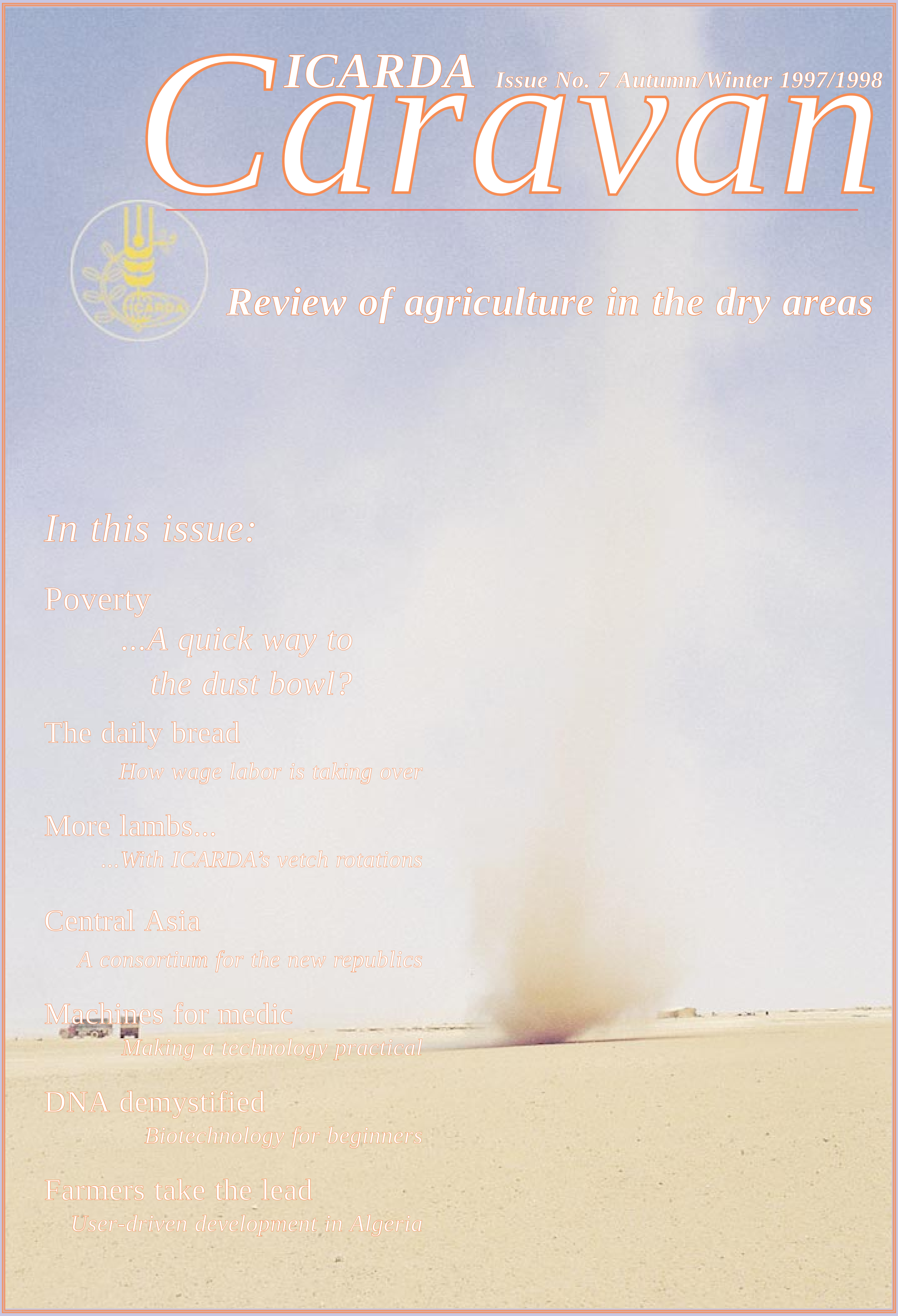

ICARDA Issue No. 7 Autumn/Winter 1997/1998

Caravan

Review of agriculture in the dry areas

In this issue:

Poverty
...A quick way to the dust bowl?

The daily bread
How wage labor is taking over

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Biotechnology for beginners

Farmers take the lead
User-driven development in Algeria

From the Director General

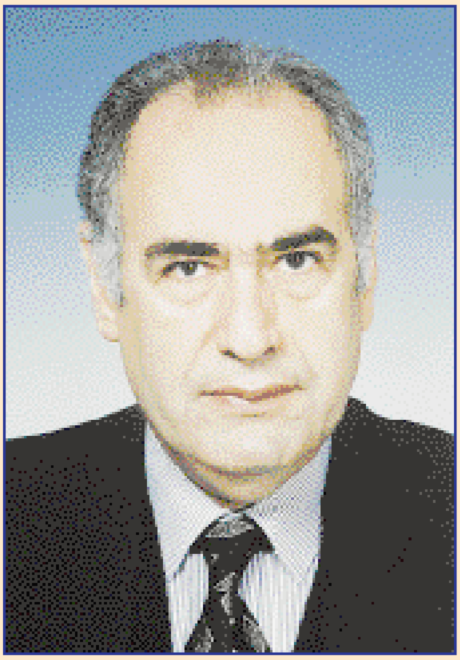
Poverty, one may argue, is a relative term, but we must not accept this argument.

Almost one billion people live in 41 countries of the world which are classified by ICARDA as constituting the dry areas. Of these, 46% live in low-income countries of the West Asia and North Africa (WANA) region, and 24% in non-WANA low-income countries. The per capita GDP of some 700 million of these people is less than US$2 per day; indeed, for 142 million of them it is less than a dollar per day. Approximately 72% of these poor people live in the rural areas and depend largely on agriculture for their livelihood.

Poverty in these areas can mean a progressive neglect of farm resources-a danger highlighted in an article in the first issue of *Caravan* back in 1995, when we reported on the challenges facing small farmers in the Anatolian plateau. This danger can be exacerbated in some countries where remittances from overseas keep people on farms that would not otherwise support them. It is a hidden danger.

But more serious is the way in which the poor are being forced to use up the environmental capital in their struggle to produce more. And this is happening more in the dry areas than anywhere else, simply because the environment in these areas is very fragile. A good example is that of water. In parts of the West Asia and North Africa region, the water table is falling at the rate of a meter a year because, in many places, non-renewable ground water sources are being mined for irrigation. All too often, inappropriate irrigation leads to soil salinity, so that another form of capital-the land itself-is lost. At the same time overgrazing continues to turn marginal lands into desert at an alarming rate. With no or little water, land and biodiversity left, the people who farmed the land tend to leave such areas. Research must be a vehicle to address this vicious cycle.

Where will the people have gone? There is no new land for them to cultivate. They will take their chances in urban areas



where the infrastructure is already unable to support them, and employment opportunities are often insufficient for those already there. Or they will attempt to migrate to countries that no longer have room for them. This can lead to both social and political upheaval.

If we are to prevent environmental capital from being exhausted in this way, we must give people the means to protect it.

ICARDA Caravan

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Poverty—it is also rural, and it is connected with agriculture. And it is perhaps the biggest single threat to the environment in the dry areas.

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Biotechnology has helped ICARDA to protect the lentil harvest.

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The knowledge generated from agricultural research can help break the complex cycle of poverty and the loss of natural resources. It can help in identifying the factors that lead to the creation of such a cycle, and in developing appropriate solutions. It can offer technologies that will help not only in increasing food production but also in generating increased income. Through a participatory approach, agriculture can integrate the poor into the research process, better use their productive capacity and generate a sense of ownership of the natural resources in them. A carefully-designed program of agricultural research can greatly help in poverty alleviation and protection of the natural resource base.

The 1992 Earth Summit in Rio was titled The UN Conference on Environment *and Development* (my italics). ICARDA believes that the two must be tackled together, in an integrated manner. That is why we are devoting increased attention to environmental protection; but we have not slowed down in developing new crop varieties and technologies that are designed to improve food security and raise farmers' cash income in dry areas. The issues of poverty, development and the environment cannot be separated. The research agenda to address these problems is the basis of ICARDA's new Medium-Term Plan for 1998-2000.

Prof. Dr Adel El-Beltagy
Director General

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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Central Asia: Getting together to set priorities

ICARDA's involvement in Central Asia is growing. It has appointed a local representative. It is now the focal point for a consortium to coordinate CGIAR activities there. And, for the first time, it has played host to scientists from all over the region to set a common research agenda.

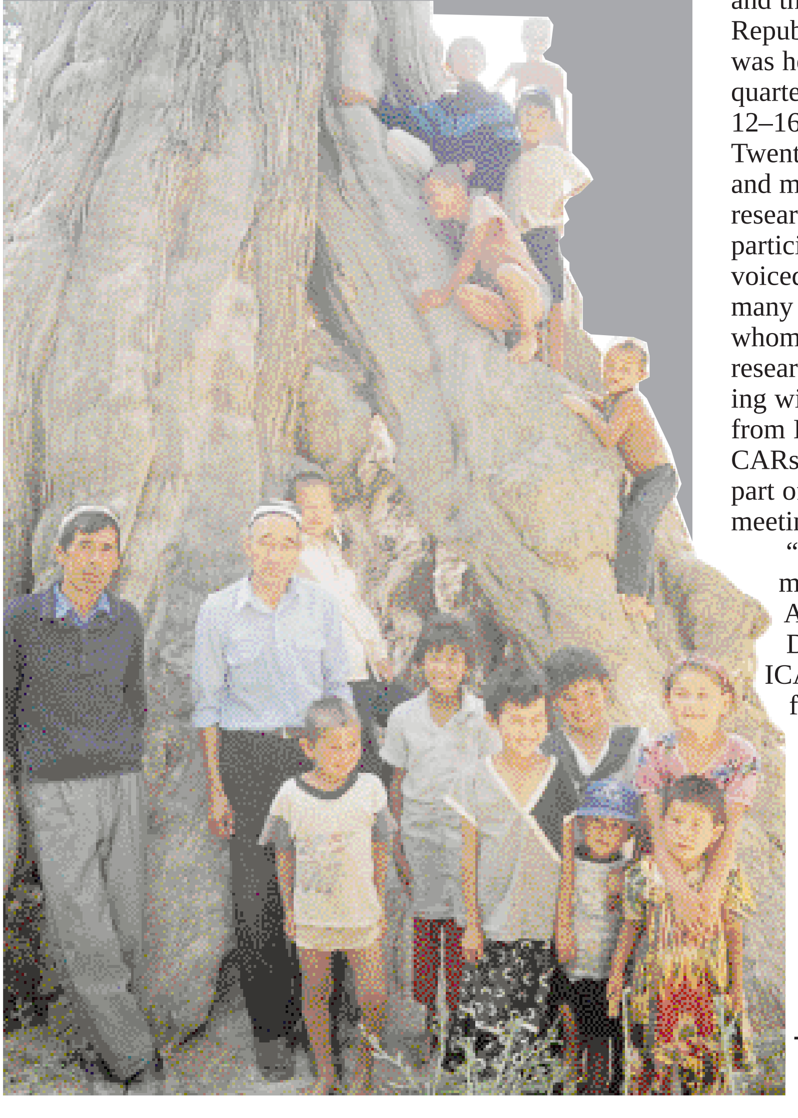
"I am deeply impressed," said Tamar Bessonova, a barley breeder and Chair of the Center for Crop Improvement in Kyrgyzstan.

Dr Bessonova was on her first visit outside her country. She was attending the First Coordination Meeting between ICARDA and the Central Asian Republics (CARs), which was held at ICARDA headquarters in Aleppo, Syria, 12–16 September 1997. Twenty-five senior scientists and managers of agricultural research from the five CARs participated. And she voiced the sentiments of many of the delegates, for whom seeing ICARDA's research facilities and talking with other scientists, from ICARDA and other CARs, was an important part of the coordination meeting.

"This is an historic moment," said Prof. Dr Adel El-Beltagy, Director General of ICARDA, "as this is the first regional coordination meeting between the key agricultural scientists of the Central Asian Republics and ICARDA... The dream has come true after two years!" The dream being the effective partnership in agricultural research in Central Asia by ICARDA and the national agricultural research systems of the five ex-Soviet CARs, to improve agricultural productivity on a sustainable basis, while protecting the natural-resource base, as these countries move towards economic liberalization.

Giving background to the meeting, Prof. Dr El-Beltagy recalled the two previous meetings that ICARDA had the privilege to organize—one in Tashkent in December 1995, where ICARDA scientists met with the representatives of the NARS in the West and Central Asia region, and the second, the Central Asia NARS/CGIAR Consultation Meeting in September 1996, again in Tashkent. Prof. Dr El-Beltagy said that the dry areas of Central Asia were part of the mandate region of ICARDA, as approved by the Consultative Group on International Agricultural Research (CGIAR). So this coordination meeting would permit development of concrete plans for collaborative research between ICARDA and the Central Asian Republics.

The delegations from each of the Central Asian Republics was headed by an eminent scientist: H.E. Deria Karakurdiev, President of the Turkmen



Gustave Gintzburger

A new challenge: Families like this one in Kazakhstan have new economics to deal with.

Participants in the First Central Asia/ICARDA Coordination Meeting. The Heads of the delegations from the Central Asian Republics are front row: Acad. J. Akimaliev of Kyrgyzstan (third from right); H.E. Deria Karadurdiev of Turkmenistan (fourth from right); Acad. S. Usmanov of Uzbekistan (sixth from right), Acad. B.S. Sanginov of Tajikistan (seventh from right) and Acad. A. Satybaldin of Kazakstan (third from left). Right: A Tajik farmer: preparing to face a different farming future.

Michael Turner

Livestock Association, Turkmenistan; Academician Jamin Akimaliev, President of Kyrghyz Agrarian Academy, Kyrghyzstan; Acad. Azimkhan Satybaldin, Director General of NACAR, Kazakstan; Acad. Saidmakhmud Usmanov, Consultant, Uzbekistan Research Insitute of Market Reforms, Uzbekistan; and Acad. B.S. Sanginov, President of the Tajikistan Academy of Agricultural Sciences, Tajikistan.

This meeting brought ICARDA and CAR researchers together to discuss in detail, and develop frameworks for, a number of urgent project proposals—building on priority areas identified in the two earlier meetings—which will be submitted to donors for funding. In the closing session, which was chaired by Prof. Dr El-Beltagy, the main project outlines were presented, and these were developed further over the following weeks.

The meeting played a special role in one particular sense—that of bringing scientists in Central Asia back onto the international circuit. Although agricultural researchers and institutions certainly did not stop work with the break-up of the Soviet Union, formal networks in Central Asia did collapse. One of the points that delegates were keen to stress was the important bridging role that ICARDA is now playing between the CARs themselves and between the CARs and the international agricultural research and development community.

ICARDA has made another constructive move towards strengthening its research contacts in Central Asia. It has appointed a distinguished Kazakh scientist, Dr Makhlis Suleimenov, as its liaison officer for Central Asia. Dr Suleimenov is no stranger to international coorperation, having traveled widely abroad.

It is hoped that ICARDA will shortly be able to establish a permanent liaison office in Tashkent, Uzbekistan, and to this end ICARDA's Highland Regional Program coordinator, Dr S.P.S. Beniwal, held consultations with senior Uzbek officials in September and October, visiting the Uzbekistan Scientific Production Center for Agriculture (USPCA), the Ministry of Foreign Affairs, the Office of the Cabinet of Ministers in Tashkent, and Karnap Farm near Samarkand (site of the USDA/ICARDA/Central Asia Small Ruminant/Rangeland Project). H.E. Azimjon I. Muhitdinov, Deputy Prime Minister in charge of Agriculture and Water Resources, has shown strong support for ICARDA's initiative.

The process took another step forward during the CGIAR's International Centers Week in October 1997, when ICARDA organized a luncheon meeting, sponsored by USAID and and the International Fund for Agricultural Development (IFAD), in Washington DC. It was attended by 73 representatives from the donor community and other CG Centers, and a senior team from ICARDA led by Board of Trustees Chair Dr Alfred Bronnimann and Prof. Dr El-Beltagy. Prof. Dr El-

Continued on page 6

Central Asia

Continued from page 5

Beltagy presented a well-illustrated account of ICARDA's past and current research and training activities in Central Asia and highlighted the plans that the Central Asian NARS had developed for implementation on a priority basis.

The USAID Representative, Dr John Lewis, expressed his appreciation of ICARDA's initiatives and efforts in Central Asia and emphasized the need for support for agricultural research in the region. Dr Abdelmajid Slama, the IFAD Representative, endorsed Dr Lewis's comments and highlighted IFAD's present activities and interest in the region. He also highlighted IFAD's support to ICARDA's projects in the West Asia and North Africa region and assured the group of IFAD's interest in assisting ICARDA's efforts in Central Asia.

The meeting had a concrete result. Dr Jit Srivastava of the World Bank suggested the formation of a Consortium on Central Asia to gather the much-needed financial support for initiating research activities in the region. And later discussions resulted in the formation of a *CG-Center Consortium for Central Asia*, with ICARDA as its focal point, by way of providing the needed administrative and logistic support to other CG Centers for their activities in the region from its office in Tashkent. Eight Centers, including ICARDA, then signed an agreement to this effect. The Consortium is open to all CG centers.

Seeds: the need for a market

ICARDA scientists continue to build links with the countries of Central Asia in various fields of research. This has included the Seed Unit. The Head of the Unit, Dr Michael Turner, visited both Tajikistan and Kyrghyzstan late in 1997 to discuss seed projects, ongoing or in preparation. These visits provided an interesting insight into the special problems of the region.

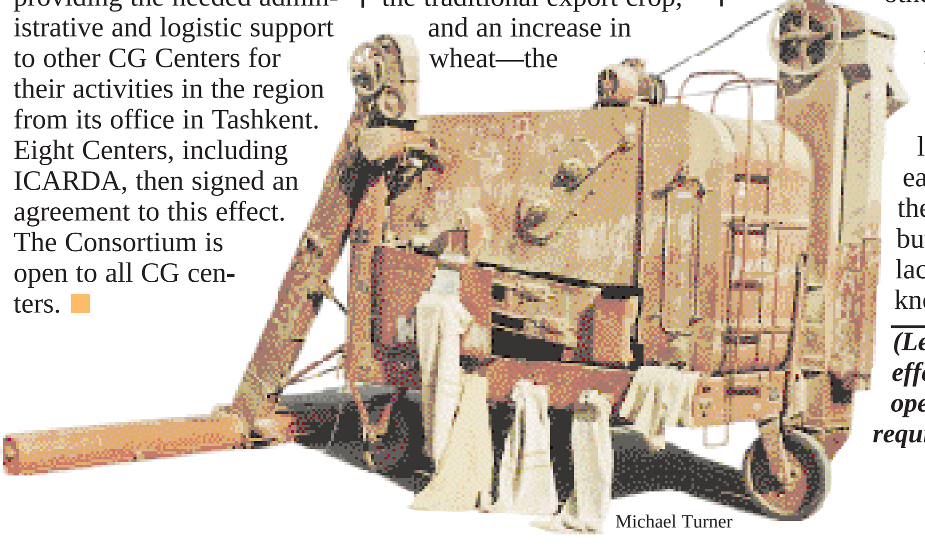
Seed supply is an integral part of agriculture and the challenges facing the seed sector are, inevitably, tied up with those of the agricultural economy as a whole. Of course, each country in the region has its own particular circumstances but they all face some common problems as they restructure their economies, and especially their agricultural production, following independence in 1991. The basic issue is the need to become much more self-sufficient in food production, whereas in the past there was a planned interdependence. Thus at a national level, there has been a decline in cotton, which was the traditional export crop, and an increase in wheat—the main staple grain of the region. There is also diversification into horticultural crops.

Michael Turner

A traditional bread oven on a farm near Dushanbe. To increase their income, farmers use some of their wheat harvest to make bread for sale in the city.

At the policy level, the main concern is to press ahead with the privatization of land from the former state and collective farms. This presents issues of its own. Former employees of those farms may lack either the confidence or the cash resources to make the decisive step to becoming private farmers. On the other hand, many professional workers bought land at an early stage in the process but they may lack the knowledge to manage it properly. The speed of all agricultural reform, including land reform, varies between the countries of the region—indeed from area to area.

For the seed sector, all this means a major change. Under central planning, certain large farms specialized in seed production, providing their own needs and those of adjacent farms, but there was no real market as such. Nowadays, as smaller private farms develop, there is no system of merchants or other suppliers to provide them with seed or other inputs. There is also very little experience in seed production outside the state farms. As a result, many farmers have reverted to saving their own seed, since nothing else is avail-



Michael Turner

(Left): Seed machinery from Central Asia: effective enough, but designed for large-scale operations on state farms. The future may require different types of equipment.

able. In some countries, this is also forced on them by the lack of cash in the economy, especially in the rural areas.

Agricultural scientists working in the region feel the lack of interaction among the newly-independent republics. The same problem affects the introduction and exchange of germplasm, which have declined markedly. ICARDA is trying to bridge the gap. It was clear in both Tajikistan and Kyrgyzstan that scientists valued the opportunity to visit ICARDA for the Central Asia meeting, both to see the work in progress and also to discuss the many topics of shared concern.

Tajikistan has great agricultural potential. Although rainfall is low and rain-fed crops are vulnerable, there are abundant water resources from the mountains, which occupy 93% of the land area. As it is the most southerly republic, winters are milder in the valleys and there is potential for early crop production.

Livestock are not as important as in the steppe that lies to the north and west in Uzbekistan and especially Kazakstan. However, Tajikistan *is* home to the Ghissar sheep, said to be physically one of the largest breeds in the world. Dr Turner reports that these 'super sheep' are very noticeable as one tours the Ghissar valley around the capital, Dushanbe.

Everyone hopes that, in a few years, we should see a diverse and productive system in which private farmers play a leading role. This will require a continuing research input—and, as in every agricultural economy in the world, an efficient and affordable supply of quality seed.

Prof. Dr El-Beltagy (center) in Hangzhou, China. With him are (left) Dr Jin Shengrong, Director of the Zhejiang Academy of Agricultural Sciences (ZAAS), Hangzhou, and Dr Xie Yinwn, Director of Zhejiang University.

China–CGIAR Forum

Prof. Dr Adel El-Beltagy, ICARDA Director General, was in China for the first ever China–CGIAR Forum held by the Ministry of Agriculture of the People's Republic of China in Beijing from 10 to 12 November.

The Director General gave a presentation on *Current and Potential China–ICARDA Collaboration,* covering ICARDA's long relationship with the Chinese Academy of Agricultural Sciences (CAAS). This has focused on the improvement of faba bean, barley, lentil, chickpea and forage legumes, in line with the agreement between CAAS and ICARDA signed in 1986. In future this will be extended to sustainable management of natural resources and sustainable increases in productivity of dry-area farming systems.

The objective of the Forum, as outlined by H.E. The Minister of Agriculture of the People's Republic of China, was to discuss how the CGIAR might assist China in expanding its agricultural research and achieve sustainable development in agriculture; review current China–CGIAR collaboration and identify areas for future cooperation; expand contacts, and develop recommendations to the Chinese Government on relevant future strategies.

The CGIAR was represented at the Forum by Dr Ismail Serageldin, Chairman, Dr Alexander von der Osten, Executive Secretary, and Directors General or senior managers from virtually all the 16 centers. Chinese participants included senior officials of the Ministry of Agriculture; President, Vice-President and senior scientists from CAAS, Chinese Academy of Sciences, Chinese Academy of Forestry Sciences, Chinese Academy of Fisheries Sciences; President and senior scientists of 17 Provincial Academies of Agricultural Sciences; and Presidents and senior scientists of National Chinese Agricultural University in Beijing and the Agricultural Universities of Central China, Nanjing, Northwest and Shen Yang. Plenary sessions covered: an overview of agricultural research systems and priorities; current and potential cooperation, and opportunities and challenges for developing strong partnership in the 21st century. The Forum's activities in Beijing ended with a call by the participants on the Vice Premier of the State Council of China.

An important part of the China–CGIAR Forum activity was the field visit to Hangzhou in Zhejiang Province. Hangzhou hosts the headquarters of the Zhejiang Academy of Agricultural Sciences (ZAAS), which has major responsibility for research on two of ICARDA's mandate crops—barley and faba bean—and thus has bilateral agreements with ICARDA. The Vice President of ZAAS, Dr Chen Jian-Ping, and the barley and faba bean researchers briefed Prof. Dr El-Beltagy on the Academy's work, particularly in the field of barley and faba bean improvement. After the meeting Prof. Dr El-Beltagy visited the laboratories and field experiments. Dr Lang Li-juan, Associate Professor of Faba Bean Breeding, who has long-standing research contacts with ICARDA, proudly showed the progress that she and her colleagues have made in improving the faba bean crop for Zhejiang Province. She thanked Prof. El-Beltagy for the support ICARDA has provided in the past for the autumn-sown faba bean research network in China.

She hoped that the collaboration between ZAAS and ICARDA will grow further in the future. Professor Liu, the National Coordinator for barley research in China, also expressed similar hope for barley.

Poverty and destruction

Did you think that poverty was a mainly urban phenomenon? Think again. A billion people live in the world's dry areas. Nearly 70% have per-capita GDP of less than US$2 a day. About 300 million fall below their nationally-defined poverty lines. And of this 300 million, 72% are rural and are dependent on agriculture. The interaction between this poverty and environmental degradation could be the big issue of the coming century.

By Abelardo Rodríguez and Mike Robbins

Poverty is, increasingly, perceived as an urban phenomenon. With one or two exceptions, such as Rwanda, starving millions in the countryside have not been seen on the world's television screens on any scale since the 1984–85 famine in the Horn of Africa. Faced with the desperate challenges that arise from urbanization in the developing world, the AIDS pandemic, pollution of the seas, greenhouse gases and declining air quality, many in the donor community no longer regard agricultural development as the pressing concern it was 25 or even 15 years ago. Agriculture, it seems, is no longer an area of pressing concern for development. At ICARDA, we believe that this could be counterproductive. Recent research at ICARDA has established, first, that there is persistent, grinding rural poverty in the world's dry areas; and second, that the link between this rural poverty, and the fragility of the environment in these areas, is an explosive one.

Where are the dry areas, and how poor are their people?

For the purposes of this study, 41 countries and three territories were selected on the basis of plant growing seasons limited to 180 days. These were, for the most part, whole countries, but not exclusively: India, for example, figured in the work because of three of its States that fall within the definition of dry areas. Of the countries included, 34 were in the West Asia and North Africa (WANA) region.

It was found that, out of a total population of one billion, 696 million had a per-capita GDP of below US$2 a day. About 300 million people lived below nationally-determined poverty lines, which are normally linked to nutrition. The poverty lines are not a comprehensive definition, as they do not take into account material deprivation, isolation,

Relics of a lost community. Once a prosperous Byzantine farming settlement, this village in North-West Syria used up the land.

lack of influence, poor food and water security, or freedom of choice. Agriculture has a key role here.

The link between agriculture and poverty is masked by the relatively low share of GDP accounted for by the agricultural sector. It varies between 27% in the lower-income countries outside the WANA region, to just 3% in the higher-income countries within it. However, this can lead to a dangerous misunderstanding: in fact, of those 300 million poor, 72% are rural and are dependent on agriculture for their income.

The relatively low GDP percentage arises partly because much production is consumed on-farm—especially in the poorer countries, where the rural population may be heavily dependent on subsistence crops like food barley and pulses. This keeps some production out of the GDP figures. However, in the poorest countries studied—Ethiopia, Eritrea, Somalia and Afghanistan—agriculture does account for about 60- 80% of GDP.

At this point, it is, perhaps, worth exploding another myth—that the presence of oil-rich states in WANA results in a relatively high per-capita income, and that the per capita income of the region cannot really be bad. This is not the case. The population of the oil-rich states is just 30 million out of 627 million for WANA as a whole, and in any case, their per-capita GDP is US$8100 (oil states plus Cyprus). This is very high by the standards of the region, but not really that high by northern standards. Far more typical are Lebanon or Tunisia with just under US$1500. Ethiopia and Eritrea have US$52; Somalia, just US$36. It is these poorer countries, with their larger populations, that have higher percentages of their people living in poverty; in Sudan, for instance, 71% of its people, and 93% of its rural population, were reported by UNDP to be living below the poverty line in 1992.

As part of this research, it was thought necessary to properly quantify rural poverty in the countries concerned. This was done by devising a rural poverty indicator (RPI). This gave us a cross-country poverty line so as to eliminate inconsistencies caused by different costs of living. Briefly stated, a welfare indicator based on per-capita income (using per-capita GDP as an estimate) was used to produce a poverty indicator which was then related to the percentage of rural poor. It was more complicated than this; allowances had to be made for differences in distribution of income and purchasing power.

The result showed a close correlation with the UNDP Human Development Index and with indicators for infant malnutrition. For example, Ethiopia topped the scale with an RPI of 0.832; examples in the dry areas included Turkmenistan at 0.216, and Lebanon at 0.040. UNDP's 1994 estimate of malnourished children under 5 in these countries in 1994 was 38.2%, 10.6%, and 8.4%, respectively. This seems to indicate that rural poverty has a direct correlation with the nutritional standard of nations included in the study.

Grinding poverty is an offence against humanity. Alleviation of rural poverty should need no further justification.

However, there *is* another factor: the combination of rural poverty and the fragile environment in the dry areas could prove explosive.

In the poorer WANA countries where more than 30% of the population is engaged in agriculture, each hectare of arable land increases daily GDP per worker by US$2.1. However, if the land is irrigated, the figure is US$3.9. Given that farmers are on the margin—the average agricultural worker has access to only one hectare—there is an obvious incentive to irrigate. But several countries in WANA have less than 500 cubic meters of renewable freshwater per head annually. Many countries are now turning to unsustainable irrigation practices; pressure to produce leads to excessive year-on-year irrigation with serious consequences for salinity and soil fertility. Non-renewable ground water is being mined.

Stefania Grando

> We must raise rural incomes to the point where communities are able to invest in environmental protection ”

There is also an alarming threat to another natural resource—the soil itself. Wind erosion in steppe areas has been aggravated by overgrazing and fuelwood collection; water erosion on sloping land, worsened by hard use of the soil, is carrying the earth away from areas where it can be used to areas where it can not, silting dams and watercourses in the process. There is also a severe threat to plant genetic resources as an impoverished rural population uses every last available square meter of land, wiping out wild plants.

There are answers. ICARDA and its partners in the national programs are working with farming communities to devise natural-resource conservation measures for farmers to use in the field; these include developing appropriate technologies for both rain-fed and irrigated agriculture. But these are useless if farmers cannot implement them. We *must* raise rural incomes to the point where rural communities are able to invest in environmental protection.

ICARDA's mandate crops are directly relevant to farming income in the dry areas. For example, in Ethiopia, barley is worth about US$114 million annually. (This will be an underestimate; as discussed earlier, on-farm consumption hides much of the output, especially where a crop is used—as barley is—for subsistence.) In Kazakstan it is worth nearly US$804 million. In fact it is a significant element in the farming income of most dry-area countries, especially the poorer ones. Faba bean is worth nearly US$10 million a year in Sudan, where it is crucial to the diet of the poor. And it is a massively important crop in China (although not, in general, in the dry areas of that country). Chickpea, for which ICARDA has a joint mandate with its sister Center, ICRISAT, is worth over US$574 million a year, and lentil US$360 million, to Turkey. Wheat, on which ICARDA cooperates with another sister Center, CIMMYT, is worth over US $1868 million for Kazakstan and US $415 million for Morocco. ICARDA is also responsible for research into feed and grazing in the dry areas, and meat and milk are significant nearly everywhere. There is a crucial role for ICARDA in combatting environmental degradation, both directly—through devising control strategies—and indirectly by helping to raise farmers' incomes so that they are in a position to implement those strategies.

We must hurry. If we fail, interaction between poverty and environmental fragility will devastate the landscape. The rural poor will then be forced to migrate to cities to place further stresses on urban infrastructures already stretched to breaking-point. Or they may travel further, attempting to enter northern countries. There could be real consequences for social and political stability.

It has happened before. The uplands of northwest Syria are a moonscape of rocks, the result of a population that clawed too much from the land in the first millennium AD. They left behind the ruined architecture of a sophisticated culture, but the soil, and the people, have gone.

Will the rural poor of the dry areas be driven, in the future, to seek the gates of some new Byzantium? ■

Dr Abelardo Rodríguez is Agricultural Economist, and Mike Robbins is Science Writer/Editor, ICARDA.

Not for gold, or fine clothes

Agriculture in developing countries is sometimes thought of as a household subsistence activity, having little in common with the agribusiness of the North. This is often true. But in some places, at least, subsistence farming is giving way to commercial production and wage labor on a major scale, and women are increasingly involved. Why? How? And where will this take them?

Agricultural growth and the intensification of production in Syria over the last generation has had an enormous impact on the social organization of agricultural labor.

Many farmers have become commercial operators, managing farms and livestock according to market forces and relying on purchased inputs and hired workers to produce their crops. Another sector of the agricultural population has farms that are too small or unproductive to support them. People from this second group are increasingly turning to off-farm income sources—indeed, many rely on such income even for their daily bread. These developments have led to the emergence of a significant wage-labor force in agriculture.

An ICARDA study undertaken in northwestern Syria has revealed an important feature of this labor force: its organization into work groups organized and led by contractors. The work groups are predominantly female; and—perhaps surprisingly in this Middle Eastern setting—the number of female labor contractors is also increasing.

The research was carried out in 42 villages in Aleppo and Idlib governorates and included informal interviews with farmers, workers and contractors, as well as formal surveys using questionnaires. The surveys were carried out over the period 1994–1996. The villages are clustered north and south along a rainfall gradient from over 350

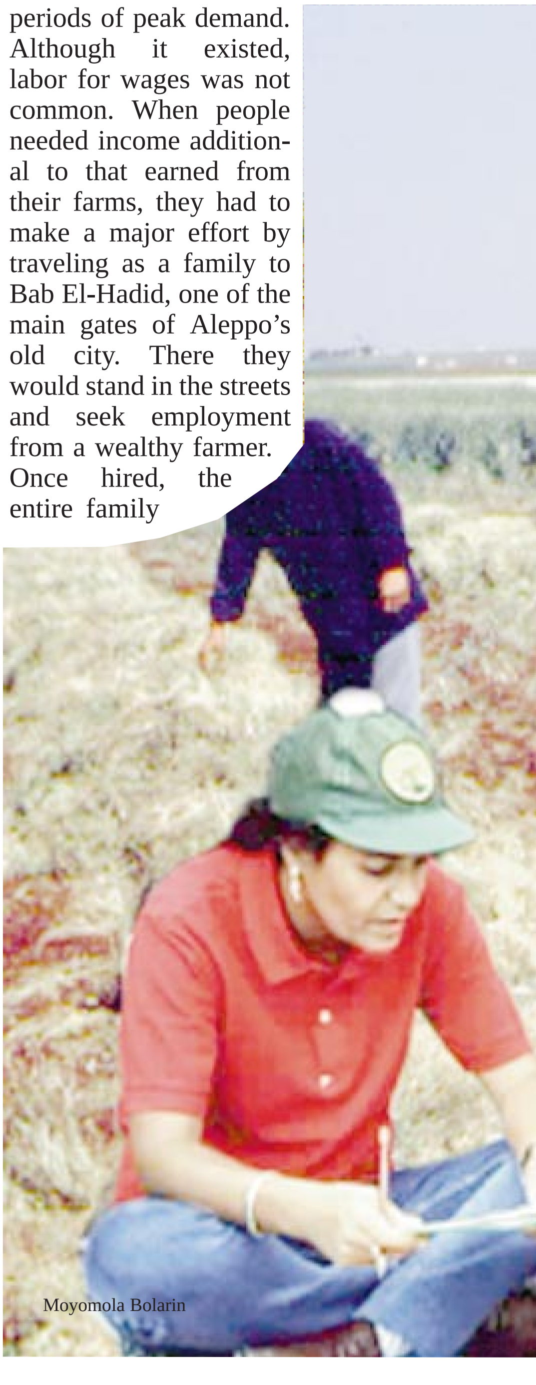
By Malika A. Martini, Richard Tutwiler and Christine Kalume

mm average annual rainfall to less than 250 mm. Wheat is the dominant crop in the wetter areas and barley predominates in the drier zones. Livestock, principally sheep and goats, are an important feature in the drier areas.

Farmers have been under pressure. There is a 3.6% growth rate in the rural population. Arable land has declined by 22% since the 1960s. Syrian farmers have had to intensify production to keep their farms economically viable. Cropping intensities have increased in rainfed areas, but the greatest change has been the growth in tube-well irrigation.

Pumping ground water has enabled farmers with sufficient land and financial resources to produce a great diversity of crops that could not be supported by rainfall alone, and to produce more than one crop on the same piece of land each year. In addition to traditional cereals and food legumes, such labor-hungry crops as cotton, sugar beet, potato and a range of vegetables are now commonplace. This means that labor is needed all year round in the fields, and the total demand for workers continues to rise.

Historically, villagers relied on unpaid family labor to produce their crops, but they also worked on each other's farms without payment—'a free exchange' based on reciprocity during periods of peak demand. Although it existed, labor for wages was not common. When people needed income additional to that earned from their farms, they had to make a major effort by traveling as a family to Bab El-Hadid, one of the main gates of Aleppo's old city. There they would stand in the streets and seek employment from a wealthy farmer. Once hired, the entire family



Moyomola Bolarin

group would walk to the farm where they were to work and live there in tents or in houses in the adjacent village. There was usually no need for a specialized labor contractor or supervisor; the head of the family was responsible for the family's agreement to provide the employer with labor, while the employer undertook to house and feed the entire family during its period of employment.

Times have changed. This labor, whether paid or unpaid, was firmly rooted in the social relations of the family and household. Today's labor force, in contrast, consists of individuals who work for wages on a daily basis. Daily wage work is fast becoming the predominant form of agricultural labor in northwestern Syria, especially on large holdings and commercial farms.

And it is in short supply. The surveys showed labor shortages in most of the study areas, and the shortage is particularly acute in areas where irrigation has become common. For example, in El-Bab district, north of Aleppo, there are only about 120 workers from a single village who are available for daily hire in the entire area. They are busy most of the time, especially at harvest time when they work for three consecutive months with no weekends off. Many farmers are finding that they have to travel far and wide in search of people who are willing to work on their farms.

Even with the high demand and shortage of available workers, those who work for wages are not becoming rich. Wage rates differ according to the area, season, task performed, length of the working day, gender and age. Daily wages in the study area over the course of a year ranged from SYP 70 to 280 (about US$ 1.60 to 6.60). Children are usually paid half the wage given to adults for hand-harvesting and the full wage for weeding.

Despite the low rates of remuneration, the poorer inhabitants of villages in drier areas, particularly those with little land or irrigation water of their own, need the income from wage work to secure basic necessities. Usually the men work in non-agricultural activities where the wages are higher—many households have long-term migrants in Syrian cities and abroad, particularly in Lebanon, Jordan and the Gulf States.

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Malika Martini

Inset: ICARDA's Malika Martini (left) with labor contractor Um Kasser. Main picture: A labor team tackles the lentil harvest.

Malika Martini

Women's wages are vital for their family's survival

Continued from page 11

The women hire themselves out as agricultural workers. In traditional Arabic culture, a family gains prestige if the women stay at home attending to domestic duties, but, as one woman put it, "We use the money from working in the fields to buy bread, and if we have no work we have no bread." In communities where bread is symbolic of life itself this means that the households are very poor, even by regional standards.

Agricultural workers are organized into working groups which, between them, control the labor market. The working groups vary in size according to region and to the labor demand, increasing in periods of peak demand. Unless the place of work is very far away they will travel by truck to work in the early morning and return to their village each afternoon (the average distances recorded in the survey were between 50 and 100km). The farmers no longer feed them.

The groups are usually made up of young and middle-aged women and children aged 9 to 13, with a few men hired for specific tasks. Women perform the more intensive, labor-demanding work, such as weeding, planting and harvesting, where groups of 15 to 40 women are needed. For example, for hand-weeding spring potatoes, 200 women-hours are needed per hectare. Men do more of the heavy work and machine work. When a work group is planting potatoes, for example, a man drives the tractor, while four women sit on the planting machine behind and feed seed potatoes into it.

Individual workers are hired through a labor contractor called, variously, a *ra'is warsha* ("work-group head"), *dallal* (lit. "broker") or *mu'alim* (lit. "boss"). A farmer who needs to hire a work group to perform a particular task on his farm, such as weeding a field of sugar beet or harvesting a lentil crop, approaches a labor contractor who is known to be able to deliver a capable work group. If agreement is reached, the contractor must then assemble the work group by contacting individuals that the contractor knows who are willing to work. The number of workers assembled by a contractor usually ranges from 30 to 50 but can be as high as 100 for certain tasks.

Transport to the place of work is

sometimes arranged by the employer and sometimes by the contractor, but once in the field, the labor contractor is the main supervisor and is responsible to the farmer/employer for the quantity and quality of work done. Sometimes the contractor also works at the same task as the group, but contractors always pay attention to how the work is going and encourage group members to do well and work at a respectable pace. The farmer/employer pays the agreed wages to the contractor, who then pays the workers. If the task is finished quickly, then payment may be on a daily basis. If the work group is engaged for a longer period of time, then payments might be weekly or at longer intervals until the contract is finished. Labor contractors perform many functions: they are negotiators, recruiters, team organizers, quality control supervisors, pace setters, and accountants. Above all, to be successful, they must be good labor-relations managers.

The emphasis of, and on, the labor contractor's job varies from village to village and region to region. They are especially important in poor areas with bad communications because they have the personal relationships that can bring together both prospective employers and workers, who would not otherwise be known to each other.

Rates of remuneration for being a labor contractor vary considerably. The study identified several arrangements:

- a fixed daily wage for the duration of the task, not related to the wage paid to ordinary workers;
- a wage slightly higher than that of the workers for the same task;
- payment according to the number of workers in the gang, with a set amount paid per worker per day.

In this last case, the number of workers in the work group is very important to the labor contractor. The rate per worker differs according to the season and the time of peak labor demand. It increases most during times of labor shortage. Other forms of payment are a mixture of these types—for example, the contractor is paid the workers' wage plus an additional amount per worker per day—giving that contractor an incentive to have a large work group.

Labor contractors interviewed varied in age between 18 and 80, but all are people of good social standing within their village. This is extremely important, as the villagers have to entrust working family members into the care of the labor contractor for the period of employment. Contractors must also have a good reputation with farmer employers for being able to recruit and manage work groups.

"I am proud of her; she is the best woman in the village," says Abu Kasser, a guard at a rural primary school, about his wife Um Kasser. Um Kasser, who is 48 years old, has become a successful labor contractor, and her husband understands that families send their daughters with his wife because of her good reputation in the village. The fact that she is a mother who has raised several children successfully has given her security and honor in the village society. Marital status is also important. A married male labor contractor is likely to be preferred to a single man. An unmarried female labor contractor is usually middle-aged or older, a *hajja* (a Muslim who has made the pilgrimage to Mecca), or working under a father, brother or another male relative.

> Some believe strongly that a female labor contractor is more successful at supervising women

While most labor contractors are still men, the number of women contractors in the study area is increasing, especially where large numbers of men have left the area in search of wage employment.

In some villages, such as Batabu in Atareb district, all the labor contractors are women; in other villages it is an exclusively male activity and in yet others, such as Bizaa' village in El-Bab district, there are both male and female labor contractors. Some of the farmer employers interviewed believed strongly that a female labor contractor is more successful at supervising women. Women are more likely to listen to her than to a man, and she understands the women's problems better than a man could.

The driving forces behind the emergence of a largely female wage labor force, organized by labor contractors who are increasingly women themselves, are complex. Intensification and commercialization of agriculture have certainly created the demand for labor that pulls people in poorer households to seek wage employment. Demand alone, however, explains neither the male/female balance of the emergent workforce, nor the way it is organized.

One partial explanation, as indicated by the study results, is the difference in relative geographic, economic, and social mobility of men and women in rural households.

Men are relatively more mobile than women. They tend to leave their families earlier in search of employment opportunities when the need arises, and they tend to look farther afield and consider a wider range of opportunities. They are therefore less likely to be available locally. A great many of the families that are supplying women to wage labor in agriculture also have men working for wages, but not as often in agriculture and frequently outside their home communities—in urban centers or abroad.

Women tend to stay closer to home and to work within a familiar context. Wage work in agriculture, organized by a well-respected person from their own village, would seem to be for them a good compromise between maintaining traditional attachments and meeting a modern need for money.

Whether or not many of the poorer families covered in the survey will end up eventually leaving the land altogether for the expanded opportunities in the towns is unclear.

What can be said, is that the women's wages are vital for their families' survival. As they put it, they work "not for gold, or fine clothes, but so that our families can eat." ■

Malika A. Martini and Richard Tutwiler are Socioeconomists in the Natural Resources Management Program, and Christine Kalume is Science Writer/Editor at ICARDA.

Twins and triplets in Tarhin

By Faik Bahhady and Mike R1obbins

In 1986, ICARDA and a group of farmers in Northern Syria started to redevelop an old technology—rotation of feed legumes with cereals. Today, farmers have higher yields, more feed...and more sheep.

Jamil Zameji

Farmer Amin Yagen of Tarhin, in El Bab, Northern Syria, had cause for satisfaction in September. Of 300 fertile ewes in his flock, 141 lambed in that month. Of these, 30 gave twins. And one had triplets.

This is a twinning rate of 31%. A more typical rate for the region would be 5–10%. Moreover, in the past, none would have lambed until December, exposing them to winter conditions. Earlier lambing has therefore much reduced mortality. It also means that Mr Yagen's lambs hit their sale weight—about 45–50 kg—at a time in the spring when there is a shortage of such lambs, and their price is high.

Mr Yagen had cause for satisfaction at harvest time, too. This year, in what was generally not a good year for cereals in Syria, he obtained a yield of around 3.4 tonnes per hectare from certain barley fields, against 2.8 from others; some neighbors got only 2 t/ha. In general, he has been seeing yields 20% above those of his neighbors in recent years.

The key to these improvements is the use of forage legumes in rotation with cereals. In 1986, ICARDA began work in the El Bab area on a project to develop and transfer the technology in farmers' fields. The idea itself was not new; traditionally, farmers did practise

Triplets (below) and lots of twins—more sheep for Amin Yagen (above).

Jamil Zameji

this kind of farming, in order to feed their draft animals as well as raising cereals. This practice ceased about 50 years ago as draft animals were replaced by motor power. ICARDA decided to work with it in the 1980s as a way of fighting falling cereals yields, which had been hit by depletion of nitrogen and organic matter, and by the persistence of pests and diseases through monocropping.

Tarhin is in exactly the sort of area where this is relevant. It receives 200–280 mm average annual rainfall. Cereal production is not actually marginal, but yields are highly variable and the environment is fragile. The use of a legume, such as vetch (*Vicia sativa*), in rotation with cereals not only helps to stabilize yields by reducing nitrogen depletion and breaking the pest and disease cycle; it also provides greater below-ground plant matter than constant cereals, stabilizing the soil itself and making it less vulnerable to wind and water erosion. (This also improves the performance of the land as a carbon sink. See *Agriculture—a weapon against global warming* in *Caravan* No. 5.) Vetch is water-use efficient, providing greater above-ground biomass in terms of available moisture, and leaving more soil moisture to be exploited in the following cereals year than would be the case with cereals monocropping. Last but not least, it provides a nutritious and flexible feed and forage source for livestock. And in the mixed farming system of West Asia, that is a crucial benefit.

From 1986 to 1993, the ICARDA team worked with a core group of eight farmers, of which Mr Yagen was one. Each of these farmers grew 2 ha of their cereals production in rotation with vetch and chickling (*Lathyrus sativus*).

In those first seven years, the team learned a lot. Initially it also tried medics (*Medicago* species) in rotation, but that crop was less productive in the drier areas; it was dropped at El Bab mainly for that reason, but also because it could not be harvested for sale or to provide a stock of feed. ICARDA's work with medics is now concentrated in higher-rainfall zones, with the emphasis on rehabilitating marginal land. For rotation, the focus switched to vetch.

Moreover, farmers were concerned at the cost of labor for harvest; they felt the system would work better if vetch-harvesting could be mechanized, and ICARDA developed machinery for this purpose (see *Machines for the millions*, page 16). Meanwhile, advanced breeding technology also played a part. ICARDA's Germplasm Program selected and bred locally-adapted varieties of vetch that were less prone to seed shattering; with earlier varieties, nearly half the harvest was lost in that way.


ICARDA technicians have helped with veterinary advice.

This collaborative approach worked. Back in 1986, there were no legumes grown in the area. Today, about 150 farmers—some of them a long way from Tarhin—have adopted the technology. Amin Yagen has been especially successful with this. He is not quite typical; whereas most farmers have holdings of about 20 ha, he farms about 200, some of it for family members. It is very mixed. He grows pistachio and olive besides cereals. The latter consist mainly of barley, but he also grows a little wheat on his best, deepest soils. Cereals are his biggest source of income, followed by sheep. The land is entirely rain-fed, with enough water to irrigate just 1–1.5 ha. Most farmers would use this for wheat. He irrigates barley on it; this is for his horses, 10 pure-bred Arabs. Syrian farmers do not irrigate barley for cropping, as this would be uneconomic, but they do frequently irrigate very small plots for grazing. On seeing these magnificent animals, one can understand why Mr Yagen does so!

From the initial 2 ha, Mr Yagen now has about 30 ha under vetch at any given time. Of this, about 10 ha is used for grazing in March–May, and the rest will be harvested. Harvest is in May, so it does not coincide with other crops, and there is no conflict in terms of labor requirement.

This calendar is part of the reason why vetch is so beneficial for sheep. Spring was hitherto a lean season for feed and forage; sheep would do better after the cereal harvest in July, when they would graze the stubble. For the first month or so of this stubble-grazing, they would benefit from the presence of heads in the barley stubble, giving a higher protein intake. Conception would take place during that period. From July onwards, the supply and quality of feed would decline. Winter would be rather a lean time. And lambing would take place in the middle of it.

This has changed. Mr Yagen grazes his sheep on 10 of the 30 ha of vetch in the spring; they do well in this period, they conceive, and more than 50% of them lamb in September. Moreover, at the time of lambing and through the autumn, there is a plentiful supply of feed—that is, harvested vetch from the remaining 20 ha. Barley stubble will still be grazed at the time that it *is* available; a farmer will use any available resource, and anyway the sheep have a function here in cleaning the field. However, the reduction in the percentage of the feed requirement obtained

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Machines for the mill

It is pointless developing technology that farmers cannot use. When ICARDA's scientists started promoting pasture legumes, they knew an economic seed supply would be critical. So they developed low-cost machinery for farmers to prepare the seed. And it is hoped that now an indigenous medic-seed industry will emerge.

By Imad Haidar, Scott Christiansen and Walid Bou Mughlebay

Medic, known as *burr clover* in California, or *nefel* to Arab shepherds, is a plant from the genus *Medicago* that shows promise in the improvement of sown pastures in the West Asia and North Africa (WANA) region. Native to the Mediterranean, it is a pasture plant which is very palatable to sheep. It has become the basis of a multi-million dollar business in Australia. In the WANA region, nearly all farmers with animals know medic and appreciate it for its benefits to milk and meat production, taste and quality. It is an annual legume that could be exploited for use by sheep—if farmers have access to an economic seed supply. To break that bottleneck, ICARDA has designed and produced low-cost sweeping and threshing machines.

Before describing this machinery, it is necessary to explain why medics are important, and how ICARDA became involved with them. In Australia, rotation of medic with cereals—ley farming—has long been a success. ICARDA thought that medic pasture could also replace fallow in the cereal–fallow systems in WANA. This would have a double benefit. It would avoid the dangers of cereal monocropping—pests, diseases and declining soil fertility. And it would provide pasture for sheep and goats. Livestock are central to the lives of millions of people in the region, as they provide meat, wool and milk, and contribute to soil fertility.

However, farmers really wanted a feed crop they could harvest, and after consultation with farming communities ICARDA has been working with vetch for this purpose—and this has been a success (see *Twins and triplets at Tarhin*, p14). In the meantime, we realized that medics had an alternative use: reseeding and restoring marginal land, a crucial grazing resource that is often degraded in the region. So ICARDA and the Syrian National Program collected, evaluated and multiplied a supply of selected annual species that would work in Syria, while national colleagues elsewhere in WANA also identified their own locally-adapted ecotypes. The problem was that farmers do not cultivate medic as they do in Australia, because, although ICARDA can provide small quantities of suitable locally-adapted seed, there has hitherto been no machinery for collecting and threshing it.

Medic grows naturally on common grazing lands, which are now mostly degraded from overgrazing and no longer contain much medic. It usually grows in places which receive an average of 150–450 mm rainfall a year; growth depends on species, distribution of rainfall, grazing pressure and soil characteristics at the site. However, where plants are grazed to the ground before producing flowers, no seed is set—one of the major causes of land degradation in WANA region. Even where medic is present, seed collection has hitherto been uneconomic; when the crop matures, the pods tend to fall to the ground. ICARDA knew of no farmers who were collecting their own medic seed. If they are to be persuaded to prepare nursery plots, they need a simple way to collect pods so that they can sow them again to create improved pasture.

the thresher
adapted to run
try the sweepe

All of the medics have fairly similar, round and coiled pods, with various degrees of spininess. Until now, the pods have been too difficult to harvest efficiently. Now ICARDA, working with local fabrication workshops, has developed three machines that can provide an economic answer.

The medic pod sweeper makes the task manageable. It has no engine and is pushed by hand, like a lawn-mower—which it very much resembles.

ions

Testing ... at ICARDA. Built locally, it can be ... without electricity. (Below): farmers ... r in Syria. (Right): Different types of

Built in prototype form by ICARDA itself and then produced in numbers by the Faraj Allah Edlebi company of Aleppo, the sweeper is easy to move around, and can collect many kinds of legume pods and seed heads. A brush assembly, rotating around a horizontal axis against the direction of travel, sweeps light material from the soil surface into a removable catch basket. When the ground is even, the sweeper can collect most of the pods in a single pass. If the soil surface is uneven or rocky, recovery is slower and more passes, in different directions, are required to sweep up the pods. Thus the best results will be obtained when medic has actually been sown on prepared nursery plots, so that the sweeper can straddle this row and brush up the pods when they are mature.

For best results from the sweeper, these plots should be rolled early in the season to make them even. Rolling after planting is primarily of interest in order to ease mechanization of harvest, particularly if the crop is short or has lodged. But it can also improve germination by improving contact of soil and seed, helping the seed to germinate and the roots rapidly penetrate, and fix themselves in the earth. So ICARDA has developed a low-cost roller for this purpose. Again, it was built in prototype form by ICARDA and bulk production is done by Faraj Allah Edlebi. It is intended for use in preparing for harvest mechanization of vetch, as well as medic.

Rolling will give its best results if the soil is neither too wet nor too dry; wet conditions cause soil to stick to the roller, and dry soils cause soil accumulation in front of the roller, an action which is more like plowing than rolling. This 'plowing' can be solved by adjusting the drawbar connection to the tractor; raising the drawbar slightly will permit the wheels to roll instead of plow.

Rolling may be done as soon as possible after planting, but it must be restricted to periods when the soil is sufficiently dry. The rolling operation should stop when the crop height is approximately 10 cm, or when it could cause damage to the plants. The roller can be towed for short distances, having wheels which can be raised out of harm's way when the machine is in use. This makes it possible for several farmers in a given area to use the same roller.

The thresher, like the sweeper, was designed specifically for medics.

The pods do not always have to be threshed. Farmers in dry areas with 200 to 300 mm annual rainfall can sow pods directly, thus minimizing the risk of losing all the seed if a drought occurs during pasture establishment. Using this method, if there is overgrazing in the first year and no seed is set, there will still be seed in the ground. Each medic pod, in fact, is nature's equivalent to the peat pots used in greenhouses to establish seedlings. They absorb water, provide insulation from the elements, and shelter the *Rhizobium* needed to inoculate the roots

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Machines for the millions

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of the legume seedling, enabling it to fix nitrogen from the atmosphere. In dry areas where the risk of establishment failure is higher, sowing pods may be better than sowing seeds.

Normally, however, the user who is rehabilitating degraded and marginal land will require as high a percentage of germination as possible. Moreover, in areas with more than 300 mm of annual rainfall, there are good reasons for sowing threshed seeds. In this case it is inefficient to sow pods because they may increase the risk of establishment failure. The germination percentage of the seed differs depending on the species, but in general annual medics have a high natural degree of hard-seededness. So it is useful in some circumstances to thresh the seed from the pods; this often scratches or scarifies them, allowing moisture to penetrate and germinate the seed. The Maktabi/ICARDA seed thresher is designed with this purpose in mind. In the process of removing the seed from the pods the seed coat is scratched, making a majority of the threshed seed germinable. It can rapidly thresh seed from a range of medic species, and yields more than 85% clean, unbroken seed.

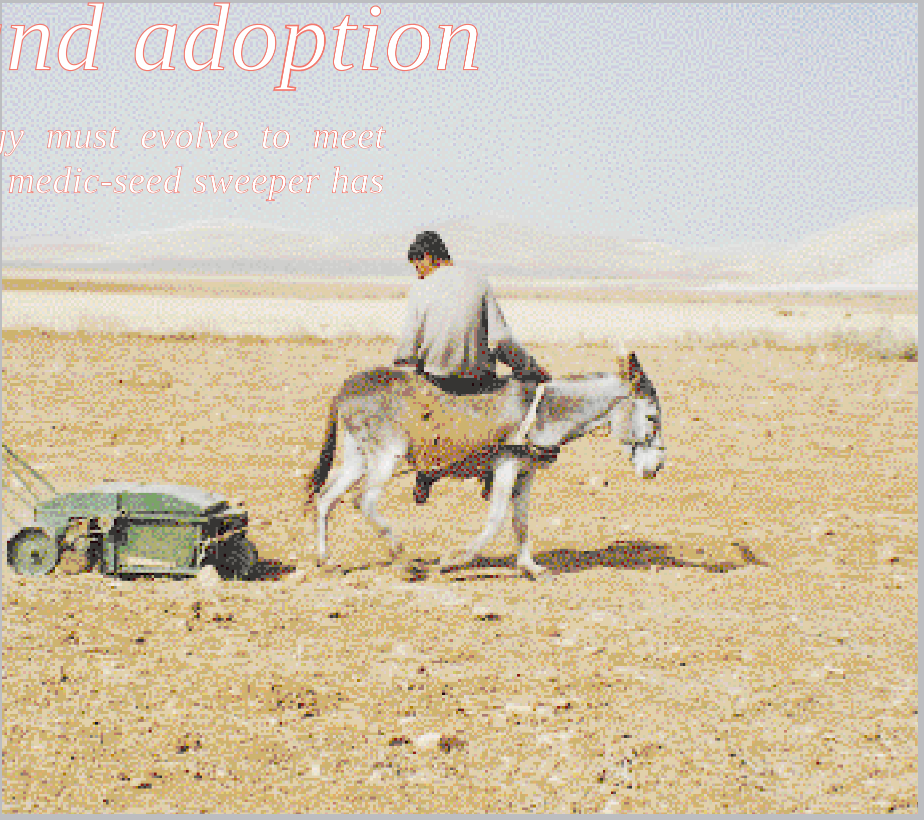
Designed and built in collaboration with the Maktabi company of Aleppo, the thresher is moveable—it comes mounted on a chassis with three wheels and a pull bar, to facilitate transportation and maneuverability. It works on electricity, but for areas where electricity supply is often a problem, it can be changed to a petrol-driven operation.

Unthreshed pods are sieved to remove stones and straw prior to their going into a hopper that holds about 2 kg of material. The pods are metered into a threshing cavity with a removable threshing drum with six fixed rasp bars, and the chamber wall has two adjustable rasp bars. Pods are threshed by collision with fixed and rotating rasp bars. Adjustment of these bars on the drum wall allows passage of different seed sizes without breakage.

After threshing, the seeds drop to a shaking table with a first screen that permits separation of dust and fine material. On a second screen, seeds fall through to a tray while coarse material continues off the table into a rubbish bin. On their way to the tray the seeds fall down an inclined plane against which a stream of air is directed to remove additional fine material. Clean seed results. If the germination is above 90%, the amount of seed to be planted is 20–25 kg/hectare.

Evolution and adoption

Even the simplest technology must evolve to meet farmers' needs. The ICARDA medic-seed sweeper has been evolving in Morocco.



Mazhar Mohamed

By Mazhar Mohamed and Mustapha Bounejmate

It is a hot July day in Sbiate, Safi Province, Morocco. An assortment of scientists, farmers and extension workers are standing in the sun, apparently looking at a modified lawn-mower. The lawn-mower is being towed by a donkey.

The outsider might be forgiven for wondering what on earth this has to do with science. For the 60 farmers, five extension agent and others clustered around this device, however, it has a great deal to do with science, and with sustainable food production. And it works.

The field day at Sbiate had been organized by one of ICARDA's most important collaborators, the Institut National de la Recherche Agronomique (INRA), Morocco's agricultural research body. INRA has been interested for a long time in medic species as a way of producing more feed. In 1985 the Ministry of Agriculture started a 15-year project to convert 150,000 ha of grazed fallow to annual legume pastures, mainly medic. Farmers were positive about medic's fast regrowth after grazing, and reported better animal health and productivity. They also found that bread-wheat yields were better after medic; indeed, ICARDA originally planned to use medic species for rotation with cereals in the driest areas of West Asia and North Africa.

But seed supply was a serious constraint. It was available, but at a price.

On average, the thresher can process 150 kg/day of pods or 50 kg/day of clean/scarified seed—enough to sow 2–3 hectares.

Up to now there has been no indigenous medic seed production in WANA, even though the crop originated in the region. Seeds have been imported from Australia, but they are expensive and are not adapted to the local conditions as local seeds, especially in areas with cold winters. ICARDA could supply small quantities of appropriate local seed to get farmers started, but if this technology is to be transferred on a regional level, seed production must become a commercial operation, even if only as a cottage industry. Village-based pasture seed units will allow pasture seed production outside the formal seed industry channels. This process will require a good deal of publicity to make farmers aware of how to improve pasture feed resources at minimum cost. The huge area in need of revegetation throughout the region justifies the relaxation of purity controls in pasture seed production.

Now ICARDA is attempting to stimulate manufacture, distribution and use of these three machines so that such an industry could become a reality. Attention will also be paid to methods of preparing fields for harvest, demonstrating the machines with other forage species, cleaning the seed pods and storing seed.

ICARDA intends to build up a network of machines for pilot operation by national programs and a few key farmers, in the hope that the technology will spread.

It is affordable technology. The sweeper costs the equivalent of about US $300. The roller is about US $ 3500 and the thresher is about $US 5500, so these two, at least, may have to be shared between groups of farmers; but as they are easy to transport, this should not be a major problem.

In any case, ICARDA thinks that the most crucial challenge is picking the seed pods off the ground in the first place, and the sweeper is perhaps the most important link in the chain.

The machines are simple, but starting a farmer-controlled seed industry in WANA is revolutionary. ■

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As a result, farmer adoption was slow, and in the early 1990s INRA, ICARDA and the Ministry of Agriculture in Morocco started to test the ICARDA sweeper and thresher. Results on-station were good, and it was decided to begin on-farm trials.

In 1995/96, six farmers were involved; the area of medic established was 29 ha. The trials continued in the following season.

They were a success. Average pod yield was 1000 kg/ha; given that seed weight is roughly 30% of pod weight, this corresponds to 300 kg/ha. Farmers reported, however, that the sweeper was hard to manage on uneven ground; two people were needed, and rocks, clods and dry vegetation had to be removed.

So farmers suggested: why not pull the sweeper with a donkey? This was demonstrated at the Sbiate field day.Using animal traction required only minor modifications to the sweeper. But it worked very well, and enabled the sweeper to pick up 500 kg of pods in a day. This is enough to seed 2 ha of weedy fallow. The thresher proved more limited in its application, as it needs electricity (although it can, in fact, be adapted to run from diesel power). But it did prove very efficient, and there is a role for it—although it might have to be shared between farmers, or perhaps run by a local cooperative.

The President of the Rural Community at Sbiate said that he would be willing to help farmers establish 20 ha of medic pasture from which they can produce their own medic seeds. Indeed, he suggested a three-year community-based project. This could be extended to other forages. Given the positive attitude farmers have expressed towards medics, and the way in which the sweeper does seem to overcome the major constraint, we hope that this work will indeed go ahead. ■

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Mazhar Mohamed

Algeria: bringing farmers into research

By Mustapha Malki, Noureddin Redjel and Ali Zeghida

Farmer participation is an essential element of successful agricultural research and development. But the technology must be there too. The Mashreq and Maghreb (M&M) Project is one of the vehicles ICARDA uses to build bridges between national scientists, farmers and their ICARDA colleagues. The Project has led to some fruitful initiatives in the Algerian steppe.

Necessity, it is said, is the mother of invention. In farming, a constraint leads to invention—or perhaps we should say innovation. Innovation need not mean the creation of something completely new. It can be the adaption of something that already exists.

Farmers' needs and constraints should form the template from which technological innovations are crafted. If this is to happen, there need to be systematic linkages between the various components of research and technology transfer. The M&M Project of ICARDA, which began in 1995, provides such linkages, encouraging national scientists to work with farmers and assisting collaboration between scientists and farmers across national boundaries. Coordinated by ICARDA in close collaboration with its sister Center, the International Food Policy Research Institute (IFPRI), based in Washington, it was generously funded in Phase I by the Arab Fund for Economic and Social Development (AFESD) and the International Fund for Agricultural Development (IFAD). Participating countries were Iraq, Lebanon, Jordan and Syria in the Mashreq, and Algeria, Libya, Morocco and Tunisia in the Maghreb.

The initial focus has been on adaptive research and technology transfer on barley and forages, rangelands, and small ruminants (sheep and goats) in the dry areas. There is another important component—research into property rights and government policies, and

Monitoring and evaluation of rangeland rehabilitation activities involving farming communities—a useful way of getting farmers' views. Feed production from the rangelands is thought to have declined by around 67% since the 1970s.

Schoolchildren in the steppe learn about rangeland issues—a good safeguard for rangeland protection in years to come.

their effects on the way farmers adopt new technology to manage natural resources.

In Algeria, the chief institutions collaborating with the M&M Project include the Haut Commissariat pour le Developpement de la Steppe (HCDS), which is concerned with the sustainable exploitation of the Algerian rangelands, and the Institut Technique des Grandes Cultures (ITGC). As in much of the West Asia and North Africa (WANA) region, the rangeland is often steppe, wide expanses of grazing land where the rainfall is insufficient for settled agriculture. As elsewhere in West Asia and North Africa, in Algeria too we must ensure that this resource is not overexploited—or the availability of grazing and, thus, of livestock products essential for human nutrition, will be hit badly. Indeed in Algeria since the 1970s, we estimate that feed production from the rangelands has declined by around 67%; clearance of native vegetation has reduced its area by 25% and an encroachment of cereal crops has increased the cropped area by 100%. This last activity can have very serious implications; this land is marginal for cropping and sooner or later this cultivation will fail, leaving the area useless for grazing as well. Algeria's figures are not untypical for the region.

> ***“ Pastoralists helped us to understand that sustainable farming systems are the ones that show a high degree of diversification ”***

But why is this happening? Answer: the constraints and challenges that farmers face. After all, why would they wreck the land on which they depend? So, as we have said, it is from these constraints that the answers must be found. Hitherto, this has not been happening. Before the M&M Project started, planning of research activities was confined to ITGC experimental stations. This can lead to a situation in which researchers, rather than farmers, define priorities. Technology developed in this way reached the farm gate, but was not necessarily adopted.

When farmers are reluctant to adopt new technologies, the researcher may, with the best of intentions, look for the reason either in the extension service, or in perceived conservatism of farmers. All too often—and not just in Algeria—nobody has tried to question the functioning of the research apparatus, its philosophy, or its planning mechanisms. Farmers do not benefit, and the training and professionalism of experienced research staff are not used to best effect.

When the M&M Project started, however, researchers and development agents of ITGC experimental stations started to use diagnostic tools such as rapid rural appraisal (RRA) and participatory rural appraisal (PRA). Use of these tools exposed the weakness of the linkages between researchers and farmers, and the constraints this imposed on development of adoptable technology. Needless to say, farmers adopt technologies willingly enough if these fit their real needs. Since then, many RRAs and PRAs have been conducted to improve our understanding of the farmer's constraints.

And we have learned something. On a general level, pastoralists helped us to understand that sustainable farming systems are the ones that show a high degree of diversification, that is a capacity to stabilize production and secure a minimal income under widely varying conditions. On a more specific level, an example that is worth noting here was the visit we made to an agro-pastoral area under the aegis of the M&M project. Our breeder was completely puzzled when farmers started naming the varieties they used. He had never heard about those cultivars at all. When farmers were asked where they bought their seeds, they said they got them in the village market.

This helped us confirm something that we had already guessed. In 1994, we developed a research hypothesis on the existence of an informal, non-institutionalized system on crop improvement, supported by farmers and their communities, and relying on local landraces and natural genetic resources. The visit had helped us verify this hypothesis. Indeed, our breeder asked farmers to give him samples of their cultivars in order to study the characteristics of this genetic material, which would help us to understand why farm-

Continued on page 22

A plantation of spineless cactus—one of a number of fodder shrubs being used to improve the feeding capacity of the steppe.

Continued from page 21

ers prefer their own cultivars to new improved varieties.

A similar visit and informal discussion with farmers elsewhere helped us to understand why farmers use different cultivars for the same species, for example durum wheat. They told us that each cultivar has different characteristics that suit a given use. A variety might be good enough for couscous but not as good for pasta; another good for breadmaking but not as good for couscous, and so on. Asked where he got this knowledge, a farmer answered: "I was taught this by my father." This reinforced the impression that the members of such a community represent a knowledge system in which information and experiences are exchanged, and this indigenous knowledge is then transmitted from one generation to another.

Such discussions helped our researchers to understand that when farmers adopt a given cultivar, they act as the custodians of a knowledge system hundreds of years old; and that, to be effective, any developmental action must consolidate the foundations of the existing knowledge system rather than start from nothing, putting pressure on farmers and peasant communities to relinquish their old practices.

In this spirit, the work undertaken under the aegis of the M&M Project has to define constraints and to devise 'solutions.' RRAs are thus an initial step within a cycle of development, and the results of RRAs were translated into innovations and put at the farmers' disposal as appropriate solutions for the revealed constraints. It is the only way to help pastoralists sustain and improve their income, while encouraging them to preserve the natural-resource base—for example, the steppe—on which they depend.

Appropriate strategies identified in this way have included the use of fodder shrubs to rehabilitate degraded rangeland. This covered 4703 ha of collective land and 196 ha for 136 private farmers. Another has been diversification of income. It is in the spirit of M&M that this has been made as gender-sensitive as possible, and included distribution of 4510 units of guinea fowl, turkey hen and other poultry to farmers with the aim of allowing women to participate in income-generation that would be environmentally acceptable.

Meanwhile, this two-way process with farmers has a long-term benefit: it increases researchers' credibility in the eyes of the farmers so that they start to take a lead in development and environmental protection themselves. Already we have seen encouraging examples of this. The first was when pastoralists were invited to watch a video demonstrating the planting and use of feed shrubs. Some of them said afterwards that this would be useful for other topics as well, and why not produce more videos? The HCDS Eastern Regional Commissioner agreed, but it was necessary to arrange a suitable camera. So the pastoralists found the finance from their own organization. The Commissioner had come up with an initiative which worked—and found that the local community would help him develop it.

This happened again when he decided that natural-resource management had huge implications for the next generation, and started to develop a pilot module for schools in steppe areas in collaboration with the Ministry of National Education. Again, the pastoralists of the area liked the scheme and themselves found the money to pay for part of it.

In our view, these developments have happened because the M&M Project does not concentrate solely either on socioeconomics (including property rights) or on the transfer of technology; rather, it recognizes their interdependence of the two and coordinates them. We understand that these two components are to be merged completely in Phase II of the Project. And, thanks once again to the generosity of AFESD and IFAD and other potential donors, that Phase II should begin very soon. ■

Mustapha Malki is the Secretary General of ITGC. He is a social scientist working on the policy and property rights component of the M&M Project. Noureddin Redjel is the Regional Commissioner of HCDS and a member of the Project team. Ali Zeghida is the National Coordinator of the M&M Project for Algeria.

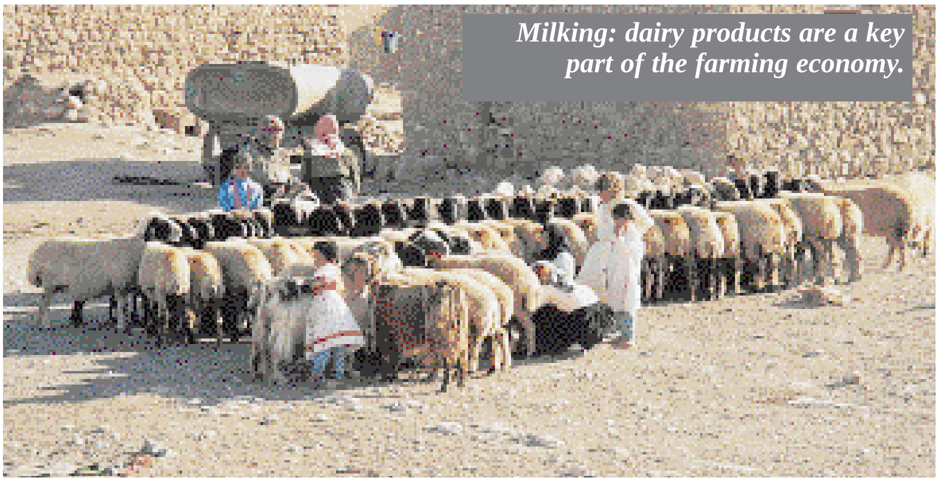
Twins and triplets

Continued from page 15

from barley residue, and the better soil-nitrogen from vetch rotations, means that Mr Yagen has actually replaced some of his barley with wheat—which is a higher-value crop.

The higher twinning rates and lower mortality of lambs on Mr Yagen's farm are only partly the result of better nutrition. The ICARDA team researching and promoting legumes has been giving advice and assistance on animal health as well, particularly to control internal parasites. An especially valuable contribution in this respect came from a team of Japanese livestock specialists from the Japan International Cooperation Agency (JICA), based at ICARDA and led initially by veterinarian Dr Giro Orita, whose enormous contribution to Syrian agriculture has now been marked by the naming after him of ICARDA's new animal health laboratory (see *Caravan* No. 3). Dr Orita was later succeeded by Dr Nishikawa.

Besides improving the health of his animals, Mr Yagen has followed his own selective breeding strategy; when he acquires replacement stock from Government sources—which he will always do, however fertile his own flocks become, as it is necessary to keep up their genetic diversity—he selects animals from twins. Back in 1986, he had 130 head of sheep; today he has 320 and is building a 300 m^2 sheep house to improve management.

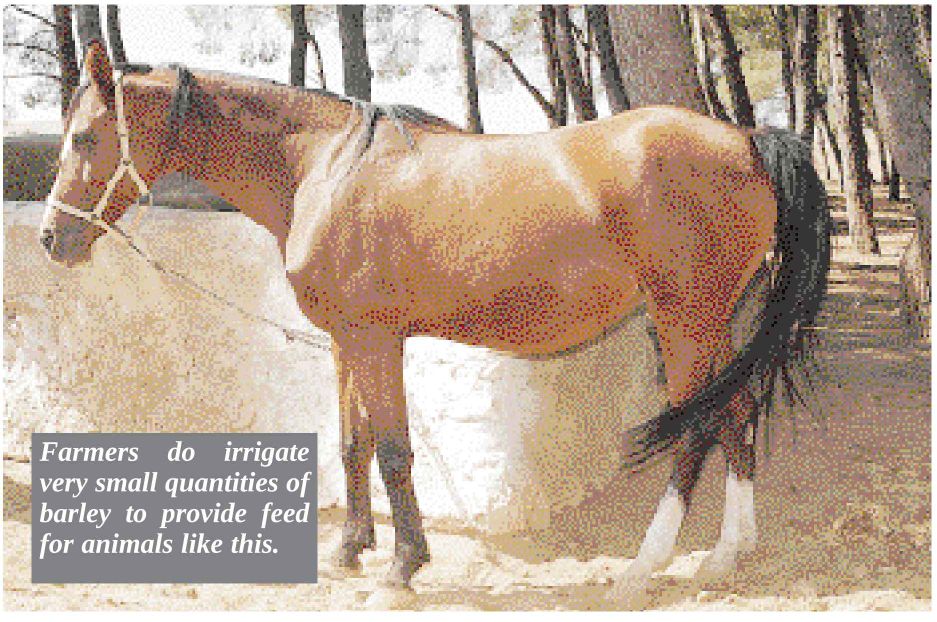


Milking: dairy products are a key part of the farming economy.

ICARDA Photo Unit

Mr Yagen's first priority is meat; he makes little use of dairy products, as he has insufficient labor for milking and processing. Elsewhere in the area, however, farmers do generate a substantial percentage of their livestock-derived income from milk as well as meat products. They are noticing an increase in milk yield per lactation, and ICARDA intends to quantify this. There is an added twist. Where flocks are lambing in September, milk is available through the autumn when yoghurt (for example) sells for about SL 70 (about US $1.60) per kg, against around SL 25 in the spring. At the higher rate, 0.5 kg sold covers the cost of keeping the sheep for four or five days. A good way of boosting added-value farm-gate income!

ICARDA began developing legume/cereal rotations with the aim of fighting a fall in cereal yields. But we always knew that there would be substantial benefits for livestock productivity, and the experience of the last decade or so has borne this out. This success has two causes. First, the technology was basically sound. Second, it was applied and developed with farmers. This taught us a lot: about the economics of the technology, for example, which led us to develop the machinery described elsewhere in this issue; and about the legumes that should be used (for example, we found vetch better than medics for the drier areas and decided to adapt the medics for another purpose).



Farmers do irrigate very small quantities of barley to provide feed for animals like this.

Will this technology be adopted over a wide area? Time will tell, but it is looking good. A trainee from the national program spends about six months each year with us at El Bab, and Syria's Ministry of Agriculture and Agrarian Reform is now running a small project at Kamishly in Eastern Syria. And there is growing interest from the farmers with which ICARDA is working through the Marsa Matrouh Resource Management Project in Egypt; early in 1997, a number of these farmers were invited to El Bab through ICARDA to see the technology for themselves and discuss it with local farmers (see *Caravan* No. 5).

One thing is certain, however. Had we attempted to develop this technology away from farmers, and outside the context of their farming system, it is unlikely that they would have been interested. ■

Faik Bahhady is Assistant Livestock Scientist, and Mike Robbins is Science Writer/Editor at ICARDA.

The personal touch


DisneyWorld

ICARDA Communicator Mazen Al-Jarrah with Puong Thang, from Ho Chi Min University in Vietnam.

In pursuit of its mission, ICARDA collaborates with scientists, research institutions, and...Mickey Mouse? Well, why not!

"I think visitors were quite surprised. They thought of agriculture in American terms and didn't realize that we in the West Asia and North Africa region have problems of food production and water scarcity. They were very interested."

So says ICARDA scientist Mazen Al-Jarrah of the United States public. He spent some weeks meeting, and talking to, them as a Communicator at the second *Gardening for Food Around the World* exhibition. It was held from 28 April to 1 June as part of the *Epcot Flower and Garden Show* at DisneyWorld in Orlando, USA. The reasoning behind the event, which is organized by the World Bank and DisneyWorld in collaboration with the CGIAR (Consultative Group on International Agricultural Research) and, this year, the Rodale Institute, is to communicate agricultural research and development issues to a wider audience than the traditional scientific community. "People learn and understand much more when they can see and feel what we are teaching," said William Ekere, one of Mr Al-Jarrah's fellow Communicators.

This is the second year in which ICARDA and other Centers have participated in the exhibition; in 1996 Afif Dakermanji, from Syria, and Imad Eujayl, from Sudan, represented ICARDA in Florida (see *Caravan* No. 3). Mr Dakermanji, who is Training Coordinator for ICARDA's Natural Resources Management Program, explains that the project began in late 1995, when Epcot (Walt Disney World Co.) and the World Bank forged a partnership to publicize the problems of feeding the world. "The objective was to broadcast a powerful message about the global challenges of feeding future generations, as the world struggles with food-stock shortages, a rapidly-increasing population and reduced availability of arable land." As ICARDA is part of the CGIAR, for which the World Bank is the largest donor and the 'umbrella' organization, ICARDA involvement was natural.


Courtesy Afif Dakermanji

A distinguished visitor, former First Lady Mrs Barbara Bush, with ICARDA's Afif Dakermanji (right), Gina Zarasadias (IRRI) and Sudi Rao (ICRISAT).

The first exhibition showcased 'typical' farms and farmers from Africa, Asia and Latin America. The Communicators looked after these displays, and found themselves in great demand.

An estimated 670,00 people visited the 1996 *Gardening for Food Around the World* displays; an estimated 168,000 took time out to at least superficially study them, nearly 10,000 attended the 20-minute presentations given by the Communicators and an estimated 28,000 took the trouble to meet the Communicators personally. With these figures, it is not surprising that the exercise was repeated in 1997.

> "People learn and understand much more when they can see and feel what we are teaching"

The educational value was borne out by some of the comments made to the Communicators during the two exhibitions. "I sometimes think—as many people probably do—about the fact that we have so much food in one part of the world, and yet there are so many people starving in other parts of it. It is good to know that there are people like you working to improve this situation," said Robert I. King, one of the 1996 visitors.

This time, CGIAR staff from ICARDA, CIMMYT (Centro Internacional de Mejoramiento de Maiz y Trigo), IITA (International Institute of Tropical Agriculture) and CIP (Centro Internacional de la Papa), were joined by university lecturers from the USA, Vietnam and Uganda. They acted as Communicators for displays on agricultural research and development in Asia, Africa, Latin America and the USA. Each display showed structures and crops associated with traditional agricultural systems and practices, along with scientific advances in crops, machinery and disease management. To make the exhibits really authentic, some 70 crops were grown on-site.

ICARDA Communicator Mazen Al-Jarrah was involved in the Asia display, which highlighted the efficient use of water in irrigation systems. He and his partner in the display, Puong Thang, from Ho Chi Min University in Vietnam, attracted guests by encouraging them to pump water using a traditional 'tapak-tapak' water pump.

Mr Al-Jarrah is a wheat breeder, and is well-qualified to brief people about the environmental challenges of growing food. Back home in Syria, he works with ICARDA colleague Dr Habib Ketata on the ICARDA/CIMMYT winter and facultative bread-wheat program, breeding lines for high-altitude environments such as the Atlas Mountains, the Anatolian Plateau and mountainous areas of Iran, Afghanistan and Pakistan. The varieties they are developing must be able to cope with temperatures that plummet to 12°C in winter, yet may reach 35°C in summer. They must also identify sources of resistance to diseases like yellow rust, a pathogen that mutates with frightening speed so that breeders must remain one step ahead year by year. Mr Al-Jarrah took advantage of his stay in the USA to visit some plant-breeding centers and compare notes with North American colleagues. In addition to giving visitors information on the work of the Centers and the problems in the areas they cover, the Center staff also spent time at Disney learning public-awareness skills to help them communicate effectively.

The messages being communicated this year included: why we all need to be concerned about the global challenges of feeding future generations; how the use of good farming practices sustains the natural-resource base and allows the production of healthy food; the central role of women in agriculture; and the vital role of science in producing food and managing pests and diseases in ways that do not destroy the environment.

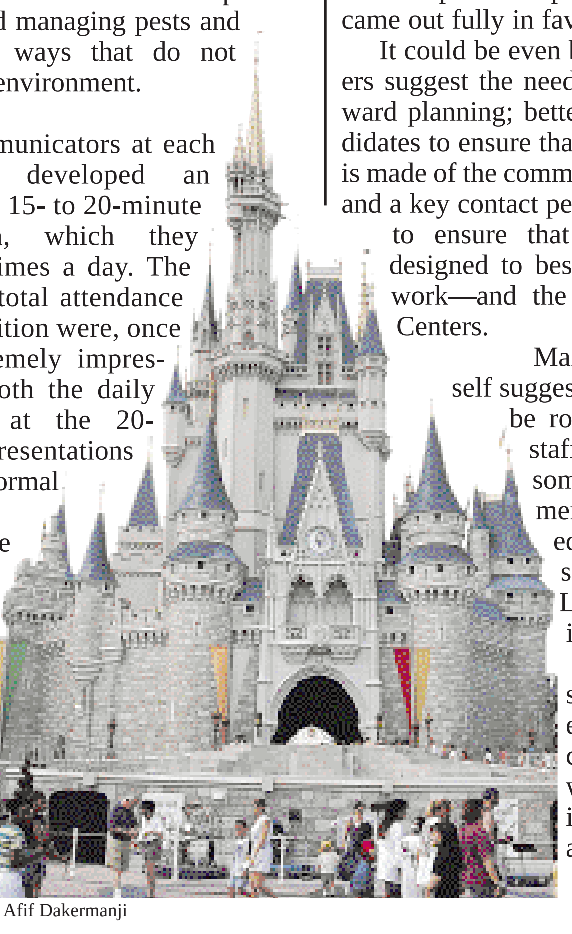
The communicators at each display developed an entertaining 15- to 20-minute presentation, which they gave four times a day. The figures for total attendance at the exhibition were, once again, extremely impressive. For both the daily attendance at the 20-minute presentations and the informal discussions between the guests and the communicators, there was more than a doubling in numbers of guests exposed to these messages (37,400 to 90,000) between 1996 and 1997. Approximately 750,000 guests went through the displays, and 5000 copies of a 48-page interactive workbook were provided to guests, in addition to public awareness material from the various Centers represented—including ICARDA's *Caravan*.

As the official report from the World Bank says, "The Communicators from all around the world were the highlight of the event. They brought authenticity to the four daily demonstrations and the displays. In fact, it was suggested that the greatest emotional attachment and take-away for the guests comes from their interaction with these individuals." Indeed Mr Al-Jarrah, according to one of the organizers, "brought much warmth and spirit to the Asian exhibit and presentation."

The positive view of the event was shared by World Bank delegates who attended a Communication Workshop at Disney in Orlando on 30 and 31 May. Their task was to examine the value of communicating sustainable development challenges in the developing world to the general public more effectively. The delegates reviewed the current partnership with Disney and came out fully in favor of it.

It could be even better. The organizers suggest the need for improved forward planning; better selection of candidates to ensure that the maximum use is made of the communications training; and a key contact person at each Center to ensure that the displays are designed to best communicate the work—and the challenges of the Centers.

Mazen Al-Jarrah himself suggests there might also be room for the Center staff to participate in some of the experiments being conducted within Epcot—such as the NASA/Land project, which is looking at growing field crops in space. Perhaps the environmental challenges there would be less than in the world's dry areas...



Afif Dakermanji

Mystery at the dawn of

Did neolithic man adopt agricultural plants, or did they adopt him? Did agriculture really lead to the first settled societies, or was it the other way around? Or was cultivation actually first practised by nomads? These and other challenging questions were aired recently at an important meeting at ICARDA.

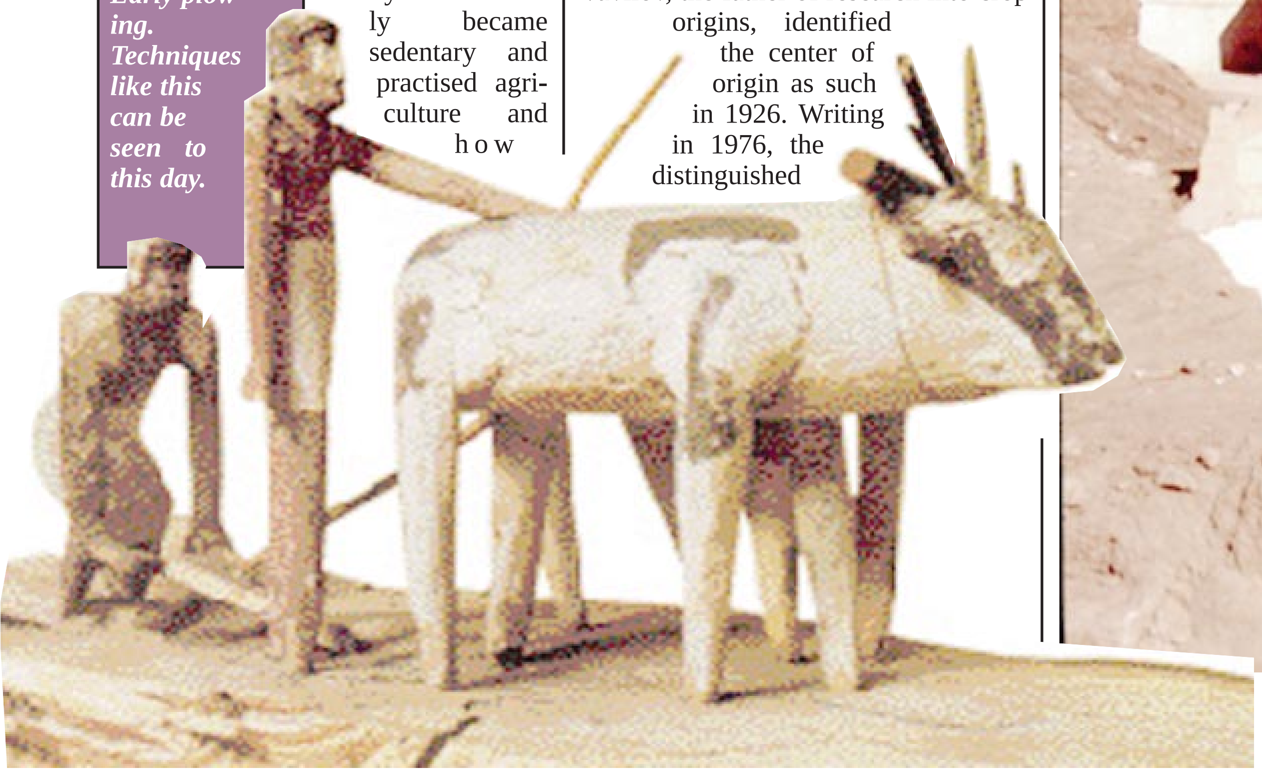
By Ardeshir Damania, Jan Valkoun and Mike Robbins

Did we adopt the first agricultural plants, or did they seek us out? It could be that certain types of weedy plants gravitated to areas of human settlement because the manure man generated was good for plants. This is, perhaps, discouraging to the human ego—we like to see ourselves as the dominant species. But there was a time when we were not.

This was just one of many points raised at the *International Symposium on the Origins of Agriculture and the Domestication of Crop Plants in the Near East*, held at ICARDA's headquarters in May 1997.

We need to understand the past if we are to manage the future; it is therefore necessary to analyze why man suddenly became sedentary and practised agriculture and how civilizations evolved. After all, it happened relatively recently. As ICARDA's Director General, Prof. Dr Adel El-Beltagy, remarked in his opening address, 10,000 years is not long in comparison to the 2.5 million years for which man has walked the planet. And that transition had revolutionary consequences—the "emergence of urban civilizations and finally... man's almost total dependence on very few plants and animals... It is debatable whether this is a positive development."

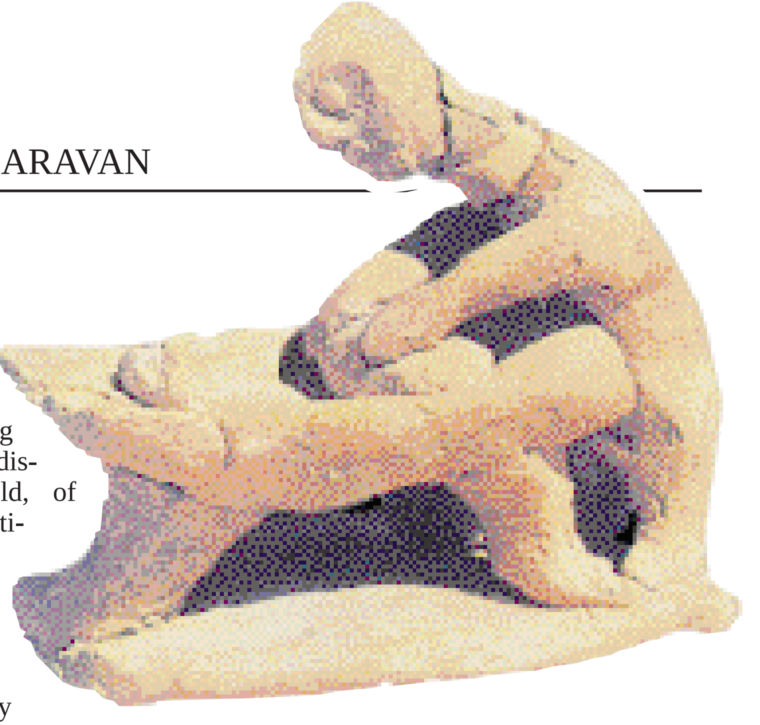
Whether it has been positive or not, it began in the West Asia region in which ICARDA is situated. Nikolai Vavilov, the father of research into crop origins, identified the center of origin as such in 1926. Writing in 1976, the distinguished researcher Jack Harlan, to whom the seminar was dedicated (see page 28), and others referred to the Near East as the "center of agricultural innovation" where barley became the first crop to be domesticated; it was followed by wheat.



Early plowing. Techniques like this can be seen to this day.

The ancient city of Ebla, not far from ICARDA's headquarters. Cuneiform tablets found there, dating from 2,400 BC, hold details of early transactions in agricultural products.

modern man



An ancient figurine showing dough kneading.

Later, other 'founder crops' such as pea, lentil, vetch, faba bean, flax, tree and vine fruits were domesticated, and the entire system spread out from the area of origin along with the agricultural techniques that had been developed. The system of settled cultivation then moved up the Danube and down the Rhine in one direction, and eastward to Northern India in the other; to the south, it spread across Arabia and Yemen and into the Ethiopian plateau. It reached China in the second half of the second millennium BC.

But how did it all begin? Our picture of this process has changed a little, thanks to the Symposium. Scientists date settled agriculture from the earliest appearance of plants such as wheat that have been modified—that is, have been selected to retain their seeds in the head rather than disperse them by head-shattering. The shattering takes place for the dispersal, in the wild, of seeds, but makes cultivation more difficult. The earliest examples of this altered non-shattering morphology, as it is referred to by scientists, are found within a radius of 15 km in the Jordan Valley and date to around 9000 BC.

But we cannot conclude that this was the dawn of settled civilization. In one of the papers presented at the Symposium, Dr Frank Hole, of the Department of Anthropology, Yale University, pointed out that archaeological evidence may be found of settled sites where no morphologically-changed wheat, barley or rye has been found. He quoted the example of Hallan Çemi in Eastern Anatolia, dating from about 1500 years earlier, where there was no trace of cereals at all; and Jerf el-Ahmar near the Euphrates, from about 9000 BC, where all three were found, but not in domesticated form.

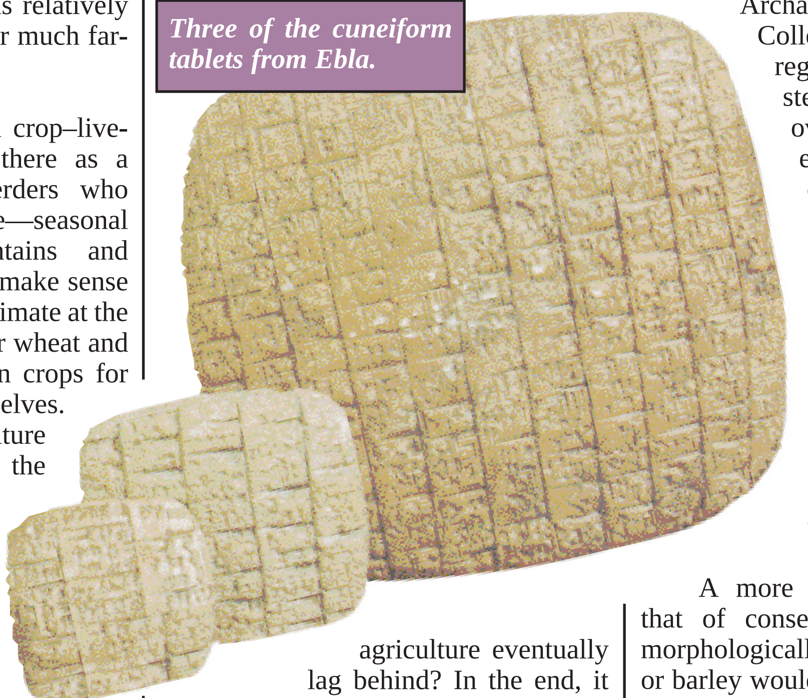
Further evidence for this was in a paper presented by Dr George Willcox, of the Institut de Prehistoire Orientale Center National de la Recherche Scientifique (CNRS) in France. He pointed out that cereals have the advantage of being able to be stored; this applies whether they have been domesticated—that is, selectively bred for human requirements—or not. He commented: "Archaeobotanical evidence indicates that wild cereals were exploited in the Near East for several millennia before the appearance of domestic types. Specialized gathering and, especially, storage of cereals and pulses would have provided a secure subsistence base, making possible a sedentary existence. During the second half of the 10th millennium BC there is evidence of wild emmer domestication [emmer is a type of wheat]. However, a millennium after the appearance of domestication, pure wild types still persisted.... [The evidence is] that cereal cultivation of progenitors does not necessarily lead to rapid domestication and that gathering from the wild continued to be practised long after domestication."

The discovery of cultivation, therefore, did not lead directly to settled civilizations. It predated them, perhaps by millennia. Moreover Dr Hole argued that, in some cases, cultivation did not lead to settlement. He bases his argument on research in the area of present-day southwest Iran. There is an enormous geographical gap between this area and the Jordan Valley; between them lies what has been called the Fertile Crescent, yet evidence of early cultivation in the Crescent is relatively sparse. Why should it appear much farther to the east?

According to Dr Hole, a crop–livestock system arrived there as a 'package,' brought by herders who practised transhumance—seasonal migration—between mountains and plains, a routine that would make sense from what we know of the climate at the time. They cultivated emmer wheat and barley and may have grown crops for their livestock, not for themselves.

If the origins of agriculture are a little murky, however, the eventual results are clear enough. The Arab conquests of the 7th and 8th centuries AD resulted in an enormous release of biodiversity throughout the region; and by this time, there were ample chroniclers, agriculturalists and others to record the process. From the 10th century onwards we hear of a countryside that had changed significantly since ancient times. Neither were the crops only those with which agriculture had begun. For example, the ninth-century writer Al-Jahiz recorded that there were 360 varieties of dates on sale in the market at Basra; in 1400, Al-Ansari, writing about a small town in North Africa, reported 65 kinds of grapes, 36 kinds of pears, 28 of figs, 16 of apricots and a number of others.

Why did the region which invented agriculture eventually lag behind? In the end, it was damaged by ecologically suicidal and unsustainable deforestation, overgrazing, monoculture and unwise irrigation. Those plants that came looking for manure 10,000 or 12,000 years ago have quite a lot to answer for.



Three of the cuneiform tablets from Ebla.

What can we draw from the history of agriculture that will be of use to us today? The Symposium heard evidence that the climate was rather wetter than it is today; given the possible climatic changes we face in the next century or two, we should ask whether we face another quantum leap in the way we grow food. Dr Hole quotes the work of Dr Gordon Hillman of the Institute of Archaeology, University College, London, in this regard: the invasion of steppe areas by cereals over 10,000 years ago enormously increased the carrying capacity of the land. Dr Hole does not speculate on any implications that this could have for the future, but arguably one could; if the climate changes are to be reversed, that increase in carrying capacity could be too—with grim consequences for human sustenance.

But that *is* speculation.

A more immediate challenge is that of conserving biodiversity. The morphologically-altered lines of wheat or barley would have lost their capacity to survive in the wild, and would soon have disappeared if untended. (This may be one reason why the earliest domestication of plants is so difficult to date; the evidence has often disappeared.) Likewise, modern selected varieties lack the ability to meet new

Tribute to Professor Harlan

The International Symposium on the Origins of Agriculture and the Domestication of Crop Plants in the Near East *was dedicated to Prof. Jack Rodney Harlan, one of the fathers of modern plant introduction—that is, collecting germplasm and introducing it elsewhere. Prof. Harlan, now 80, had intended to be present at the Symposium but was unable to travel as he was recovering from injuries sustained in a road accident. Prof. Harlan's work at FAO in the early 1970s was partly instrumental in the setting up of ICARDA's sister Center, the International Plant Genetic Resources Institute (IPGRI), and IPGRI's current Director General, Dr Geoffrey Hawtin, presided over a ceremony to honor Prof. Harlan. Dr Hawtin paid generous tribute to him as a pioneer who had helped establish the importance of genetic diversity to crop improvement.*

Dr Harlan graduated from George Washington University in 1938 and later took a PhD in Genetics from the University of California at Berkeley. During his long career, he has conducted plant exploration expeditions to many countries, including Turkey, Syria, Lebanon, Iraq, Iran, Afghanistan, Pakistan, India and Ethiopia, and introduced nearly 15,000 accessions to the USA; these have been widely used in crop-improvement programs. He also has a keen interest in archaeology, and has taken part in a number of digs.

To mark the occasion, a plaque was presented to Prof. Harlan by Prof. Dr Adel El-Beltagy and Dr Hawtin made out of seeds that he himself had collected in Syria in 1948, and which returned to the region when they were donated to ICARDA by the US Department of Agriculture in the mid-1980s. It was accepted on his behalf by his friend and colleague Dr Calvin O. Qualset of the University of California.

The first recorded plant collection mission (right)—ordered by Queen Hatshepsut of Egypt to Punt (possibly the Somali coast) in about 1495 BC. By the time of the medieval Castle Jabr near Aleppo (above), there was enormous agricultural biodiversity in the Arab world.

environmental challenges that was present in their wild progenitors, and that is why a wide range of plant genes must be preserved, not in the gene bank but in the field.

It is also important not to become too heavily dependent on crops that rest on too narrow a genetic base. Two examples of this may be quoted. Coffee originated in Ethiopia, but its use as a beverage was discovered in Arabia only about 500 years ago. A single plant was exported to Amsterdam by Dutch plant explorers in 1706 and this one plant was the origin of Latin American coffee, which thus has a very narrow gene base and is prone to devastating periodic attacks by pests and diseases. Another example is lentil, which originated in West Asia but found its way to South Asia about 4000 years ago. South Asian strains, developing under different climatic conditions from those in the area of domestication, received little further genetic input, and it became impossible to raise their yield until work was undertaken by ICARDA and several national programs to cross them with lines growing under diferent conditions—complicated but worthwhile work which has greatly raised the yield potential (see *Caravan* No. 4). It is this need for the conservation of biodiversity which led to the foundation of sister Center of ICARDA dedicated to plant genetic resources—the International Plant Genetic Resources Institute (IPGRI), which is based in Rome and which co-sponsored the Symposium.

With this in mind, the Symposium participants made a series of recommendations. These included: extra protection for collections of plant genetic material in the former Soviet Union; preservation of traditional farming systems and indigenous knowledge; and, most important of all, establishment of a center in West Asia for the conservation of archival archaeobotanical material, which would disseminate information worldwide in the cause of biodiversity conservation and use. There is a precedent: such a center for South and Southeast Asia already exists at Secunderabad in India.

However, if we were to define the chief impact of the Symposium, it would be this: that the origins of agriculture are far more complicated than they appear. Discovery of cultivation did not lead directly to settled civilizations; and such settlement, when it did occur, did not lead to the breeding of modified plants immediately, and perhaps not for some time. Indeed, in some areas, cultivation may have been begun by nomads—people who were not settled in any way at all. If there is a lesson in all this, it could be that, even today, the dynamics of agricultural development may be less obvious than we think. ■

Dr Ardeshir B. Damania is former Curator of ICARDA's cereal germplasm collection and is currently a consultant to the Center.

Dr Jan Valkoun is Head of ICARDA's Genetic Resources Unit.

Mike Robbins is Science Writer/ Editor, ICARDA.

The book of abstracts for the Symposium is available in limited numbers from ICARDA. The Proceedings will be published during 1998.

Symposium partners

Besides ICARDA and IPGRI, the *International Symposium on the Origins of Agriculture and the Domestication of Crop Plants in the Near East* was sponsored by: the Genetic Resources Conservation Program of the University of California; the Institut de Prehistoire Orientale Center National de la Recherche Scientifique (CNRS), France; the Department of Antiquities, Aleppo, Syria; and the Institut Français de Archéologie au Proche Orient (IFAPO), Damascus. The French Embassy supported the participation of five archaeobotanists.

Go down to DNA...

...And find out how to make your lentils survive the winter. That has been part of high-tech PhD thesis work that has been going on at ICARDA.

By Mike Robbins

How do you breed crop varieties for tolerance to climatic extremes and pests and diseases? You must cross various lines which have such traits and select the progenies until you have what you want in one plant. But this takes time. Biotechnology can speed the process.

Using it, PhD researcher Imad Eujayl has just succeeded in tracking the genes for frost susceptibility and vascular wilt in lentil. He used a technique called gene mapping, which is being used more and more at ICARDA. This will have real advantages for farmers who are dependent or partially dependent on this important food crop. He will be defending the resulting PhD thesis at the University of Helsinki in Finland early in 1998.

"I am from the Sudan, where we use lentil a lot. It's an important source of protein," says Mr Eujayl. "It's our breakfast—we call it *addis*—and our national program has made great strides in lentil production over the last few years. But all producers can use better disease resistance." (ICARDA worked with Sudan on the country's plan for lentil—see *Caravan* No. 2.) ICARDA is currently developing cold-tolerant lentil varieties to increase productivity in the highlands of West Asia and North Africa—often the least-developed parts of the region. So cold-tolerant varieties could have a significant impact on poverty.

Mr Eujayl has been working with ICARDA for some years. After he graduated in agriculture from the University of the Gezira, Wad Medani, in Sudan in 1985, he became a teaching assistant at the University of Science and

Mr Eujayl at work in the laboratory with research technician Aman Sabbagh.

Technology in Khartoum. In 1991 he came to ICARDA to do an MSc in tissue culture (he specialized in horticulture at Wad Medani). In 1993 he joined the Center's staff and also began his PhD work.

"It is worth explaining how gene mapping is done, because we can dispel a few myths about biotechnology," says Mr Eujayl. "The cloning of a sheep in Scotland recently has led some people to see biotechnology as something mysterious and rather sinister. It's true that it has implications for the future, and must be used responsibly. But this applies to any form of technology.

"What we do at ICARDA is actually quite simple, at least in theory. Characteristics of any species are passed from one generation to another in the genes. We physically look at the the genes and see what is there. Then we map them. Just as you use aerial photography to find out where a natural feature such as a watercourse goes, you can photograph the structure of a chain of genes to find out where it will lead you."

Scientists will start with the plant itself. Parent plants with known phenotypic characteristics—that is, color, size, time to flowering and maturity, yield, tolerance to pests and climatic conditions—will be crossed to produce the hybrid, which is the product to be studied. In this case, an ICARDA lentil variety (known as Talia in Lebanon) of known good performance was crossed with a wild lentil from ICARDA's genebank to produce a population of progenies with a combination of genes that would repay study.

The next target is the genome. This is the structure inside a cell made up of chromosomes. The chromosomes are rods made up of the genes in order, and it is this order that the scientist wants to see. To get at it, the researcher physically and chemically breaks down the structure of the cell, dissolving the proteins, the cell wall and nucleus membrane. The chromosomes are then left free in a solution, and can be studied.

"There is actually nothing magic about this," says Imad Eujayl. "It is, of course, physical matter, and if you can look at something, then you may be able to understand it".

"Genes are made out of DNA—the stuff of life itself". DNA is a molecule in an acid form. It is made of four elements called nucleotides, composed of phosphate, the sugar deoxyribose and a nitrogene base. These make up two strands which twist around each other. This double twist is what is called the double helix and it is this that caused such excitement when it was discovered in the 1950s.

"What you need to understand is that the helices are made up in a certain sequence and combination of nucleotides. It is these different combinations of chemicals making up the DNA that are in fact the traits/characteristics. Several hundred or thousand of these nucleotides form a gene, the smallest unit of complete information. The gene, when it encounters a gene from another parent, will combine with it in a certain way, and hence it carries certain information. And that is what inheritance is. There is nothing unique about human genetics in this respect. You're the product of a bunch of nucleotides coming together and combining in a certain way, and so is a lentil!"

> "Biotechnology is like any science or engineering product—including the automobile; it's as safe or as dangerous as the people who use it"

The trick is to get down to the DNA. There are no less than two meters of DNA in a cell. Incredibly, once treated, it can be seen with the naked eye—"like long, thin strands of cotton," says Mr. Eujayl. But it is extremely fine; in the case of lentil, it weighs 4.2 picograms, a picogram being 10^{-12} of a gram. The researcher can hardly string it out with tweezers. However, it is negatively charged; so s/he exposes it to a positive charge, and it will then stretch itself in the direction of the positive charge. The next step is to stain it with a dye that interacts with DNA so that the latter may be seen under ultraviolet light.

Those genes will be strung together in a certain order to make the hybrid chromosome. "If we can look at the chromosome and find a pattern of genetic markers which segregates in the same manner as the trait—cold tolerance, for example," explains Mr. Eujayl. Then we hit the region where the gene(s) controlling that trait is/are located.

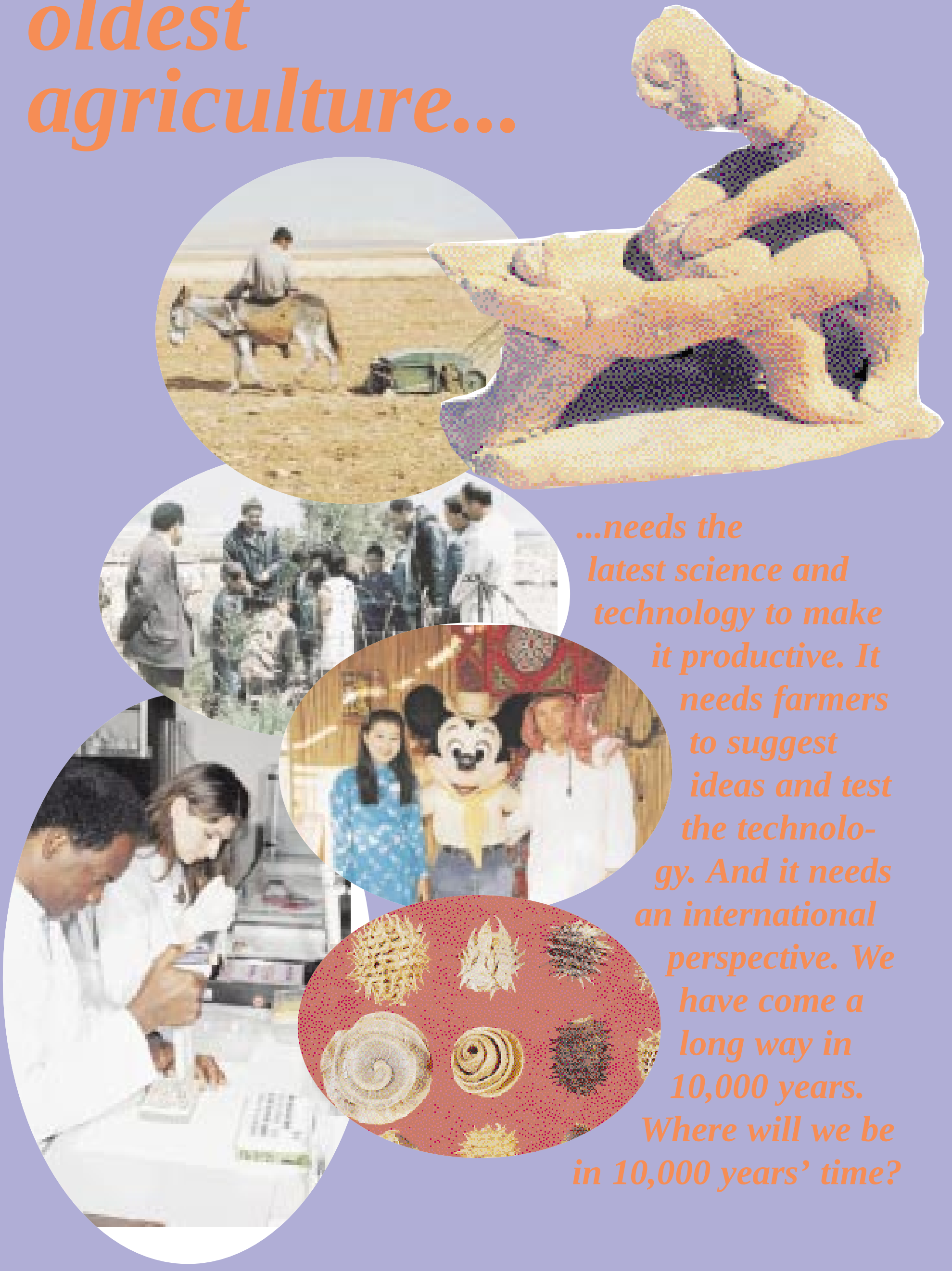
"And then we're there. We can compare the genetic makeups of plants which share known characteristics and see which patterns occur where in the progenies. We have then identified the linkage between the DNA marker pattern and the trait—in this case, resistance to vascular wilt, or cold tolerance. Henceforth, if we want to know whether a wild relative someone has collected in the wilds of Turkey has the traits we're looking for in a breeding program, we can find out by subjecting the genetic material to the same inspection. There's no need to test it in the field at that early stage, though of course we will do so before the product is released to farmers. This can save an enormous amount of time in plant breeding."

The technique of breaking down the cell was pioneered in the mid-1980s; gene mapping has now been going on for several years, at ICARDA and a number of institutions worldwide. What is exciting about Imad Eujayl's work is the large number of markers mapped—254, making it by far the most comprehensive lentil gene map so far. Moreover the study was done with lentil population which had been bred to the eighth generation, giving an exceptionally stable genetic composition.

"We can then use the tool [the linked marker] on lentil sent to us by cooperating national programs, say Sudan, Iran or Argentina—and we can tell them where they can find the genes for what they may be lacking, for example, wilt resistance. They can then cross the relevant parents, which we may well be able to supply. This will save years, and a lot of money, in lentil breeding.

"This, to me, is what biotechnology is all about. We need to apply this technique to more and more crops. But we also need to demystify the process. It is neither magical nor sinister. In this case, it's just an analytical tool. Anyway, biotechnology is like any science or engineering product—including the automobile; it's as safe or as dangerous as the people who use it." ■

The world's oldest agriculture...



...needs the latest science and technology to make it productive. It needs farmers to suggest ideas and test the technology. And it needs an international perspective. We have come a long way in 10,000 years. Where will we be in 10,000 years' time?