouraged, focusing on solving problems with cross-border consequences. For the IAEA, such problems include the control of communicable diseases, water and land resources management and pest control, particularly the ecological barriers presented by the tsetse fly and mosquito, as well as pests such as fruit flies and moths.

7 Conclusions

In setting the parameters for creating demand for knowledge-intensive policy preparation and priority setting in development-oriented research, there are two key questions: how can development strategies become more knowledge based? And how can research strategies be more demand based?

The IAEA experience suggests that by focusing on technical and scientific self-reliance at the institutional level, as a normative outcome for all technical cooperation activities, the emphasis in development strategies will shift from technology to knowledge transfer, because self-reliance requires specialist competencies – the confluence of skills, behaviour and knowledge within an institutional setting of capabilities. This shift will also require greater recognition of individuals as the custodians and brokers of knowledge.

The IAEA experience validates two possible approaches for making research strategies more demand based. First, the performance characteristics of technical applications should be periodically assessed against criteria such as efficiency and effectiveness, and the sustainability of outcomes and impacts. The acquired learning should be converted into requirements for new research or technical adaptations that will enhance the benefits of those applications. Second, analytical and planning processes should identify the most promising scientific knowledge and connect to the most pressing development constraints. Science and development partnerships work best in proximity to the problem where collective efforts can harness the labours of those most seriously affected with those capable of effecting the necessary scientific and technological advancements.

On a broader question, developing countries can create demand for research and knowledge-intensive policies by taking ownership of their development constraints and opportunities. They need to set national objectives and targets that call for solutions that are suitable to national circumstances, mobilize indigenous resources, and pursue national policies and programmes to achieve expected results.

The challenge to this notion is the strength of national science and technology institutions and their ability to lead or contribute to sustainable solutions. This is greatly determined by investment in such institutions, building and maintaining the necessary competencies, and the management of science and technology to produce high-value results. The question to be addressed by professionals working in international organizations and the scientific, academic and technical communities remains: are we working collectively to effectively enable and apply scientific and technological know-how at the national and regional levels?

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Water resources in the semi-arid areas of southern and eastern Africa, http://www-tc.iaea.org/tcweb/publications/otherpublications/sustainable_groundwater.pdf

Mutation Breeding Review, http://www-pub.iaea.org/MTCD/publications/newsletter.asp?id=55

Improved Nutrition through Nuclear Science, www.iaea.org/NewsCenter/Features/Nutrition/start.html

Science Serving People, www.iaea.org/Publications/Booklets/Ssp/index.html

IAEA Maps Out Programme of Action for Cancer Therapy, www.iaea.org/NewsCenter/Features/Radiotherapy/index.shtml