Profile of technical co-operation activities in Latin America

Interest remains high in using nuclear technologies for social, economic, and environmental benefit

by F. Muñoz-Ribadeneira and E. Villarreal

From the border of the Rio Grande to Cape Horn, Latin America is a region full of contrasts: Large and modern cities surrounded by belts of poverty. Immense virgin forests and deserts. Modern medical facilities, yet not enough medical assistance for most of the population. Luxury cars move alongside carts being drawn by donkeys.

Common problems of development are being faced, yet full regional integration in solving them stands largely on the horizon. While there still exists a tendency to form a group of nations within nations, each country has its own set of problems, possibilities, ambitions, and political environments.

Such characteristics have influenced technical assistance and co-operation programmes in Latin America, including those of the IAEA. The Agency's programme has become most active in the more advanced Latin American countries. Most countries in the region, however, only started activities in 1976, nearly 20 years after the IAEA's formation.

Notable strides have been made since then. In 1989, Latin America for the first time received the highest percentage of technical assistance among all IAEA regions, despite economic problems that continue to hinder delivery of planned assistance. There were postponements of expert missions, delays in construction of infrastructure facilities and laboratories, and personnel problems caused by counterpart staff leaving the institutions to seek better salaries. Moreover, two countries postponed activities due to political unrest.

Nevertheless, results that have been achieved clearly point towards the ongoing interest in, and development of, nuclear techniques and applications for social and economic progress.

The Agency's programme operates in Latin America under two modalities: national projects and regional activities. This report presents an overview, necessarily selective, of projects being executed in a variety of nuclear and related fields.

Regional co-operation

Over recent years, regional activities have assumed greater importance in Latin America, particularly in areas of common need such as nuclear information, radiation protection, and maintenance of instruments used in nuclear research and related studies. Training is emphasized in these projects, which make use of the infrastructure that has been built up mainly through national technical assistance projects supported by the Agency.

Regional activities are valuable because resources can often be used more effectively: experts can advise counterparts in several countries during the same assignment, equipment can be purchased more economically in large quantities for several laboratories, and training can be organized regionally at lower cost and in the mother tongue of participants. Another important feature of regional programmes is the concept of technical co-operation between developing countries in the region. Decisions about activities typically are made by participating countries themselves.

Most IAEA regional projects are part of a programme known as ARCAL (which as translated from Spanish stands for Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America). ARCAL today has 15 member countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Mexico, Panama, Paraguay, Peru, Uruguay, and Venezuela.

The programme — which has now moved into its second 5-year phase, running through 1994 — has been financed to a large extent by Latin American countries themselves. Hard currency contributions have come from different sources within the Agency, and from extra-budgetary contributions of several countries and

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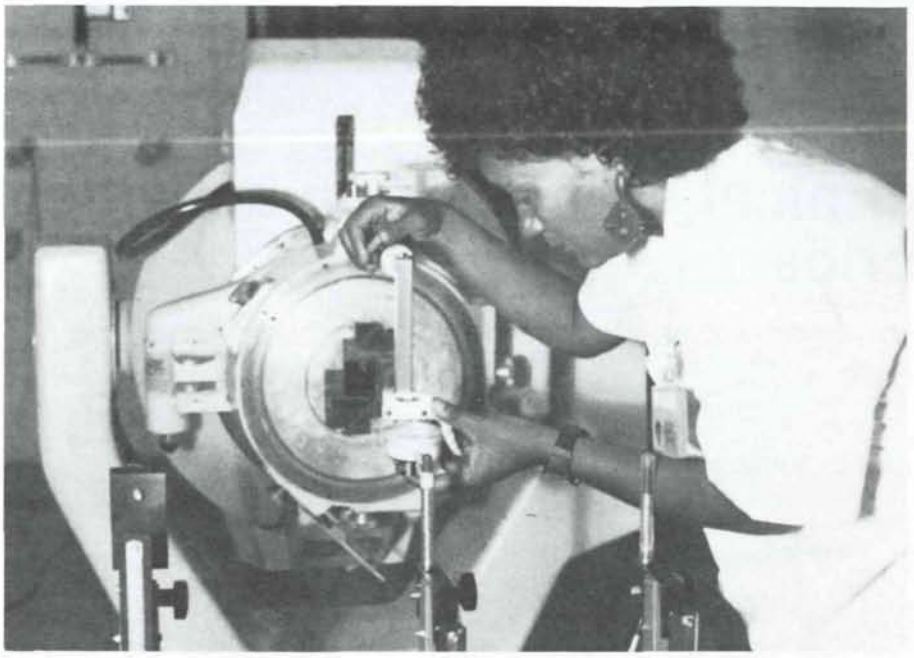


Calibration of radiation measurement instruments at the Radiation Protection and Dosimetry Institute in Rio de Janeiro, Brazil. (Credit: CNEN)

organizations. Main contributors have been the Federal Republic of Germany, Italy, the United States, the European Economic Community, Canada, and France.

Projects and achievements

Through ARCAL, other regional efforts, and national projects, Latin American countries have registered significant progress in applying nuclear technologies in many fields:

● ***Basic nuclear research, education, and development.*** Nuclear information centres have been established in Chile, Colombia, and Guatemala through ARCAL. Others are envisaged elsewhere with the objective of organizing a network of centres regionally. Activities include training librarian and information scientists in modern technologies for handling information, and automatizing procedures for documentation and information dissemination.

Through national projects supported by the IAEA and United Nations Development Programme (UNDP), a number of educational projects have been effective. Argentina, Brazil, and Mexico, for example, have well-established scientific nuclear information services. In Argentina, a graduate study programme set up at the Bariloche Atomic Centre and the Balseiro Institute has served as an avenue for training nuclear engineers since 1979. Most technical personnel involved in nuclear power development in Argentina have been trained there, as have many professionals from other Latin American countries, notably Peru and Uruguay. In Bolivia, an overall nuclear development programme has been established at the Viacha Nuclear Research Centre, where an operational personnel radiation monitoring system, a soils laboratory, and an analytical laboratory are operating. In Paraguay, assistance is going towards establishment of a nuclear research development centre to complement an accelerator laboratory at the University of Asunción, and in Guatemala, a nuclear research centre was recently inaugurated.

Among the most far-reaching national projects — one that has provided regional benefits — is Brazil's application of nuclear techniques in agricultural and environmental studies of the Amazon Basin. Through IAEA and UNDP assistance, Brazil initiated the establishment in 1972 of the Centro de Energia Nuclear na Agricultura (CENA), which has since become one of the world's best-known agricultural research and educational centres. More than 100 specialists from Brazil and other Latin American countries have obtained graduate degrees from CENA. The centre's capabilities and achievements have made it possible to initiate a large-scale ecological study in the Amazon Basin that when concluded will contribute to the conservation and prosperity of the Amazon Region.

● ***Nuclear physics and radiation dosimetry.*** Secondary Standards Dosimetry Laboratories (SSDLs) — which are engaged in ensuring the measurement accuracy of radiation sources used in medicine and other fields — have been set up with IAEA assistance in Brazil, Colombia, Ecuador, and Venezuela, and work to do so is in progress in Cuba, Guatemala, and Mexico. The effort is timely, since in Ecuador, Guatemala, Nicaragua, and Venezuela, radiotherapy in cancer treatment is gaining importance, and new medical equipment is being introduced. As part of efforts to address associated training needs for hospital physicists, Ecuador has initiated a graduate study programme open to students throughout the region.

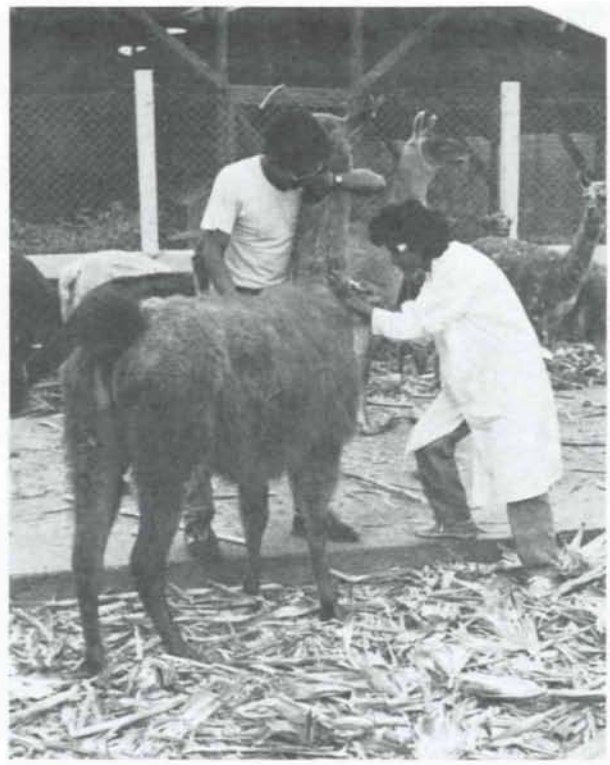
The Agency is also supporting national projects involving specific analytical techniques and instruments used in research and scientific studies. In the Dominican Republic and Ecuador, for example, laboratories are being set up for Moessbauer spectroscopy; Brazil, Chile, Mexico, and Venezuela already have such laboratories. In Brazil, studies have also been initiated at the Institute for Nuclear Science and Research (IPEN) to produce silicon crystals, which are electronic solid-state devices that presently have to be imported.

Through ARCAL, a project on the application of nuclear analytical techniques is directed at upgrading analytical procedures in laboratories, by training people in different techniques associated mainly with the analysis of food and agro-industrial products. Some countries now desire to start activities relative to environmental aspects and mineral resources.

● ***Nuclear research reactors and nuclear chemistry.*** An ARCAL project on the use of research reactors has emphasized reactor core analysis, including physics and thermo-hydraulic studies, supplemented by training courses on the use of research reactors. Problems of conversion to low-enriched uranium fuel and the safety of reactors are also being stressed. So is the use of research reactors to produce radioisotopes and for analysis of trace elements in, for example, airborne particulates or foodstuffs. In Colombia, the safe operation of the heavily utilized research reactor in Bogotá, which has been operating for more than 20 years, is being upgraded with IAEA assistance. In Jamaica, a low-power research reactor is serving as a useful tool in analytical chemistry and other areas, supporting research relating to soil fertility, rare earth metals, and mineral resources.

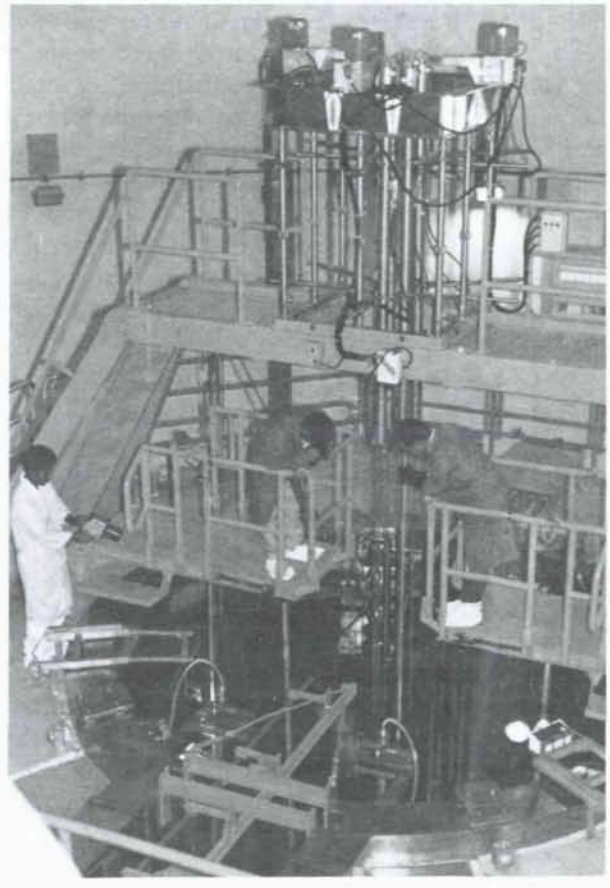
Altogether, eight countries in Latin America — Argentina, Brazil, Chile, Colombia, Jamaica, Mexico, Peru, and Venezuela — have research reactors. Accompanying analytical laboratories have either been established or are planned.

● ***Nuclear medicine and human health.*** National capabilities in nuclear medicine vary greatly in Latin America. Practitioners in some countries are routinely using nuclear diagnostic procedures involving sophisticated equipment and techniques, whereas others are first initiating preliminary work for labelling compounds with iodine-131 or technetium-99m, for example. Many countries, including Bolivia, Chile, and Panama, have made extensive use of Agency assistance to set up nuclear medicine diagnostic services, including the use of modern gamma cameras. Others are also pursuing production and distribution of radiopharmaceuticals. Radiopharmaceuticals are being produced in Brazil and Mexico, while Colombia and Ecuador are developing such capabilities. A number of countries are participating in a study assessing production of kits for *in-vitro* diagnosis of thyroid hormones using components that are imported in bulk quantities.



Studies in animal health and reproductivity at the veterinarian institute, Universidad Nacional Mayor de San Marcos, in Lima, Peru. (Credit: IPEN)

Nuclear research reactor in Lima, Peru, at the Centro Nuclear "RACSO". (Credit: IPEN)



The Nuclear Information Centre in Chile. (Credit: CCHEN)

In several countries, efforts are directed at specific diseases and health problems. In Cuba, for example, researchers are being trained in the use of radioisotopes for biological studies that will be useful in advanced research of arteriosclerosis. In Brazil, attention is being devoted to using isotopic techniques in the diagnosis of communicable diseases, and in Colombia and Panama, the Agency is supporting projects in malaria studies.

Through a regional project, quality control in nuclear medicine is being emphasized in training courses for practitioners engaged in medical procedures involving advanced instruments.

● ***Nuclear engineering, instrumentation, and technology.*** Nuclear power plants for electricity generation are operating in only a few Latin American countries, namely Argentina, Brazil, and Mexico. A number of others are being built in these countries and Cuba. The Agency has been actively assisting these countries in areas such as construction and operational safety through different programme channels, including technical co-operation. Through technical co-operation projects, for example, Mexico has received considerable assistance in setting up local production of fuel elements for its Laguna Verde nuclear power plant. Peru's electric utility and atomic energy authority have also received help in launching a programme assessing the possible introduction of a nuclear electricity plant there; several sites have been identified.

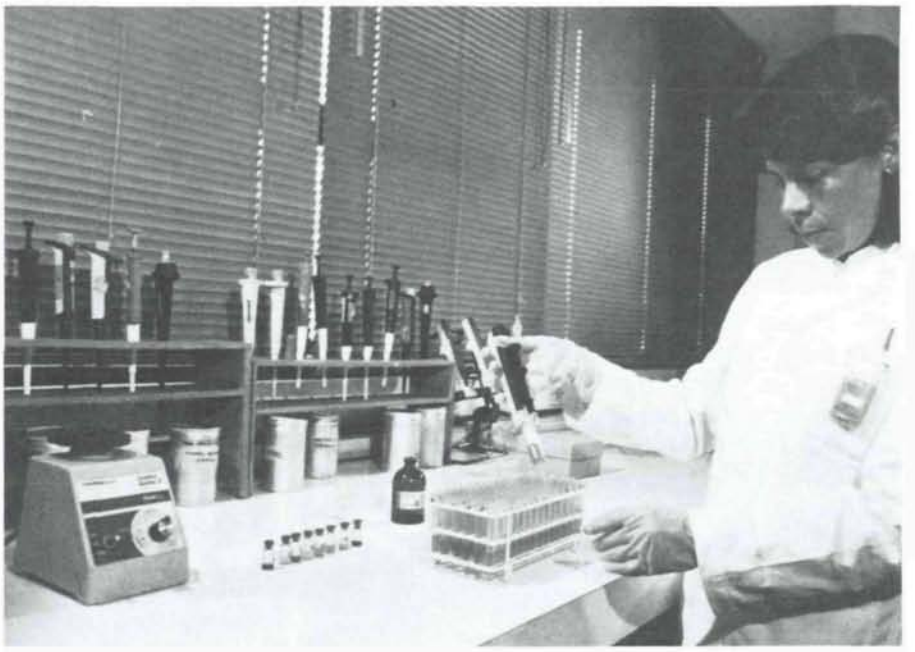
Additionally, an ARCAL project on nuclear instrumentation has trained technicians on different aspects of maintaining specific types of equipment, and on new electronic technologies. For example, the project has organized the provision of spare parts and expert services for corrective maintenance. Also being established is a databank of operating and maintenance manuals for the equipment that is available in the region. Future activities will stress the establishment of national and regional laboratories to provide maintenance services.

● ***Water and other natural resources.*** Isotopes are being used extensively in Brazil's Amazon Basin project to study precipitation, water vapour, and surface water conditions; results will prove valuable in assessing effects of changing land use on the ecology. Isotopic hydrological studies are also being supported in Chile, Colombia, Cuba, Dominican Republic, Ecuador, Guatemala, Nicaragua, Peru, Uruguay, and Venezuela. Problems being addressed range from assessing effects of water pollution in Venezuela, to determining water conditions for agro-industrial development in Nicaragua, to identifying water resources for irrigation plans in Peru. Through ARCAL, a regional project on the application of isotope techniques in hydrology aims to collectively help countries solve practical and scientific problems related to the assessment of groundwater resources and contamination.

The use of isotopes to explore geothermal energy resources is drawing attention as well. In El Salvador, for example, geothermal energy provides about half of the country's electricity, and studies are being done to assess resources. Work is also being done in Mexico, where geothermal resources have long been part of the energy mix, and in Nicaragua. Regionally, through ARCAL, a project on the use of isotope and geochemical techniques in the exploration of geothermal resources is helping countries to evaluate areas where geothermal energy resources may be tapped.

Countries have also shown considerable interest in assessing their uranium ore bearing deposits. Such deposits have been found in Argentina, Brazil, Chile, Mexico, and Peru, with the IAEA supporting many exploration activities. While the number of active national projects has diminished in recent years, countries remain interested in commercially exploiting available resources. Peru, for example, plans to call for international bids for exploitation of ore deposits discovered through projects supported by the IAEA and UNDP. Bolivia, Colombia, Costa Rica, Ecuador, Nicaragua, Guatemala, Uruguay, and Venezuela also have received IAEA assistance in assessing their uranium deposits.

● ***Radiation technologies in food and industrial fields.*** Experimental irradiators are operating in Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Venezuela for research on the application of ionizing



Radioimmunoassay is used in Colombia in animal reproduction studies. (Credit: IAN)

radiation in industry; in Ecuador, an electron beam accelerator has been installed. Areas of interest include the sterilization of medical supplies and polymerization of wood surface coatings.

Food preservation is another potential application. Studies have been done in countries with experimental irradiators on tropical fruits and staple products, such as onions and potatoes. Test marketing of irradiated potatoes has been done in Argentina and Uruguay. In Cuba, a pilot irradiation plant built with IAEA assistance is the focal point of research efforts. Regionally through ARCAL, countries have conducted a number of prefeasibility studies on the potential use of large-scale irradiators for food processing.

Outside of the ARCAL umbrella, a very important project initiated in 1982 is directed at non-destructive testing (NDT), including radiography and the use of radioisotopic tracers, in the manufacturing and industrial sectors. Involving 18 countries, the project is specifically oriented toward training and creation of national and regional self-sufficiency in this technology; nearly 80 training events are being implemented in 1990. A large effort is being made to train technicians at basic levels and on advanced techniques. Nearly 25 000 people have been trained since 1982. A regional NDT federation was established in 1989 that, in the long run, may become the project's executive body. Another sign of progress is the admittance in 1989 of 11 Latin American countries as new members of the International Committee for NDT. Nearly one-third of the Committee's membership is now composed of Latin American countries.

• ***Agricultural and animal sciences.*** National agricultural projects are active in most countries. Many focus on the effects of fertilizer applications, and on the uptake of nutrients, such as potassium and nitrogen, from the soil by crops. A prime example is the Amazon Basin project in Brazil, where the fate of agrochemicals is being extensively studied.

In the field of mutation breeding and plant genetics, projects have led to development of improved varieties of sorghum crops in Venezuela, for example, and of wheat and barley in Peru that is more resistant to the Peruvian highland environment, thereby making it possible to increase production and lower import requirements for these cereals. Through an ARCAL project involving the use of mutation breeding methods to develop new cereal varieties, the capabilities of laboratories throughout the region that work with tissue culture are being upgraded, as are the skills of scientists who are being trained on different aspects of mutation breeding.

In pest control, a number of countries are applying the sterile insect technique (SIT) in efforts to control or eradicate insects that lead to crop damage or animal sicknesses. They include Guatemala, Mexico, and Peru. In Guatemala and Mexico, facilities for rearing large quantities of sterile insects for use in pest control campaigns are operating. In Peru, an experimental facility has been set up to rear sterile species of an insect that damages olive crops. Work there has interested Chile, where similar insects are doing damage.

Activities in animal sciences are continuing to emphasize the use of radioimmunoassay (RIA) to study factors influencing health and productivity. An ARCAL project on the use of RIA in animal production is entering a new 5-year phase dealing with the development of food strategies to improve ruminant productivity. Another planned activity focuses on animal disease diagnosis. Nationally, a project involving RIA techniques has helped Chilean and Peruvian scientists to study the

reproductive cycle of cameloids important to the Andean agricultural economy. The results have been used to improve animal reproductivity significantly; data indicate a 75% increase in the annual rate of newborn calves.

● ***Nuclear safety and radiation protection.*** While matters of nuclear safety and radiological protection are emphasized throughout Agency-supported activities, some projects are specifically directed at subjects in these fields. Through ARCAL, a project on radiation protection is directed at determining the immediate radiation protection needs in the region. Training of personnel is being conducted at national and regional levels, with courses and workshops organized to study requirements of radiation protection in selected situations where ionizing radiation is used. Radiation protection guidelines that can serve as prototypes in the region are also being prepared.

Apart from their exposure to natural sources of radiation, most people in Latin America are susceptible to radiation exposure from medical treatments. In view of this, the IAEA and World Health Organization (WHO) are working together with national authorities for proper regulation and control of radiation sources. In Ecuador, for example, the Government has set up regional offices to strengthen control efforts, and all private and governmental medical and dental facilities have been subjected to inspections. Awareness of radiation protection requirements has grown considerably in the region, following accidents in Brazil and El Salvador involving radiation sources.

Safety evaluation services also are being offered by the IAEA at research reactors, and missions have gone to Peru, Chile, and Venezuela, for example. Additionally, IAEA advisory services supported through technical co-operation channels are assisting countries in areas of radiation protection and radioactive waste management, most visibly through missions known as RAPAT and WAMAP, respectively. Through these and other avenues, countries are able to improve their practices, procedures, and national infrastructures for the safe use of nuclear energy, and for proper storage and disposal of radioactive waste to protect the population and the environment.