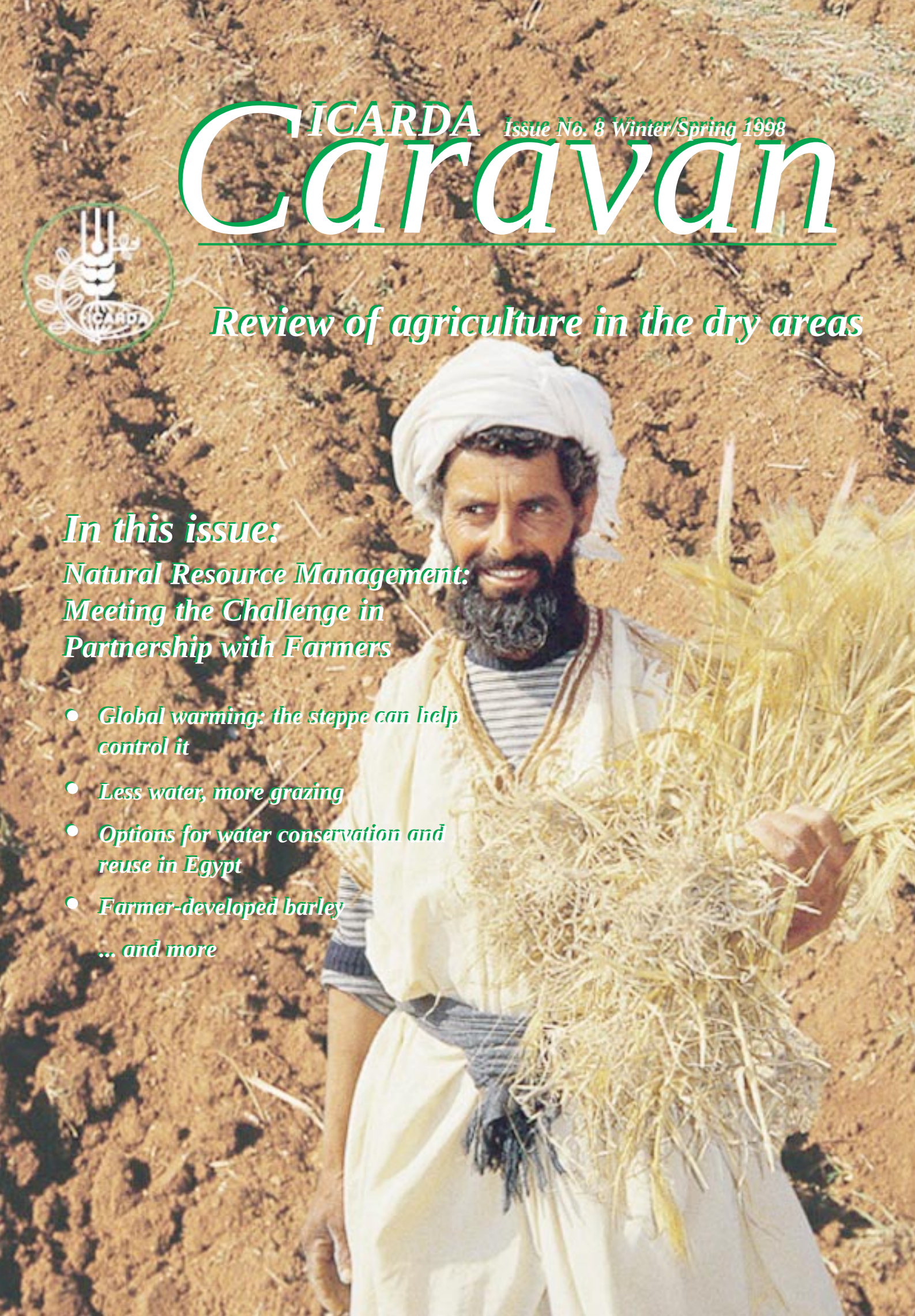
ICARDA

Caravan

Issue No. 8 Winter/Spring 1998

Review of agriculture in the dry areas



In this issue:

Natural Resource Management: Meeting the Challenge in Partnership with Farmers

- Global warming: the steppe can help control it
- Less water, more grazing
- Options for water conservation and reuse in Egypt
- Farmer-developed barley

... and more

From the Director General

Natural resource management has been an integral component of ICARDA's agenda since the birth of the Center, along with research on increasing productivity of the food and feed crops. An evaluation of the progress made to date pointed to the need for balancing the equation, and guided the development of ICARDA's Medium-Term Plan for 1998-2000. The Center is now striving more than ever before to integrate improved food production with the efficient management and conservation of natural resources.

In this issue of *Caravan*, we present a few examples of the harmony of our research with nature. Our collaborative long-term trials in Egypt have produced tentative guidelines which will help farmers to use less water, and fewer external inputs (and thus spend less). We also report here on our collaborative work in Egypt's North-West Coast, where a major Egyptian Government project is seeking integrated productivity and resource management strategies for a fragile environment.

The agricultural research community is increasingly becoming aware that it will have to incorporate climate change—both controlling it if possible, and living with it—as an element in its research agenda. We have already reported on how wise land husbandry can stabilize soil structure and carbon content, preventing the catastrophic loss of carbon sequestration that hasty agricultural development can lead to (see *Agriculture—a weapon against global warming* in *Caravan No.* 5). In this issue we report our work on rangeland CO_2 flux monitoring in Uzbekistan—a project that we hope will be extended to Kazakhstan and Turkmenistan soon.

In many areas in ICARDA's geographic mandate, rangeland degradation is a growing problem. If not controlled, this could lead to desertification. In some of these areas livestock production depends on irrigated forages that use frightening amounts of scarce water. Also, there is a need to replace the naturally occurring unpalatable grazing species with palatable ones. ICARDA, in collaboration with its national partners, is tackling this by using indigenous knowledge to identify potential grazing species, and then multiplying the seed and testing the lines for water-use efficiency, palatability, and other desirable qualities. This work has implications for the environment in three ways: biodiversity will be preserved *in situ*, water use will be cut, and plant cover of the rangeland will be preserved –

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reducing the threat of desertification. In the meantime, forage production for grazing is being improved, and with it the supply of dairy products which are essential for nutrition.

Fighting hunger is a key part of preserving the environment, so the productivity side of the equation must not be forgotten. This issue of *Caravan* gives an example of how the use of farmer-selected lines developed from landraces-based barley breeding keeps biodiversity in the field, and raises productivity.

Integrating research on sustainable increases in productivity with natural resource management is a challenging task, particularly in the harsh, unpredictable environments of the dry areas. Modern tools of agricultural research and information technology offer a great promise in addressing the issues involved with precision, speed, and reliability. ICARDA is increasingly reorienting its research methodology to take advantage of these tools. The Center is sharing its expertise in the use of modern tools of research with its national partners to multiply the efforts in enhancing sustainable agricultural development.

Prof. Dr Adel El-Beltagy
Director General

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About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is governed by an independent Board of Trustees. Based at Aleppo, Syria, it is one of 16 centers supported by the Consultative Group on International Agricultural Research (CGIAR).

ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and the West and Central Asia and North Africa region for the improvement of bread and durum wheats, chickpea, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national agricultural research and development systems.

The results of research are transferred through ICARDA's cooperation with national and regional research institutions, with universities and ministries of agriculture, and through the technical assistance and training that the Center provides. A range of training programs is offered extending from residential courses for groups to advanced research opportunities for individuals. These efforts are supported by seminars, publications, and specialized information services.

The CGIAR is an international group of representatives of donor agencies, eminent agricultural scientists, and institutional administrators from developed and developing countries who guide and support its work. The CGIAR receives support from a wide variety of country and institutional members worldwide. Since its foundation in 1971, it has brought together many of the world's leading scientists and agricultural researchers in a unique South-North partnership to reduce poverty and hunger.

The mission of CGIAR is to promote sustainable agriculture to alleviate poverty and hunger and achieve food security in developing countries. The CGIAR conducts strategic and applied research, with its products being international public goods, and focuses its research agenda on problem-solving through interdisciplinary programs implemented by one or more of its international centers, in collaboration with a full range of partners. Such programs concentrate on increasing productivity, protecting the environment, saving biodiversity, improving policies, and contributing to strengthening agricultural research in developing countries.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP) are cosponsors of the CGIAR. The World Bank provides the CGIAR System with a Secretariat in Washington, DC, and a Technical Advisory Committee, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

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Tel.: (963-21) 2213477, 2225112, 2225012.
Fax: (963-21) 2213490, 2225105.

E-Mail: ICARDA@CGIAR.ORG.
Web site: http://www.cgiar.org/icarda.

Executive editor: Dr Surendra Varma
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Director General Visits Yemen, Meets Prime Minister, Senior Government Officials

ICARDA Director General, Prof. Dr Adel El-Beltagy, visited the Republic of Yemen, 8 to 12 June 1998. He met the Prime Minister, H.E. Dr Abdul Kareem Al-Iryani; Deputy Prime Minister and Minister of Foreign Affairs, H.E. Mr Abdul Kader M. Bajamal; Minister of Planning, H.E. Mr Ahmed Sofan; Minister of Agriculture, H.E. Mr Ahmed Salem Al-Jabali; and a number of other distinguished officials.

On his return to Syria, Prof. Dr El-Beltagy commented that "Yemen is an important country from ICARDA's point of view. Per capita income is low, and the environment both harsh and diverse. But there has been progress in agricultural research and development and ICARDA's contribution in this regard is important. I am glad that our collaboration with Yemen is growing."

Besides meeting with high-ranking officials of the Government, his program included visits to agricultural research facilities in Sana'a and Dhamar and on-farm research sites in the northern highlands. Accompanied by Drs S.V.R. Shetty and Mohamed Zainul Abedin of the ICARDA Yemen office, and the senior officials of the Ministry of Agriculture and AREA (Agricultural Research and Extension Authority), he also visited the officials of the World Bank, FAO, UNDP and the University of Sana'a.

Prof. Dr El-Beltagy briefed the Prime Minister on ICARDA's work and role in improving the productivity of crops and the quality of life of the rural population, and conserving agricultural resources. The Prime Minister extended his Government's support to ICARDA activities in Yemen and called for more effort by agricultural research systems in improving food production, and conserving natural resources.

In the meetings with Ministers of Agriculture, Foreign Affairs, and Planning, the discussions covered the progress made in increasing food production, the role of agricultural research in development, the problems in rainfed agriculture, the on-going cooperation between Yemen and ICARDA, and the role of ICARDA in the development of future national agricultural research programs. The Ministers expressed satisfaction over the existing cooperation and thanked ICARDA for its contribution to the agricultural development in Yemen.

During the discussions with the representatives of the World Bank, FAO, and UNDP, ways were discussed to strengthen AREA and the Yemen national program for meeting future challenges in food security, resource conservation (particularly water) and alleviating poverty.

During the field visit to Al-Mahweet area, discussions were held with farmers and extension agents on the Rapid Impact Program activities implemented by AREA/ICARDA. During this visit it was decided that, in addition to its existing office in Dhamar, ICARDA would soon establish an office in Sana'a to be in close contact with the Government offices, international organizations, and donors working on agricultural development in Yemen. ■

A harsh environment: Prof. Dr El-Beltagy (second from right) and national-program and ICARDA colleagues in Yemen.

ICARDA, Uzbekistan Sign Agreement

On 8 May 1998, the Republic of Uzbekistan and ICARDA signed an agreement to cooperate in agricultural research. It was signed in Tashkent, on behalf of the Prime Minister of Uzbekistan, by His Excellency Mr Ismail Djurabekov, the First Deputy Prime Minister and Cabinet Minister in Charge of Agriculture and Water Resources (MAWR), and by the ICARDA Director General, Prof. Dr Adel El-Beltagy.

The agreement provides diplomatic status to ICARDA's mission in Uzbekistan, and allows establishment of ICARDA's Regional Office in Tashkent.

The signing ceremony, held in the Ceremony House of the Ministry of Foreign Affairs, was witnessed by a number of high officials of the Government of Uzbekistan, including H.E. Mr Shavkat S. Khamrakulov, the First Deputy Minister of the Ministry of Foreign Affairs (MoFA), and Prof. Nejmetdin Makhmudhodjaev, Director General of the Uzbek Scientific Production Center for Agriculture (USPCA) and Deputy Minister of Agriculture and Water Resources. From ICARDA, Dr Surendra Beniwal, Coordinator of the Highlands and Central Asia Regional Program, and Dr Mekhlis Suleimenov, Liaison Officer for Central Asia, attended the ceremony.

H.E. Mr Ismail Djurabekov (left), the First Deputy Prime Minister of Uzbekistan and Cabinet Minister in Charge of Agriculture and Water Resources, and Prof. Dr El-Beltagy, DG, ICARDA, sign the agreement.

In his remarks on the occasion, His Excellency Mr Djurabekov thanked ICARDA for its keen interest in agricultural research and development in Uzbekistan and for agreeing to establish its Regional Office in Tashkent. He highlighted some recent steps that his Government had taken to achieve self-sufficiency in grain and food production. He said: "We very much appreciate the efforts and initiatives of ICARDA and the CGIAR in addressing the needs of agricultural research and development in the region, and in assisting the Republics in their efforts to increase agricultural production in a sustainable and eco-friendly manner."

After signing the agreement, ICARDA Director General Prof. Dr El-Beltagy thanked the Government of Uzbekistan and especially H.E. Mr Djurabekov for all the assistance so far provided to ICARDA—including provision of a special status through this agreement. He appreciated the recent steps that the Government of Uzbekistan had taken on land reform and encouraging private farmers for achieving self-sufficiency in food. He assured Mr Djurabekov that "we shall complement you and be your dependable partner in these efforts."

He also highlighted the decision of the CGIAR to work with the Republics of Central Asia and the Caucasus (CAC) to fulfil its mandate and mission, and to add the CAC region to ICARDA's mandate region. Thus, he emphasized, the establishment of an ICARDA Regional Office for Central Asia in Tashkent was a very important development in expanding the partnership with the countries in the CAC region.

A reception to mark this important occasion was organized on behalf of the Director General of ICARDA, and was attended by high-ranking officials of MoFA, MAWR, USPCA, Samarkand University, and ambassadors and officials of the embassies represented in Tashkent. ■

Swaminathan at ICARDA: the Evergreen Revolution

In May 1998 ICARDA had the privilege of welcoming Dr M.S. Swaminathan, the first World Food Prize winner, to the Center. He visited ICARDA to chair the meeting of the CGIAR System-wide Genetic Resources Policy Committee (GRPC). During his visit, Dr Swaminathan delivered a stimulating address to a large and attentive audience.

The Director General, Prof. Dr Adel El-Beltagy, introduced Dr Swaminathan as "one of the leaders of agricultural research of this century." He added that Dr Swaminathan was a pioneer of the Green Revolution and had played an instrumental role in the development of agriculture in his own country, India, as well as elsewhere in the world.

It was a view shared by a former Secretary General of the United Nations, Javier Perez de Cuellar. In 1987, when Dr Swaminathan was awarded the first World Food Prize, Dr Cuellar wrote that Dr Swaminathan was a "living legend... His contributions to agricultural science have made an indelible mark on food production in India and elsewhere in the developing world. By any standards, he will go into the annals of history as a world scientist of rare distinction."

In his address at ICARDA, *Science and sustainable food security: challenges ahead*, Dr Swaminathan—one of the fathers of the Green Revolution—called for an 'evergreen revolution' which would provide real food security during the century ahead. And he took his audience step by step through exactly what he felt had to be done to achieve this.

Dr Swaminathan told the audience that the Green Revolution had saved lives. "But we are beyond the Green Revolution now. Land and water resources are diminishing in per capita terms. And the last 25 years have seen enormous changes in science and technology. For example, genetic engineering has moved ahead, especially in the last 10-15 years."

The question to be dealt with was poverty. Birthweights as low as 2.4 kg are common in South Asia, he said, causing what the UN has called "the cruellest form of inequity"—retarded intellectual development which would prevent people in the developing world from coming to grips with the new Information Age. How were such people supposed to compete in a world of the Internet and galloping information technology? "The gap will widen," he said. "If you have more, you can get more."

Dr Swaminathan then described the main components, as he saw them, of an 'evergreen revolution' that would fight such poverty. The Green Revolution had achieved much, but we now know its ecological repercussions.

As part of this, a broad range of issues had to be addressed, including those related to nutrition. What about food *absorption*? Many people received less nutrition from their food because of stomach infections from substandard water.

What is needed, he said, is ecotechnology—a blend of modern technologies that would reconcile production needs with the environment. He divided ecotechnology into several priorities. First, there was the environment, for which much better natural-resource management was needed. Second, there was economics, the need to understand cost, risk and income for farmers as part of any new technology. Third, there was equity, both social and gender. Fourth, the energy challenge, and the need to use blends of renewable and non-renewable sources. Agriculture had to be considered in this context; fertilizer and products had to be transported, and water pumped. Finally, there was employment. Many developing countries didn't even have any real statistics on unemployment. There is a need for eco-jobs and eco-preneurs.

Dr Swaminathan moved on to biodiversity, in which he has special interest and expertise. Farmers have long been quietly preserving it. A mixture of on-farm, *ex-situ* and *in-situ* conservation was needed. Equitable shares of the benefits were needed. We had achieved much with Mendelian genetics but must now blend these

Majed Khateb

with molecular genetics. The information explosion, too, would have consequences. Its benefits must be used. The technology should be used to record traditional knowledge, which was not always available. Dr Swaminathan quoted the example of Cherapunji in India. The wettest place on earth, with annual rainfall as high as 11600 mm, it faces a shortage of drinking water. Yet Jaisalmer, also in India, with 150-200 mm annual rainfall, has more drinking water than Cherapunji . What is known to people in Jaisalmer must be understood also in Cherapunji. One answer might be rural 'information shops,' and the M.S. Swaminathan Foundation is working on this concept.

All this had to be considered when planning the 'evergreen revolution.' Its elements, said Dr Swaminathan, should include precision farming, with precise delivery of inputs; and an integrated intensive farming system, or IFS, which would include intensification and diversification with added value from crops.

This should include currently-neglected crops which were rich in micronutrients, and should be part of a multifaceted attack on poverty which should include training and trade. Public policy must be carefully tailored to include appropriate pricing and natural-resource management policies.

It would also be necessary to plan for climate change. "It's no longer speculation," said Dr Swaminathan. Agriculture was not primarily responsible for global warming, but it would be the chief victim.

We need an action plan for all this. Dr Swaminathan suggested:

- Identification of the ultra-poor. Rural people could usually identify who amongst their neighbors were in this position.
- Better transfer of information to the poor.
- Attention to protein/calorie deficiency.
- Concentration on better sources of micronutrients (such as vegetable gardens).
- Better water and environmental hygiene, so that people could absorb the nutrients available to them.
- More concentration on women and children, in particular a fight against low birthweights so that young people would be able to meet the challenges of the information age.

> Swaminathan: "A living legend...A world scientist of world distinction."
> —*Javier Perez de Cuellar*

To attain these objectives, said Dr Swaminathan, we need more science, not less.

For this, partnerships with national programs must be strengthened. And scientists *must* take time to bring technology to people in the countryside.

It was an exciting time, said Dr Swaminathan. There was so much new technology. But the scale of hunger, poverty and deprivation was vast.

The Director General warmly thanked Dr Swaminathan for his address—which, he said, was like a symphony. He expressed his admiration for the work of the M.S. Swaminathan Foundation. Development, he said, can only be taken forward by certain individuals with brains and courage, and Dr Swaminathan was one on a world-wide scale. The seminar finished with an enthusiastic standing ovation from a large audience. ■

A glorious career

Born in Tamil Nadu, India, in 1925, Dr Swaminathan was educated at Travancore and Madras Universities before receiving his PhD in genetics at Cambridge University in 1952. For the next 20 years he worked at the Indian Agricultural Research Institute (IARI), New Delhi, mainly in wheat improvement. It was during this period that he and Nobel Prize Laureate Norman Borlaug, founder of what later became ICARDA's sister Center CIMMYT, were leading figures in a successful attempt to avert food catastrophe in South Asia and elsewhere, largely through the development and transfer of new dwarf wheat varieties that revolutionized food production. In his address, Dr Swaminathan paid generous tribute to Dr Borlaug—and said that he thought CIMMYT (Centro Internacional de Mejoramiento de Maiz y Trigo) and IRRI (the International Rice Research Institute), both now part of the CGIAR, had played a leading role in averting disaster in the 1960s. Dr Swaminathan later went on to become Director General of the Indian Council of Agricultural Research and Secretary of the Department of Agricultural Research and Education, and in 1979 was appointed Principal Secretary of the Ministry of Agriculture and Irrigation. From 1980 to 1982 he was Member in charge of agriculture and rural development in India's Planning Commission. In 1982 he became Director General of IRRI, a post he held until January 1988.

The author of over 200 scientific papers and books, Dr Swaminathan has served with distinction as Chairman of a number of international bodies, including the U.N. Advisory Committee on Science and Technology for Development, the FAO Council, and the Advisory Panel on Food Security, Agriculture, Forestry and the Environment to the World Commission on Environment and Development. He is a Fellow of the Indian National Science Academy and of the Royal Society of London, and of the Science Academies of China, Italy, Sweden, the United States and the then USSR.

Besides the World Food Prize he has won a number of international awards, including, in 1986, the Albert Einstein Prize. In recent years, the funds associated with some of these awards have been used to set up a modern research center at Madras, the M.S. Swaminathan Research Foundation, of which he is Chairman. He has served as President of the International Union for the Conservation of Nature and Natural Resources (IUCN) from 1984 to 1990 and is currently President of the National Academy of Agricultural Sciences, India, and the World-Wide Fund for Nature in India. ■

Uzbek Steppe Could Help Fight Global Warming

Through carbon sequestration, rangelands can play a significant role in controlling global warming. Their vegetation isolates carbon dioxide from the atmosphere and converts it into plant biomass through photosynthesis.
This provides feed for livestock,improves the quality of the soil, and limits soil erosion.

Gustave Gintzburger

Installation of a carbon-dioxide Bowen Ratio Equipment at a site near Samarkand in Uzbekistan. The equipment will be used for carbon-dioxide flux monitoring.

How much does the Central Asian steppe do to control global warming? ICARDA is trying to find this out, in collaboration with US scientists from ARS-USDA-USU Logan (Utah, USA), and Uzbek colleagues from the Karakul Sheep Breeding Institute (KSBI) and the Samarkand University in Uzbekistan.

The work took a major step forward with the installation of a CO_2 Bowen Ratio equipment at a site near Samarkand on 3 and 4 March 1998. ICARDA Range Specialist Dr Gustave Gintzburger oranized, and participated in, the installation.

"Most people realize that vegetation is our major ally in the war against global warming. But they don't always know why. We also tend to underestimate the vegetation of the arid zones because the plant cover is small compared to other, more humid, environments," he says.

There are three major 'greenhouse gases' which are contributing to global warming by trapping heat from the sun inside the atmosphere. The biggest single culprit is carbon dioxide, or CO_2. It is released into the atmosphere by the burning of fossil fuels; plants, however, claw it back out of the air and convert it to plant biomass and soil organic matter. In these forms, it helps provide feed for the livestock on the range, improves the quality of the soil, and limits soil erosion.

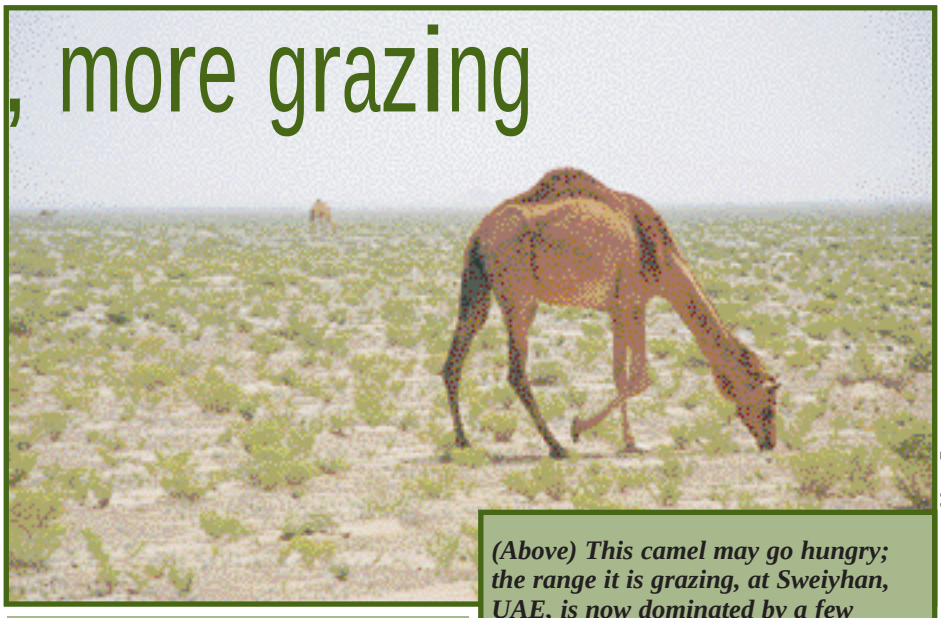
The steppe and rangeland of North Africa, West and Central Asia has a lot to offer in this respect. The area is so vast—a bit over 500 million hectares in ICARDA's regional mandate, of which 260 million are in the Newly-Independent Republics—that it is thought to be a major potential contributor to the global carbon sequestration. The Bowen Ratio equipment will allow scientists to evaluate the CO_2 budget from a representative *Artemisia* spp. range in Uzbekistan, thus quantifying the carbon-sequestration process. Similar Bowen Ratio equipment is currently running on 12 rangeland sites in USA as part of a world effort.

Installing this micro-meteorological equipment was quite a challenge, as the team was trying to catch the beginning of the season that generally comes abruptly after a harsh winter. Dr Nick Saliendra (CO_2 Plant Physiologist, ARS-USU Logan), Dr Mukhtor Nassyrov (Plant Physiologist, Karakul Sheep Breeding Institute), colleagues from the Samarkand University in Uzbekistan, and Dr Gintzburger spent a week installing the Bowen Ratio Equipment in freezing temperature, snow and a bitterly cold wind in the Uzbek steppe. After some minor teething troubles, the complex equipment is now up and running on the range. It is under the scientific and technical control of Dr Nassyrov, who is in charge of monitoring and downloading the data. The site is on a protected range site at the Karnap station 120 km southwest of Samarkand, in a district where ICARDA scientists are also studying the structural and economic changes of the livestock and range systems.

Dr Gintzburger pays special tribute to Dr Doug Johnson (CO_2 Project Leader, ARS-USDA), and Dr Tagir Gilmanov (a leading Russian Vegetation Modeler, South Dakota State University) for joining with ICARDA in the CO_2 flux monitoring project as part of a GL-CRSP project in Central Asia.

The team has surveyed possible locations for CO_2 monitoring in the Karakum desert of Turkmenistan and Akmola (in Kazakhstan) to establish the CO_2 flux monitoring sites. ■

Less water, more grazing



Morag Ferguson

(Above) This camel may go hungry; the range it is grazing, at Sweiyhan, UAE, is now dominated by a few unpalatable species (notably* Zygophyllum hamiense*). (Below): Farmers can help in the identification of locally-adapted species which can provide sustainable forage production.

TheArabianPeninsula is one of the harshest environments on earth. It also has important livestock industry. But is forage for those animals costing too much water? Is livestock degrading the region's rangelands? The answers may lie in harnessing local plant genetic diversity.

By Morag Ferguson, Ian McCann and Guy Manners

Many people view the countries of the Arabian Peninsula—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen—as basically desert lands, and they are not far wrong. Some places may receive no rain at all in a year. There are some exceptions, of course, such as Ibb in Yemen, which is at high elevation; and Salalah in Oman, which receives summer monsoon rain. But total average yearly rainfall in the region ranges from below 50 mm to about 250 mm. Also, temperatures can exceed 50°C, among the hottest on earth.

These conditions mean that the plant-growing season ranges from nothing to about 150 days, hardly enough to grow any of ICARDA's traditional commodity crops. The Arabian Peninsula occupies some 246 million hectares, but a mere 2% of this is cultivated with arable or irrigated crops. However, this by no means implies that the rest of the land is useless. There is agriculture of a different kind, because nearly half of the land exists as pasture. It is not surprising, therefore, that livestock production is the main type of agriculture, in the form of sheep, goats and camels. It is estimated that there were 11 million sheep, 8 million goats and 841,000 camels in 1993, and that these numbers represented a significant increase over the previous 15 years.

Unfortunately, these increasing animal numbers are resulting in the over-exploitation of the fragile rangeland. As elsewhere in West Asia, the rangelands in the Arabian Peninsula are considered a common resource, and farmers practise open-access grazing by allowing their animals to roam free to find food where they can. Trees are also 'lopped' for fodder, and wood is harvested for fuel, timber and charcoal. Over 90% of the total land area now suffers from some form of desertification, and 44% is severely or very severely degraded.

Overgrazing of arid rangeland does not instantly result in devegetated sand dunes, but it can over time. However, the initial effect of overgrazing is to change the plant species composition of an ecosystem. The palatable species are consumed by animals very quickly, leaving an ecosystem dominated by a few unpalatable species. These species nevertheless hold the sand. If the grazing pressure continues, animals will be forced to eat even those species which they dislike. *Cyperus conglomeratus*, which is usually never grazed, was found to have been grazed in the Wahiba Sands of Oman, where it was one of a handful of surviving species. When even the unpalatable vegetation begins to disappear, the sand starts moving and a classical sand dune desert forms.

Many of the rangelands in Oman and the UAE appear to be supporting an abundance of vegetation. On closer examination, however, it is found to consist of a relatively few unpalatable species such as the attractive-looking, but unpalatable *Calotropis procera*. Along with this change in vegetation composition and abundance is a decline in the potential productivity. In the most severe situations such as in Al-Jouf in Saudi Arabia and Salala in Oman, not only have the unpalatable species disappeared, but so has the soil!

In order to supplement the declining amounts of feed from the range, farmers grow irrigated forages, namely, alfalfa and rhodes grass. Both these crops use an enormous amount of water, mostly because they require a high level of irrigation during the long hot summers. Total water use can be as high as 35,000 m^3 per hectare per year. This is the same as 48,000 people each drinking three liters of water per day for a whole year, and that is only for one hectare (100 m x 100 m). Furthermore, the water for irrigation is often derived from non-sustainable or non-renewable sources, such as deep fossil groundwater. Although some governments have banned the drilling of new wells, it is difficult for them to control the amount of water which is pumped from existing wells. "Twenty years ago, wells were 100 feet deep; today they are 1000 feet and, even at this depth, the water is not freely available, necessitating the intermittent use of pumps," explains Abdulla Al-Moalla, Director of the Central Region of the Ministry of Agriculture and Fisheries, UAE. "Salinity levels are also increasing dramatically."

Morag Ferguson

(Above): Is this sustainable? A vast pivot-irrigation system used to produce forage—in this case, rhodes grass. (Left): Lopping of* Prosopis cinerea *for camel feed as well as firewood in Oman. This may not be sustainable, either. Use of native species to provide rainfed forage may provide at least part of the answer.

So, the range is degraded and supplementary feed in the form of irrigated forages are drinking up water reserves. What can be done? ICARDA, through its Arabian Peninsula Regional Program (APRP) based in Dubai, is addressing this problem. The research involves livestock, water, rangeland, forages and of course people, and necessitates a multidisciplinary holistic approach.

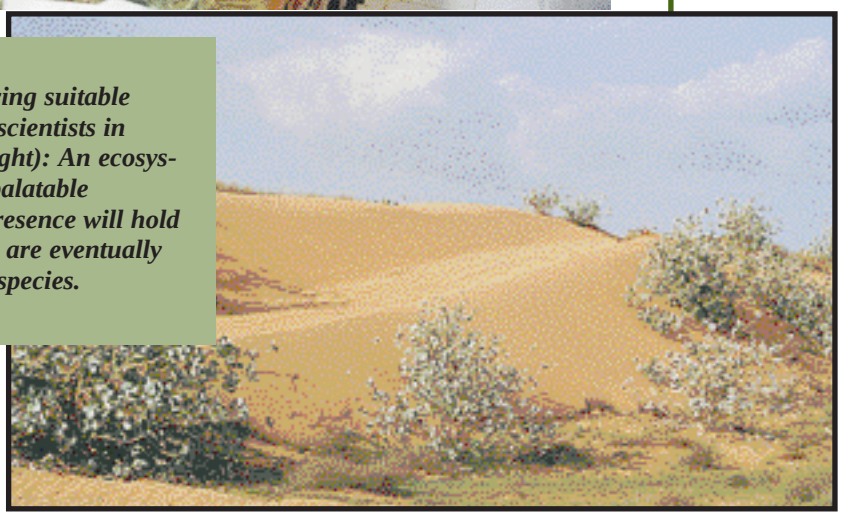
Where to begin? Let's start with the question of producing forages using far less water. One strategy would be to improve current irrigation strategies. Abdulla Al-Moalla believes "that we could save 50% of the water with new irrigation systems." However, while such systems can be more efficient, they also require new management techniques. Furthermore, even the best equipment and management will still have to provide sufficient water to keep rhodes grass and alfalfa 'happy' during the peak summer months.

Another strategy may be to bring some of the indigenous plants, which are adapted to the heat and drought of the region, into cultivation. The Arabian Peninsula's flora is rich with approximately 3400 indigenous species, despite the arid conditions. At ICARDA-APRP we have set out along this path. In May 1997, the Central Region of the Ministry of Agriculture and Fisheries (UAE) and APRP convened a meeting at the Al-Dhaid Research Station, Sharjah, to which local farmers brought samples of rangeland species favored by their livestock. Two farmers took the lead in explaining the forage value and stress-resistance of the various species; then, with the help of botanists from the Sharjah Natural History Museum and the Environmental Research and Wildlife Development Agency, Abu Dhabi, as well as published floras of the Arabian Peninsula, we identified 74 of the 85 species collected. The farmers were then asked to rank the plants in order of preference to the animals. This was in addition to consultations with various range experts and botanists in the region, as well as personal observations, and allowed us to develop a first list of priority species. The next step was to obtain seed of the priority species, and assess their genetic variation in the region. We needed to organize collection missions in the 'wild'.

For this, national scientists required training in germplasm collection and conservation. The principal techniques of genetic-resources work were taught in two courses in early 1998: *Germplasm Collection and Maintenance*, held in Sharjah, UAE, and *Seed Production Technology* in Oman. These courses laid the foundation for collaboration between APRP and the national programs in collecting potentially useful rangeland species. Practical training was then given on a one-to-one basis during two collection missions, one undertaken in the United Arab Emirates, another in northern parts of Oman during March and April.

In total, 182 accessions of 37 species were collected. In addition, much indigenous knowledge was obtained from local farmers and herders, and our list of high priority species was revised once more. The list now includes 10 grass species which have potential for use as irrigated forages,

John Peacock



(Above): Farmers identifying suitable species at a meeting with scientists in Sharjah in May 1997. (Right): An ecosystem dominated by the unpalatable* Calotropis procera. *Its presence will hold back erosion, but animals are eventually forced to eat unpalatable species.

and two grass shrubs as well as 15 trees or shrubs which could be used for rangeland rehabilitation and enhancement.

Apart from the small seed samples collected from many sites during the missions, we needed large quantities of seed to start our experiments in the next growing season. Many of the target species occur naturally in large stands where they are protected. We therefore carried out 'bulk' seed collections from these single sites for 10 grass and shrub species. This has provided us with sufficient seed to start with.

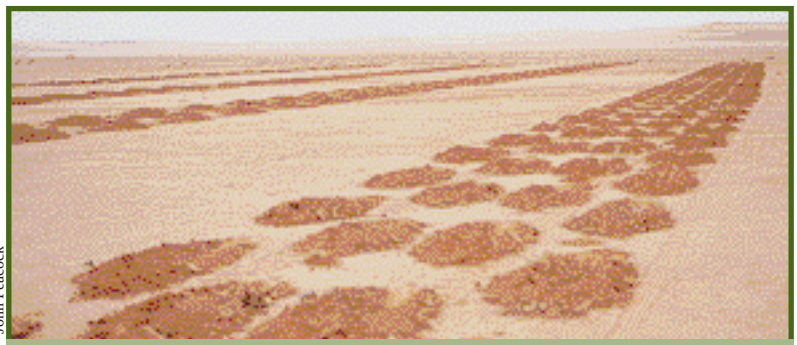
The next step in the research process will be to determine the water-use efficiency of the selected species. The most important criterion may be the weight of animal product produced per unit of water applied, under both optimum and sub-optimum water amounts.

It will also be important to determine the chemical composition and *in vivo* degradation to estimate the nutritive value of the 'new' forages in relation to rhodes grass and alfalfa. This is being done through a collaborative project with the United Arab Emirates University in Al-Ain.

Initial results show that *Cenchrus ciliaris* and *Panicum turgidum* are compatible with rhodes grass in having a similar crude protein content, a low neutral detergent fiber (which provides an indication of better intake), and a low ash content (which provides an indication of the silica content—which makes forages less palatable). Moreover *Cenchrus ciliaris* had a similar dry-matter degradability to rhodes grass in both goats and camels. It was found however that camels were 50% more efficient in digesting the grasses than goats—a fine demonstration of the advantages of natural adaptation!

On the rangeland-rehabilitation and enhancement front, ICARDA has a vast amount of experience from its work in the steppes of North Africa and the Near East. Technologies already developed will be tested and adapted in the Arabian Peninsula. One point of particular interest in the Peninsula is the regenerative capacity of the range itself; in some areas, simple fencing of parts of the range to exclude livestock results in dramatic and rapid regeneration of native vegetation, and not just the unpalatable species. Other areas are unfortunately too degraded for any rapid recovery and will have to be replanted.

The work has potential impact in two directions: first by rehabilitating the range itself to improve its present levels of productivity, and second by identifying new forages for cultivation which will use less water than those currently grown by farmers.



John Peacock

Bringing the range back to life: replanting using a pitting machine at Tamriat in northern Saudi Arabia.

By seeking to maintain the resources of natural vegetation and water, we aim to enable animal production to continue into the future and provide much-needed food for the people of the region—a goal we believe is achievable.■

Dr Morag Ferguson is a consultant on rangeland plant genetic resources and Dr Ian McCann is Water/ Irrigation Management Specialist, at APRP, ICARDA, in Dubai. Guy Manners is a former Editor/Writer, ICARDA.

Save the Water, Save the Land

Egyptians are among the world's most experienced farmers. For millennia, they have fed their people with unparalleled land-use efficiency and cropping intensity. But it is getting more difficult every year. Per capita water supplies are declining, and use must be made of more land not historically used for agriculture. ICARDA and the Egyptian Government are working together to find answers for the future.

By Hamdy E. Khalifa and Mohamed A.S. Abdel Monem

Egyptian agriculture is one of mankind's oldest and proudest achievements. Skilled use of limited water and land resources since ancient times has enabled the narrow strip of arable land beside the Nile to support great civilizations; today, these limited resources are under tremendous pressure. The population, expected to reach 70 million by the turn of the century, is projected to reach 100 million by 2025.

Will there be enough water? A century ago, there were 5084 m^3 of freshwater resources per person; today there are only 930 m^3, and this could be slashed by over half in the next 25 years. This could be catastrophic; Egypt has no effective rainfall except in a narrow strip along the northern coastal area, where the average annual rainfall is 200 mm. So irrigation is a way of life. Indeed, 84% of the available water is used for agriculture, so if there is an answer, it will have to be found in the agriculture sector.

Will there be enough land? There was 0.21 ha per person in 1897, but only 0.05 ha in 1993. Much of the land is being taken away from agriculture by increasing urbanization—perhaps as much as 30,000 feddans annually (a feddan is about 0.42 of a hectare). As the available land becomes more and more precious, it will be necessary to protect it from environmental damage. The threats to it are real; and they have much to do with the way water is used—and reused. In modern Egypt, soil and water are as inextricably linked as they are anywhere.

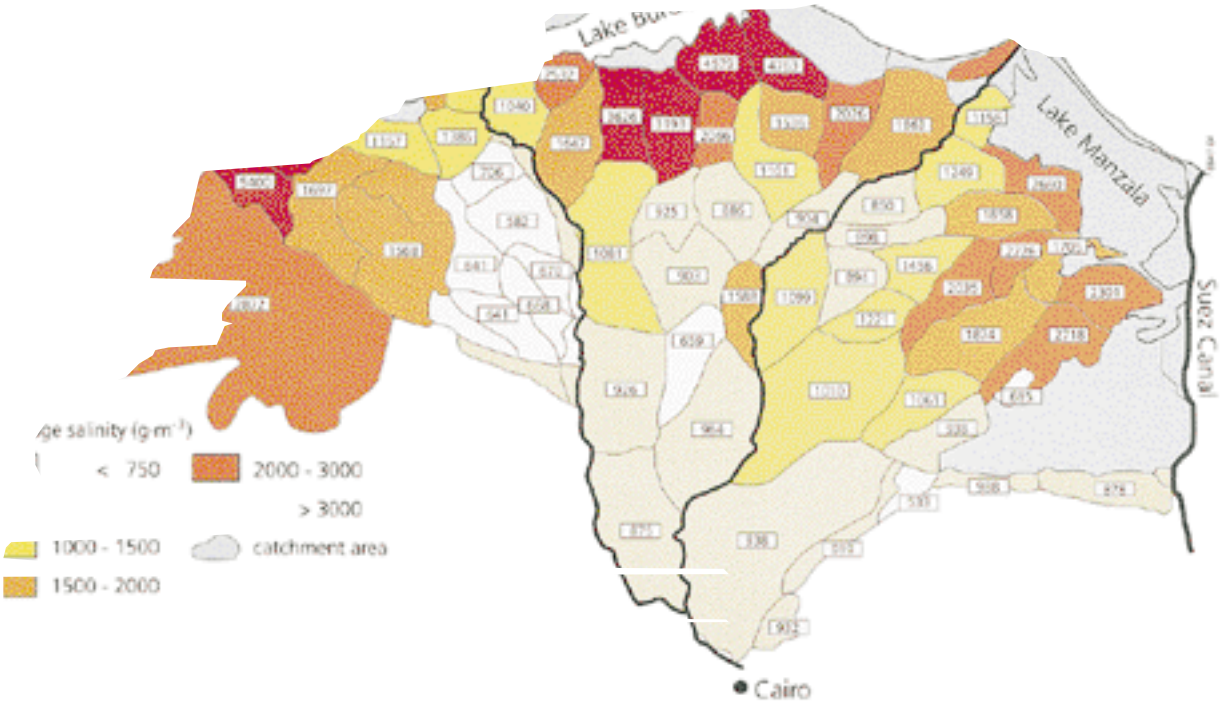
Already, Egypt is making huge efforts to conserve water through increasing water-use efficiency and the reuse of agricultural drainage water in irrigation. Nearly 2 m ha in the Delta are served by a 1600 km drainage system; the amount of water reused can exceed 4 billion m^3 (BCM). This is a considerable achievement, but it has a side effect: soil salinity. Caused largely (but not only) by an inefficient drainage system and recycling of irrigation water, it now affects about 30% of the soil. What constitutes excessive salinity is, in some ways, an open question; it depends on what you are growing, and how likely that salinity is to be leached out. In some parts of the Delta, the concentration in irrigation water is about 750-1000 parts per million (ppm), which we would not regard as very serious for irrigation. However, in some northern areas, where it is aggravated by the artesian upward seepage of saline groundwater and by seawater seepage, it is nearer 3000 ppm.

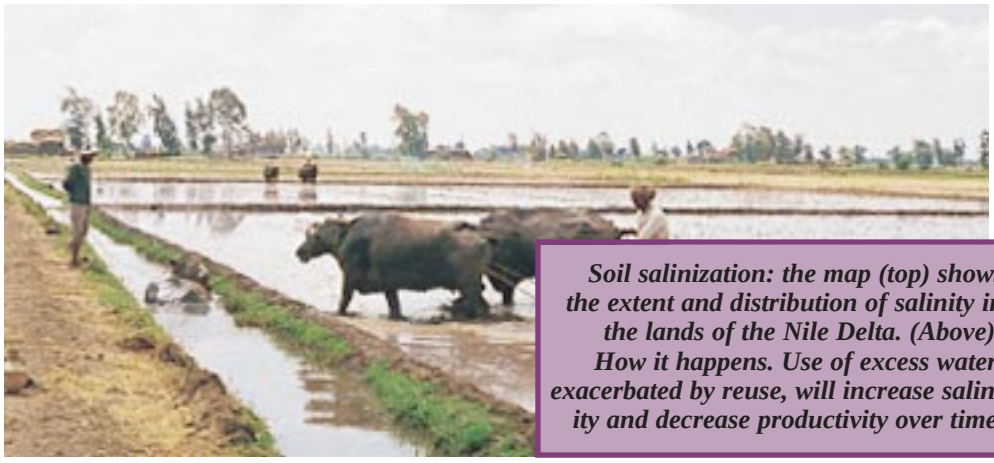
There are plans to increase the amount of precious irrigation water that is reused from 4 to 7 BCM. This does make sense. After all, it is still only a small percentage of the 45 billion-plus m^3 used for irrigation. But it will exacerbate the problem. And there is another problem, which cannot be separated from water-use efficiency—fertilizer misuse, and its attendant dangers for water quality.

ICARDA and Egypt's Ministry of Agriculture, Agrarian Reform and Land Reclamation (MOA) both attach high priority to the protection of the natural-resource base. MOA has been evaluating the options for water conservation and reuse for many years. In 1994, ICARDA and the Ministry came together to start a Resource Management Program (RMP) to explore the options for, and constraints to, dealing with these issues. Fieldwork is done by Egypt's Agricultural Research Center, and ICARDA provides technical input. Implementation on the ICARDA side is through the Center's Nile Valley and Red Sea Regional Program, based in Cairo. The RMP, which is now in Phase II, was made possible by funding from the European Union.

The project started with a year of preparatory studies. This included a review of relevant work to date—in order not to reinvent the wheel! We ended up with several volumes of literature.This was followed by rapid rural appraisals (RRAs) by a multidisciplinary team that was equipped to look at different aspects, such as crops, soil/water and socioeconomic factors. The scientists talked to farming communities at a number of sites to find out what their problems were, and what they saw as the main issues. Going by the impressions received, the team moved on to a more detailed study and multidisciplinary surveys, using a specific questionnaire on soil/water. The findings were discussed between national and ICARDA scientists to select tested variables and crop rotations which would need to be studied in the field for different agroecological areas of Egypt.

There were several different environments to be looked at. Two sites in the newly-reclaimed land, newly-





Soil salinization: the map (top) shows the extent and distribution of salinity in the lands of the Nile Delta. (Above): How it happens. Use of excess water, exacerbated by reuse, will increase salinity and decrease productivity over time.

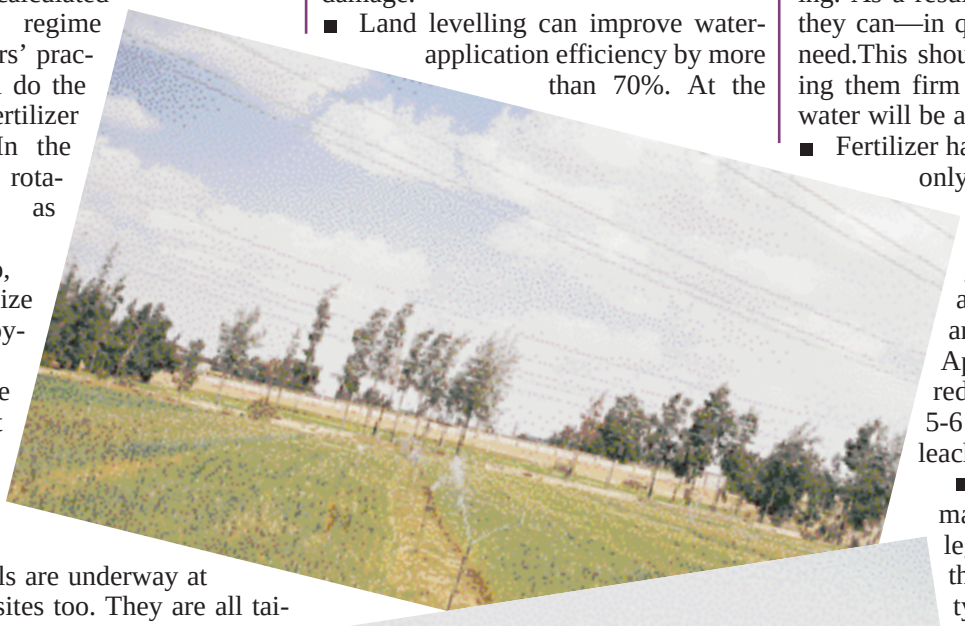
exploited for agriculture, were chosen: Nubaria, with calcareous soil, and Bustan, with sandy soil. Other sites were El Serw, with heavy clay saline soils; Sids in Middle Egypt, selected as typical of the old cultivated land; and Rafah in Northern Sinai, which is rainfed.

At these sites, two basic strategies are being followed. The first is long-term monitoring. This takes place in the areas surrounding the fixed sites, not on the research stations. The joint teams of researchers, which include extensionists, meet the individual farmers twice a year. These farmers were carefully selected to represent different aspects of resource use. Some have plenty of water, as their land is at the head of an irrigation canal; others have land at the tail end and have less water. With their help, both socioeconomic and biophysical data is taken. The biophysical data, coming as it does from farmers' fields, rather than from a research station, give us a clear indication of what happens to the soil and water *under farmers' practices*—which is what we want to know.

The second strategy is long-term trials. These do take place on research stations. The trials have been carefully tailored to the sites. At Nubaria, we are dealing with newly-reclaimed, calcareous soils; these can have poor water infiltration and poor fertility. Prevailing crop sequences are berseem/maize, wheat/maize and wheat/tomato. Given the deficiency of nitrogen, which is common in these soils, we will be looking hard at berseem. It is a feed legume, so it fixes nitrogen, but it is cut four or five times a year; could it therefore be using so much of nitrogen that it is actually counterproductive?

The issue of nitrogen is important because we suspect that farmers are overusing fertilizer. This has two consequences. First of all, it is expensive. There have been great changes in the administration of agriculture in Egypt over the last 10 years or so, all designed to make agriculture more profitable and more responsive to the market. Compulsory delivery quotas and fixed farm-gate prices have gone. But so have subsidies on inputs like fertilizer. This overuse is costing farmers money. Second, surplus fertilizer will be leached back into the water supply because of overuse of water and badly-timed nitrogen application. This has environmental consequences. There is not much evidence of fertilizer pollution in the Nile itself, but there *is* mounting evidence of it in the reused irrigation water. We must help farmers find ways to stop this. The waste of nitrogen also occurs on calcareous soils for the same reason that water wastage does—far from being leached, it can

simply stay on the surface. Just as the water evaporates and is wasted, the nitrogen is lost through volatilization, disappearing into the atmosphere as ammonia. So the trials at Nubaria are comparing a calculated irrigation regime against farmers' practices and will do the same for fertilizer application. In the meantime, rotations such as berseem/sunflower/tomato, sugar beet/maize and wheat/soybean-forage maize will be tested against the prevailing practices.



Similar trials are underway at the other sites too. They are all tailored. For instance, the Bustan site is also newly-reclaimed soil, but sandy rather than calcareous. Water infiltrates, but how long does it stay in the soil, and how much good does it do? We suspect overuse of irrigation water in the area, exacerbating symptoms such as a high water-table and salinity build-up. Besides testing required irrigation levels against farmers' practices, we are also trying the sprinkler irrigation system. And, once again, the prevailing crop rotations are being tested against others which we think will be more profitable and sustainable.

Water issues. (Top): Fields under supplemental irrigation in the Delta. (Above): Part of the complex irrigation system. There are plans to increase the amount of precious irrigation water that is reused from 4 to 7 billion BCM.

Detailed results from the long-term trials will become available later; the first rotation will be finished this year. However, the trials are already throwing out some interesting questions. In the Bustan area, the Egyptian researchers got twice the water-use efficiency (WUE) that the farmers did. And they got rather more than twice the nitrogen-use efficiency (NUE). Disastrously, NUE in the newly-reclaimed lands rarely exceeds 20%. Why?

The long-term monitoring, as opposed to trials, is already giving us some of the answers. Using it, we are designing tentative recommendations for improving WUE and NUE in the areas, and preventing waste of water, waste of money and environmental damage.

- Land levelling can improve water-application efficiency by more than 70%. At the moment, a lot of water is simply running off, instead of infiltrating the soil. The Government does already provide some help with this.
- Canals need to be lined. Some already are, particularly in the newly-reclaimed lands, but elsewhere a lot of water is lost.
- Farmers are unaware of the water-holding capacity of the soils. They need this information.
- Farmers sometimes use too much water because they are not confident they will have it the following day. Those at the head of an irrigation canal may know, but those farther down are not sure. Also, there are "on" and "off" days for water supplies. Farmers don't know for certain when these are coming. As a result, they take water when they can—in quantities that they don't need.This should be addressed by giving them firm information as to when water will be available.
- Fertilizer has to be used because not only the sandy, but also some of the clay soils are deficient in nitrogen. But NUE is as little as 20% in some places, and never exceeds 50%. Application needs to be reduced, and divided into 5-6 splits in order to prevent leaching and volatilization.
- We need more information about the role of legumes in rotations and their effect on soil fertility—especially faba bean and berseem.

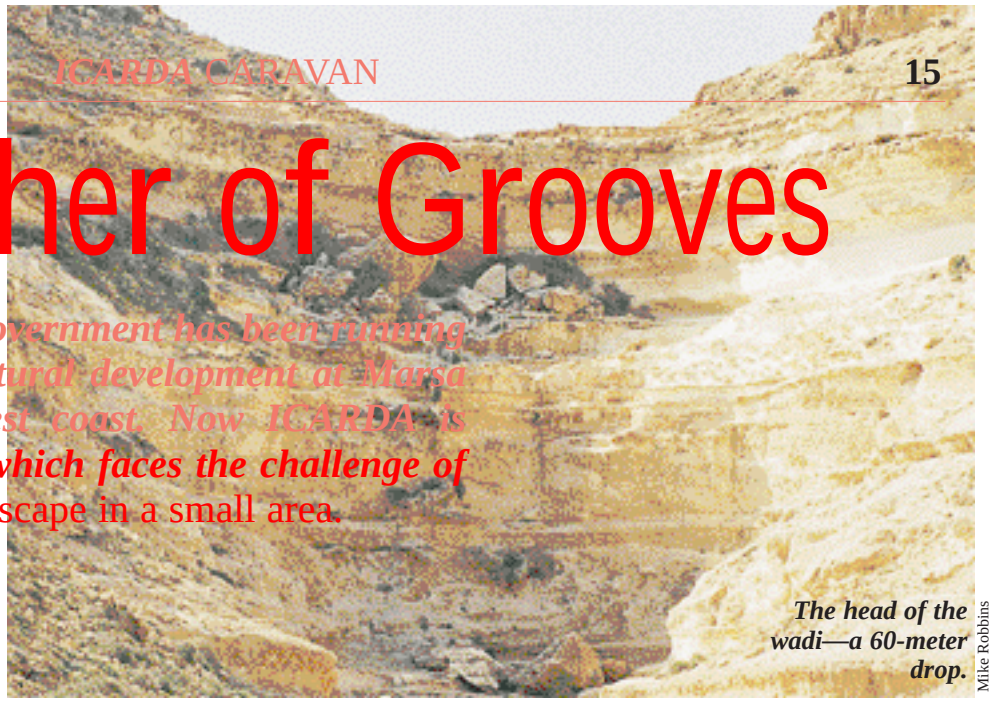
There is an important role for the extensionists in all this. They have already been an important part of the project. One of the things we have discovered through the long-term monitoring is that farmers really need the information extensionists can bring them. Farmers *do* care about the waste of water. And they care a great deal about waste of fertilizer, which is far more expensive now than it was before.

Four years into the project, we are cautiously optimistic. We are getting the information we need. There are answers. Egyptian agriculture has a proud tradition of being both sustainable and productive. It can continue that way.

Mohamed A.S. Abdel Monem is National Professional Officer (NPO) in Soil Management, and Hamdy E. Khalifa is NPO in Water Management, in ICARDA's Nile Valley and Red Sea Program, based in Cairo, Egypt.

The Father of Grooves

Since 1994, the Egyptian Government has been running a major project for agricultural development at Marsa Matrouh on the North-West coast. Now ICARDA is working with the project—which faces the challenge of integrating three tpes of landscape in a small area.



The head of the wadi—a 60-meter drop. Mike Robbins

Wadi Abou Grouf. Or, in English, Father of Grooves. It is an apt description of this steep wadi which descends from the North Egyptian plateau to the relatively fertile coastal plain below, overlooking the Mediterranean a few miles east of Marsa Matrouh in North-West Egypt.

Marsa Matrouh is a resort town. It is easy to see why; a long, attractive beach curves round a sea which, even in winter, is a quite startling blue. The town stands on a coastal plain which varies in depth; it can be as little as a kilometer or two, but generally runs about five kilometers inland. Behind it rises a scarp of 100 meters or so which runs right along the coast. Behind this scarp is rangeland—a vast area with little vegetation and poor soil, but not desert. Down the scarp run the wadis. Wadi Abou Grouf is one of the most dramatic. Halfway up, one turns a bend to be confronted with a wall of rock 60 meters in depth. It is indeed surmounted by a deep groove, eroded by water pouring off the rangeland above—hence the name; another wadi is called Wadi Om El-Shaitan (mother of the devil), but no one seems to remember the story behind that one...

It is through these wadis that the rainfall, such as it is, cascades off the bare plateau towards the coastal plain below. It can be forceful; the rain may be sparse, but in the Mediterranean region it often falls all at once. The result can be savage erosion and, once every 15 or 20 years, a flash flood—bad news for anyone who was trying to grow something in the wadi below.

At midday on a clear winter's day, as one stands in the now-dry wadi, the sea below is a spectacular color. Above, on top of the rock wall in the distance, a group of 15 or 20 figures emerge against the pale blue sky and starts to walk purposefully towards the steppe above. Their task: to ensure that this area is made as productive as possible—without disturbing the delicate balance of land and water resources.

The task is an urgent one throughout this part of Egypt. To tackle it, the Egyptian Government started the Matrouh Resource Management Project (MRMP) in 1994. The Project will continue until 2001, and is financed by the World Bank/International Development Association. ICARDA's role is to provide consultancy and technical backstopping for the project. The group walking along the edge of the escarpment on this warm winter day is composed of a number of specialists from MRMP, and four scientists from ICARDA. They are drawn from a wide spread of disciplines. They need to be, for they are dealing with three different agroecological zones and mixed farming systems, and they must treat them as a whole.

MRMP's Director General, Mr Abdel Wahab El-Weteedy, believes strongly that development must be multidisciplinary. "You don't get much development without that," he says. He also emphasizes that the ultimate goal of MRMP is to eliminate poverty. "Don't look for poverty along the seashore," he urges the ICARDA team. "In the escarpment, people are very poor. They have few resources, and little access to services such as health." He feels strongly that there has been real progress in the project over the last year, but stresses the size of the task. "Six years," he says, "will not be enough."

The project area extends for about 300 km along the coast, and 60 km inland. Unlike most of Egypt, the area can support rainfed agriculture, but it is on the margin; there is about 140 mm of annual rainfall on the coast, but this drops by half just 20 km inland. The coastal strip is not bad for agriculture; the soil is capable of holding water, both from the scarce rain and from runoff from the steppe above. But this strip is generally about 5 km deep at best, and some of it is now built on. Behind it, for about 10 km, there is a zone about 10 km deep where agriculture is possible, based on a mixture of barley and live-

Barley cultivation is possible on the plateau, particularly in small depressions or other areas of runoff. But with such low rainfall, it is unreliable.

Gustave Gintzburger

stock; where sufficient water accumulates in wadis and contours, it is possible to grow fruit trees. Finally, behind the escarpment, is the steppe, or rangeland, where people depend on livestock, supplemented by scattered patches of barley in very shallow depressions. This area is threatened with desertification.

Wadi Abou Grouf is in the escarpment and presents an excellent opportunity for integrated, multidisciplinary teamwork. That is why MRMP's Deputy Director General, Dr Sobhi El-Naggar, has selected it for today's exercise. "I want to focus more and more on work in the field," he says. Like Mr El-Weteedy, he thinks that MRMP has moved faster towards its goals in the last few months than it ever has before, but there is much to be done; he wants to strengthen the capacity of the watershed staff. This is where the ICARDA team can help.

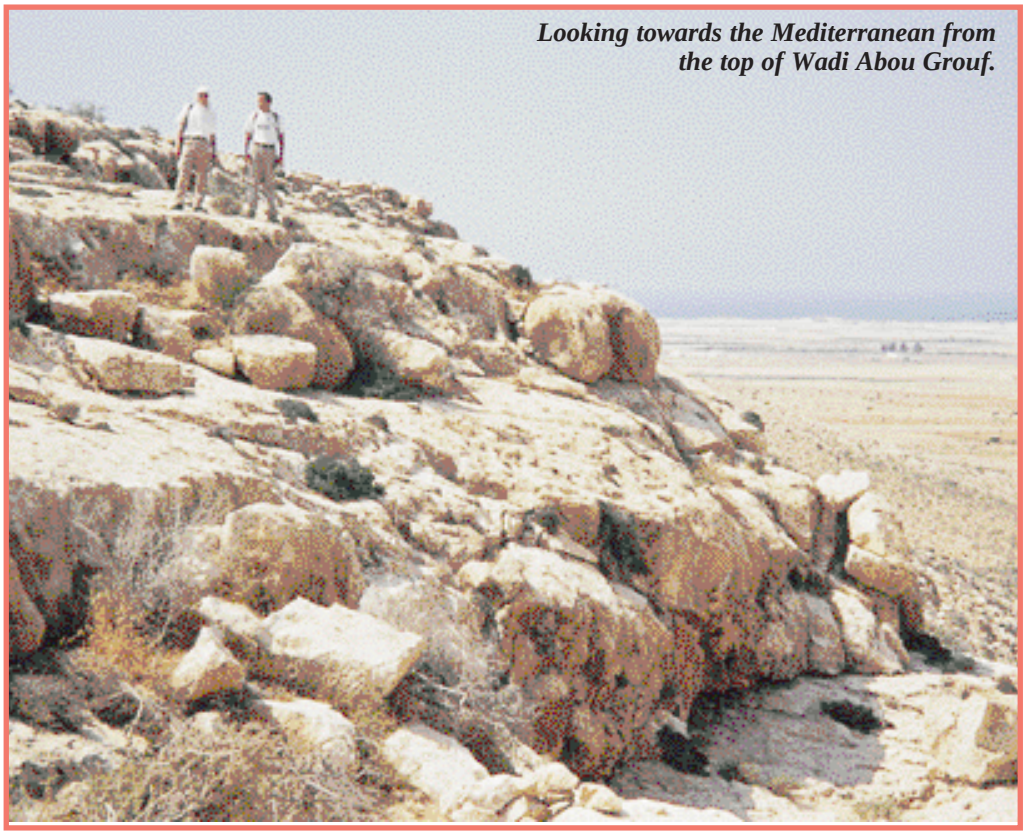
Today, the team walking back from the escarpment are considering the problems of the steppe. This has been degraded by overgrazing, reducing the feed available for sheep, goats and camels—and, therefore, of meat, milk and other dairy products. Encouraging regeneration of vegetation is not easy.

One problem is the presence of calcareous soils. MRMP hydrologist Mohamed Ramsy Shaker runs his fingers over the surface of the soil. "This is a crusty surface, making rainwater infiltration difficult," he explains. "That means not much soil moisture for plants."

One answer in the past has been ripping. This involves bulldozing of the soil to create a long trench which will encourage collection of water and growth of new vegetation.

That this can work, is demonstrated by the presence of a very long trench indeed running along the front of the escarpment. In it grow trees, bushes and rangeland species that are scarce elsewhere on the steppe. The trench, however, was not dug for that purpose. It is a relic of the clash of armies at Marsa Matrouh nearly 60 years ago. It is intriguing that what once meant death and destruction now means the growth of new life along many kilometers of the escarpment, providing food for sheep and goats.

So is the answer to copy this work on the steppe, using modern machines instead of soldiers with pickaxes?



Looking towards the Mediterranean from the top of Wadi Abou Grouf.

"No. Not in this case," says ICARDA range scientist Dr Gustave Gintzburger, who has been discussing the issue with MRMP rangeland researcher Mustapha Hakim and his colleagues. "The Egyptian authorities have very mixed feelings about ripping and have now forbidden it within a certain distance of the sea. The problem is that rainwater runoff from the steppe is providing the water supply for agriculture in the wadis and on the coastal strip. That's one reason why the soil on that strip is so much better; centuries of runoff have carried it down there along the wadis.

"And this water is coming from a long way inland. The very shallow slope of the steppe, and the calcareous soil which slows infiltration, mean a very deep watershed. Rip the rangeland on a large scale 10, 20, even 30 kilometers back from the escarpment and there'll be less water in the wadi. And less water means less food. You have to choose."

It is a message strongly reinforced by another member of the party—a farmer from Wadi Salloufa, a narrower wadi a few kilometres down the valley. He tells the scientists bluntly that sometimes they must choose between range development and wadi development, as the former could totally disrupt the sophisticated farming system in the wadi. Moreover there is another consideration—biodiversity in the wadi tips, where Dr Gintzburger has found an unusual mixture of low- and high-rainfall species. "I wouldn't want to lose those, either," he says.

Understanding the exact depth and shape of the watershed is therefore critical. One way to obtain that information is by digital satellite images so that the topography can be analyzed using Geographic Information Systems, or GIS. ICARDA is placing increasing emphasis on this tool. MRMP is already working with GIS and a GIS expert from ICARDA, Nick Thomas, is here to see what can be done to strengthen their capacity.

"GIS is one of those things that is simple in theory, but difficult in practice," he explains. "First of all, GIS is a tool for using information. That information can be derived from a number of different types of sources—a map, an aerial photograph—we do use those—or a satellite image. Suppose you are working from satellite images, which is known as remote sensing. How good is your satellite image? The more recent the satellite, the higher the resolution.

The latest ones can see an object only a meter wide. But images from satellites that good are costly. "Moreover, whatever the source, you have to know what you are seeing and represent it correctly in the GIS database. Some totally different vegetation types can become confused with each other, especially on rangeland, and then the resulting database will be wrong. However, if you want to model a wide area or watershed and come up with integrated solutions, it is a marvellous tool." MRMP staff already have skills in GIS and Mr Thomas hopes to build on these with a training course for them.

While his colleagues make sure that the wadi below has enough water, Dr Dieter Gomer is planning for those occasions when there is too much. Standing by the dry watercourse where it comes out at the foot of the escarpment, he points past a clump of palms to what look like the remains of long-ago earthworks.

"The Romans and others built a lot of structures here," he says. "They knew the danger of flash floods, and they knew how to harvest the water in the wadi—but without stopping so much of it that, in a flash flood, the structures were carried away. So they built spillways."

Dr Gomer, who is a consultant for ICARDA, also points out the ancient cisterns, sometimes still in use, that dot the area. There is real potential for learning from the past. In the meantime, he is working with MRMP on the design and construction of structures. This must be done properly. Traveling in the area between the coastal strip and the escarpment, it is possible to see shallow wadis where earth dams have been built to control and exploit the runoff. Some have been done well, but others, dating from a past project in the area, have not. One, lacking a proper spillway, has been neatly split in the center. It's a reminder that farmers have two problems with water in the region. One is its scarcity. The other is its tendency to come all at once.

The next day, it's time to summarize what has been learned in Wadi Abou Grouf.

"If you're going to come up with integrated solutions in a watershed, you need to discuss the problems as a team," says ICARDA soil conservation researcher Dr Michael Zöbisch. He is addressing a meeting of MRMP's own researchers, accompanied by ICARDA's permanent representative on the project, socioeconomist Dr Abdul Bari Salkini. "People from every discipline should be at a meeting like this, and the farmers should be involved too," Dr Zöbisch goes on. "You could make your own individual plans, and then stitch them together—but would the result make sense?"

Then Mohamed Ramsy Shaker helps the scientists to list the challenges faced, in Wadi Abou Grouf and elsewhere in the project area. The factors that may or may not have to be considered include water scarcity, lack of proper runoff control, improper design and maintenance of old structures, conflicts of interest between farmers, water and/or wind degradation, deterioration in vegetative cover, shallow soils with low fertility, poor infrastructure, low incomes and a highly dispersed population.

MRMP's civil engineer, Khamis Mahmoud Habbash, argues for minimum intervention in the upper, rocky, part of the wadi lest it should interfere with the water supply lower down. But he and his colleagues agree that some erosion control is needed up on the steppe. Lower down the wadi, they feel, there is no water scarcity—for agriculture; but there is not enough for drinking and livestock, so attention should be paid to cisterns, including possible rehabilitation of the old Roman structures. There is potential for orchard development in the wadi bed.

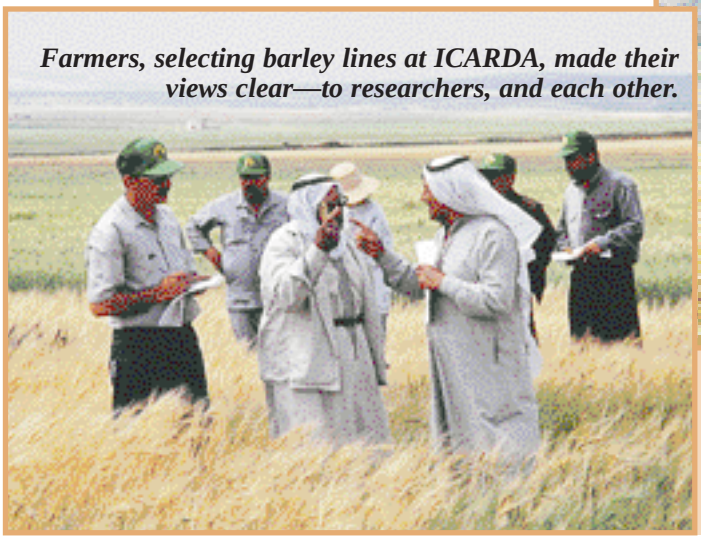
Integrated development of this sort has already been underway in the area

Continued on page 20

Mike Robbins

Ripping, 1940s-style. The war left its mark on Marsa Matrouh (including landmines; there are still fatalities). These fortifications at the head of Wadi Abou Grouf have trapped runoff and produced trees and other vegetation, which can be used for grazing. But interfering with the runoff patterns of the watershed may adversely affect the agriculture in the wadi.

Preserving Diversity in the Field



Salvatore Ceccarelli

Farmers, selecting barley lines at ICARDA, made their views clear—to researchers, and each other.

Hugo Vivar

An Ecuadorian farmer-couple in their barley field. They were among 240 farmers who grew two improved landraces-based varieties of barley in Ecuador in 1997. The new varieties gave a six-fold increase over the national average.

On a hot spring morning in May, seven farmers are standing in a field on ICARDA's research farm in northwest Syria. They are surrounded by barley. Not just one type of barley, but a wide variety of selections. They are arguing about these. Which is the most drought-tolerant? Which has the better straw quality? With the farmers is a group of scientists and technicians, but they are not saying much. They are here to listen.

The farmers are ICARDA's partners in research on barley impovement. Tomorrow, though, they won't be standing here. They will be repeating the experiment in one of their own fields. They will travel around northern Syria for several days, analyzing, discussing, arguing—and making their selections for further study next year. And not all those selections will be the same.

Which is the whole point, says senior barley breeder, Dr Salvatore Ceccarelli. "We have about 335mm average annual rainfall on the research farm, but only a few kilometres east of here farmers are working with 200mm or less. They don't all want the same thing from us."

The participatory barley-breeding project in Syria, which is supported by the German aid arm BMZ, has been in operation since 1996 (see *Caravan* Nos. 1 and 4). But ICARDA started on this road about 15 years ago. Conventional plant breeding aims for broad adaptation; that is, to produce crop varieties that can be grown over a wide area, producing economies in scale for commercial seed production. This means a compromise. To get adequate yields from these broadly-adapted varieties, you need expensive fertilizer; and they may not cope at all with extreme conditions in a bad year. That could be OK in moderate environments in wealthy countries. It isn't in Syria. Or Ecuador. Or Ethiopia..."

These broadly-adapted varieties have another drawback: their widespread adoption occurs by replacing local varieties, thus reducing the amount of genetic diversity in farmers' fields.

This is mortgaging the future. That diversity in farmer's fields is the raw material for food security. ICARDA believes that the crops in the fields should be as genetically diverse as possible. ICARDA's answer to the question of diversity *vs.* productivity is to breed from landraces. It works: Arta, the first widely- used variety ICARDA bred this way, outperforms local landraces by 20% in Syria, yet it retains many of their characteristics. But this is not enough. The crops must be very location-specific. And that is where the farmers can help.

The Syrian project initially involved farmers testing 208 lines at nine locations; they were also tested on the research station. Two years on, the process has evolved; instead of inspecting the lines in each others' fields, in 1998-99 the farmers want to prepare test plots for the lines they think are promising. This is how ICARDA hoped they would react. They are likely to start commercial production of these location-specific varieties themselves and supply seed to their neighbors (thus overcoming the seed-supply problem).

It's not the first time ICARDA has joined hands with farmers to do diversity-friendly crop breeding. A long-standing project in Ethiopia has produced interesting results.Whereas in West Asia and North Africa farmers grow barley mainly for animal feed, in Ethiopia barley is a subsistence food crop. But that makes it even more important to breed from landraces and keep stable-yielding local varieties in the field, as a hedge against famine. In Ecuador, ICARDA breeder Dr Hugo Vivar and the national scientists are developing landrace-based varieties; in a joint project with farmers near Loja, in the south of the country, they are seeing high but stable yields. The number of farmers participating in the Ecuador project has shot up over the two years of its existence.

There are broader implications of this sort of breeding work, says Dr Ceccarelli. "Perhaps most important, harnessing biodiversity to produce varieties suitable for harsher environments tends to benefit the poorer farming communities. "That's a crucial investment in the future."

Biodiversity? But it is an Arid Environment!

Marsa Matrouh is a treasure-house of useful plant species.

By Gustave Gintzburger

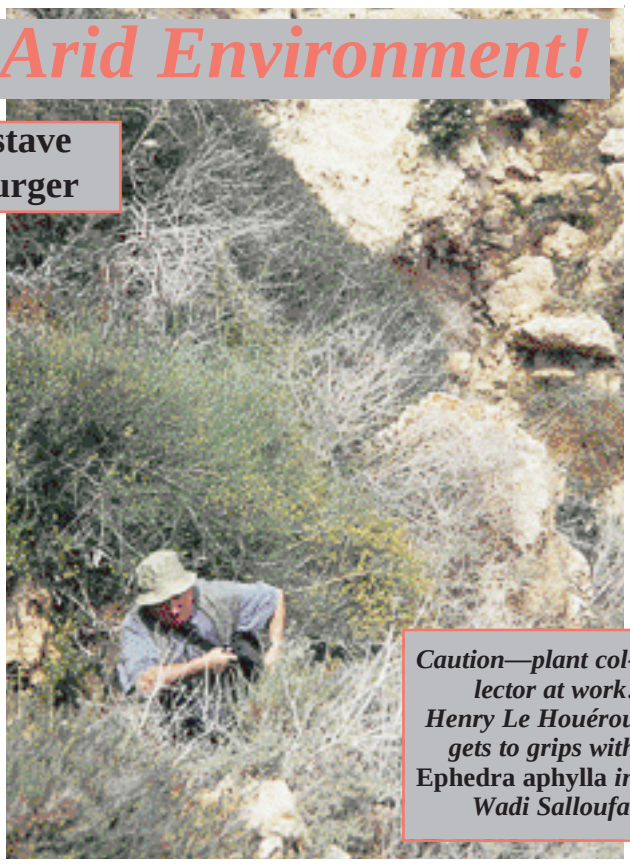
Some people collect stamps, or train numbers, or sightings of rare birds. Others combine their passion for collecting with a determimation to save the genetic resources we need to feed future generations.

Earlier this year, a multidisciplinary team returned from a long, hot day's walk into Wadi Saloufa and Wadi Abou Grouf, in Egypt. The party was tired—but very excited about the native vegetation they collected there. The collection trip was a part of the activities of the Marsa Matrouh Resource Management Project (MRMP) in Egypt, which is supported by the World Bank and the International Development Association.

The party consisted of Drs Henry Le Houérou (Consultant botanist, MRMP), the author (ICARDA), Nabil Nabawi (Soil Scientist, SWERI—the Soil, Water and Environment Research Institute, part of the Egyptian national program), Mr Taher Kasser (Extension Specialist, MRMP), Mr Nick Thomas (GIS Specialist, ICARDA) and François Delaroque (GIS trainee from the Geographical Institute for Regional Land Management at Nantes University, France, known by its French acronym of IGARUN).

On the face of it, it is not a good hunting ground for biodiversity. The area receives enough rain not to be called a desert: just over 130 mm/year on the coast. But that is not much, and the rainfall drops drastically about 10-20 kilometres from the coast where the real desert starts: flat bare rocky land gently sloping towards the coast just with a few sand patches, and nearly no vegetation.

But this is the beauty of it: the entire bare rocky and sandy plateau is an extraordinary water-harvesting system. It catches every drop of rain and sometimes gently, sometimes savagely takes most of this harvested water to the coast. First it dribbles to shallow depressions cropped with barley patching the plateau, but most of it goes to the coastal plain. To get there, it runs off the plateau through wadis filled with figs, olive trees and grapes. These wadis have fed the prehistoric tribes, the ancient Egyptians, the Romans, the Byzantines and now the present Egyptian farmer. These wadis are a blessing for the local population and they have known for millennia how to make the best use of every drop of water coming from the plateau into the wadis.



Gustave Gintzburger

Caution—plant collector at work! Henry Le Houérou gets to grips with* Ephedra aphylla *in Wadi Salloufa.

The chaotic rocks, cliffs and deep gullies in these wadis protect these plants from uprooting and overgrazing. It is not easy, and often not worth the trouble, for the shepherd and his flock to get into some of these narrow and steep wadis. Moreover, these wadi tips are owned by individual landlords and are not usually open to common grazing. Given the concentration of water from the plateau above, this makes these wadis exceptional natural reserves in a very arid environment.

Dr Le Houérou has listed no less than 57 plants species in Wadi Salloufa itself and 37 on its northwest slope.

> "The remarkable wadi tips of Egypt's North-West Coast should not be seen as a plant museum, but as a blueprint for the future. Let us preserve them."

Among them is a small tree, *Rhamnus oleoides*, abundant here but rare elsewhere in the region. There are also several useful fodder shrubs—such as *Periploca angustifolia*, once found on the plateau and now taking refuge into the wadis, and potentially good for range rehabilitation; *Ephedra aphylla* (a medicinal plant) hanging from the cliffs, and a perennial and woody *Silene fruticosa*. Here and there, the team found the yellow-flowered, untouched and endemic *Verbascum letourneuxii*. Very abundant and unexpected also is *Dactylis glomerata* (var. *hispanica*), the famous cooksfoot (now Europeanized) pasture grass at the edge of the plateau and hiding in the wadi steep slope. A valuable fodder plant and a perennial Crucifer with fleshy leaves, *Moricandia nitens* is likewise all around and gets as tall as 1.5 meter on top of the cliff of Wadi Abu Grouf. Dr Gamal Sami Mikhael and Mr Taher Kassr (MRMP range scientist and extensionist) have collected *Moricandia* seeds and will grow them in the MRMP nursery for propagation on some of the new range sites, where parts of the slope below the plateau are being rehabilitated as the useful grazing land that they used to be in the past.

An interesting find by the author was a wealth of *Globularia alypum*, a woody and Bonsai-like shrub with pretty globe-shaped blue flowers. This is exciting because this *Globularia* is usually a forest companion species of *Pinus halepensis*, the Aleppo pine; this is, after all, found not far away on the magnificent coast of the Libyan Marmarica, but under much more favor-

able rainfall conditions. Was it here too once? A careful search near Matrouh reveals a few Roman kilns and tons of pottery shards along the plateau cliff and in the wadis. There must have been a lot of fuel wood in the area to allow all this pottery to be produced.

The day before, the Range group had roamed Wadi Remel (the sandy wadi) just 15 km south of Matrouh. They found plenty of other attractive and valuable range plants: not only the traditional *Retama retam* (a valuable legume shrub producing some good fuel wood and fruits which are good forage), but also scores and scores of others like *Oryzopsis miliacea* (a very palatable bunch grass which reaches two meters in height in the wadis); *Hyparrhenia hirta* (growing on sandstone in the very eastern tip of Wadi Remel), *Periploca angustifolia* (an Asclepiadaceae and a good fodder shrub), and more!

We really had not expected such a rich and diverse flora in a desert-like environment. This prompted Dr Le Houérou and the author to suggest to the local authorities that some wadi tips be classified as Natural Reserve Areas: a small investment, but a valuable one for the future of biodiversity in Egypt.

Gustave Gintzburger

***Mr Malouka of Wadi Salloufa shows some* Rhamnus oleoides.**

Regeneration of much of this biodiversity can lead to real opportunities for those who are trying to rehabilitate degraded land in harsh, marginal environments. And a study of these plants *in situ* can help us understand how ancient cultures achieved a good living from this land, probably with very little more rainfall than we have now. A good example was the discovery of an unusual wild pea in the low-rainfall zone of Syria last year (see *Caravan* No. 6), an intriguing clue as to how large Greek, Roman and Byzantine cities supported themselves in what is now virtually desert.

The remarkable wadi tips of Egypt's North-West Coast should not be seen as a plant museum, but as a blueprint for the future. Let us preserve them. ■

Dr Gustave Gintzburger is Range Specialist, ICARDA.

Continued from page 17

since 1988, through the Qasr Rural Development Project (QRDP). A bilateral project between Egypt and Germany, it is implemented with the assistance of the German aid arm GTZ, and has had considerable success in increasing productivity through soil conservation and water-harvesting measures. In fact, it is a good example of what is good for the environment is also profitable for farmers. QRDP's Hans Jochen Regner and his colleagues are now looking at additional water-harvesting measures, such as the use of "incisions"—very shallow depressions that can be seeded with barley—and the exploitation of the ancient cisterns. Farmers meet at least some of the cost of the interventions, so they have an incentive to make them work. Mr Regner thinks that this has been a factor in the project's success, and reports that farmers are eager to get involved.

> "Farmers have two problems with water in the region. One is its scarcity. The other is its tendency to come all at once."

But MRMP covers a much larger project area than QRDP; over two million feddans, or nearly a million hectares. Part of the challenge will be "selling" interventions to farmers, and convincing them of the benefits of technology. Twice in 1997, ICARDA invited farmers from the project area to Syria to see water-harvesting, range improvement and cereal/legume rotation projects. These visits were a success (see *Caravan* Nos. 5 and 6), and are likely to be repeated. In the project area itself, MRMP has organized about 200 meetings with the community, started two local radio programs, and prepared extension materials.

It has also worked directly with farmers, training them to produce fodder-shrub seedlings for rehabilitating rangeland, and selecting 24 sites for on-farm trials in horticulture, animal husbandry, cereal production and other activities. And in one community, 33 underground cisterns has been excavated, and the erection of dykes has been started.

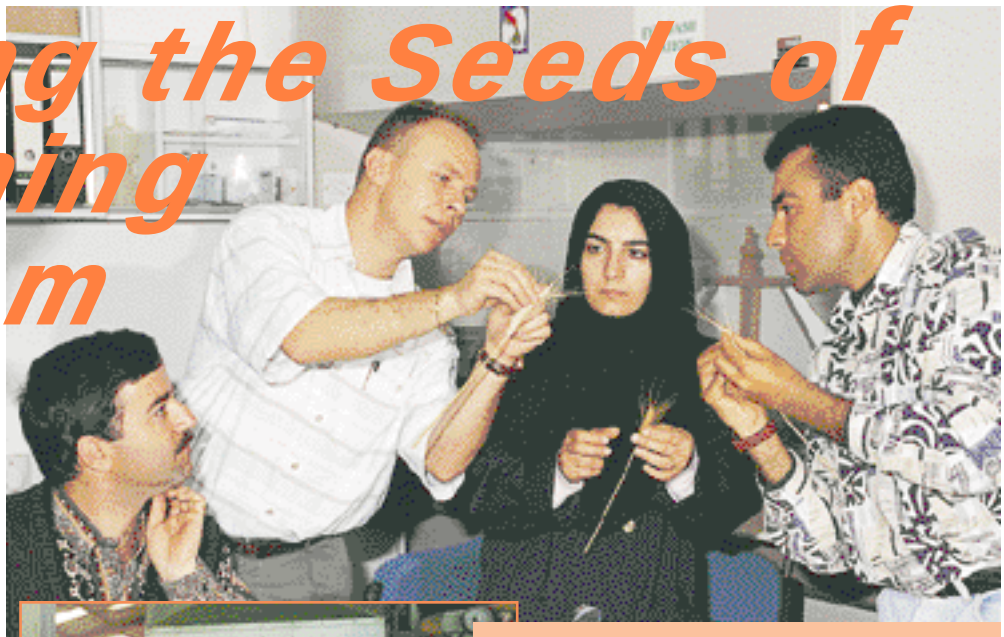
In the meantime, MRMP staff are looking forward to moving into a brand-new research center covering 35 feddans about 7 km outside Marsa Matrouh. This will have the land and laboratory facilities to carry out research into all necessary aspects of the farming system—including animal husbandry and fruit and vegetable production as well as conservation measures.

All of this will have to be integrated. As MRMP's Director General, Mr Abdel Wahab El-Weteedy, says, only multidisciplinary work succeeds in agricultural development. It is a point brought home to the researchers as they descend Wadi Abou Grouf in the warm sun of a winter's afternoon, passing through each level of the wadi system. Urgent action is needed here, both to protect the environment and keep it productive, and to raise the living standards of the people who live here. But that action must be well thought out. Nothing must be done in isolation.

Wadi Abou Grouf's future is taking shape. ■

Planting the Seeds of a Training Program

Good development should have a multiplier effect. ICARDA's Seed Unit has started using a Train-the-Trainers approach which is having real impact.



Majed Khateb, Sam Kugbei

(Above): Author Dr Lahcen Grass (second left) demonstrates morphological characteristics to (left to right) Oussama Rihaoui of Syria, Victoria Askari of Iran and Driss Mghabar of Morocco. (Left): Seed agronomist Mohamed Bouchrifa, left, of Morocco's SONACOS, explains aspects of seed processing to trainees from the Maghreb.

By Sam Kugbei and Lahcen Grass

The course was a success. ICARDA's Seed Unit staff were not surprised; we knew it would be. Titled *Processing and Economics of Seed*, it was held in Morocco in March 1998. ICARDA's trainers were there, but we were not training the 31 participants. That was the task of colleagues like seed agronomist Mohamed Bouchrifa, of the Moroccan organization Societe National de Commercialisation de Semences (SONACOS).

ICARDA already knew Dr Bouchrifa from a similar course at its headquarters in Syria the previous year. During that earlier course, which he attended as a participant himself, he demonstrated leadership qualities and the ability to communicate practical matters. Indeed, he had been selected by SONACOS to attend the course with such qualities in mind. He and the other trainers on the course had taken part in the ICARDA Seed Unit's Train the Trainers program.

The program started in 1990, and has been funded by the Dutch and German development agencies, DGIS and GTZ. The reasoning behind it is simple: why just train 15 people in (say) seed processing at headquarters, when you can instead have the national programs select people with relevant technical skills and aptitude for training, and then not only give the course, but show them how to do so themselves? Then they will return to their home countries and give the course to colleagues.

Apart from the obvious multiplier effect, this has four main benefits. First, far more people receive training for the money spent. Second, it allows training to be decentralized to collaborating countries, which is general ICARDA policy—saving worthwhile sums on travel and per diem costs. It was this factor which was the immediate motive for starting this type of training. Third, the skills acquired stay in the target country, even if the individual concerned moves on. Fourth and last, but far from least, it means that training courses, being given in specific countries, can be tailored to their requirements. As an example, one national program may like to emphasize the problems and opportunities of seed-industry privatization; another might be more interested in farmer-run distribution systems. And a course concentrating on diseases needs to have examples there for trainees to see.

But it is the multiplier effect that concerns us most. There are not nearly enough seed specialists in the West Asia and North Africa (WANA) region. Human capacity building through training is one of the most effective means of promoting agricultural productivity in developing countries. The seed industry is unique in this sense, in that it is concerned with local means of feeding people by enabling them to have access to and sow seeds of the right varieties. This requires knowledge and capacity to build the relevant institutions, select appropriate planting materials, maintain and keep these in the right condition, and disseminate within farming communities. ICARDA has a vital role to play here by coordinating training efforts at regional level, and providing access to international experience and

lessons learned in solving particular problems.

The methodology is simple. Colleagues are selected as potential trainers by their national programs, and sent to attend "mother courses" at ICARDA headquarters. The selection is done well; we have had very few participants at the mother courses who did not have the aptitude to become trainers themselves. Back in their home country, the participants act as trainers initially for a "follow-up" course (the Moroccan course at which Dr Bouchrifa was training was one of these). ICARDA's own trainers attend the follow-up courses but don't do any training there. Their job is to evaluate the follow-up course as an activity in its own right. They do this in collaboration with their national colleagues.

Part of the Moroccan course saw the participation of the Directors General of the three main seed-related organizations—SONACOS, SOGETA (Societe de Gestion des Terres Agricoles) and INRA (Institut National de la Recherche Agronomique), Dr Abdel Aziz Arifi, Dr Mokhtar Bouanani, and Dr Saaoud, respectively. The course coincided with a period of reorganization of the seed sector in Morocco, since a comprehensive study has just been conducted which has resulted into what is now known as "The National Seed Plan." Constructive discussion followed. The Directors General recommended that Morocco be used as a base for regional follow-up courses for North Africa to minimize problems of language and to enable broader participation, and that a bilateral project proposal be developed. Morocco is in fact suggesting that a mother course be held in-country for the Maghreb region—a suggestion that ICARDA takes very seriously. To mix a metaphor or two, this would certainly mean that the multiplier effect is spiralling!

The choice of subject matter and content of any training activity are targeted at specific needs in seed production. The Seed Unit works with national programs to formulate course curricula based on need and comparative advantage. Gender issues are considered too. For example, seed testing courses are offered more for female workers, as they seem more interested and proficient in this task. On the other hand, field inspection courses are more for male participants since these involve extensive travel to countryside locations. Much of this training takes place in the national programs in partnership with government agencies, the private sector and NGOs. This is to ensure that training is demand driven by the development needs of particular countries, thus focusing efforts on location-specific needs and constraints. "Together with ICARDA, we should bring training to focus on our urgent developmental needs," said Dr Aberu Dagnew, General Manager of Ethiopian Seed Enterprise, at a follow-up course in Economics of Seed Production in Addis Ababa in September 1997.

Trainees from Kyrgyzstan get in-the-field advice from Siham Asaad (center) of ICARDA's Genetic Resources Unit.

The trend in training needs also changes over time, reflecting the evolution of seed industry development in particular countries. For instance, as countries seek to commercialize new varieties and develop cost-effective systems, courses in Morphological Variety Description and Economics of Seed Production are becoming more popular, with decreasing need for normal courses in seed agronomy and quality control. There is also increasing awareness about the informal seed sector and forage management.

The train-the-trainers approach is being applied to all of this. But any methodology must be tested to make sure it is doing what it is supposed to do. Monitoring and assessing effectiveness of the Train-the-Trainer approach has been an ongoing process since the first training course in 1990.

The results are positive. Trainer and follow-up courses in quality control have greatly enhanced staff skills in field inspection and increased general awareness of its importance in seed crop production. Similar courses in Economics of Seed Production have been instrumental in setting up management-accounting systems, which have encouraged the production of high-quality seed at lower cost. As a direct consequence of trainer and follow-up courses, trainees and ICARDA staff have jointly assembled user-friendly training materials in the forms of manuals, field guides, and audio-tutorials, which are currently used in further training and as guidance materials on the job. Examples of these include *Field Inspection Procedures* (Egypt), the *Legume Seed Production Manual* (Pakistan), *Seed Science and Technology* (Jordan), and *Economics of Seed Production* (Egypt/Ethiopia, forthcoming).

This is all encouraging. But realizing returns from investment in training is long-term, and accomplishments are generally difficult to assess and quantify. Experience with the Train-the-Trainer approach shows that careful selection of subject matter and targeting of needs is crucial in assessing the impact of training programs.

So evaluation should not be considered as a single study conducted at the end of a training effort. It should be continuous. And ICARDA plans to assess the impact of the Train-the-Trainers program at farmer level, too; what effect has it had on, say, seed selection?

By the time the current donor support ends in 1999, we should have a well-established methodology. And we should also see impact in the area where it really counts. More food.■

Dr Sam Kugbei is Seed Economist, and Dr Lahcen Grass is Training Scientist, Seed Unit, at ICARDA.

Seeds: the Starting Point for Plant Research

Whether we are concerned with discovering new forages to replace the 'thirsty' species used today, or looking for species to use in rehabilitation work, we need seeds. We need to know when to collect the seed, how to germinate it, how to clean it and then how best to multiply it.

The winter of 1997/98 was particularly wet in the UAE, giving good potential for seed production of range species in the 'wild.' Six priority species identified in the May 1997 farmers' meeting in Sharjah were all found growing in an area adjacent to the Sharjah Natural History Museum and Desert Park which has been protected from livestock by fencing for six years. The director kindly offered the area for ICARDA to carry out its research.

Every week, from mid-January onwards, observations on the development stages of the plants were made, together with seed collections. Four species exhibited sequential ripening, with flowering, immature seeds and mature seeds being found on a single plant at the same time from mid-February all the way through to early May. Another species had a more restricted maturation window and a further species flowered all at once, much later in the season.

Seed samples are being tested at ICARDA's headquarters in Aleppo, Syria. The idea is to test the germination of seeds from harvests at intervals through the season and identify dormancy problems. Many plants have devised very clever strategies for dealing with harsh environmental conditions; for example, one species has water-soluble germination inhibitors in its glumes, so only after it has rained, and the inhibitors have dissolved away, will the seed germinate—ensuring that there is sufficient moisture around to support life.

Of those species that produced mature seed early, two exhibited no dormancy (once the glumes were removed!), but another two are still showing the signs of dormancy. Tests are continuing with the larger bulk collections and additional species.

Once we are able to get the seed to germinate, we will have to overcome the problems of sequential ripening at harvest time, in addition to the added problem of shattering seed (a very useful strategy for seed dispersal in the wild, but not favorable for organised seed production). All these problems are being addressed with the objective of providing enough seed for the widespread commercial use of these species.

Women got out into the field, in fact several fields, during the course.

Jamil Zameji

Gender issues: Training Course at ICARDA

ICARDA has recently been host to 25 women working in agricultural development—23 of them Egyptian, and two Syrian—for a major course in gender issues. The course, which took place between 1 and 12 March 1998, broke new ground for ICARDA.

These were participants in the first Gender and Development Training Course held at the headquarters. Twenty Egyptian participants came from three Governorates: Menia, Beni Suef and Fayoum. All are working in the Agricultural Intensification Project (APIP), funded by IFAD. Three participants also came from the Matrouh Resource Management Project (MRMP), funded by the World Bank. The two participants from Syria are both working at the Badia Project for Rangelands Regeneration and Nature Reserves Project in the Palmyra area, funded by FAO.

ICARDA trainers were joined by Dr Fatima Nassif, originally of INRA, Morocco, who is now a consultant in gender issues and has been collaborating with ICARDA in Marsa Matrouh. Dr Nassif talked about Women in Development, extension, credit and women's organizations, and assisted Ms Malika Martini of ICARDA's Natural Resource Management Program with the fieldwork. Ms Martini presented concepts of gender and gender analysis and their incorporation into development, the characteristics of intensification in Syria and other research techniques.

Several other ICARDA scientists participated; Dr Ahmed Mazid of ICARDA's Natural Resource Management Program introduced the participants to farmer-survey techniques, and made a valuable contribution in the fieldwork, while further assistance came from Barley Breeder Drs Stefania Grando, Seed Unit Head Dr Michael Turner and Seed Economist Dr Sam Kugbei.The course also included three days in the field. Ms Martini arranged for 50 local women agricultural workers, with whom she has been working in her own research (see *Caravan* No. 7), to join the participants for fieldwork. The last day of fieldwork included a visit to the Centre of Rural Development in Afrin, Northwest Syria.

The course finished with a day of lively discussion, which resulted in a set of recommendations."The participants showed great dedication throughout, and seemed really interested in the course content," said Ms Martini.

...ICARDA has consistently striven, through scientific excellence and close cooperation with national partners, to confront the challenge of food production in the dry areas. As the need grows to claw more from the land, so does the risk of environmental damage in a fragile environment through misuse of water, destruction of biodiversity, depletion of soil nutrients, loss of topsoil and pollution from excess chemical use. Time is running out. But ICARDA and its partners believe answers can be found, through development of sustainable farming practices, stable-yielding, water-efficient and productive new varieties, identification of natural resistance to pests and diseases that will remove the need for herbicides and fungicides, and capacity-building to increase the potential of national programs.