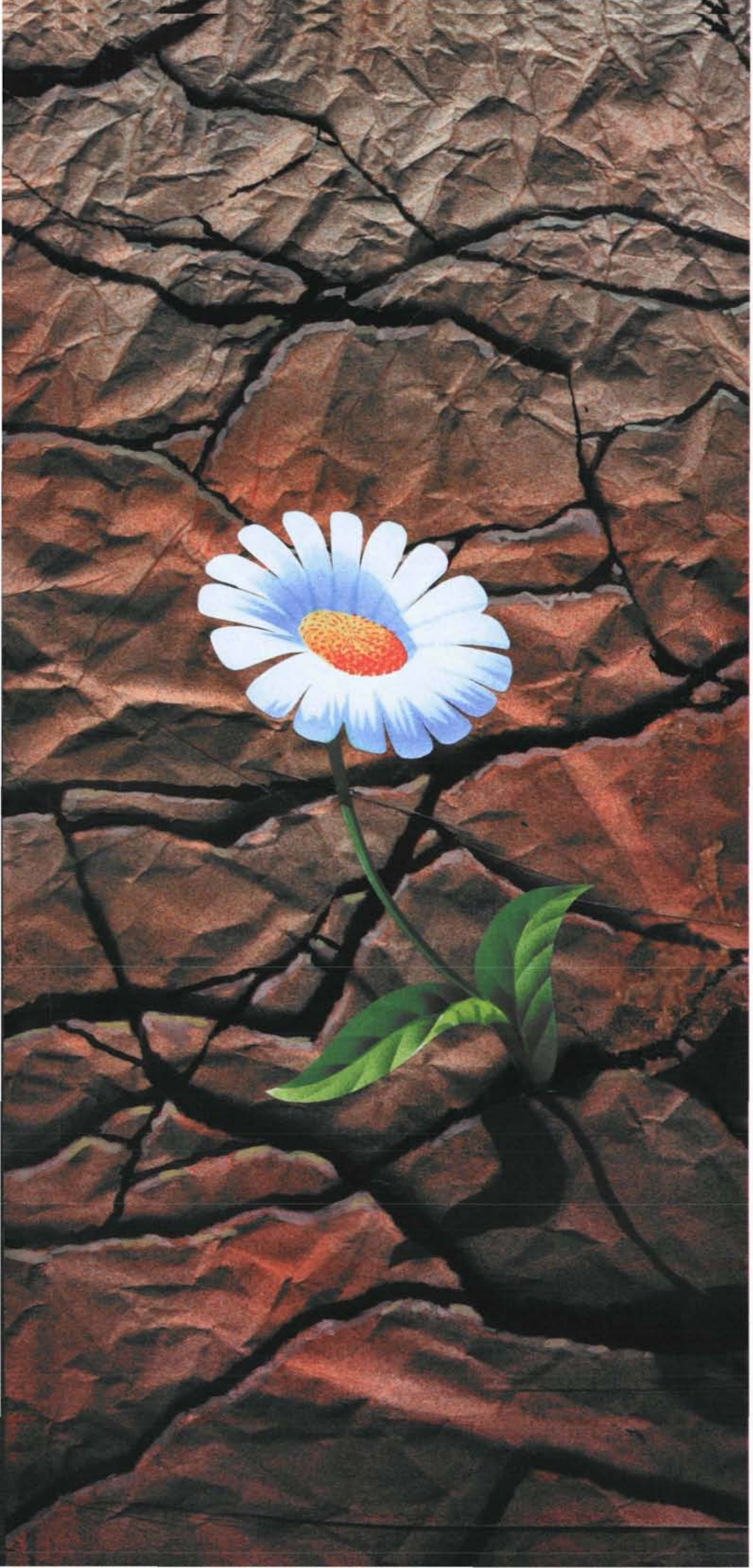


FROM DR

Atomic energy inspired high and lofty dreams generations ago — of electricity so cheap to generate that people everywhere could have it...of cars, trains, and flying machines that would run on longlife powerpacks...of desalting ocean waters and turning arid deserts green. As David Fischer recounts in his rich history of the IAEA, many people then so fiercely awakened to the atom's dark side in the warn-torn 1940s later strongly embraced the 1950s cause of harnessing its brighter future. Winston Churchill saw the peaceful atom as a "perennial fountain of world prosperity". He was not alone among the day's politicians or scientists.

Alongside deep fears and stark realities of the post-war years, those early dreams set the imperatives, popular images, and expectations for the peaceful development of atomic energy, and the roles of the IAEA. Not all the dreams withstood the tests of time, and some died early. But many more were studied, pursued, and demonstrated in research laboratories, hospitals, and farmer's fields. They yield lasting results societies benefit from today.

The past decade's major events and political changes transformed the global picture significantly, and left their signature on the IAEA's programmes for peaceful nuclear cooperation. Chernobyl, the Gulf War, the Iraq inspections, alarms over global warming, health problems of "hidden hunger", agricultural threats in Africa and Latin America, concerns over radiological safety at

EAMS TO NEW REALITIES

old nuclear dumping and testing sites in the Arctic seas and the South Pacific— all commanded action. They tested the capabilities of nuclear-based tools and the readiness of the IAEA to mobilize its own and others' analytical, laboratory, and technical resources for investigating, solving, and preventing serious problems.

Now, as the decade unwinds, nuclear technologies, like many others, increasingly are tested on commercial and developmental, not military, fronts. The world's changed global security climate and rising concerns about social and environmental threats to the earth's "sustainable development" are key reasons why. States meeting at the UN's Earth Summit in Rio in June 1992 set targets for the next century, adopting the document called Agenda 21. They revisited the Agenda — examining water, food, environmental, and other problems — and gauged progress at a UN special session in June this year. On many key issues, they found the distance to go long and hard, the politics difficult, and the costs high.

At another key event — when Parties in May 1995 gave permanent life to the Treaty on the Non-Proliferation of Nuclear Weapons and associated IAEA safeguards agreements — States strongly reaffirmed governmental interest and support for global nuclear cooperation through IAEA channels. They lauded Agency approaches and initiatives for the transfer of peaceful nuclear technologies, especially for strengthened technical cooperation and nuclear safety programmes. Renewed efforts were needed, they said, to adequately fund and support them.

So newly challenged and directed, today's global picture is framed in familiar fields of long-held dreams and new realities. The dream of health for all...and the reality of child malnutrition. The dream of food in every hand...and the reality of eroding soils. The dream of fresh water to drink...and the reality of drying wells. The dream of a safe environment to live in...and the reality of polluted air.

Nuclear energy — fresh from long years of being saddled and strained by polarizing images of "mushroom clouds" and "perennial fountains"— can make new and important contributions for sustaining basic human needs. Proven tools and expertise are at hand. Supported through targeted IAEA projects, people in countries around the world are demonstrating how their dreams to overcome some hard realities can drive and sustain their own futures, and their nation's social and economic development.

—Lothar Wedekind

Mansour Shahein and his family are part of a modern day "atomic" dream in Maradja, Egypt. On a farm in arid countryside, they grow wheat, fruit trees, sugar cane and other crops on lands that once were desert. Their fields, and others like it in this oasis village, rely totally on water tapped from seventy kilometres underground. Where the water comes from — seepage from the Nile river or an aquifer deep below the sands— and how long the wells will last, no one yet knows. They are now beginning to find out. Egyptian hydrologists are gathering data about the groundwater's origins and capacity using isotopic methods of investigation. What they learn will help them better manage the water supply or identify other sources that can prolong the years of harvests for Manzour and farming families

in Maradja. The IAEA is supporting their efforts through a regional water project extending beyond Egypt to Morocco, Senegal, and Ethiopia. Less than one percent of the world's total fresh water resources is found in the Middle East and North Africa. As scientists explore their region's water lifelines, isotope techniques could hold the answers to sustain scarce and fragile resources.

—based on a report by David Kinley, IAEA Division of Public Information.

FOOD FOR MORE OF THE WORLD

By sheer numbers alone, the challenge is daunting. About 840 million people — one of every five women, men, and children in developing countries — are hungry and malnourished. Less than thirty years from now, an estimated 680 million more hungry people, mostly in our poorest societies, will live among the world's projected population of 8.3 billion. The bottom line: the food we produce has to be better conserved and distributed, or otherwise food production has to grow by more than seventy-five percent between now and then.

Solving food problems is not easy, and all the tools and knowledge at our disposal are needed. Over the past decades, important strides have put more food in the hands of people. Food production has grown, in some countries dramatically. Overall, each of today's 5.8 billion people has more food than people had twenty years ago, when the world's population was four billion. Yet clearly much more needs to be done.

The IAEA's work over the past decade, jointly with the UN Food and Agriculture Organization (FAO), has faced different sets of challenges. In some countries, specialists have zeroed in on technically helping them to protect and preserve the food resources they have, and prevent losses of indigenous crops and livestock to pests or disease. Elsewhere, the target has been on ways for enriching harvests through plant, soil, water, and other food-related research. (*See report page 16.*) Countries have attained significant results in the process.

Soil scientists in Bangladesh and Zimbabwe are applying nature's ways to overcome problems of crop nutrition. Over the past decades, they further demonstrated the effectiveness of using natural "biofertilizers" to increase crop yields. Their work involves fertilizers produced by rhizobia bacteria. Detailed studies to analyze crop nutrients and growth are done using isotope techniques. When rhizobia treatments are applied to seeds of suitable pulse crops, such as peas or soybeans, they stimulate the production of root nodules that can biologically produce nitrogen from the air and stimulate plant growth. Zimbabwe field trials have shown that rhizobium biofertilizers more than doubled soybean yields, out-performing crop fields treated with expensive ammonium nitrate fertilizer. In Bangladesh, studies found that the biofertilizers typically can increase the harvest of grain legumes by about one-fourth. Larger scale production, now planned through a demonstration plant, could lead to potential savings of about US $30 million a year by reducing the country's need to import grain and chemical fertilizers. The IAEA has launched separate model projects in Zimbabwe and Bangladesh to further support national efforts.

In Asia overall, grain legume production has grown by an average of twenty-five percent using biofertilizers. Pakistan recently introduced one for rice estimated to bring benefits of $133 million annually in terms of higher yields and lower use of chemical fertilizers.

In Romania, farmers have benefitted from other types of isotope studies, ones directed at more efficient use of chemical fertilizers. By tailoring field applications of nitrogen and phosphorus to the studies' results, farmers achieved yield increases for maize worth $217 million a year — and saved $60 million in fertilizer costs.

In Mexico, the USA, Libya, Tanzania's Zanzibar Island, Chile, Belize, Guatemala, Honduras, and El Salvador, project teams have successfully battled insect pests threatening crops and livestock. A key common tool of the campaigns: the radiation-based technology known as the sterile insect technique (SIT), a biological method developed at the Agency's laboratories and transferred to the field by FAO/IAEA technical staff and scientists. The com-

bined value to agricultural economies from the use of SIT in these campaigns exceeds $3.5 billion per year.

Most benefits accrue from campaigns in the USA and Mexico, where the New World Screwworm, a fly which attacks livestock, was eradicated in 1991. The pest found its way to Libya in the early 1990s, and was eradicated there in 1992 at a cost of $60 million. The timely campaign saved North Africa's agricultural economies fifty times as much as it cost, in terms of losses avoided and benefits gained. Another devastating insect, the Medfly, was eradicated in Chile, netting the country benefits valued at $500 million per year, mainly through access to Asian export markets.

In Zanzibar — where the battle is against tsetse flies and the disease trypanosomosis it can inflict — the families of Jozani village measure benefits of eradication in other ways. Before the campaign about ten years ago, they simply saw no cattle around because of the constant threat of disease. Today the community rears more than 300 head of cattle for meat, milk, and hides. An IAEA-supported project is now providing technical assistance for SIT's use against the tsetse fly on mainland Africa, starting in Ethiopia.

Elsewhere throughout Africa, the challenge is to free livestock from another serious health threat, rinderpest or "cattle plague". When the regional eradication campaign began in the late 1980s, the disease was found in fourteen African countries. Today it is restricted to relatively isolated pockets, where IAEA-supported animal vaccination programmes and disease monitoring are being done. Such high levels of immunity have been achieved that it's been possible to stop mass vaccination, saving several hundred million dollars a year. Some of the twelve countries in an IAEA project have or will soon make international declarations of freedom from rinderpest. Once all do likewise, Africa could realize economic benefits to agriculture of over $900 million a year.

In China and Peru, a common challenge is to boost crop production. Plant breeders are using mutation techniques to help meet specific needs. In China, among the latest achievements stand eleven new rice varieties. They were planted in fields of a million hectares over six provinces. Rice production there grew by 380,000 metric tonnes, at an estimated value to farmers of more than $50 million. In the oxygen-thin Peruvian highlands, new varieties of cereal signal harvests even under a harsh and variable climate. Seeds of a mutant variety of barley Peru produced now are being distributed to 200,000 people resettling Andean farms. Within three years, they should be growing on about 40,000 hectares of highland.

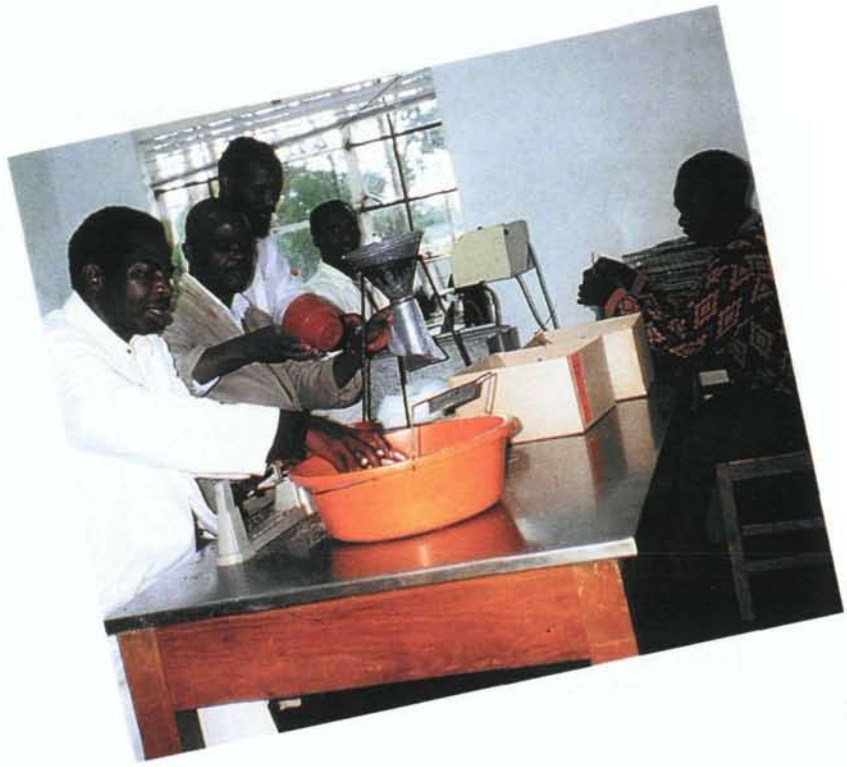
These achievements show the Agency's multi-dimensional roles and the practical benefits that nuclear tools can help countries attain. Results are closely linked to team efforts typically engaging expertise and resources among IAEA partner organizations and scientific networks, spearheaded by the Agency's Seibersdorf Laboratories through its joint FAO/IAEA laboratory and other branches. The transfer channels extend to three regional arrangements for countries in Asia and the Pacific, Latin America, and Africa, where twenty-one countries have joined since 1990. A key is research, and over the past decade, the IAEA directly financed research and demonstration activities valued at over $43 million. Nearly 2000 research contracts and agreements were put in place in some ninety industrialized and developing countries, in agriculture, hydrology, and a range of other fields.

Over the past thirty years, global food production has grown about eighty percent, serving more of the world. Over the next thirty, projections are it needs to grow another seventy-five percent. Just to keep up. — *Lothar Wedekind, based on reports by James Dargie, Royal Kastens, David Kinley, Ali Boussaha, and Paulo Barretto.*

Photo: Green fields in Zimbabwe. (Credit: Kinley/IAEA)

ADVANCING RESEARCH

Research in agricultural fields keeps advancing in the 1990s, and IAEA and FAO scientists working with counterparts worldwide are contributing in important ways.



ANIMAL HEALTH

About ten years ago, scientists realized that a nuclear-based diagnostic technique — enzyme-linked immunosorbent assay, or ELISA — could overcome many technical problems and be effectively applied for nearly all major diseases affecting livestock in developing countries. In the 1990s, the Joint FAO/IAEA Division developed methodologies and approaches for transferring ELISA technologies efficiently. Standardized and validated kits tailored for the developing world now are used by authorities in seventy countries, including many engaged in an intensified global campaign against rinderpest, or "cattle plague". The ELISA technique today is a key management tool to monitor progress in support of other animal health campaigns worldwide: foot-and-mouth disease, which has been eradicated from Europe, Indonesia, and Uruguay and is being wiped out in the Americas; brucellosis, where a blueprint now exists for its eradication across Europe and Arabia; trypanosomosis, nearing eradication in Zanzibar and now targeted for elimination in parts of Ethiopia.

SOIL&WATER

About two-thirds of all river water is used for agriculture, and scientists are looking closely at how to achieve more with less. Through IAEA-supported research, they are studying a practice called "deficit irrigation" using neutron probes to investigate and evaluate soil moisture and crop water requirements. So far, some positive results have been seen. In Argentina, researchers found that cotton growers could achieve high yields by using half as much water during the vegetative and flowering stages, and no irrigation whenever the soil moisture content is ninety percent or higher. In Brazil, irrigating with half as much water at certain growth stages netted higher yields for bean and corn crops. In Morocco, the technique was applied to develop better water management schemes for sugar-beet and wheat.

PEST CONTROL

Through work of the IAEA's Seibersdorf Laboratories, the radiation-based sterile insect technique (SIT) has become the bane of pests ravaging crops and threatening animal and public health. Over the past decade, working through global research networks, scientists have zeroed in on biotechnological approaches to improve the applicability and effectiveness of the technique against fruit flies, specifically the Mediterranean fruit fly, or Medfly. They now have developed a genetic technology designed to optimize the rearing of male flies and reduce the overall costs of applying SIT in the field. In other research, scientists recently recorded the first confirmed case of genetic transformation in the Medfly, a breakthrough that offers the chance to develop strains of the species that can be more effectively and economically used for insect control campaigns incorporating SIT.

FOOD SAFETY

National laws and global trade agreements require food to be free from contaminants that provide unacceptable risks to human health, and in more

and more cases, consumers also are demanding that the food they buy causes no undesirable environmental effects. Taken together, these developments have intensified research to monitor food, water, and other environmental materials for chemical contaminants (including biotoxins), and in the case of food, pathogenic microorganisms as well. Easy to see is that the number of analyses is enormous. Conventional methods usually require expensive equipment and reagents, and they are time consuming. Now being more closely looked at is the use of immunoassays as screening methods for organic contaminants, such as pesticides, which offer advantages in terms of costs and time for analyzing large numbers of samples. But the method holds disadvantages as well, and scientists involved in IAEA-supported research are examining technical factors affecting potential applications, as well as potential costs. In the case of pesticides, the cost of developing an assay is about $100,000. Nevertheless, kits for over thirty pesticides are now commercially available that in some cases show a cost saving of three hundred percent compared to one alternative method. Another potential screening tool widely used in other fields, thin layer chromatography, or TLC, is gaining a fresh look for monitoring pesticide residues from advances in biotechnology. Methods have been developed that adequately check if a foodstuff complies with international food safety requirements, and scientists in twelve countries now are evaluating the methods under a newly started research project.

IMPROVING CROPS

Known as plant or crop breeders, scientists have tried since civilization began to develop and cultivate the world's crops, numbering about 80,000 edible plants today. It's a hard job: after centuries of painstaking work, less than thirty species, but thousands of varieties, provide nearly all the world's food. Over the past decade, DNA probes and related molecular biological methods, combined with mutation techniques and diagnostic radioactive isotopes, particularly have quickened the pace through greater understanding of plant variations. Laboratories in developing countries are engaged in work through an FAO/IAEA programme that facilitates the transfer of DNA probes and methods. Advances in using radiation-based techniques also keep being recorded. One technique now is used to develop varieties of date palm resistant to Bayoud disease in Algeria, Morocco, and Tunisia where fifteen million trees have been killed by the fungal pathogen. As a result of research combining induced mutations, conventional breeding techniques, and biotechnology, new varieties of linseed, rapeseed, soybean, and sunflower are becoming commercially important. Two new varieties of linseed were registered in Canada in 1993 and 1995. Over recent decades worldwide, scientists at the Agency's Seibersdorf Laboratories have irradiated about 22,000 samples of seeds, vegetative materials, and *in vitro* cultures that were sent to laboratories in over 100 countries, including seeds used for molecular biology research. Worldwide, over 1800 mutant varieties of crops and plants have been developed, most of them using radiation-based techniques.

FOOD QUALITY

Research over the past ten years has more firmly demonstrated that the technology of irradiation is safe and effective for ensuring the hygienic quality of food, especially products such as chicken, seafood, meat, and spices. Recent advances have enabled its application as a quarantine treatment of fresh fruits and vegetables against insect pests; research was jointly sponsored by the IAEA, FAO, and World Health Organization. National and international food regulatory bodies have moved in the 1990s to endorse irradiation, issuing standards and policies governing its wider application. A major breakthrough came in May 1996. The United States Department of Agriculture accepted irradiation as a quarantine treatment against fruit flies in fruits and vegetables, enabling national trade from Hawaii to mainland states of papaya, lychees, and other commodities. The action is heightening interest in the technology among developing countries seeking expanded global markets for their products.

— Based on reports contributed by Raymond Nance, Paisan Loaharanu, Felipe Zapata, Martyn Jeggo, and other staff of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture.

Photo: Scientists at the Soil Productivity Research Laboratory in Marondera, Zimbabwe, work closely with the IAEA in agricultural fields.

BRINGING BENEFITS HOME

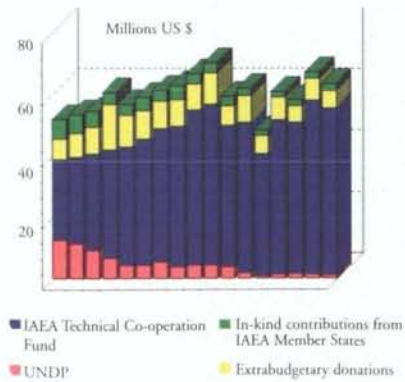
Countries in the developing world have received almost US $800 million in IAEA technical support over the past forty years. In 1958, technical programmes aimed at building national capacity in nuclear science and technology were carried out in forty-two countries. By the end of 1996, new and more targeted programmes reached ninety-five countries. These activities — all financed from voluntary contributions of Member States — are now increasingly aimed to produce greater social and economic benefits for the farmer and environmentalist, physician and patient and other end users of nuclear science and technologies. The challenge of redefining the Agency's strategy for technical cooperation was set in motion in 1994 by a Policy Review Seminar of Member States. The focus was on three themes: strengthening radiation protection and waste management infrastructures; the need for systematic country planning; and increasing the impact of IAEA technical cooperation by reaching the technology's end users. For guidance, a Standing Advisory Group on Technical Assistance and Cooperation was formed with representatives from Member States, to help ensure that new targets are met.

Becoming a partner in national development is a new thrust of the IAEA's technical cooperation programme. But the Agency is not a "development" organization, and it has no related field offices or large pool of funds. Its traditional role has been catalytic — in areas of research, development, and demonstration of nuclear-based "solutions". Expanding these benefits beyond the demonstration phase requires funds, project management, and operational support that exceed the Agency's traditional resources. "Partners in Development" is the new term for the process of connecting technology to the end users, and the active engagement of a broader community of interests. A new generation of "Model Projects" launched over the past decade represent the wave of the future. They must meet tough criteria: respond to priority national and regional needs; produce sizable economic and social impacts; employ nuclear technologies only when they have distinct advantages over others; and attract strong governmental commitment. As such, they stimulate a "problem solving" approach, and a very intensive dialogue between the Agency and governmental partners, so that the projects reach well beyond the counterpart institutions to beneficiary communities and their citizens.

The Agency has launched several broader policy initiatives to better coordinate the uses and applications of nuclear technologies for greater economic and social impacts. In years to come, the Model Project approach will be expanded through "Country Programme Frameworks" that identify priority activities in each developing Member State, and "thematic planning" that singles out the most significant technical solutions for duplication across several countries. These new mechanisms will ensure that IAEA development partnerships are focused on where they can produce the greatest benefits. The first thematic plan now becoming operational is in radiation protection — meeting the Agency's Safety Standards that are a statutory pre-condition for all activities involving ionizing radiation. Significantly, one of every three Model Projects proposed for 1997-98 reflect radiation safety priorities.

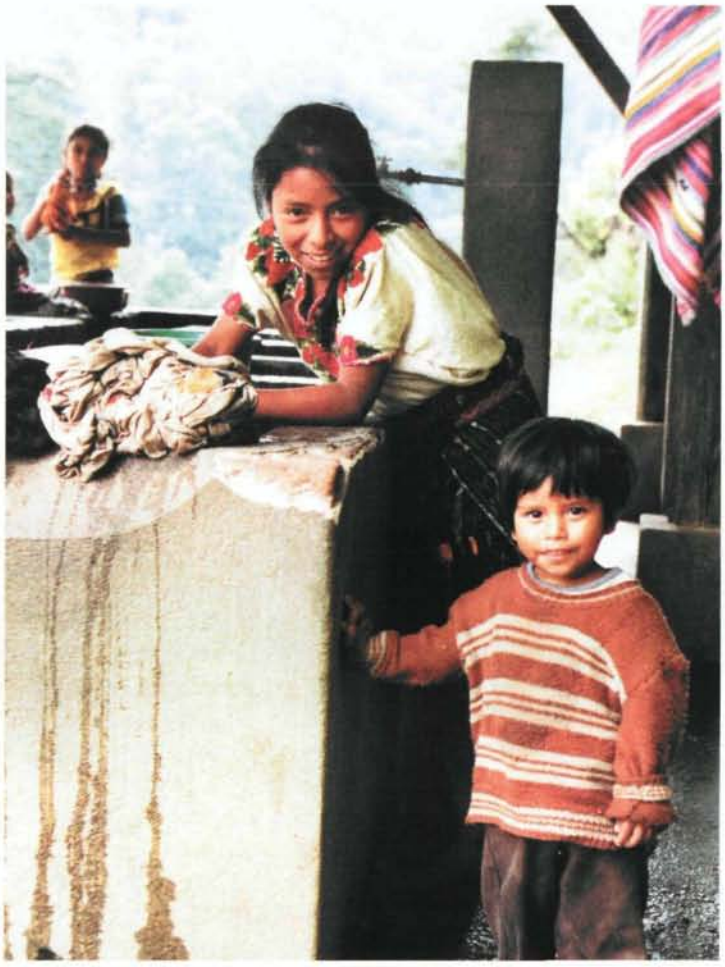
In some countries, the combination of increased investment, demonstrated technology, and a more vibrant commercial sector is moving the development process forward quickly; in many others, it will take more time. The past decade has seen the IAEA better position itself to meet the needs of its Member States, regardless of their level of development or technological sophistication.

—Based on reports by Mr. Qian Jihui, IAEA Deputy Director General for Technical Cooperation, and Royal F. Kastens of the Department.



$2.01 was the amount 12-year-old Joseph Santore and his friends gave the IAEA back in 1958, to help kick off contributions for the Agency's technical cooperation work. Today's resources top $60 million in support of over one thousand projects. Yet the challenge remains to effectively fund activities, and the 1990s saw some hills and valleys that negatively affected programmes. The Agency and its Member States are looking closely at trends and ways to maximize efficiency and stabilize available resources.

SUSTAINING WATER LIFELINES



Faces around the world visibly frame the imperative of sustaining our freshwater resources:

- More than one in four people still lacks clean water supplies.
- On a global scale, the rate at which we are withdrawing freshwater resources is more than double the rate of population growth.
- Nearly seventy percent of all freshwater is used for the rising demands of food production.

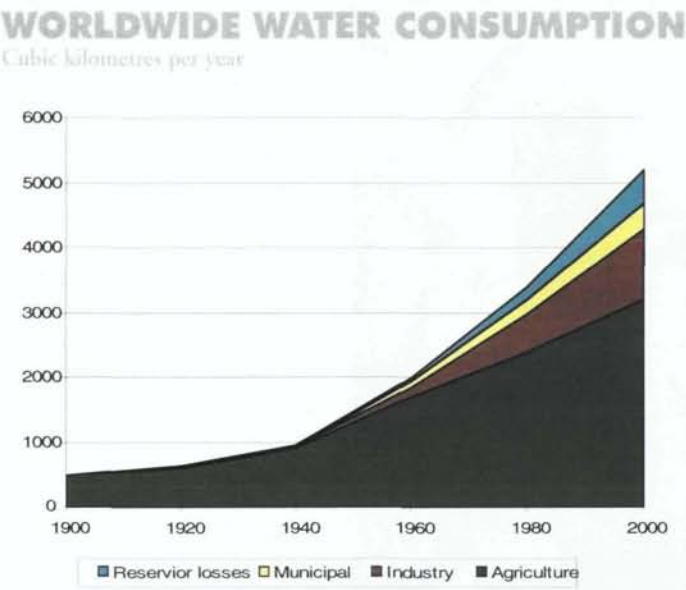
Behind the numbers are special problems in growing population and industrial areas. There, pressures on resources are mounting, and freshwater often has to be transported from dammed reservoirs far away, or carried in vessels from distant wells. In many areas, local rivers and groundwater are new homes of chemical and other sources of pollution.

For the IAEA's technical support cadre, the realities are confronted on local, national, and regional levels in more and more countries. Work has correspondingly intensified over the past decade to sharpen capabilities for assessing, monitoring, and preserving water resources with the tools of isotope hydrology. Central aims have been to assist water authorities in using these techniques to improve the efficiency of water use, identify and prevent sources of pollution, and map the birth and life expectancy of groundwater resources. Some 150 technical cooperation projects totalling $19 million were put into action over the past decade to assist altogether sixty-three countries in water-related areas. In the process, more than 550 young scientists have been trained to apply isotopes in investigations to improve the management of water and other natural resources in these countries. At the same time, countries have renewed their interest in technologies for producing more water, specifically in the use of nuclear energy for desalting seawater, an old atomic dream that is nearing tests of the marketplace again. *(See box, next page.)*

A large part of the earth's water resources is not safe, clean or renewable, and finding new reserves is costly. Often, the technology is not yet at hand to economically exploit potential resources locked deep inside the earth's crust. Experts say that greater steps are needed to conserve and use water more efficiently,

Photos: Children at an old well in Guatemala. (Marshall/IAEA).

FRESHWATER FROM THE SEA



Economics are changing — water is an increasingly expensive commodity — and the technology is advancing rapidly. As water needs mount in large regions of the world, experts over the past decade have started looking more closely at systems to tap abundant oceans and seas. Among the candidates are facilities coupled to nuclear power plants that produce the electricity for the energy-intensive process of desalting seawater. The idea is not new: nuclear desalination was explored decades ago, and demonstrated in Japan and Kazakhstan. But for the wider water marketplace, it was too expensive. The method still is costly, but the gap is closing. Costs generally have become competitive with those of alternative desalination systems using other sources of energy supply.

Through IAEA programmes, more than twenty countries are involved in assessments of the technology's potential. One study focused on North Africa, analyzing needs and possibilities in Algeria, Egypt, Libya, Morocco, and Tunisia. Analysts found that nuclear seawater desalination could be a technically and economically feasible option. In the mid-1990s, efforts intensified to more closely look at the economic competitiveness of systems. Many desalination and reactor systems were screened, leading to identification of three practical options for demonstration plants.

Future cooperative projects now are planned in countries including China, India, the Russian Federation, and the Republic of Korea, which recently hosted an international symposium that reviewed the latest technological and economic developments in the context of water needs. Large-scale use is some years away, but more demonstration plants for desalting seawater may soon line shores.— *Based on report by Toshio Konishi.*

and IAEA-supported research is leading to some solutions in agricultural fields. *(See report on page 16.)*

Other water-saving measures include improving irrigation techniques and preventing water losses as high as forty percent from transportation, distribution, and storage systems. At the core of solutions stands our knowledge of earth's water cycle, and how freshwater resources are renewed. A longstanding network of monitoring stations the IAEA runs with the World Meteorological Organization collects key data on the isotope content of rainwater. They are used for regional and global circulation models. Analysts can investigate how the earth's changing climate affects the sustainability of our water resources. The pioneering databank today serves as a global reservoir of pooled knowledge that can lead to greater understanding of how earth's dynamic cycles recreate and renew our water supplies.

Strides have been made to bring water to more people. By 1997, the world's collective efforts in the 1990s had given nearly 800 million more people access to safe drinking water. — *Lothar Wedekind, based on reports by Yuecel Yurtsever, David Fischer, and Royal Kastens.*

HEALTH FOR ALL: REDIRECTING THE VISION

Noble and all too needed, the goal of "health for all" into the next century has driven the medical profession to new heights throughout the past decade. In its latest global status report, the World Health Organization reports significant progress in campaigns against a body of major human diseases — including smallpox, polio, leprosy, and the disabling Chagas disease.

But changing patterns of how and where we live have brought other, in some ways more troubling, challenges to national and global health agendas. Many problems are attributed to negative ripple effects of urbanization — overcrowded cities, polluted air and water, poor and unsafe living conditions, and strained health resources, especially for preventive care. Cancer became a serious and more visible problem in developing countries. So, too, did "hidden hunger", or malnutrition, particularly in children; illnesses linked to food contamination; deaths from re-emerging infectious diseases such as malaria; and sickness caused by health dangers in our environment.

At the start of the 1990s, more than 600 million men, women, and children lived in large cities in developing countries that are threatened by lack of food, water, and adequate health care. More than half of the developing world's citizens could be concentrated in urban areas when this decade closes. Undeniable interconnections between political, social, and economic conditions, and the state of our health, emerged magnified from the decade.

The fast-developing picture accelerated the need to find out more about the detection, prevention, and treatment of diseases. More countries turned to the IAEA's expertise and specialized health and analytical services. IAEA health-related projects today number 175, up seventy-five percent over the past fifteen years. The investment is valued at nearly $48 million over that period for improving national health-care capabilities at hospitals, clinics, and laboratory facilities. By the mid-1990s, most of the Agency's 125 Member States had set up medical programmes involving uses of nuclear tools, ranging from radiopharmaceuticals, to nuclear analytical techniques, imaging systems, and radiotherapy.

Especially in the 1990s the Agency's programmes in human health have adjusted to better fit the changing needs and conditions. Outreach efforts were broadened and objectives finetuned for specific problems that can best be met by nuclear techniques. Among them stand the early diagnosis and treatment of cancer, the assessment of nutritional deficiencies in women and children, the timely detection of communicable diseases, and the accurate measurement of radiation doses to patients.

The upswing in demands and related programme adjustments are opening new windows of opportunity for better health care through nuclear applications in more countries. They also identified new doors that must be unlocked to sustain progress.

● Diagnosis and treatment of cancer has advanced considerably over the past decades. In industrialized countries, "cure" rates have doubled since the IAEA was formed in the 1950s, achievements generally attributed to earlier and better diagnostic screening and to advances in surgery, radiation, and chemotherapy treatments. In developing countries, however, more help is needed as cancer takes a stronger hold. With national research teams, the IAEA is coordinating clinical trials in radiotherapy to improve treatment and control of the disease. New treatment centres also are being supported. In Mongolia, nearly 2400 patients were treated at a new teletherapy centre within its first five months. In Ghana, the first of three planned radiotherapy centres now serves cancer patients who otherwise had to seek expensive

Photo: Children in Viet Nam. (Tuong Linh for UNESCO/ACCU)

treatment overseas, or go without it. To evaluate radiation treatments against global standards, a joint IAEA/WHO programme has expanded its network of services.

In Thailand, Uruguay, and other countries of Asia, Latin America, and Africa, communities need help for potentially crippling children's health problems. Some notable strides are linked to greater use of highly sensitive nuclear techniques, sometimes teamed with biomedical methods. Their reliable and affordable application now is supporting effective national screening programmes of all-too-common thyroid deficiencies in newborn babies and children.

Because its effects are too often masked and overlooked, "hidden hunger", or malnutrition, can take on serious proportions. By the mid-1990s, health experts reported that nearly 800 million people in developing countries were chronically undernourished. Most at risk are women and children living in poverty. Though nuclear-based techniques are no substitute for nutritional deficiencies, they do support improved health monitoring and research programmes to uncover and prevent cases of hidden hunger. Joining with global partners, IAEA-sponsored research and field projects now extend to more than thirty countries. The work has identified improvements to the dietary treatment of severely malnourished children and alerted health practitioners to specific diet deficiencies of protein, vitamins, zinc, iron, and iodine needed for proper nourishment and growth. As importantly, it has led to stronger public health programmes in more countries, including Chile, Sri Lanka, and Venezuela, for setting nationally recommended nutritional requirements. Now planned is distribution of a "toolkit" of proven isotope techniques that countries can readily use in their nutrition programmes.

More needs to be known about the causes and health effects of environmental pollutants contaminating our air, water, and food. Over the past decade, more than forty countries have intensified cooperative research and analysis of non-radioactive pollutants, including mercury and pesticide residues, through Agency programmes. Air pollution, particularly fine particles, has drawn close attention, since particulates can settle deep in lungs, potentially causing serious illness or death. Findings add to valuable data shared through an established global network of centres that collects and analyzes airborne samples. The work helps health and environmental authorities more effectively identify and monitor pollutants as part of health protection measures.

In different ways, other types of radiation technologies are being used to remove pollutants from industrial emissions before they enter the atmosphere. One method, known as electron beam processing, gained ground over the past decade through demonstrations in several countries with Agency support. In Poland, an industrial-scale demonstration plant for removing sulphur dioxide and nitrogen oxide — causes of "acid rain" and linked to respiratory diseases — from emissions at coal-burning power plants. Demonstrated costs of the cleaning process are lower than conventional systems. Other countries now interested include Brazil, Bulgaria, China, and Mexico.

Alarming reports of food contamination over the past decade became a driving force

for greater interest in the technology of food irradiation. Foodborne illnesses traced to contaminated poultry and meats led the United States to approve food irradiation's commercial use for the products, since the technology cleans them of contaminating microorganisms. At the international level, Golden Rule #1 of the World Health Organization's ten-point food safety advisory issued in the 1990s encourages consumers to choose poultry treated with ionizing radiation whenever they can.

● Medical research laboratories worldwide continue to be tested by new and resurging infectious diseases. In Latin America and Africa, IAEA-supported work initiated over the past decade aims to improve diagnostic capabilities. Researchers are being trained in the use of biomedical techniques, including radioactive DNA probes, for more effectively diagnosing communicable diseases, as a step to help control them. Chagas disease in parts of Latin America, malaria in Africa, and tuberculosis in other regions are among diseases under study.

Progress is important: the re-emerging threat of malaria, for instance, still is known to strike more than 300 million people in 103 countries and claimed the lives of one million children alone in 1995. Against Chagas disease, the fight is gaining ground: WHO reports that ongoing efforts in Argentina, Bolivia, Brazil, Chile, Paraguay, and Uruguay soon will eliminate the disease.

● In Asia, eye surgeons have long been served by Sri Lanka's eye bank. More than 10,000 Sri Lankans have regained their vision with the bank's help, and surgeons in sixty countries have received tens of thousands of corneas needed by their patients. With the IAEA's assistance through a regional project of thirteen Asian countries over the past decade, such medical services are expanding. They include a new medical bank in Colombo that sterilizes membranes, tendons, and other tissues needed to treat severely injured patients such as burn victims. The bank is intended to serve health needs throughout the region.

Sri Lanka's facility reflects heightened interest among more countries in radiation sterilization of medical products for hygienic and safety reasons. By the mid-1990s, the technology had become the preferred method to sterilize about half of all the disposable needles, scalpels, and other medical supplies used in hospitals, clinics, and medical centres around the world.

Through these and other avenues, vital progress is being made to more strongly arm countries against emerging and re-emerging dangers to human health. In key applications, nuclear and related techniques can give doctors unparalleled insights into what is happening in the human body without the need for incisions or surgery. Other tools enable researchers to track and analyze causes and sources of potential health hazards, so that steps can be taken to prevent them. In no small measure, the work is helping to extend the reach of key medical technologies, to bring into closer view the global vision of health for all.

— Lothar Wedekind, based on reports by Ms. Jordanka Mircheva, Robert Parr, Ms. Carla Fjeld, John Castelino, Vitomir Markovic, G. Ghopinathan Nair, David Kinley, and Paisan Loaharanu.

Photo: Patients being helped at the National Cancer Institute in Bogotâ. (Perez-Vargas/IAEA)

CHERNOBYL'S CHALLENGE

Health affects attributed to radioactive fallout from the tragic Chernobyl nuclear plant accident in April 1986 commanded keen attention over the past decade, among the public and scientific communities alike. Key studies were done to help clarify a controversial picture greatly shaped by public fears and perceptions about the potential dangers of radiation exposure. Radioactive fallout from the accident was mainly concentrated in Belarus, Russia, and Ukraine, but it also came down at low concentrations over much of the Northern Hemisphere. Within weeks of the explosion, scientists working through the IAEA's laboratories at Seibersdorf, Austria, and at its Marine Environment Laboratory in Monaco were collecting and analyzing earth, food, water, and other samples to monitor and assess the health and environmental impact of the fallout beyond the former USSR's borders. Seibersdorf analytical teams proved instrumental in coordinating and supporting campaigns in parts of Austria and neighbouring countries. Monaco's tracking teams found that sinking ocean particles had taken Chernobyl radioactivity rapidly to depths of two hundred meters along the Mediterranean coastline within a month of the accident.

In the 1990s, the IAEA co-sponsored two projects with the World Health Organization and other global partners that included scientific assessments of Chernobyl's radiological health effects. The health teams of the International Chernobyl Project in mid-1990 included one hundred physicians and scientists from twelve countries that closely looked at only specific groups of people living in affected areas of Belarus, Russia, and Ukraine. Key technical and medical monitoring support came from experts of the Agency's radiation safety and dosimetry services at IAEA headquarters in Vienna and at its Seibersdorf Laboratories. The health teams found significant health disorders, most of them not related to radiation exposure directly but to other social, economic, and environmental factors. Roughly nine of every ten people living in contaminated settlements — and about seven of ten living in *un*contaminated villages — thought they had, or might have, an illness due to radiation exposure, even though medical examinations found they did not. The finding focused greater attention on psychological health issues raised by the accident. Teams spent most of their time with children, and found cause for real concern. Their detailed but limited examinations did not rule out the chance that cases of thyroid cancer linked to high radiation exposure would rise in the future.

In 1996, about five years later and ten years after the accident, more than 800 experts from seventy-one countries and twenty organizations reassessed the picture, from health, environmental, and other perspectives. The venue was a major scientific conference in Vienna co-sponsored by six organizations of

the UN family, including the IAEA, and two regional agencies. The landmark event served to consolidate an international consensus on the accident's consequences, report proven scientific facts, and clarify technical information and prognoses that could be, and have been, misunderstood. The major health findings addressed both short- and long-term effects.

Regarding radiation-related thyroid cancers, the experts reported a sharp increase among children from the affected areas. By the end of 1995, three children had died of the cancer, and about 800 cases had been diagnosed in children under 15 years of age, living mainly in northern Ukraine and Belarus. These effects have been the only major public health impact from radiation exposure documented to date. In the future, thyroid cancers might arise in several thousand adults who were young children at the time they were exposed to radiation from the accident. Experts recommended continued monitoring of these affected groups to detect early signs. They noted that thyroid cancers generally can be successfully treated surgically and by medication.

Long-term health effects from Chernobyl radiation exposure had not been detected by 1996, although they could not be ruled out for the future. Experts urged close monitoring of cancer registries and further investigations to determine ongoing public health impacts and to confirm predictions. Regarding psychological health disorders and symptoms, the conference confirmed significant cases of anxiety, depression, and other illnesses among affected populations. These health effects, not caused by radiation exposure, were more generally related to other factors, notably the Soviet Union's dissolution and sudden economic and political changes.

The accident's immediate victims were among the emergency workers, who were exposed to high doses of radiation. Altogether 237 workers were admitted to hospitals and 134 were diagnosed with acute radiation syndrome. Of these, 28 died within the first three months, and at least fourteen additional patients have died since 1986, not necessarily due to radiation exposure. Two other people died in the explosion, and one from presumed heart failure.

In affected areas, severe environmental impacts were short term because of rapid radioactive decay, and no sustained impacts on people or ecosystems have been observed. Environmental monitoring continues, and it's expected that low-level radioactive contamination of lands will persist for decades. Over the past decade, much work has been directed through IAEA and other global channels toward protecting people living in these areas and rehabilitating affected lands. They include radiation protection measures; medical monitoring systems; and agricultural countermeasures to lower the radioactive content in milk and other food products to acceptable levels. Through its joint work with the FAO, the IAEA sponsored work by nearly forty scientists in nineteen countries who prepared comprehensive guidelines in 1994 of effective measures that have been demonstrated and put into place. Additionally in 1994, combined efforts of the IAEA, WHO, FAO and other organizations led to international guidelines that clarify the problem of when authorities should intervene and take protective measures for public health and safety in a radiological emergency. The intervention criteria are important, since they help to maintain credibility and confidence in decisions and prevent the kind of problems arising after the Chernobyl accident. Then, neighbouring countries set varying standards for foods that confused the public and disrupted trade.

Broader issues related to radiation health effects, and how the public hears and learns about them, commanded attention in 1994 in France, where four hundred policymakers, journalists, and nuclear experts from over fifty countries met at an IAEA-sponsored conference. Among problems addressed were the public's understanding of radiation's actual and perceived health and environmental risks, a problem linked closely to how well scientists and the media communicate the facts about radiation.— *Lothar Wedekind, based on IAEA documents and reports by John Richards, Abel Gonzalez, Franz-Nikolaus Flakus, Malcolm Crick, and David Kinley.*

Photo: "Let there always be sunshine", a painting by schoolchildren in Kiev done after the accident.