SCIENCE SERVING PEOPLE

IAEA-SUPPORTED PROJECTS ARE HELPING COUNTRIES APPLY THE RIGHT TOOLS TO FIGHT FOOD, HEALTH, & WATER PROBLEMS

A new booklet — Science Serving People — features stories about how IAEA-supported projects are making a difference in many poorer countries. The stories describe applications of nuclear science and technology that are being used through technical cooperation channels to overcome challenges of water scarcity, food shortage, malnutrition, malaria, environmental degradation and many other problems. They also illustrate how the complementary development, safety, and security initiatives of the IAEA are fostering atoms for peace in the developing world.

"Extreme poverty and deprivation remain a problem of monumental proportions at the dawn of the 21st century," notes IAEA Director General Mohamed ElBaradei in the booklet's Introduction. Through effective partnerships, collaborative research, and strategic direction, the IAEA is contributing to global efforts to help the poor. IAEA programmes have entered an important phase, he said, in which "scientific contributions to Member States are yielding very sizeable human benefits."

It's clear that science and technology must be better mobilized to meet the needs of the poor, emphasizes Jeffrey Sachs, Director of the Earth Institute at Columbia University, USA, and Special Advisor to UN Secretary-General Kofi Annan. "The UN agencies, such as the IAEA, have a great role to play," he says in the booklet's

Foreword. This is especially so, he points out, "if they act as a bridge between the activities of advanced-country and developing-country scientific centres, and if they help to harness the advances of world science for the poor as well as the rich." The bottom line, he concludes, is that rich countries should expand support for those United Nations organizations that can help in solving the unique problems confronting the world's poorest peoples.

The booklet features stories on managing water resources, promoting food security, focusing science on health problems, new tools for environmental management, and strengthening nuclear safety and security. Copies are available from the IAEA Department of Technical Cooperation. Stories also are featured on line through the Agency's WorldAtom web site, at http://www.iaea.org/worldatom /Press/Booklets/Ssp/index.html

GETTING TO THE BOTTOM OF ALGAL BLOOMS: NUCLEAR METHODS TARGET TOXINS

The Philippines -- Suddenly, in the early days of February 2002, milkfish started floating to the surface of the clouded ocean waters. Hundreds of tonnes of milkfish (locally known as bangus) valued at tens of millions US dollars were dying in their cages and traps, and beginning to decompose en mass on local beaches. (*See photo, next page.*) The coastal town of Bolinao in western Luzon—one of the principal sources of fresh seafood for Metro Manila—was rapidly turning from prosperity to an economic and environmental disaster area. The Bolinao Municipal Council declared the town under a state of emergency.

"We knew that the heavy concentration of aquaculture in the area made it extremely vulnerable to an algal bloom at some point," says Professor Rhodora Azanza of the Marine Science Institute of the University of the Philippines (UPMSI). "But the severity and magnitude of the fish kill was nearly unprecedented, and the nature of the phytoplankton bloom causing all the damage remained a mystery."

It was critically important to find out. Some algal blooms are laden with a toxin that can con-

centrate in mussels, clams, and other shellfish and be lethal to consumers.

Scientists call these varieties Harmful Algal Blooms (HABs). One health condition they can cause is paralytic shellfish poisoning (PSP), characterized by death from respiratory arrest. Dr. Azanza and her team at UPMSI went to work quickly analyzing water and shellfish samples in their laboratory in Quezon City. Within a few days, and thanks to a powerful microscope provided by the IAEA, they were able to inform the concerned public that a phytoplankton, *Prorocentrum minimum*, was the source of the bloom. While it had helped kill a lot of fish, it posed no danger of toxic effects on humans.

While that was good news to seafood consumers in the Philippines, the incident points to a much more extensive set of environmental problems that are not about to go away. With more than 7000 islands spread across thousands of square kilometres of tropical seas, the Philippines is a fisherman's wonderland—and an ideal location for aquaculture, the cultivation of seafood in artificial environments. Indeed, Philippine fisheries production surpassed the 3 million metric tonne mark in 2000, and aquaculture growth represented the most dynamic subsector surging at 10.6% annually.

But along with the growth of coastal aquaculture over the past two decades, the incidence of "red tides" like the one in Bolinao and toxic algal blooms causing PSP have been on a rapid rise. There are now 17 coastal areas across the country that are known to have been affected by an algal agent known as *Pyrodinium bahamense var. compressum*, and some 1800 cases of PSP have been reported and over 110 deaths over the period.

The government agency in charge of tracking HABs is the Philippine Bureau of Fisheries and Aquatic Resources (BFAR), which has established monitoring stations across much of the country and a central laboratory to conduct toxic testing of water and shellfish. According to BFAR's senior aquaculturist, Fe Bajarias, who now heads an inter-agency National Red Tide Task Force, "Our labs are constantly monitoring to ensure safety for the public. Due to potentially harmful algal blooms, we currently have placed three coastal areas under a complete shellfish harvesting ban. Our warning system is working, but our methods of testing and analysis would benefit from more advanced knowledge and testing technologies."

BFAR's shellfish testing laboratories rely on a tried and true—if slightly primitive—technique, injecting lab mice with the suspect shellfish toxin concentrate and measuring how long it takes for the mice to die. The "live mouse bioassay" method has been employed throughout the Asia-Pacific region for decades, even though its level of specificity in toxin determination is mediocre at best.

"The mouse bioassay is very imprecise, and the fishermen complain that harvesting bans are imposed even though their products are perfectly safe to consume," explains Elvira Sombrito, chief of Chemistry Research at the Philippine Nuclear Research Institute (PNRI). "The Philippines has had more than half of all the HABs occurrences throughout the whole region in recent years. It's clear that we need more thorough and accurate, and more humane means for determining which samples are safe and which are toxic to humans."

Since 1997, an IAEA Technical Co-operation project has been working to transfer a more scientifically advanced and precise method—the receptor binding assay technology—to assist the government in evaluating shellfish toxins resulting from increasingly frequent toxic "red tides."

Ms. Sombrito's views are given even more credence by those of Elmeterio Hopio, President of the Paranague Fisherman's cooperative on the southwestern shore of Manila Bay. Mr. Hopio's cooperative of 81 boat owners is the biggest source of fresh mussels for Metro Manila consumers. "The testing and information from the government is not very good or reliable," says Mr. Hopio. "Most of our members are very leery of their results. The United Nations could really help us if they would work with BFAR to make the shellfish testing more accurate and reliable."

That's precisely what the UPMSI has set out to do, in collaboration with PNRI, BFAR, and the IAEA programme.

"HABs is an environmental problem that has emerged rapidly with the growth of the aquaculture industry, and all indications are that it is only going to get more dramatic over time," says UPMSI expert Rhodora Azanza. "We owe it to Philippine and overseas consumers to provide the most accurate evaluation of any safety hazards in our seafood products. Our eventual adoption of the receptor binding assay technique using a tritium labeled saxitoxin is the very best way to ensure that."

PNRI and UPMSI have been making excellent progress in adopting the new method, and are already providing backup testing and analysis for the conventional laboratories operated by BFAR. "We're still in the experimental phases of adopting this advanced approach," says Professor Azanza. "But within a few years, we expect that the nuclear technique will assume the lead role in ensuring safety for the public."

Improved testing can deliver immediate results in terms of reducing human poisonings and lingering consumer uncertainty after a major HAB incident. Obviously, it will take far more than just better technology to bring the Philippine aquaculture industry into a more sustainable balance. "Devastating incidents like the one in Bolinao can occur because local governments are charged with regulating their local economies and marine environment," explains Sandra Arcamo, chief of fisheries resource management at BFAR. "We can provide the essential technical expertise, but it is up to the local authorities to properly implement the mandated environmental plans."

Intensive media coverage of recent fish kills and a more focused policy dialogue at the national level are beginning to question some aquaculture production methods that are currently widespread—such as fish cages and traps in high concentrations combined with heavy inputs of artificial nutrients. Clearly more ecologically sound methods will need to be identified if coastal peoples of the Philippines are to make a living from the sea on a sustainable basis.

GUARDING THE GUARANI: IMPROVING MANAGEMENT OF SOUTH AMERICA'S PRECIOUS GROUNDWATER

South America -- The Guarani is the largest aquifer in South America: it extends over 1.2 million square kilometres in Brazil alone—equal to the areas of England, France, and Spain combined. The system is shared by Argentina, Brazil, Paraguay, and Uruguay, and already supplies some 15 million people in the region. *(See photo, next page.)* Best estimates show that the Guarani contains enough water to supply 360 million people on a sustainable basis. Already, some 500 cities and towns across Brazil draw their water from the Guarani.

Since water consumption is rising rapidly for domestic, industrial and agricultural uses, the continent is turning increasingly to groundwater, which is especially valuable because it does not normally require chemical treatment. But the Guarani is a unique resource that must be managed strategically and protected to ensure its sustainability.

"The Guarani system is a striking example of an international water body threatened by environmental degradation," says Karin Kemper, a water resources specialist with the World Bank. "Without better management, the aquifer is likely to suffer from pollution and rapid depletion. Uncontrolled exploitation could reduce it from a strategic water reserve to a degraded resource that is a focus of conflict in the region."

This is the principal challenge being undertaken by the four national governments together with the Global Environment Facility (GEF), a funding consortium jointly managed by the UNDP, UNEP, and the World Bank. A GEF grant of US$ 27 million is helping to ensure that, in the face of increasing scarcity and

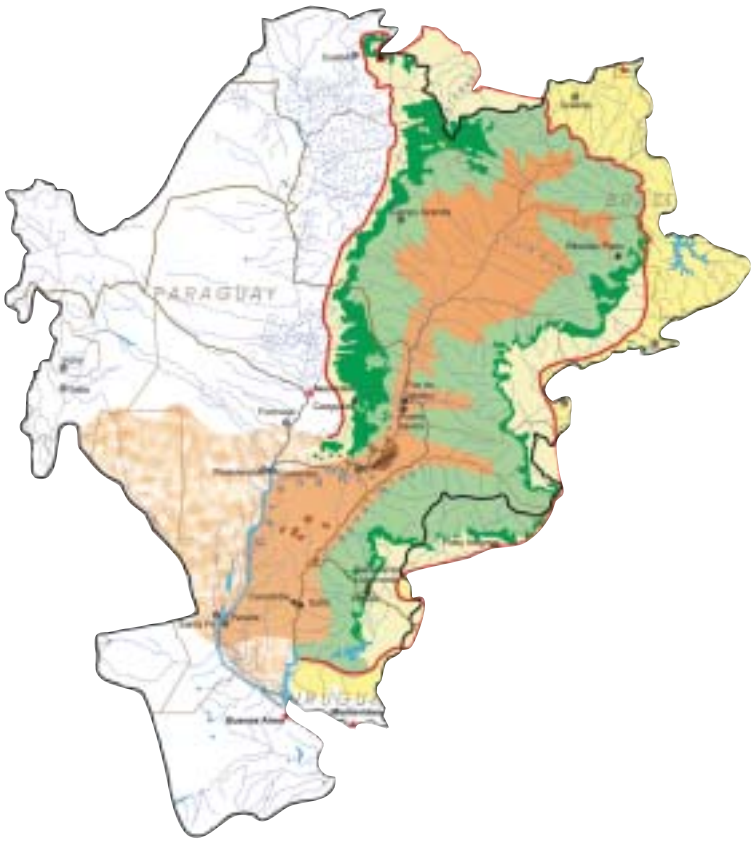
pollution of surface waters, the aquifer is preserved and kept available as an important reserve for the future.

The GEF project is supporting the creation of a common institutional and technical framework for managing the Guarani. This entails consolidation of scientific knowledge, implementation of a management plan, and enhancing stakeholder participation through communication and environmental education.

The governments and the GEF have sought help from the IAEA in utilising the analytical techniques of isotope hydrology. These methods facilitate the systematic measurement and interpretation of hydrological information that cannot be obtained by any other means. Isotope hydrology offers a set of unique tools, which are often the most cost-efficient and easiest to use. Isotopic information is usually combined with other hydrological information to produce a comprehensive understanding of an underground system and provide a scientifically sound basis for management decisions.

The principal threat to the aquifer system stems from uncontrolled pollution in its extraction and recharge areas. IAEA participation is improving the understanding of these potential threats.

As Laurence Gourcy of the IAEA Isotope Hydrology Section explains, "This is a unique opportunity to contribute significantly to protecting the Guarani Aquifer by ensuring the quality of the analyses, and the reliability of laboratories and isotope expertise. There is a pressing need for better international collaboration



of activities related to isotope hydrology."

The IAEA project component is enhancing knowledge in several scientific areas:

- Defining the key hydrodynamic features of the aquifer;
- Assessing water quality and differentiation of contamination patterns in terms of origin, impacts, and pathways of pollutants;
- Improving analysis of groundwater's origin and age, evolution, boundary conditions, recharge-discharge charateristics, and geothermal character; and
- Assembling a comprehensive, multilateral database to be shared among the four countries.

The IAEA will also support specialized training and participation of international experts to strengthen applications across the region. "Scientists in the field are currently completing a wells inventory, setting up a monitoring network, determining key parameters to be measured, providing technical training of staff, and preparing a hydrogeological map and conceptual model," says the IAEA's Laurence Gourcy. "Within a few years, we hope to have a comprehensive information system functioning fully to guard the Guarani from the most dangerous sources of contamination."

By building the capacity of local institutions in handling more sophisticated science and technological tools, the IAEA is thus helping South America realize the objective of comprehensive and sustainable management of its precious water reserves.

MEASURING THE BENEFITS OF FORTIFICATION: THAILAND'S BATTLE AGAINST "HIDDEN HUNGER"

Thailand-- The Asian continent remains one of the world's largest concentrations of poverty and hunger. Yet some countries have made remarkable progress in eliminating both protein and calorie malnutrition. Incomes and living standards across most of Thailand have risen dramatically in recent decades, and the protein-energy malnutrition that was once widespread has been drastically reduced.

But that's not good enough to satisfy the dedicated staff at the Institute of Nutrition at Mahidol University on the outskirts of Bangkok. Leading scientists here are hungry for new knowledge and technologies that can serve the battle against "hidden hunger" for the benefit of Thais and people across the developing world.

"We still have pockets of malnutrition and micronutrient deficiencies in Thailand, especially in the impoverished North and Northeast," explains Professor Emorn Wasantwisut of the Institute. "It's our responsibility to develop creative and practical ways of addressing these problems through our research and collaborative activities."

One way the Institute has been pursuing better nutrition for all income groups is through fortifying foods that are staples in the Thai diet. Experiments in adding basic micronutrients to various popular foodstuffs began in the early 1990s, and a special public-private sector committee was assembled under the chairmanship of the Ministry of Public Health to facilitate the commercialization of the best fortification formulas.

"Our initial work focused on triple-fortification of pre-packaged instant noodles, because it is a 'fast food' that many Thais eat regularly - rich and poor alike," explains Dr. Visith Chavasit, Deputy Director of the Institute. *(See photo this page)* "We convinced several manufactures of the marketing value of noodle seasoning fortified with iron, iodine, and Vitamin A, and they readily assumed the challenge of making their products more nutritious. Now 60 to 70 % of all noodle packets are triple fortified."

As any food chemist knows, however, adding nutrients to a foodstuff can alter the taste and appearance and turn consumers away. "When elemental iron was added to the duck flavoured noodle sauce, it turned dark and made the taste rather unpalatable," explains Dr. Chavasit. "We continued our search for the best food source for delivering essential micronutrients."

Adding complexity to the fortification process is the key issue of "bioavailability"—that is what portion of the additive is actually absorbed and utilized by the human body. For example, there are numerous forms of iron to choose from, and scientists need to experiment with various dietary combinations to see what forms are useful from a nutritional perspective, are cost effective, and remain appealing to consumers. For instance, inexpensive elemental iron is absorbed at a 10 to 50 % rate; while more costly ferrous sulfate provides iron than is close to 100 % absorbed.

Beginning in 1999, the Institute researchers began collaborating with the IAEA through a regional project involving seven Asian countries, all involved in analyzing the bioavailability of micronutrients supplied from fortified staple foods.

"Fish sauce is the most universal ingredient of

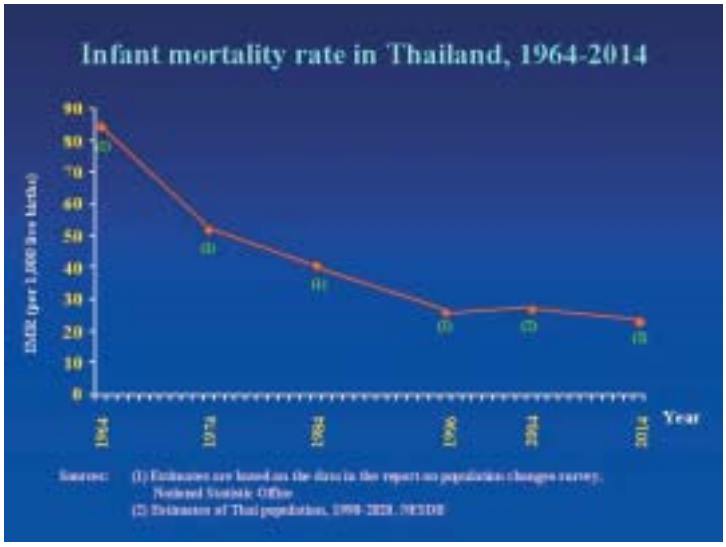
Thai cuisine," explains Dr. Wisantwisut. "We surmised that if we could come up with the right formula for fortifying inexpensive mixed fish sauce with iron and iodine, we would have the right vehicle for improving the diet and health of even the poorest Thais."

During the last two years, the Institute staff has thus been experimenting with nine different forms of iron fortificants in fish sauce. Testing includes not only the taste and appearance of the enhanced product, but also how it stands up in real life settings. The Institute team prepared and tasted some 1200 local dishes to scrutinize the improved sauces.

"The formula for fish sauce is centuries old, and the product is manufactured by numerous small and large companies," says Dr. Chavasit. "We found four producers that were willing to work along with us in the experimental phases.

One of those companies is Rayong Fish Sauce Industry Ltd., a family owned and operated producer with 40 years of experience. "We started working with the Institute on sauce fortification almost five years ago, and now we're aiming toward commercializing the product within a year," says Kawin Yongsawasdigul, director of marketing. "The value of fortification is not well understood," he says. "More public education is needed about nutrition. The private sector cannot do that job alone."

"Squid Brand" fish sauce is the second most popular sauce in Thailand. It's maker, the Thai Fish Sauce Factory, has also gotten involved in the Institute's pioneering research. "This kind of fortification is new for us and very good for the Thai people," says Ms. Poraya Jiramongkollarp, the assistant managing director. "We are getting excellent technical support and co-operation from our colleagues at Mahidol."



But the proof is in the pudding—or in this case, the sauce. The final measure of which formula is most nutritionally effective will launch the Institute into a new phase of its research.

"Our tests on human subjects will measure the bioavailability of iron in the best fortificants for fish sauce," says Dr. Wisantwisut. "It will be the first time that we've worked with stable isotopes as tracers," she explains. "We are truly excited about acquiring these new capabilities as isotopic analysis is really the state-of-the art in our field."

The trials will be conducted on women of childbearing age, the segment of the population that is most vulnerable to iron deficiency anemia. "What might take years to learn by observation can be achieved in weeks using isotopes," says Dr. Wisantwisut. "Policy people don't want to hear 'maybe' when they ask a scientific question. Using isotopes, we'll soon be able to give them answers with assurance."

The collaborative work of the Institute of Nutrition and the IAEA has captured the attention of the Asian Development Bank (ADB), which is already helping some 14 Asian nations to use combinations of fortification and bio-fortification to meet both macro- and micro-nutrient needs.

As ADB's Dr. Joseph Hunt explains, "We are inviting the IAEA to join the ADB food-based regional projects as an advisor and partner; that will open up new possibilities of using stable isotopes to measure nutrient content of all processed foods and bio-fortified seeds for rice, wheat, and other staples; and will aid in the burgeoning biotechnology industry. The nutrient pathway analysis is IAEA's special contribution to the ADB efforts in the region, and ADB in turn needs a partner that can create analytical skills and methods here in the region." ❑