LEARNING FROM ZTOUTI'S FARM

GREEN FIELDS TAKE ROOT IN MOROCCO'S SALTLANDS

BY LOTHAR WEDEKIND

Sed El Masjoune, Province d'El Kalaa des Sraghna, Morocco -- It's not the desert, but close. Dry, flat, and virtually barren, the land around Hassan Ztouti's small family farm about an hour north of bustling Marrakech is rugged terrain. Even in good years — which the country's drought-stricken farmers have not seen for awhile — rainfall averages a few centimeters a year. That's enough to feed checkered patches of shrubs and grasses. But the fallow fields can't sustain crops like fig and olive trees, wheat, and barley that Morocco's small farmholders harvest in more fertile areas of the Atlas mountain range

So why are Mr. Ztouti's fields turning into greener pastures? He's practicing a new approach to farming, one that soil scientists and land managers call "biosaline agriculture". Progress in the field is being driven in key ways by tools of nuclear science and technology. *(See box, next page.)* Over the past three years, Mr. Ztouti's farm has become a demonstration site for Morocco's plans to grow plants in saline soils. The saltlands collectively add up to hundreds of thousands of hectares throughout the country -- around Sed El Masjoune alone they exceed 10,000 hectares. The soils contain too much salt for the survival or healthy growth of most crops -- but not all.

On plots of several hectares irrigated with brackish water from a nearby well, Mr. Ztouti is cultivating various plants. They include eucalyptus and acacia trees, a mustard-type plant called rapeseed, olive trees, and the forage bush artiplex that can help feed pack animals and livestock.

As his plants grow, so does the interest of fellow farmers in following his lead. Yet, for the most part, they lack the knowledge and support to reclaim the land around them.

"This is new to them," says Dr. Abdel Ilah Ambri, a soil scientist who heads the Department of Environmental Physics at Morocco's National

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Photos: Hassan Ztouti (center, top photo) shows his fellow farmers how green fields can take root in Morocco's saltlands. Below, Dr. Ambri of INRA briefs the local farming community.

(Credits: Wedekind/IAEA)

Mr. Wedekind, a senior public information officer, is Chief Editor of the IAEA Bulletin and WorldAtom Web site, where this article was first featured.

WHY NUCLEAR?

The IAEA project on saline soils illustrates how the use of atoms in agriculture can help to prevent the degradation of farmlands and point the way towards more productive harvests. The project combines several proven nuclear techniques and applications to provide key pieces of information to soil scientists, farmers, land managers, and irrigation specialists.

■ *Neutron moisture gauges, or probes, are being used to monitor soil conditions and irrigation practices.* One result is that irrigation can be better managed — only needed amounts of irrigated water are applied and salt accumulation is better controlled.

■ *Chemical elements called isotopes are being used for water, soil, and plant studies.* Both stable and radioactive isotopes help scientists analyze groundwater resources, providing information about the quality and quantity of groundwater recharge and thus the sustainability of its use. Other isotopes can be used for "labelling" plants to trace the pathways of elements such as carbon and nitrogen that circulate from the atmosphere to plants to soil and again into the atmosphere. *(Also see box on page 31.)* Their study can provide information on the effect of plants on soil structure and fertility, for example. Some isotopes, such as those of chlorine, can be used to monitor the movement of saline water, yielding valuable information to guide sustainable farming practices on saline lands.

■ *For water studies, isotopes of hydrogen and oxygen are of special interest.* Deuterium, or hydrogen-2, and oxygen-18 are heavier and much rarer than the more abundant isotopes hydrogen-1 and oxygen-16. Tritium, or hydrogen-3, is even rarer and radioactive. Rising water vapour from oceans has a lower concentration of the heavy isotopes than seawater. This means that when it rains, the heavy isotopes rain out first, and that the precipitation changes isotopically as clouds move inland. In the process, water acquires individual and characteristic "fingerprints" in different environments. In groundwater studies, the decay of tritium dates the groundwater over decades; radiocarbon in dissolved lime can "date" many millenia. When hydrologists analyze data from water samples, they gain historical insights into the water source's dynamic lifespan, including its age, origin, and transport processes, that help shape decisions about how the water is used in the future.

Taken together, nuclear and isotopic techniques have become keys of efforts to fight the environmental degradation of arable lands. The tools are safe, precise, affordable, and sometimes the only means to study the complex interrelationships between soils, water, and plants.

Agricultural development is a central component of the IAEA's technical cooperation programme, which is placing renewed emphasis on demonstrating innovative solutions for conservation and agricultural production of marginal lands. An overriding goal is to strengthen national capabilities for implementing common policies and international protocols. Projects particularly seek to encourage and broaden technical cooperation among developing countries to tap regional expertise and resources in applying tools of nuclear science and technology to shared problems.

Through technical cooperation and research channels, the IAEA is seeking to strengthen its collaboration with international and regional organizations committed to sustainable agricultural development. A central role is played by the United Nations Secretariat of the Convention to Combat Desertification, which helps to mobilize resources to support national and international actions against land degradation. The IAEA's scientific and technological resources can contribute in key ways to overcoming the challenges ahead through stronger partnerships and well-defined cooperative programmes.

Photo: Key analytical services are provided by experts at the IAEA's Laboratories in Seibersdorf and Vienna, Austria. (Credit: Calma/IAEA)

Institute of Agronomic Research (INRA) supporting Mr. Ztouti's work. "And they are interested to learn more about it. They see the greener fields in these saltlands and they want the 'know-how'."

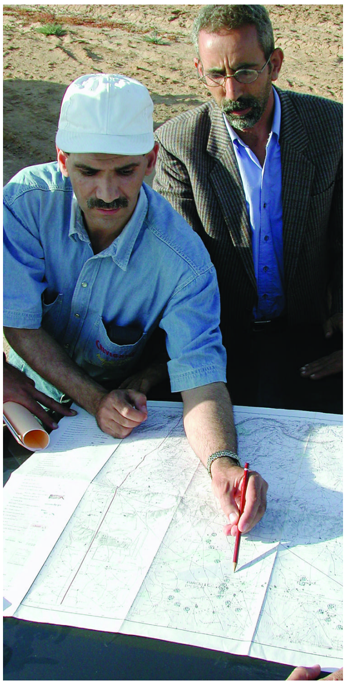
Among the curious are old and new generations of farmers in Sed El Masjoune. About two dozen have gathered today for a sun-sheltered briefing inside a spacious tent set up a stone's throw from the well near Mr. Ztouti's fields. The colourful tapestry flaps, display boards flip, and papers flutter in stiff spring winds, as a circle of men sipping tea learn about the new way of farming and the government's support for it. Dr. Ambri, chief engineer Lahcen Belbahri, who heads the Provincial Agriculture Directorate at El Kalaa des Sraghna, and other local representatives explain the aims and how farmers can get involved. A few take written notes, most rely on pictures, charts, and memory - a contrast illustrating the practical challenges of "show-and-tell" technology transfer in this poorly literate and traditional farming community.

For thirty-year-old Abderrahman Basri and sixty-year-old Abdennebi Salah, the chance of a new well like the one the government tapped for Mr. Ztouti piques their interest. Far too little rain has fallen over the past 10 years, Mr. Salah says, shrinking harvests of melon, alfalfa, and cereal grains that most farmers try to grow. Access to water, even brackish water, may not support those crops. But maybe the wells can help farmers stop waiting for rain and start turning abandoned fields into pastures.

"Water and the feeding of animals are the main things on farmers' minds here," says Mr. Abdelsadek El Mahir, the local representative of the provincial agricultural union. "Most of the union's meetings and emergency sessions every year focus on those issues, plus animal and plant diseases. If more land could be developed for grazing, it would be a big step in the right direction."

Teaming with Partners. To help its farming communities, Morocco has teamed with seven other north African and west Asian countries in research and demonstration of biosaline agriculture on drylands like those in Sed El Masjoune. The partnership is the cornerstone of an IAEA model project initiated in 1997

Photos: Top left, two generations of Morocco's farmers -- Mr. Abennebi Salah, 60, and Mr. Aberrahman Basri, 30 -- share a common interest in learning from the IAEA's saline soil project. Top and facing page: Near their farms, more wells are being drilled in the dusty fields, to provide the water the farmers need. Mr. Abdel Ilah El Hattami, an agro-engineer, pinpoints the potential sites. (Credits: Wedekind/IAEA)



for a six-year period through the technical cooperation programme.

One core objective has been to show farmers how to properly apply saline and fresh groundwater for irrigating plants that tolerate salt conditions and are economically useful. Besides supplying feed for sheep, goats, camels, and mules, the mix of salt-tolerant plants can be used as sources of biomass fuel, fertilizer, and industrial raw materials. As importantly, the greener fields bring refreshing signs of life to harsh and hot environments, helping to conserve soil moisture, slow erosion, and brake encroaching desertification.

Joining Morocco in the project, now into its second three-year phase, are countries where farmers face similar challenges tilling fields in arid and semi-arid zones - Egypt, Jordan, Syria, Pakistan, Iran, Tunisia, and the United Arab Emirates. Project managers there are moving to establish or expand demonstration sites where plants are cultivated by local farmers on plots of ten hectares or more. In Iran, sites are being expanded to about thirty hectares, for example; Pakistan is eyeing up to 5000 hectares; and Morocco is digging another saline water well at Sed El Masjoune to irrigate more demonstration plots initially covering about twelve hectares of the vast dirt-road plains.

"We're monitoring up to 25 wells here," says Mr. Abdel Ilah El Hattami, an agro-engineer with the Provincial Agricultural Directorate in El Kalaa des Sraghna, as he pinpoints the sites on a topographical map. Digging the wells mostly by hand, workers with shovels, picks, pails, and drills can take up to forty days to tap the saline aquifer more than fifty meters below, he says.

Their labour is an essential factor of Morocco's biosaline equation. Once tapped, the aquifer can be studied, mapped, and monitored. Is it big enough to irrigate an expanded plant demonstration site? How is it recharged? How salty is the groundwater? What's happening to the soil? Scientists and hydrologists using analytical tools including nuclear and isotopic techniques will answer these and other questions in studying the groundwater's dynamics and monitoring soil and plant conditions.

"We couldn't make a decision on site expansion without the data," says Dr. Ambri of INRA. "Once farmers start the new plants, we need to know there will be enough water to sustain them in the soils here."

Networks of Knowledge. Instructive channels of cooperation have opened through the project for Morocco and other countries. Because they share common problems of agricultural development, the countries draw upon each other's experience and expertise. Working networks today link multi-disciplinary teams of farmers, soil scientists, agro-engineers, hydrologists, and land managers who had little or no contact five years ago. The plants growing in Morocco's fields, for example, were imported under the project from Pakistan, where their seeds were nurtured and grown. At no cost, Pakistan now plans to support Tunisia's extension of demonstration sites in several provinces with a one-ton shipment of a variety of salt-tolerant plant seeds.

"In Pakistan, many farmers are growing salt-tolerant grasses for forage and for improving the land, and they've found that many other plant species perform very well," says Dr. Mujtaba Naqvi, the IAEA consultant coordinating the model project and former head of Pakistan's Nuclear Institute for Agriculture and Biology. "We're now looking to share and transfer more of that experience, to help scientists and farmers develop larger-scale plantations on saline land."

Salt is an age-old farmer's nemesis that today limits agricultural development on more than 80 million hectares worldwide. Though global initiatives are targeting problems, farming saltlands may demand a new way of thinking, Dr. Naqvi says, one that weds science and nature.

"Agriculture traditionally is carried out by suiting the soil to the plant," he says. "But we've found that it is perfectly possible to suit the plant to the soil, even under adverse conditions." There are hundreds of salt-tolerant plant varieties, and laboratory and field research is adding to knowledge about where they grow best, and why. The results are vital to decisions on agricultural policies, practices, and land management at the heart of national, regional, and international development programmes.

The IAEA project's knowledge network extends well beyond the field demonstration sites — to group workshops and courses on specialized topics, hands-on laboratory training in soil, plant, and water science, and periodic coordination meetings that bring together national project managers and international experts.

Mr. Ztouti and Mr. El Hattami in Sed El Masjoune are among those who have benefited from the opportunities. They visited Pakistan's sites in November 2000 to learn from counterparts engaged in the country's development of saline soils, and associated plant and irrigation management practices. Other scientists - including Mr. Athar Khan of Pakistan and Mr. M'hamed El Khadir of Morocco - have been awarded scientific fellowships to work with the IAEA's Rebecca Hood and colleagues. Over a period of several months, they plan and carry out research projects at the FAO/IAEA Agriculture and Biotechnology Laboratory, a branch of the Agency's Seibersdorf Laboratories near Vienna, Austria, that is operated jointly with the Food and Agriculture Organization of the United Nations. *(See box, page 31.)*

The lab work and field studies are essential paths to learning. They yield information about plant varieties that stand the best chance of growing in soil and environmental conditions back home.

THE FIELDS OF AIN EL ATTI

About a day's drive through the snow-peaked Atlas mountain range and 400 kilometers northeast of Sed El Masjoune, rows of eucalyptus and acacia trees sway in the breeze at Ain El Atti. The fields on the rocky, barren outskirts of the Tafilalet Province oasis are home to what might be described as Morocco's "biosaline nursery". Ain El Atti was the first site set up under the IAEA project in 1997 to test under local conditions salt-tolerant seeds imported from Pakistan and sown as seedlings.

The past four years have seen eucalyptus grow to four meters and more, and flowering acacia cover what once were wind-swept dusty fields. Every week, Mr. Mohamed Mansouri, the site's keeper, opens the irrigation channels that bring brackish water from an artesian well to plants sown in sun-baked soil. Some of the land registers a salt content as high as one-third of that measured in seawater. The channels stretch hundreds of meters, regulating the water's path and flow from the old crusted uncapped well tapped ten years ago. It still delivers seven liters of groundwater a second, day and night, Mr. Mansouri says.

How much water the nursery's plants receive is vital to their fate, requiring soil, plant, and water assessments and accurate interpretations of results. The science extends to monitoring tests using neutron probes and other instruments that track a string of interrelated agricultural variables, including water

Photo: Where the river oasis ends on the far horizon, wastelands have become agricultural test grounds near the village of Ain El Atti. (Credit: Wedekind/IAEA)

PARTNERS IN THE LAB

Scientists Athar Khan and M'hamed El Khadir share a common goal. They come from countries -- Pakistan and Morocco -- where saline lands are widespread barriers to agricultural development. The goal they share is to see the fields become productive through contributions they can make back home.

For several months this year, they worked as scientific fellows with the IAEA's Rebecca Hood, a soil scientist from the United Kingdom, at the Agriculture and Biotechnology Laboratory, a joint FAO/IAEA branch of the Agency's Seibersdorf Laboratories near Vienna, Austria. Under the IAEA's project on saline soils, Mr. Khan and Mr. El Khadir conducted separate experiments whose results could help their countries reclaim wastelands.

Mr. El Khadir, a microbiologist with Morocco's National Institute of Agronomic Research (INRA), studied the decomposition of organic matter in soils. Using a method called "dual labelling" with the stable isotopes nitrogen-15 and carbon-13, he tracked the rate at which different types of organic materials decomposed in saline soils.

Mr. El Khadir used tropical nitrogen-fixing seedling trees grown in the Seibersdorf greenhouse. He then labelled them using carbon-13 and placed the seedlings inside a small rectangular gas chamber sealed in plastic. More difficult was assessing how the breakdown of labelled organic matter affected soil conditions. The work entailed reviewing and interpreting extensive data from samples measured by the laboratory's mass spectrometer. The highly sensitive analytical instrument measures about 10,000 samples a year under projects supported by the Soil Science Unit.

"The experiments will help me in my research at INRA," says Mr. El Khadir. "We need to better understand the composition of our own soils, and that will help us tell farmers how and where different types of plants can grow best."

Mr. Khan's research was similarly directed to helping his country more productively use saline lands, which extend to more than six million hectares nationwide. A plant physiologist with Pakistan's Nuclear Institute of Agriculture, Mr. Khan's research at Seibersdorf focused on studies of wheat, a staple crop in Pakistan. He sought to learn more about a technique known as "carbon isotope discrimination" and its potential as a screening tool for salt-tolerant varieties of wheat. His research built on work done at Seibersdorf by a fellow Pakistani, Ms. Robina

Shaheen, an IAEA associate professional officer who studied wheat and rice varieties.

Mr. Khan's experiments involved determining the relationship between salt tolerance and carbon-12 and 13 ratios in more than 50 varieties of wheat that he brought from Pakistan and planted as seedlings in soils containing different levels of salinity. Carbon measurements were done using the Laboratory's mass spectrometer. Mr. Khan also played a key role in developing new preparation methods that would allow materials to be analyzed using a commercial instrument called a breath test analyzer. The Soil Science Unit is seeking to develop the instrument as a low-cost measurement system for carbon isotope studies.

"Screening for salt tolerance in cereals requires reliable techniques," says Mr. Khan. "Doing it under field conditions is difficult and involves many complex factors that take a long, long time to study".

If research singles out carbon-13 as a useful criterion, it could lead to a rapid and inexpensive screening technique for agricultural laboratories in Pakistan and other countries facing salinity problems.

"Pakistan's population is growing fast and we need to increase food production," says Mr. Khan. "Salinity affects about 50% of our irrigated land, so we have to cultivate plant varieties that can grow in saline soils."

Carbon-13 applications are common as a tracer and in studies investigating the process of photosynthesis in plants, says the IAEA's Dr. Hood. "We know it can be a useful tool in the selection of plant varieties that tolerate drought," she says. "If it turns out to be a reliable technique for screening salt tolerance, that would be a big step forward."

Photo: Pakistan's Dr. Khan, checking the fruits of his research at the Seibersdorf Laboratories. About half of his country's irrigated land is affected by saline soil conditions. *(Credit: Calma/IAEA)* salinity, soil moisture, and each plant's health and growth.

"We try to follow a holistic approach through these experiments to better understand the interrelationships between soil, plant, and water," explains Dr. Ambri of INRA, who manages the IAEA project in Morocco. When using saline water for irrigation, for example, quantity is one major factor. "The basic idea is to water the plants with a calculated amount that's enough to leach the salt below the plant's active root zone," he says. Over the course of a typical year, the nursery's plants receive about 24 times more saline water from irrigation than rainwater from the sky, he says. Rainfall averages a scant 60 to 100 millimeters a year.

Trying to keep the soil-plant-water triangle in balance at Ain El Atti demands a range of expertise, and detailed studies that provide farmers with the knowledge they need to cultivate selected plants. A group of specialists and scientists from INRA and the Regional Agency for Agricultural Development, known as ORMVAT, support the project's multiple dimensions. They include Mr. Kouider Barhmi, an INRA soil physicist; Mr. Mohamed Beqqali, an INRA specialist in soil fertility and physical chemistry; Mr. Mohamed El Allam, an INRA soil scientist; Mr. Moutaouaki El Ghali, an ORMVAT agronomist; and Mr. Mohamed Ourahou, an ORMVAT agro-engineer.

Still, not all the experiments have achieved desired results. More than two dozen varieties of cereal grains, including barley and wheat, were tested over the past four years. Most performed well the first year, but then succumbed to the elements over time. "We found that these cereals just don't tolerate salt at the levels seen here," Dr. Ambri says.

Trees and shrubs have been a different story, which could be good news for the country's agricultural development. Their potential productive uses are varied: eucalyptus, for example, can provide fuelwood for homes and pulp at paper mills. Acacia and eucalyptus flowers attract bees, which opens possibilities for honey production. The shrub called artiplex, which grows well even in highly saline soil, can be grown as a fodder crop.

For INRA's Mr. El Allam, who heads the tree and shrub experiments, the results are encouraging and instructive. He received the seeds from Pakistan, cultivated them at INRA's nursery in Rabat, and then planted the seedlings at Ain El Atti. Now he's looking for more plant seeds, even as INRA tests indigenous seed varieties in saline soil research. "It's been much easier to work with seeds of plants already growing well in saline soil," he says. "Morocco has acacia and eucalyptus trees, but they are not the same species as those in Pakistan and tend not to do as well."

Steps taken at Ain El Atti are leading toward more productive agricultural research and development of Morocco's saline lands.

"What we need is support to expand the nursery here," says Dr. Ambri, "to more visibly show what can be done and improve our capabilities to produce seeds from the plants we grow."

The IAEA project has been a "key catalyst" for driving national support and awareness of biosaline agriculture and its development, he adds. With greater national and international support, he thinks much more could be achieved to engage farmers and agricultural communities, as well as managers of industries requiring agricultural raw materials.

"They have to see the potential economic benefits," says Dr. Ambri, "and the demonstration sites can help show them the possibilities."

SALT OF THE EARTH

The problem of salt in agriculture is not new, or limited to the countries participating in the IAEA's project. Worldwide, FAO experts estimate that salinity affects productivity on about 80 million hectares of arable land -- just about the total land area of a country the size of Pakistan -- predominately in developing countries having hot and dry climates.

The problem arises when salt is left behind in the soil as water passes back into the atmosphere through the processes of evaporation and plant transpiration. In areas with good rainfall and effective drainage systems, the soluble salts change in composition and concentration as water carries them away, eventually to the seas.

But in parts of the world having little rainfall and restricted drainage, the salts cannot easily be transported. They accumulate in lowlands, or in the groundwater below them.

Nature's own geographical and geological processes are a major contributor to salinity. Experts say that more than 30 million hectares of salt-affected land arise from natural causes, aridity, and high rates of evaporation. In many cases, problems are exacerbated by the loss or destruction of natural vegetation from animal grazing or the search for biomass to burn for cooking and heat.

Most saline lands, however, are in or near areas where irrigation is the backbone of farming, predominately developing countries. Lack of good drainage is a major contributor to salinity. So is seepage from irrigation systems and drainage fields which can lead to a loss of nearly half of the water. Gradually the groundwater table rises, bringing salts to soil layers where crops get nutrients. The result is stunted or dead plants. As surface waters evaporate, the fields become white encrusted, salt-capped wastelands. Farmers abandon them and agricultural economies suffer.

Salinity can be controlled, and lands reclaimed, though not overnight and not easily or inexpensively. One approach is constructing good irrigation systems that gradually improve soil conditions and prevent formation of waterlogged and unproductive fields. Systems need to apply slightly more water than the crop needs, to promote leaching, and then drain and catch groundwater so that it can be recyled for agricultural or industrial uses.

Unfortunately, poor irrigation practices often promote rather than control salinity, and engineered drainage systems extending over large areas of land are financially out of reach for most countries. The World Bank, for example, has estimated that about $600 billion needs to be invested globally in rural and urban water delivery systems.

Biosaline agriculture -- suiting salt-tolerant plants to soil and water conditions -- may offer a more affordable alternative, though not necessarily an easier one. It depends upon good irrigation practices, especially where the groundwater already has higher than normal salt concentrations. And it takes years of research and testing to match the right plants with the right soil and water conditions, then maintain the ecological balance for sustainable agricultural production.

Whatever the selected approach, experts agree on the need for greater investment in collaborative campaigns to control salinity. Each year, hundreds of millions of dollars — no one knows exactly how much — are lost to national agricultural economies from saline lands and desertification processes.

More certain is that in years ahead, the world's population growth, especially in developing countries, will heighten needs for productive land, food and water, about 70% of which is used for agriculture. Irrigated farmlands

Photos: Young plants take root beneath the sun-baked, salt-capped crust of saline soils in Sed El Masjoune. In the nursery at Ain El Atti, irrigation channels caked by nature's elements carry saline water to experimental crops. (Credits: Wedekind/IAEA)

CERTAIN CHALLENGES

Agenda 21 adopted at the Earth Summit in 1992 crystallized problems facing sustainable agricultural development. One chapter of the action plan, entitled Promotion of Sustainable Agriculture and Rural Development, highlights key issues:

■ *By the year 2025, more than 80% of the expected global population will be living in developing countries.* Yet the capacity of available resources and technologies to satisfy the demands of this growing population for food and other agricultural commodities remains uncertain. Agriculture has to meet this challenge, mainly by increasing production on land already in use and by avoiding further encroachment on land that is only marginally suitable for cultivation.

■ *Land degradation is the most important environmental problem affecting extensive areas of land in both developed and developing countries.* The problem of soil erosion is particularly acute in developing countries, while problems of salinization, waterlogging, soil pollution and loss of soil fertility are increasing in all countries. Land degradation is serious because the productivity of huge areas of land is declining just when populations are increasing rapidly and the demand on the land is growing to produce more food, fibre and fuel. Efforts to control land degradation, particularly in developing countries, have had limited success to date.

■ *Major gaps and weaknesses exist in the capacity of existing national and international mechanisms to assess, study, monitor and use plant genetic resources to increase food production.* Existing institutional capacity, structures and programmes are generally inadequate and largely underfunded. There is genetic erosion of invaluable crop species. Existing diversity in crop species is not used to the extent possible for increased food production in a sustainable way.

■ *Techniques for increasing production and conserving soil and water resources are already available but are not widely or systematically applied.*

For more information, see the United Nations Web pages at http://www.un.org Agenda 21 comes up for governmental review in September 2002 at the Earth Summit + 10, hosted by South Africa.

Photo: Brackish wells like these in Morocco can lead to greener fields in harsh environments. *(Credit: Wedekind/IAEA)*

today supply about half of the world's food and fiber, and far more in countries where farmers rely upon groundwater for their harvests.

The drive for sustainable development charts a challenging course for international cooperation. The world's blueprint for action — Agenda 21, which governments adopted in 1992 at the Earth Summit and comes up for decennial review in June 2002 — set ambitious targets. It called for a multi-year range of integrated activities exceeding $31 billion to promote sustainable agricultural and rural development, including concerted action against salinity, land degradation, and desertification. Strong emphasis was placed on closing gaps of "insufficient basic knowledge" and in wider applications of science and biotechnology.

As it seeks to expand its reach, the IAEA project is contributing to progress. Farmers and scientists are working together to factually feed the knowledge base upon which bigger development programmes must be built. If more farming communities can be enlisted in the fight to reclaim wastelands, their work could stimulate broader-based partnerships for progressive agriculture in needy countries.

With more hands joined for the productive transfer of knowledge and technologies, life on the farm can change. Until then, farmers on saltlands like those in Sed El Masjoune face little choice but to plough ahead in the best way they know how. ❐