

ICARDA Caravan

Issue No. 13, December 2000



Review of agriculture in the dry areas

In this special issue on Central Asia and the Caucasus (CAC):

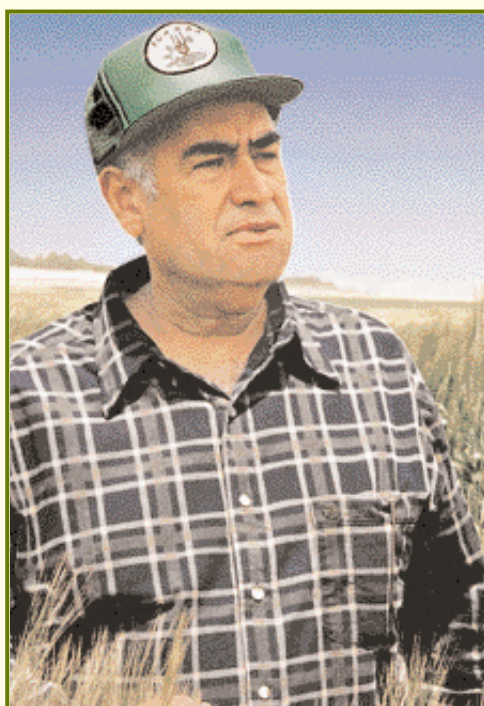
- *Transforming agriculture in CAC: The role of ICARDA*
- *The hunt for green gold: Conserving the plant genetic resources*
- *Nurturing the Vavilov legacy*
- *Reviving food legume cultivation*
- *Forage crops for sustainable agriculture*
- *Boosting barley and wheat production*
- *Reaching new horizons in livestock production*
- *Improved land and water management*
- *Global warming and the rangelands*
- *Making bridges between CAC and West Asia farmers*



From the Director General

In the newly independent republics of Central Asia and the Caucasus (CAC), the agricultural research systems of the former Soviet Union are no longer relevant. Those systems had integrated all aspects of food and industrial production into centrally controlled operations, that included research, and support services such as veterinary care and extension advice, supply of inputs, and marketing of end products. Each republic now faces the challenge of developing a 'stand alone' economy, a process that requires enormous efforts to diversify agricultural production in a sustainable manner.

Food imports, unlike in the past, no longer supplement production in the CAC region, and this had led to a drive for food security and, thus, an urgent need to increase domestic food production. This is being done by agricultural intensification, and expansion of area. The first has caused monoculture that is damaging soil fertility and leading to increased build-up of insect pests and diseases, while the second is leading to reduced crop



diversity and encroachment of marginal lands. In some parts of Kazakstan and Kyrgyzstan, feed and fodder supply problems have resulted in a serious decline in livestock numbers. Meanwhile, there is reduced availability of inputs. The agriculture

in the CAC republics needs immediate attention. The agroecological conditions in the region are similar to those in West Asia and North Africa (WANA); hence the region falls within the research mandate of ICARDA.

ICARDA has been working on building partnerships to address the problems of agricultural research and development in CAC by making bridges between the CAC republics and between CGIAR centers and CAC. The Center played an active role in establishing what has come to be known as the CGIAR Program for CAC. Nine CGIAR centers, including ICARDA, have formed a Consortium for the implementation of this Program.

This "one-stop shop" of CGIAR provides pooled expertise of the Centers and a single point of contact for the national programs of the CAC region. It is a concept that has been enthusiastically welcomed by the CAC NARS.

From the CGIAR consortium, all partners can draw on the knowledge-pool created. Duplication of effort is

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Cover: Three generations of an Uzbek farming family in their orchard: an oasis in the middle of a stretch of rangeland.

Photo: Tom Nordblom.

avoided, the Centers gain in efficiency, the NARS get the best possible service, and donors are assured that their investment is being spent wisely.

This issue of Caravan chronicles ICARDA's efforts in developing a research strategy and a need-based research program for the CAC region. In doing so, ICARDA played a major role in bringing together all partners, most importantly donors. The article on page 8 traces the history of this effort and provides an overview of the current status of collaboration. The research program for the CAC region includes crop improvement; management of natural resources of land, water and biodiversity; nutrition and management of livestock; and rehabilitation of rangelands and assessment of their role in carbon sequestration and global climate change. Highlights of the key achievements in these areas of research are reported in this issue.

All partners involved in the CGIAR Program for Central Asia and the Caucasus can rightly share the pride with CAC NARS in what has been achieved in such a short time. As a partner in the CGIAR Program for CAC, ICARDA will continue to contribute to improving food security, alleviating poverty, and protecting the natural resource base in CAC with greater speed in the future.

Prof. Dr Adel El-Beltagy
Director General

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About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is governed by an independent Board of Trustees. Based in 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 the 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), and the United Nations Development Programme (UNDP) are cosponsors of the CGIAR. The World Bank provides the CGIAR System with a Secretariat in Washington, DC. 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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ICARDA Wins CGIAR Chairman's Award for "Outstanding Scientific Article"

“**A** Methodological Study on Participatory Barley Breeding: I. Selection Phase,” published in *Euphytica* 111: 91-104, won the CGIAR Chairman's 2000 award for “Outstanding Scientific Article.” The article was authored by Dr S. Ceccarelli, Dr S. Grando, Dr R. Tutwiler, Mr J. Baha, Dr A.M. Martini, Mr H. Salahieh, Dr A. Goodchild and Mr M. Michael.

On behalf of the authors of the article, Prof. Dr Adel El-Beltagy, Director General, received the award from the CGIAR Chairman, Dr Ian Johnson, on 26 October at the International Centers Week in Washington DC.

The award-winning research is an excellent example of an international endeavor, with the authors of the paper representing six different nationalities. The award consists of a lumpsum cash prize of US\$5000, and a certificate of recognition, signed by the CGIAR Chairman. The senior author, Dr S. Ceccarelli, and his co-authors announced they were pleased to donate the cash prize to support the participatory barley breeding project in Syria.

The paper presents a significant innovation in the area of participatory plant breeding. It compares four different strategies of selection; challenges the widespread belief that farmers can only handle a limited number of crop varieties; analyzes the diversity of selection between breeders and farmers in relation to the environment in which the selection is made; and compares the efficiency of selection between breeders and farmers. The research reported in the paper was carried out jointly with the Directorate of Agricultural Scientific Research, Syria.

The results of the study demonstrate that farmers can select from a larger number of crop lines/populations than previously thought. The study shows that farmers are effective in identifying high yielding

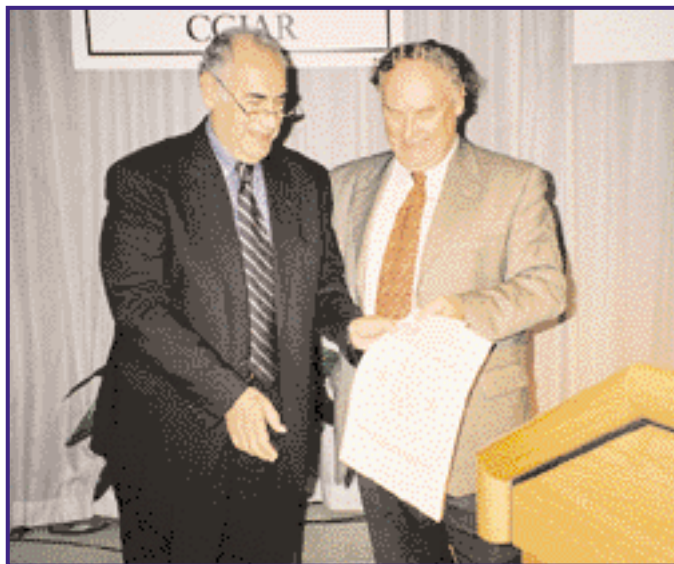
entries both in their fields and in the experiment stations. The lines selected by the farmers and by the breeders at nine farm locations never differed significantly in grain yield, with the exception of one location, where farmers' selections yielded significantly more grain and more biomass than breeders' selections.

The paper also addresses the question whether farmer participation would further contribute to the maintenance or enhancement of genetic diversity. The study showed that there was a high degree of similarity among the selections carried out by the breeders in the various farmers' fields, and much less similarity among the selections made by the farmers in their fields. This suggests that decentralized participatory selection is more effective in maintaining biodiversity than decentralized non-participatory selection.

The announcement of the award makes ICARDA proud of its research team and adds to its reputation as a “Center of Excellence” in the dry areas. ■

Arab Congress of Plant Protection Awards for ICARDA Research

The Seventh Arab Congress of Plant Protection, jointly organized by the University of Jordan and the Arab Society of Plant Protection, 22-26 October in Amman, awarded prizes for three papers from ICARDA's col-



On behalf of the authors of the award-winning paper, Prof. Dr Adel El-Beltagy, Director General, received the award from the CGIAR Chairman, Dr Ian Johnson (right), at the International Centers Week in October 2000 in Washington DC.

laborative research work with the University of Aleppo and Agricultural Research Center, Syria. These were:

- Sitona feeding preference on some legume species, by M. El-Damir (ARC, Aleppo), M. El-Bouhssini (ICARDA), M.N. Al-Salti (University of Aleppo) and Ali M. Abd El-Moneim (ICARDA).
- Survey of Common root rot disease in northern Syria, by R. Naeb, A. Yahyaoui and A. El-Ahmed.
- Integrated management of lentil broomrapes in Syria, by B. Bayaa, N. Al-Hossain and W. Erskine.

ICARDA is also well represented on the new Executive Committee of the Arab Society of Plant Protection, with Dr B. Bayaa as its President, and Dr K. Makkouk as Editor-in-Chief of the Arab Journal of Plant Protection. ■

More Awards...

Two research papers from the collaborative work between ICARDA, ARC, Syria and the University of Aleppo also won prizes during the Fourth Conference of Agricultural Scientific Research, held in Douma, Damascus, Syria, 20-21 September. The first one was on Sunn pest egg parasitoids in northern Syria, and the second on screening lentil accessions for resistance to *Sitona crinitus* (H). These two papers were part of the M. Sc. theses prepared at ICARDA by Mohamed Abdel Hay and Mohamed El Damir, respectively. Dr A. Babi and Dr N. Al-Salty were the co-advisors from the University of Aleppo and Dr M. El-Bouhssini from ICARDA. ■

New Crop Varieties

The year saw the release of several new varieties:

- Barley: 'Furat 3' and 'Furat 4' in Syria
- Bread wheat: 'HAR 2501 (Hawii)' in Ethiopia, 'Tannour' in Lebanon, and 'Cham 8' in Syria
- Durum wheat: 'Masarra' in Lebanon, '30603' in Syria
- Faba bean: 'EH011-22-1' in Ethiopia
- Chickpea: 'IPA 510' in Iraq
- Lentil: 'ILL 7180' and 'ILL 5582' in Afghanistan, 'Rachayya' in Lebanon, 'FLIP 84-99L', 'FLIP 86-51L' and 'FLIP 92-48L' in Lesotho, and 'Idleb 2' in Syria. ■

Syria Becomes a Member of the CGIAR

The Prime Minister of Syria, Dr Muhammad Mostafa Miro, approved a bill on 2 May for Syria to become a member of the CGIAR. Its objectives include Syria's participation in agricultural research development at home and in other countries, and to support the agricultural research carried out by ICARDA.

First Vice-President of the Islamic Republic of Iran Receives ICARDA Board of Trustees

His Excellency Dr M. Habibi, the First Vice-President of Iran, received the Members of ICARDA Board of Trustees on 3 May 2000 in his office on the occasion of the 34th Meeting of the Board in Tehran. The



H.E. Dr M. Habibi, First Vice-President of the Islamic Republic of Iran (second from right) holding discussions with ICARDA Board of Trustees. Seated on the left is Board Chairman, Mr Robert Havener, and on the right Dr Ali Ahoonmanesh, Vice Chair of ICARDA Program Committee, and President of Isfahan University, Iran.

Chairperson of the Board, Mr Robert Havener, thanked the Government of Iran for inviting the Board of Trustees of ICARDA to hold their meeting in Tehran and for extending excellent hospitality to the participants. Mr Havener and Prof. Dr Adel El-Beltagy, Director General of ICARDA, thanked H.E. Dr Habibi for finding the time out of his busy schedule to meet the Members of the Board. They briefed the Vice-President on ICARDA's research and training activities in the service of the dry-area agriculture and the successful collaboration between the scientists of Iran and ICARDA and highlighted their long-standing ties, which go back to the very start of the Center.

Dr Habibi expressed his appreciation for the research work the Center is doing to improve the welfare of the farming community of the dry areas in the Central and West

Asia and North Africa (CWANA) region in general and in Iran in particular. He assured Iran's fullest support to ICARDA to enable the Center to play a larger regional role in serving the dry-area agriculture.

The ICARDA Board of Trustees paid a courtesy visit to H.E. Dr Issa Kalantari, Minister of Agriculture, on 1 May. Iran and ICARDA signed a new Memorandum of Understanding (MOU) for future Iran-ICARDA collaboration. Under this MOU, 13 new projects will be executed over a period of five years, with a total budget

of US\$7.77 million provided by the Government of Iran. The Trustees also visited H.E. Dr M. Mouin, Minister of Higher Education, on 3 May. Dr Mouin emphasized his government's commitment to promoting the research and education linkage in Iran.

During its meetings in Tehran, the Board appointed the following new members: Dr Margaret Caltley-Carlson (Canada), an outstanding international authority in the field of development and women interest; Dr Abbas Keshavarz (Iran), Deputy Minister of Agricultural Research, Education and Extension of Iran and a specialist in irrigation engineering; Dr Khalil Khazzaka (Lebanon), Director General of Lebanon Agriculture Research Institute and Pedologist/Agronomist; and Dr Richard Gareth Wyn Jones (UK), Associate Director of the Center of Arid Zones Studies at the University

New Approaches to Water Management in Central Asia

An international workshop on “New Approaches to Water Management in Central Asia” was held at ICARDA headquarters, 9-11 November. Jointly organized by the United Nations University (UNU), Japan, and ICARDA, with support from UNESCO, the workshop was the first of its kind in partnership with UNU to be held at ICARDA to address the agricultural research needs of Central Asia.

ICARDA Director General, Prof. Dr Adel El-Beltagy, and the Vice Rector of the United Nations University in Tokyo, Prof. Motoyuki Suzuki, opened the workshop. Statements were also made at the opening session by H.E. Mr Kishichiro Amai, Ambassador of Japan to Syria; Prof. Dr Iwao Kobori, Program Advisor, UNU, and Vice-Chairman of ICARDA’s Board of Trustees; and Acad. Jamin Akimaliev, President, Kyrgyz Agrarian Academy.

Over 35 researchers from four Central Asian countries (Uzbekistan, Kyrgyzstan, Kazakhstan, and Tajikistan), China, France, Iran, Japan, Kuwait, Niger, Pakistan, Russia, Saudi Arabia and Syria participated in the workshop, in addition to those from UNU and ICARDA.

In his opening statement, Dr Motoyuki Suzuki, Vice-Rector, UNU, introduced the major thrusts of the UNU: peace and governance, and environment and sustainable development. The programs cover agrobiodiversity, forestry, coastal and trans-boundary waters, eco-restructuring of industries for sustainable society, and land degradation, he said.

“The world today has six billion people and the population is projected to increase to 10 billion in the next 50 years. Therefore, we have to think very seriously about food security,” Dr Suzuki emphasized. “Since water management is a key issue in food security, we need to develop innovative and sustainable approaches to water management. Solutions may be different from place to place, but our common objective is to alleviate poverty.”

H.E. Ambassador Kishichiro Amai expressed his government’s concern for the problem of global warming and desertification, which, he said, greatly affect food production. He said Japan recently launched a new concept—human security—which pertains to people’s freedom from fear of war and conflict, disease and death, and lack of food and water. He expressed hope that the workshop will serve as a springboard for future international cooperation and suggested to the participants to appeal to the world community to give more attention to global warming, desertification, water crisis, and food production.



Opening session (right to left): H.E. Mr Kishichiro Amai, Ambassador of Japan to Syria; Prof. Motoyuki Suzuki, Vice-Rector of the United Nations University in Tokyo; Prof. Dr Adel El-Beltagy, ICARDA Director General; Acad. Jamin Akimaliev, President, Kyrgyz Agrarian Academy; and Prof. Dr Iwao Kobori, Program Advisor, UNU, and Vice-Chairman, Board of Trustees of ICARDA.

The Director General, Prof. Dr Adel El-Beltagy, welcomed the participants and distinguished guests to ICARDA. He stressed the importance of water management in the Central and West Asia and North Africa region, which he described “as the longest and largest continuous strip of dryland area in the world.” He said that peace and stability

starts from agriculture, which is highly linked with water use, as has been the experience of past and present civilizations.

Acad. Jamin Akimaliev, President, Kyrgyz Agrarian Academy, thanked Prof. Dr El-Beltagy for the attention that ICARDA has been giving to Central Asia. He expressed the readiness of Central Asian countries to host a similar workshop in the future, and stressed that new approaches to water management can contribute

to improving the standard of living of the poor in Central Asia.

Prof. Dr Iwao Kobori, Vice-Chairman, ICARDA Board of Trustees and Program Advisor, UNU, recalled the first time he arrived in the region in 1956 when he was a member of the Tokyo University-Iraq-Iran agricultural expedition. Since then, he has continued to work on the problems of arid areas, especially on irrigation. He said he had long wanted to see UNU and ICARDA working together, as both institutions share the common objective of using research to alleviate poverty. He stressed the workshop, jointly sponsored by UNU and ICARDA, was a dream that had come true for him.

The workshop focused on critical issues related to water management in Central Asia. Presentations over the three days included country presentations by representatives from Uzbekistan, Kazakhstan, Kyrgyzstan and Tajikistan, and commissioned presentations from experts on Central Asia, WANA, China and Niger. Selected presentations from ICARDA, UNU and several advanced institutes on issues related to water management in CWANA were also made. ■



Prof. Dr El-Beltagy briefs the distinguished participants on ICARDA’s trials under controlled conditions.

of Wales, Bangor, and a specialist in stress physiology and biochemistry. ■

Biosafety Regulations for WANA

A workshop on “Developing and Harmonizing Biosafety Regulations for Countries in WANA (West Asia and North Africa)” was held at ICARDA, 11-13 September. It was jointly organized by Egypt’s Agricultural Genetic Engineering Research Institute (AGERI), FAO, ICARDA, USDA, and the Syrian Atomic Energy Commission. Financial support for the workshop came from the Arab Fund, FAO, GTZ, and USDA. Additional support (in the form of participation of their representatives) came from UNEP/GEF and USDA-APHIS. The



Prof. Dr Adel El-Beltagy (third from right), Director General, and representatives of the sponsoring organizations welcomed the participants. Left to right: Dr Subhash Gupta, APHIS, USDA; Dr Andre de Katheren, GTZ; Dr Maria Zimmerman, FAO; Dr Magdi Madkour, AGERI, Egypt; and Dr Ahmed Abd El-Kader, Atomic Energy Commission, Syria.

objectives of the workshop were to assess the current situation related to biosafety in WANA countries and to formulate national action plans for the development of biosafety regula-

tions for the region. Representatives from Algeria, Egypt, Iraq, Jordan, Lebanon, Morocco, Palestine, Sudan, Syria, Tunisia, and Turkey attended the workshop and reported on the

Tribute to Acad. Saidmakhmud Usmanov

Academician Saidmakhmud Usmanov—a man of vision, a distinguished scientist, and a model government leader in Uzbekistan—passed away on 18 March 2000 at the age of 70, leaving the stakeholders of the CGIAR Program for Central Asia and the Caucasus (CAC) deeply grieved.

Without the strong support of Acad. Usmanov, the establishment of a CGIAR collaborative program in CAC would not have been possible. Backed by his strong scientific expertise and linkages in Uzbekistan and other countries of Central Asia, he co-hosted the first Consultation Meeting in Tashkent organized by ICARDA, in collaboration with BMZ/GTZ of Germany, after the eight countries of Central Asia and the Caucasus achieved their independence. He also hosted the CGIAR Task Force Meeting in Tashkent in September 1996. These pioneering efforts laid the foundation for the CGIAR Program in Central Asia and the Caucasus.

The CG Centers will always remember Acad. Usmanov as a distinguished scientist whose more than 200 scientific papers, monographs and dissertations won for him State recognition. His scientific contributions to labor management in agriculture based on collective and family contract remain realistic and applicable in today’s agricultural production.

Acad. Saidmakhmud Usmanov, who was a leading economist, taught his students with a patriotic spirit. The eight Doctors of Science and 30 PhDs, whom he advised during his academic career, are now making major contributions in the agricultural sector of the Republic.

Acad. Saidmakhmud Usmanov served as Director of the Institute of Agricultural Economy in Tashkent from 1974 to 1984. In 1984, he became President of the Uzbekistan Academy of Agricultural Sciences, and held that position until his retirement in 1998. He then served as a consultant for the Research Institute of Market Economy in Tashkent.

The Stakeholders of the CGIAR Program for Central Asia and the Caucasus will always remain indebted to Acad. Saidmakhmud Usmanov for his pioneering spirit, commitment and contributions to agricultural science and to the development of the CGIAR/CAC Program. This is his indelible legacy to mankind. They express their deepest condolences to the family of the late Acad. Saidmakhmud Usmanov. May his soul rest in peace.



—The Stakeholders of the CGIAR Program for Central Asia and the Caucasus, Ashgabat, Caucasus, 30 May 2000

Transforming Agriculture in Central Asia and the Caucasus: The Role of ICARDA

In the Soviet era, the Central Asia and the Caucasus (CAC) region, consisting of Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan in Central Asia, and Armenia, Azerbaijan and Georgia in the Caucasus, was essentially a commodity-producing component of a larger system, importing agricultural inputs from elsewhere and exporting its produce within the USSR. Following the breakdown of the USSR, each of these countries now faces the challenge of developing a stand-alone economy, a process that requires a major effort to diversify agricultural production. CAC countries are aware that this can only be achieved by their working together and joining hands with international agricultural research and development programs. ICARDA is one of their major partners in this effort and is playing an active role in jointly developing and implementing a research strategy that meets the specific needs of each country and helps them to make a smooth transition from a central to a market-driven economy.

By

S.P.S. Beniwal and S. Varma

Challenges Facing the CAC Region

The Central Asia and the Caucasus countries face three major challenges: ensuring food security, alleviating poverty, and protecting the environment. During transition since 1991, food output has decreased by 15-45%, whereas per capita food need has substantially increased due to increasing population with the exception of Kazakstan, where population has shown a declining trend. There is a general decline in living standards (GNP US\$776) and 25-40% of population is estimated to be living below the poverty line. Over 50% of these people live in rural areas, where farming is a primary source of livelihood for them.

The region faces a serious challenge to its natural resource base. Croplands, rangelands and mountains are getting degraded. The reduced availability of agricultural inputs, and feed and fodder is resulting in a decline in livestock numbers. Water scarcity and misuse is compounding the threat to food security, human health, and ecosystems.

If the CAC countries have to succeed in developing a market-driven economy, they must transform their agriculture to ensure that it can feed their people, that it is sustainable in the



Gus Ginzburger

The transition from a centralized system in the Soviet era to economic liberalization in Central Asia and the Caucasus calls for a rapid growth of market-driven economies, which in turn are driven by agriculture.

long term, and that it responds to the changes in global priorities and trends.

Strengths of the CAC region

The region covers an enormous area of 418 million ha, of which about 275 million ha are classified as rangelands. The environment in the region is characterized by low and variable rainfall and extremes of temperature. The landscape is a mixture of mountain, desert and steppe.

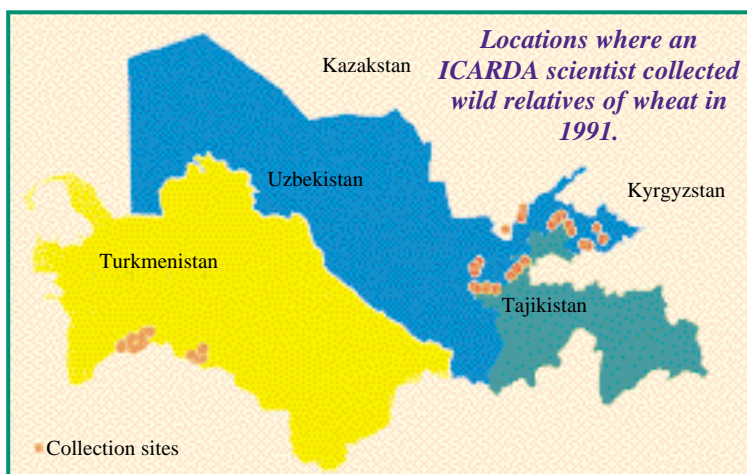
The region, however, has several strengths. It has diverse agriculture with great potential. It has a wealth of

intellectual resources, whose expertise draws on a long history of agricultural research in the region. There are also many institutes and experiment stations, some of them quite large, such as the Research Institute of Grain Farming in Shortandy, Kazakstan; Institute of Karakul Sheep Breeding and Desert Ecology in Samarkand, Uzbekistan; and Institute of Soil and Crop Management in Bishkek, Kyrgyzstan. Unfortunately, however, the CAC researchers have suffered due to their isolation from the international research programs and inadequate access to modern research tools and technology.

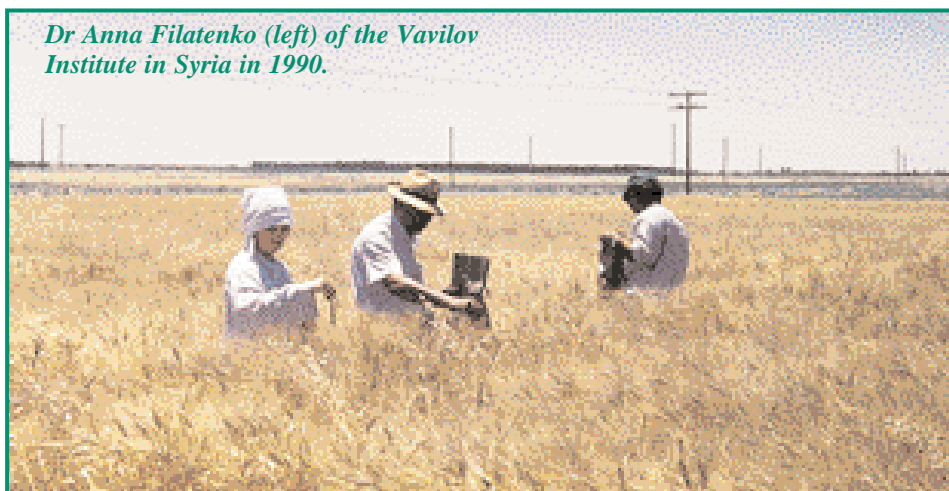
Development of Partnerships with CAC

Laying the Foundation

In the 1980s, ICARDA had collaboration with VASKHNIL (The Soviet Union Academy of Agricultural Sciences) and, through it, with CAC. This was in the form of exchange of germplasm and scientific visits. The first scientific visit from ICARDA to Kazakhstan took place in 1987. Subsequently, a visiting scientist from Uzbekistan spent a year (1989-90) at ICARDA, working in the Center's Genetic Resources Unit. In 1991, an ICARDA cereal taxonomist together with national plant genetic resources scientists collected germplasm of wild relatives of wheat in Turkmenistan and Uzbekistan.



It was in May 1995 that ICARDA launched a major effort in CAC when a scientific mission visited the region. Based on the findings of the mission, the Center took the initiative to organize a workshop on "Identification of the Needs for Agricultural Research and Seed Production in the Newly Independent Republics of Central Asia and the Caucasus," in collaboration with GTZ/BMZ (German Assistance Agency/German Ministry of Technical Cooperation) and the Uzbekistan Academy of Agricultural Sciences (UAAS) in Tashkent, 5-9 December 1995. In addition to ICARDA scientists and managers, representatives from the eight CAC countries, and three other CGIAR (Consultative Group on International Agricultural Research) Centers – CIMMYT, ISNAR and IFPRI, as well as GTZ and BMZ,



Dr Anna Filatenko (left) of the Vavilov Institute in Syria in 1990.

Jan Valkoun

the Agha Khan Foundation in Tajikistan, and TACIS (Technical Assistance for the Commonwealth of Independent States)-supported Cereals Project in Turkmenistan attended the

workshop. The workshop identified agricultural research needs, including research on water-use efficiency in irrigated systems; control of soil salinity and soil erosion; and development of mountain agriculture.

The workshop also analyzed the effects of the transition from centralized to private farms – especially how the changes in ownership and management affect soil and water management, seed production, and livestock and range management.

Further initiatives from ICARDA in the CAC region continued in 1996 through its Highland Regional Program (HRP), based in Ankara, Turkey. Exchange of germplasm, information and scientific visits increased. Scientists from CAC were supported to attend regional and international conferences and training activities.

With livestock being a key agricultural commodity in the region, another meeting on "Regional Assessment of Animal Production in Central Asia" was organized in Tashkent, 27 February to 1 March 1996, in collabo-

ration with the SR-CRSP (Small Ruminant – Cooperative Research Support Program, now called Global Livestock-CRSP) of the USAID (United States Agency for International Development), the University of California, Davis, and the UAAS. Animal scientists, pasture and range specialists, and socioeconomists from the five Central Asian (CA) countries, the USA, the United Kingdom's Department for International Development (then the Overseas Development Administration), and ICARDA attended the meeting. The meeting led to the identification of important research activities under two themes: livestock and environment, and policy and economics. Participants agreed to develop a regional network on livestock activities, with ICARDA playing a significant role. Also, a committee was formed, with one representative from each of the five CA countries, to coordinate action at the regional level.

The Role of the CGIAR

In 1996, a CGIAR Task Force on Central/Eastern Europe and the States of the former Soviet Union was formed to identify the needs of agricultural research of these countries. ICARDA actively participated in, and contributed to the deliberations of this Task Force. In view of ICARDA's comparative advantage and its established linkages with the CAC region, the CGIAR asked the Center to assist in organizing a consultation meeting between the CGIAR and CAC. The

meeting was held in Tashkent, 5-7 September 1996, in collaboration with UAAS. In addition to the CG Centers that had attended the December 1995 meeting, several other CG Centers participated in this meeting.

The consultation reinforced the need for collaboration in those areas of agricultural research which were identified in the December 1995 meeting. Based on this, the Task Force recommended to the CGIAR to support agricultural research and human resource development in the region. The CGIAR approved this recommendation at the International Centers Week (ICW) 1996 in Washington, DC, and encouraged the CG Centers to develop partnerships with the NARS in CAC in their respective mandated areas of agricultural research. However, the resources for these linkages were to be found from sources other than the CGIAR allocation of funding for each Center.

At ICW-96, nine CG Centers* agreed to form a Consortium to assist the eight CAC countries in agricultural research with ICARDA as the lead Center. From the CGIAR consortium, all partners—CAC NARS, CGIAR Centers and donors—can benefit from the common pool of knowledge and expertise. Duplication of effort is avoided, the Centers gain in efficiency, the NARS get the best possible service, the donors are assured that their investment is used wisely, and the pace and efficiency of research is accelerated.

By the end of 1996, ICARDA had successfully created a regional agricultural forum for CAC, which was considered a vital development in the post-Soviet era. The CAC region is geographically and agroecologically a continuum of the West Asia and North Africa (WANA) region, which is ICARDA's traditional area of regional responsibility. For that reason, the CAC region became a part of the geographic mandate of ICARDA in 1997, and this was approved by the CGIAR. The ICARDA-mandated region is now known as CWANA (Central and West Asia and North Africa), and the CAC



The first major workshop, held in Tashkent in December 1995, brought together participants from ICARDA and other CG centers, from donor organizations and CAC countries to identify areas of collaboration.

countries have become partners of ICARDA similar to the WANA countries. To fulfill its new role, therefore, ICARDA, in its Mid-term Plan 1998-2000, spelled out its strategy and mechanisms for forging stronger research partnerships with the CAC countries.

In May 1997, a Liaison Officer from the region, Dr Mekhlis Suleimenov, was appointed and based in Tashkent, Uzbekistan, where a temporary Liaison Office was established in June 1997. It was on 8 May 1998 that an agreement of cooperation in agricultural research was signed with the Government of the Republic of Uzbekistan, which also authorized establishment of ICARDA's Regional Office for CAC in Tashkent with full diplomatic privileges. As a result, ICARDA's CAC Regional Program Office was formally established in Tashkent on 1 August 1998.

Meanwhile, a program proposal on "CGIAR Collaborative Program for Sustainable Agricultural Development in Central Asia and the Caucasus," developed by the Consortium of nine CG Centers, in consultation with the eight CAC NARS based on their needs and priorities, was approved by the CGIAR in May 1998. The CGIAR also provided startup funds to initiate the program and to establish a Program

Facilitation Unit (PFU) in conjunction with the CAC Regional office in Tashkent. This collaborative program took off the ground in September 1998, guided by a Program Steering Committee.

Concurrent with these developments, the First ICARDA/CAC Coordination Meeting was organized at ICARDA in Aleppo, 12-16 September 1997, to develop frameworks for a number of project proposals building on priority areas identified in earlier meetings. Twenty-five senior scientists and research managers from five Central Asian countries attended this meeting. Following this, seven senior scientists and managers from the three Caucasus countries were invited to attend the HRP Regional Coordination Meeting, held in Ankara, 21-24 October 1997. This was followed by the Second ICARDA/CAC Coordination Meeting in Almaty, Kazakhstan, 22-25 September 1998; the Third ICARDA/CAC Coordination Meeting in Tashkent, Uzbekistan, 27-30 September 1999; and the Fourth ICARDA/CAC Coordination Meeting in Bishkek/Issy-Kul, Kyrgyzstan, 18-21 September 2000. These meetings helped in shaping a strong collaborative program between the eight NARS of CAC and ICARDA.

* International Potato Center (CIP), Lima, Peru; International Maize and Wheat Improvement Center (CIMMYT), Mexico; International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria; International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India; International Food Policy Research Institute (IFPRI), Washington, D.C., USA; International Livestock Research Institute (ILRI), Nairobi, Kenya; International Plant Genetic Resources Institute (IPGRI), Rome, Italy; International Service for National Agricultural Research (ISNAR), the Hague, Netherlands; and International Water Management Institute (IWMI), Colombo, Sri Lanka.

Coordination Mechanisms

Appropriate mechanisms were developed to coordinate the joint activities in different countries of the CAC region.

At the national level, the coordination of project activities is done by a National Coordination Committee, which consists of the head of the NARS, a National Coordinator (NC), and the research activity leaders. This committee holds national coordination meetings to develop work plans for collaborative project activities. At the regional level, the coordination is done by a Regional Coordination Committee, which consists of the eight NCs, ICARDA project coordinator and scientists and representatives of donor(s) and NGOs (Non-Governmental Organizations). The plan of work for regional project activities is developed at regional coordination meetings. A Steering Committee (SC) oversees the project activities, and is responsible for approving the annual work plans and budget. The members of the SC include the heads of the participating NARS, NCs, a donor representative, and ICARDA's Assistant Director General for International Cooperation, Regional Coordinator and senior scientists responsible for leading the on-going activities in different disciplines.

Current Collaborative Research Activities

ICARDA and the CAC countries are currently collaborating in a wide range



The first ICARDA/CAC coordination meeting was held in Aleppo in September 1997.

of research areas, in partnership with other CGIAR Centers, international organizations such as USDA, USAID (GL-CRSP), ICARDA's West Asian collaborator in its Highland Regional Program, and donor agencies such as the International Fund for Agricultural Development (IFAD), the Asian Development Bank (ADB) and the World Bank. The current ICARDA collaborative activities in CAC are carried out under five major themes, which reflect the five major undertakings of the CGIAR-agreed agenda:

- (1) Productivity of agricultural systems,
- (2) Natural resource conservation and management,
- (3) Conservation and evaluation of genetic resources and biodiversity,
- (4) Socioeconomic and public policy research, and
- (5) Strengthening national programs.

A selection of major achievements in each of these five areas is presented in the articles that follow.

Looking Ahead

ICARDA, through its active and persistent efforts, and in collaboration with its sister Centers and donors, has laid a strong foundation for agricultural research in the CAC countries. The future challenge lies in building on this foundation through collaborative activities in strategically important research areas. These include strengthening the facilities and expertise in the use of molecular marker techniques in crop improvement, integrated disease and pest management, seed production, conservation and utilization of plant and animal genetic resources, socio-economic and policy issues, and technology transfer. ICARDA is actively working with its partners to develop project proposals for financial support from the donor community to maintain, and possibly increase the momentum of work in the CAC region. ICARDA and its partners look forward to sharing the pride of CAC countries in seeing the transition period as an opportunity to provide a more secure future to their present and future generations. ■

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Training in the use of English language is receiving emphasis in the collaborative program between ICARDA and CAC.

The Hunt for Green Gold in Central Asia and the Caucasus

From the desert steppes of Kazakhstan to the rugged but picturesque mountains of Armenia, ICARDA scientists and collaborating national partners are out there panning for green gold. In a race against time, ICARDA, in collaboration with researchers from Central Asia and the Caucasus (CAC); the famous N.I. Vavilov All-Russian Scientific Research Institute of Plant Genetic Resources (VIR), St. Petersburg; the Australian Centre for International Agricultural Research (ACIAR); the Cooperative Research Centre for Legumes in Mediterranean Agriculture (CLIMA, Australia); and the International Fund for Agricultural Development (IFAD), is taking the lead in helping to conserve valuable and unique genetic resources that are endangered in the region. But why all this fuss about a few plants that look like weeds to the untrained eye? To answer this question we need to take a step back to gain an overview of the agricultural sector in the CAC region.

Over half of the population in Central Asia and the Caucasus is rural, so the economy of the region depends heavily on agriculture. In fact, agriculture contributes more than 50% to the economy of the region, a figure that is more than twice the average for all developing countries. Clearly, agricultural research and development are of extreme importance to the region. During the Soviet era this was centrally controlled; now each CAC country faces the daunting challenge to develop stand-alone agricultural research, production and marketing systems.

Plant Genetic Resources at Risk

The transition phase is fraught with difficulties. The foremost is the drive for food security and thus a concentration on domestic production of cereals. This calls for dramatic changes in the farming systems employed earlier during Soviet times. But CAC countries face a lack of expertise and infrastructure to support the new cereal-based systems. This is leading to poor crop husbandry and subsequent damage to the environment. For example, inappropriate rotations are reducing soil fertility, causing erosion, and increasing pests and diseases. Poor drainage and increased irrigation is causing salinity, while overgrazing is resulting in desertification or severe deterioration of the natural rangelands. Lack of improved food and forage crop varieties adapted to local environments and production systems is a major con-

By Kenneth Street and Mustapha Bounejmate

straint. An obvious source for developing such varieties is the landraces and native progenitors of domesticated species that are endemic to the region.

CAC: A Treasure Trove of Plant Genetic Diversity

It is well known that the CAC region has a wealth of genetic resources. In fact the area has two distinct centers of genetic diversity of important crop plants, where unique and vitally important germplasm is still available. For example *Aegilops tauschii*, one of the progenitors of wheat; *Hordeum spontaneum*, the progenitor of barley; *Lens orientalis*, the progenitor of lentil, and several species of wild chickpeas, are native to the region. In the deserts of Central Asia, which account for about 65% of the land area, a great number of endemic range species still thrive. These



Dr S. Khusainov, Director of the Aral Sea Area Experiment Station in Chelkar, Kazakhstan, collects range species in Kazakhstan, during a joint ICARDA/VIR/NARS collection mission.

species have enormous potential to reverse land degradation in fragile desert environments in the CAC region as well as in other parts of the world.

On the other hand, these unique sources of novel genes are under extreme threat of being lost forever as a result of human neglect and unsustainable systems of land use and farming. Therefore, there is an urgent need to conserve and exploit the genetic resources in CAC, and use them not only for the benefit of the CAC countries but also of the world at large.

During the Soviet era almost all genetic resources activities were coordinated and carried out by the Vavilov Institute (VIR), based in St. Petersburg. The countries of Central Asia and the Caucasus now face the challenge of developing their own genetic resources programs.



*Mr Sergey Shuvalov of the Vavilov Institute shows the diversity of *Aegilops tauschii* collected in a single population in Kazakhstan, during a joint ICARDA/VIR/NARS collection mission.*

ICARDA Joins Forces with its Allies: A Timely Action

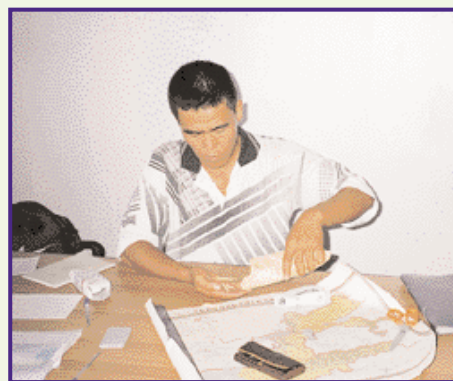
To deal with the needs of CAC, ICARDA brought together the CAC National Agricultural Research Systems (NARS) and donors into an alliance geared to safeguard the future of genetic resources of the region. With financial support from the Australian Centre for International Agricultural Research (ACIAR), ICARDA has launched a timely project on "Development and Conservation of Plant Genetic Resources from the Central Asian Republics and Associated Region." The project focuses on the conservation of endemic landraces and wild relatives of food crops as well as potential forage species, and strengthening the national plant genetic resources programs. Another project on "Integrated Feed and Livestock Production in the Steppes of Central Asia," funded by the International Fund for Agricultural Development (IFAD), is seeking to investigate ways to enhance the productivity of the rangelands by utilizing the region's prolific range genetic resources. Both projects are led by ICARDA in cooperation with the Central Asian republics, the Vavilov Institute, and the Cooperative Research Centre for Legumes in Mediterranean Agriculture (CLIMA), Australia.

The collection missions are jointly carried out by scientists from ICARDA, CAC countries, the Vavilov Institute, and Australia. The first step is to identify priority species for collection. For food crop and forage species, endemic landraces and wild relatives are targeted. The forage crop species belonging to the following genera are of most interest: *Haloxylon*, *Callygonum*, *Kochia*, *Salsola*, *Eurotia*, *Artemisia*, and *Astragalus*. These have been recommended to Kazakhstan, Kyrgyzstan and Turkmenistan for further evaluation and seed increase.

To date, six collection missions covering an area of more than 10,000 km through a diversity of environments ranging from deserts to rugged mountains have been completed. The countries covered were Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. In all, 1,030 accessions have been collected representing over 120 species or sub-

species of food and forage crops. What is notable about this material is the ecotypic diversity within a given species. This is particularly the case for bread wheat landraces and wild relatives.

As a general rule, seeds of the accessions collected are equally divided among the participating organizations. At ICARDA, the material is grown for *in situ* conservation, as well as for seed increase for long-term storage in the gene bank (*ex situ*). Visiting scientists from the countries in which the germplasm was collected cooperate in this work. The distribution of each species and the biological characteristics of the ecotype populations, especially their reproductive characters, are documented and added to ICARDA's genetic resource database. This valuable information provides a basis for the selection of the genotypes most likely to succeed under the climatic, soil and management systems prevailing in the host countries.



Mr Bitore Djumakhanov of the Uzbek Research Institute of Plant Industries, examines ears of wheat landraces that he and partners from the Vavilov Institute and national programs collected in Tajikistan.

Training and Networking

Training and networking are also important aspects of the projects. Scientists from the CAC countries are given the opportunity to work along side scientists from ICARDA, VIR and Australia during the collection, evaluation, and documentation phases of the project. For example, young scientists from the national programs visit ICARDA for a period of two to three months to participate in the characterization of the collected material. While at ICARDA they also benefit from

exposure to an international research environment and have the opportunity to develop contacts with other scientists working in similar fields. In addition, they gain computer and English language skills, which are urgently needed in the CAC countries.

The ACIAR- and IFAD-supported projects also provide opportunities for scientists from CAC countries to come together and discuss common problems. For example, at a workshop held 16-26 June 2000 in Ashkabad, range specialists from Central Asia prioritized potentially useful species for rangeland rehabilitation, thereby providing a more focused and synergistic approach to developing rangeland management strategies. Likewise, a regional meeting in Tashkent led to a commitment by the eight countries to form small plant genetic resources units whose first priority will be to document the genetic resources holdings of their countries for food and fodder crop species.

Infrastructure Strengthening

The projects have also provided computers, geographic positioning systems, operating funds and technical backstopping to the collaborating institutes in CAC. For example the Uzbek Research Institute for Plant Industries (UzRIPI) houses the most important gene bank in the region. However, prior to ICARDA involvement, it did not have computer facilities to manage a collection of over 50,000 accessions. In 1998 ICARDA's database specialist visited UzRIPI to initiate the development of a computerized documentation system. In 1999 the documentation officer from UzRIPI visited ICARDA for three months to give finishing touches to what is now a functional database. To enhance the utility of the system, funds were also made available to network the computers at the institute.

The hunt for green gold, which holds the key to future food and feed security, will continue. ■

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Nikolai Vavilov's first collection mission was in 1916, in Tashkent oasis and southwest Turkmenia. He continued collecting in the valleys of Tedjen, Murgaba, Golodnaya steppe, Samarkand and Bukhara oasis, Fergana, western Pamir and southern Tajikistan. His collected germplasm was planted for the first time in the early spring of 1917 at the Zarafshan experimental plot in the Kattakurgan district of Samarkand region. It included unique forms of wild wheat as well as salt-resistant barley, rare forms of cereals, and valuable species of fodder and other crops.

Central Asia's richness in genetic resources encouraged Nikolai Vavilov to establish a research center in the region. The Department of Applied Botany, Genetics and Breeding opened in 1924 near Botanica in the Kibrai district of Tashkent Region. During that time, 1,400 accessions of Asia wheat representing 11% of the VIR collection were available at the All-Union Institute of Applied Botany and New Crops. From the very start, scientists at this department were dealing with the study of global genetic resources of cultivars and their wild relatives.

In 1927, the department was renamed the Central Asian Station, and, in 1979, the Central Asian Branch of the All-Union Research Institute of Plant Industry (CAB-VIR). Much has been done to implement the ideas of Vavilov whose aim was to "...make a breeder's work thoughtful from genetic point of view and to make a geneticist's work closer to breeding."

Since 1965, indigenous local cultivars and their wild relatives have been systematically collected in Central Asia and stored at CAB-VIR for use as initial material for breeding purposes. Between 1965 and 2000, 115 collection missions were conducted and more than 200 cultivars of grain crops (cereals, food and forage legumes), vegetables, fruits, industrial crops and other crops have been developed as a result of these collections. These include about 50 crop varieties that are widely cultivated in Uzbekistan and other Central Asian countries.

Uzbek Research Institute of Plant Industry (UzRIPI), Botanica, Kibrai district, Tashkent Region, Uzbekistan.



Nurturing the Vavilov Legacy

It was in Central Asia where Russian scientist Nikolai Vavilov began a 25-year mission—collecting germplasm across continents. The work goes on today and is gaining greater momentum with ICARDA's participation.

**By Z. Khalikulov,
R. Movlaynova, J. Konopka,
P. Khodjaev, K. Street, and
F. Abdullaev**

A variety of winter barley 'Unumli-Arpa,' developed by means of selection from a Syrian accession, has been cultivated for about half of century and is still one of the best in terms of its heat and drought resistance in rainfed conditions.

Another development has been establishment of linkages between CAB-VIR and ICARDA, through VASKHNIL (former Soviet Union Academy of Agricultural Sciences). In 1988, a scientific delegation from ICARDA visited CAB-VIR to discuss

collaboration in plant genetic resources, and a cereals scientist from CAB-VIR visited ICARDA the following year. In 1991, ICARDA collaborated with CAB-VIR and Agrarian Academy of Armenia scientists on a collection mission on cereals and their wild relatives in Turkmenistan and Uzbekistan.

Following Uzbekistan's independence in 1991, the name CAB-VIR was changed to the Uzbek Research Institute of Plant Industry (UzRIPI). The Institute's 52,000 accessions of 120 crops were considered a valuable genepool in Central Asia—essential for the success of crop breeding. But like all other such centers of the former Soviet Union in Central Asia, the institute faced challenges of safe storage of the accessions, maintaining manual records, and the danger of losing some of the valuable material.

ICARDA-UzRIPI collaboration in documentation

Documentation of the germplasm collection at UzRIPI was manual—introductory and field books with evaluation results were the only source of information. But the database of VIR covered a large part of collections maintained in Tashkent. The first task was to transfer as much data as possible from St. Petersburg to Tashkent. UzRIPI asked ICARDA to help the institute develop a computerized database of its germplasm collection. As Academician Vavilov emphasized,

"...it is necessary to make order in the plant kingdom of our planet."

A regional training course on "Conservation and Use of Plant Genetic Resources in Central Asia" was organized in 1997 by ICARDA and IPGRI (International Plant Genetic Resources Institute) in collaboration with the Academy of Science, Uzbekistan. Scientists from all five Central Asian countries participated in the course; documentation of genetic resources was high on the agenda.



Mr Faizulla Abdullaev, Head of Documentation at UzRIPI at his computer recently provided under ICARDA/UzRIPI collaborative Project.

In March 1998, Mr Faizulla Abdullaev, Head of Information Section of UzRIPI, visited VIR bringing computer files and other data. These documents complemented UzRIPI's hand-written books. Subsequently with the help of ICARDA's documentation expert, the database structure was determined and data files from VIR transferred to the new system. The database management software developed at ICARDA for managing genetic resources collections was adopted. This set the stage for inputting more information into the database, and also for the verification of the existing records and for use of a database to help with handling the collections. The following year the UzRIPI database was critically reviewed and necessary adjustments made, after Mr Abdullaev made a three-month study visit to ICARDA genebank.

Having realized the importance of documentation in plant genetic resources, UzRIPI established a new Department of Documentation in 2000 with significant support from ICARDA, including the provision of a

computer. The present database at UzRIPI accounts for more than 35,000 accessions of crops. The department continues to work in close cooperation with ICARDA's specialists.

Collection missions

Several joint collection missions have been organized since 1989 in both Central Asia and Syria, including the recent ones supported by the ACIAR-funded project. The missions focused on cereals, food and feed legumes and forage crops and their wild relatives. Some of the collections of wheat, barley and chickpea, which were made in Uzbekistan, were evaluated by an Uzbek scientist at ICARDA during the 1998/1999 crop season. This provided an excellent opportunity for the Uzbek scientist to learn techniques of evaluation, data processing, and analysis of results.



Dr Alexei, a senior scientist at UzRIPI, collects cereal wild relatives in Uzbekistan.

Developing a good storage facility at UzRIPI was another challenge as the existing facilities were primitive. ICARDA sent experts to evaluate the situation and recommend suitable measures for upgrading the facilities. With modernized facilities as a result of the UzRIPI-ICARDA collaboration, seeds can now be stored for 6 to 10 times longer periods than before, without negative effects on germination.

A Regional Technical Meeting on Field Crop Genetic Resources was organized by ICARDA in collaboration with the Uzbek Scientific Production Center of Agriculture (USPCA) in Tashkent in December 2000. National coordinators of plant genetic resources and senior scientists from Armenia,

Azerbaijan, Georgia, Kazakstan, Kyrgyzstan, Turkmenistan and Uzbekistan participated, along with VIR (Russia) and ICARDA representatives.



This seed storage facility at UzRIPI needs further improvement for ensuring long-term storage of the valuable germplasm.

The meeting again showed that field crop genetic resources are an important and necessary component of agricultural research and should be given constant attention. Participants agreed to establish a small working group to make an inventory of field crop collections and establish computerized databases in all the countries of Central Asia and the Caucasus.

After being acquainted with the activities carried out at the UzRIPI and its Documentation Department, participants expressed a desire to have a similar institute and department in their countries. It was emphasized that the cause of biological science to which Nikolai Vavilov devoted his life must be continued and further developed. ■

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How “Forgotten Crops” could Help Agricultural Revival in CAC

The eight newly independent CAC countries are looking to agriculture to revitalize their economies. The leguminous crops, chickpea and lentil, could play an important role.

The leguminous crops, chickpea and lentil, hold considerable potential for farming systems in CAC countries, both as food for people and as feed for animals. Chickpea (*Cicer arietinum* L.) and lentil (*Lens culinaris* Medikus) are already an important component of subsistence farming in many other countries.

The seed of these crops is nutritionally rich in protein, essential amino acids, phosphorus and calcium and is relatively high in fiber. These characteristics rank these crops among the world's important cool-season food legumes. Green or fresh chickpeas are sometimes used as vegetable before the crop is mature, while their straw is used for livestock feed.

During the Soviet era there was little emphasis on grain legumes in the CAC region. Wheat, barley, cotton, fruits and vegetables in Government-controlled collective farms were then dominant. Following the break-up of the USSR, national programs focused only on cereals, as bread is the key staple in the region.

National agricultural research systems (NARS) of CAC countries tried to increase production of wheat both vertically (through high inputs, includ-

ing irrigation) and horizontally (increasing land area). Recently, however, national program scientists and the research administrators in CAC have realized that diversification is needed to ensure the availability of diverse foods in a cereal-based, sustainable cropping system.

**By R.S. Malhotra,
A. Sarker, W. Erskine,
V. Shevtsov and S.P.S. Beniwal**

While both chickpea and lentil have been grown in CAC countries since time immemorial, their cultivation declined in the Soviet era and they are now “forgotten crops” to the region's farmers and researchers. National statistics barely mention them. Figures for Kazakhstan started appearing in FAO's Production Year Book only in 1997. But an attempt has been made to gather estimates from different research workers in the CAC countries (Table 1).



Dr Nadir Ergashev, a Legume Breeder in Uzbekistan, explains a chickpea nursery planted in Uzbekistan using the ICARDA winter chickpea technology, to legume scientists from CAC, in the company of ICARDA scientists.

The total arable area in CAC countries is estimated at 26.6 million hectares, of which legumes are grown on 157.5 thousand hectares, 0.59% of the total area. Chickpea occupies 86,500 thousand hectares of the land under legumes, mostly in Uzbekistan where around 60 thousand hectares is under the crop. Productivity averages 720 kg/ha. Chickpea is normally grown as a rainfed crop in the spring season, except in certain lowland areas where it is planted in the autumn. The area under lentil cultivation is much lower, about 14,300 hectares, with a modest productivity of 528 kg/ha. Lentil is also grown as a spring crop.

Both chickpea and lentil are viewed as indispensable protein and energy

Table 1. Area, production and productivity of chickpea and lentil in CAC countries, 1999.

Country	Area (ha)		Legume production (tonnes)	Chickpea			Lentil		
	Arable land (Rainfed)	Legumes		Area (ha)	Production (tonnes)	Grain yield (kg/ha)	Area (ha)	Production (tonnes)	Grain yield (kg/ha)
Armenia	483 500	1 812	1 739	141	184.7	1 310	100	88.0	880
Azerbaijan	1 500 000	12 100	11 858	6 330	7 089.6	1 120	1 100	572.0	520
Georgia	799 000	25 000	30 250	4 440	5 372.4	1 140	2 200	1 496.0	680
Kazakhstan	15 300 000	14 180	7 657	5 120	3 174.4	620	1 200	456.0	380
Kyrgyzstan	1 400 000	7 500	6 600	2 380	2 332.4	980	720	345.6	480
Uzbekistan	4 500 000	70 560	52 920	60 510	43 567.2	720	2 300	1 288.0	560
Tajikistan	810 000	20 120	15 694	4 120	2 842.8	690	5 460	2 620.8	480
Turkmenistan	1 800 000	6 210	5 092	3 450	3 139.5	910	1 220	683.2	560

sources and potential crops for farming systems to diversity cereals or cotton monoculture. Since ancient times, local varieties of chickpea have been developed through mass selection in Kazakstan, Uzbekistan, Tajikistan, Turkmenistan and the Trans-Caucasian countries.

More than 600 accessions of cultivated chickpea, collected in CAC countries, are maintained in the genebank at ICARDA. The Andijan Research Institute of Grain in Uzbekistan has made concerted efforts to evaluate some of the genetic resources for various traits, including *Ascochyta* blight, a fungal disease, and has identified sources of resistance.

A large number of high-yielding lines were developed through hybridization and selection and released for general cultivation in Uzbekistan and other CAC countries. These include 'Azerbaijansky 583,' 'AZNII 303,' 'AZNII 304,' 'Milutinsky 4,' 'Milutinsky 6,' 'Uzbekistansky 8,' 'Ulduz,' 'Camilla,' 'Zornukhat,' and 'Uzbekistan 32.'



Kazakstan chickpea scientist Dr Baizomat Janizbayev discusses the performance of winter chickpea in a chickpea research plot at Almalyak, Kazakstan with ICARDA's Dr Victor Shevtsov (right).

Improved landraces of lentil have also been released in some of the countries—'Tazik 95,' for example, is being grown in Tajikistan, the variety 'Azer' in Azerbaijan, and 'Aykanan' and 'Talini' varieties in Armenia. Average yields of these varieties vary from 600 to 900 kg/ha. Small farmers in these countries grow their own landraces without any specific variety name.

In the era of Soviet Union, research on genetic resources and breeding was centrally planned and managed, but it had links with individual republics and the Vavilov Institute of Plant Genetic

Resources in St. Petersburg. Following independence, this linkage was broken and the changes left the NARS seriously under-resourced and entirely dependent on introduced germplasm and improved breeding materials.

Under the umbrella of the Consultative Group on International Agricultural Research (CGIAR) Program for CAC, ICARDA, ICRISAT, CIP and CIMMYT joined forces in 1998 to develop a project "Germplasm Conservation, Adaptation and Enhancement for Diversification and Intensification for Agricultural Production in Central Asia and the Caucasus." And under the auspices of the CGIAR Program, ICARDA has taken the lead in linking the CAC countries to its food legume research. ICARDA has a world responsibility for the improvement of lentil and a regional responsibility for the improvement of kabuli chickpea in collaboration with ICRISAT.

A large number of elite lines of chickpea and lentil have been supplied by ICARDA for adaptation to local

conditions in the different CAC countries. Efforts are also being made to improve the capability of national systems and to strengthen links between different CAC countries through training courses at ICARDA headquarters, in Aleppo, and in traveling workshops.

This collaborative effort has identified terminal drought as the common abiotic stress in both lentil and chickpea. Among the biotic stresses, *Ascochyta* blight in chickpea and *Fusarium* wilt in lentil were found to be important. In some areas, spring weeds also caused serious damage and

needed special attention. Furthermore, the agronomy of the crops needs exploration throughout the region. In places where winter is mild, the winter planting gave much higher grain yields than traditional spring planting.

Preliminary results of the evaluation of chickpea and lentil in Azerbaijan, Georgia, Kazakstan, Kyrgyzstan and Uzbekistan indicate a good potential for these crops in the region. Chickpea yields in a trial in Kazakstan in 1998/99 ranged from 1.56 to 3.91 t/ha. At Galal-Aral in Uzbekistan, ICARDA-supplied chickpea lines, tested in spring planting, yielded 4.1 t/ha compared to 3.1 t/ha from local varieties. These improved materials also possess resistance to *Ascochyta* blight and cold.

Some of the best performing lines of lentil yielded up to 1.5 t/ha under on-farm conditions. Since the commencement of the project more than 300 germplasm and breeding lines of lentil have been supplied by ICARDA to six countries.

A Food Legume Network for CAC countries was recently established in cooperation with ICARDA. This will give the legume scientists from these countries a common platform and facilitate exchange of visits, information and genetic materials. With the adoption of improved technologies and their fast dissemination, the output of food legumes could be increased rapidly in these countries, leading to their availability in diets and eventually to self-sufficiency.

Because of the diminishing availability of animal protein in the CAC region, there is now an urgent need to incorporate legumes into production systems in order to substitute for protein shortfalls. The recent collaborative studies suggest that both chickpea and lentil have great potential in the CAC region. ■

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Vetches and Chicklings in Central Asia and the Caucasus

Forage crops, such as vetches and chicklings, are beginning to replace fallow in the countries of Central Asia and the Caucasus (CAC), giving agriculture an important boost.

“It was like a green oasis in a desert” commented a speaker at a meeting in Bishkek, Kyrgyzstan. The “oasis” was the forage crop, *Lathyrus sativus* (grasspea), growing in Georgia. While most crops in Georgia were wiped out by severe drought in 1999/2000, *L. sativus* was the green exception.

Yet forage crops in CAC are relatively new. They were hardly sown under the extensive cropping systems of the former Soviet Union. Rotations usually included fallow periods when large areas remained unsown. There is now an excellent opportunity to step up production of forage crops, such as vetches (*Vicia* spp.) and chicklings (*Lathyrus* spp.), and to plant them after cereals, instead of letting the land lie fallow.

The introduction of improved forage legume crops to the CAC countries could therefore make an important contribution to boosting agriculture in the newly emerging economies. They can be used for direct grazing, for grain and straw or for hay making, providing quality feed, especially when other feed is scarce.

Since 1998 ICARDA has placed special emphasis on introducing such forage crops, using improved germplasm. The Center’s main aim is to achieve sustainable increases in crop and livestock production through the introduction of improved vetches and chicklings in CAC, especially in those areas that were left fallow in the year following a cereal crop.

A large number of improved lines of these forage crops have been introduced to CAC republics for evaluation and selection, under rainfed conditions, and eventually for seed multiplication and distribution to farmers.

Selection of promising lines is made by scientists from CAC and ICARDA. In the selection program, a strategy was developed with NARS which seeks to introduce certain characteristics into the forage legumes. They should be productive, palatable, competitive, vigorous as seedling, a good seed producer, cold tolerant, drought tolerant, resistant to diseases and insects, and adaptable to harsh environments.

Selected lines of common vetch, Narbon vetch, Hungarian vetch, grasspea and dwarf chickling, possess the majority of these traits. Narbon vetch

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seeds contain 33% protein that has amino acid composition nearly equivalent to that of soybean meal. It yields 1.4 t/ha grain in dry areas (300 mm rainfall), has good resistance to birds, is easy to establish because of its large seed, and may be planted deeper than other legumes. It therefore has great potential as a forage legume in rotation with a cereal crop, and is also good for stockpiling as straw for sheep—it does not lose its leaves following frost like other legumes.

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*Above: Scientists from CAC countries evaluate the performance of *Vicia narbonensis* lines for cold tolerance at the Galal-Aral research station in Uzbekistan.*

*Right: Adapted promising lines of grasspea (*Lathyrus sativus*) from ICARDA, grown in farmers' fields for seed multiplication in Uzbekistan.*



Promising On-Farm Wheat Trials in Uzbekistan

Increasing the output of wheat in a sustainable way is the most important objective for Uzbekistan in its goal of achieving food self-sufficiency. Cereals were grown in the past under rainfed conditions on only 0.5 million hectares. The area under irrigated winter wheat is now increasing steadily, reaching 1.1 million hectares in 2000.

The main limiting factors to wheat production are diseases and insect pests. During the last three years yellow rust has decreased wheat productivity in Uzbekistan by 10% to 40%. Sunny bug is the most widespread insect pest, affecting both yield and grain quality.

The common problem of agriculture in the country is high soil salinity. Farmers have to frequently wash their soil with fresh water otherwise crop productivity would be badly affected. Heat and drought are frequent constraints under rainfed conditions.

Socioeconomic factors are also holding back grain production. Both investment and time are needed to enable *shirkat* (cooperative farming units) farms and the private sector to adopt new agricultural development systems. And farmers need training to help them grow cereal crops.

While local breeders have developed drought-tolerant winter wheat varieties for rainfed farming, there are still no reliable cultivars for irrigated conditions. This means that farmers have to use non-indigenous varieties which are often not suited to local environments. The national breeding program therefore faces the task of developing new cultivars with good resistance to diseases, strong stem (resistance to lodging)—a common problem in irrigated farming—high

Orientated in the past to cotton production, Uzbekistan is experiencing the negative consequences of crop monoculture. But hopes are now high for winter wheat.



Uzbek scientists, development officers and farmers visiting a wheat demonstration site in the Kashkadariya region.

yield potential and improved grain quality. It is important to breed early-maturing varieties which use limited water reserves effectively, and are suitable for double cropping on soils with a high salinity level.

Close cooperation with ICARDA and CIMMYT has sought to overcome the main limiting factors. During the last five years a large amount of breeding material, including thousands of lines from the International Winter Wheat Improvement Program (IWWIP) of Turkey/CIMMYT/ICARDA, have been tested under irrigation and rainfed conditions at the national breeding centers in Galal-Aral and Andijan and their branch stations.

Many promising lines have been identified. The best-performing line, a selection from BDME-9 (YMH/TOB/MCD/3/LIRA) named 'Dostlik,' out-yielded the standard 'Intensivnaya' by 10-40% in trials at different sites throughout the country.

Prompt introduction of the new variety requires its multiplication, on-farm testing and farmer training. The Participatory Variety Selection model—the most applicable for CAC countries—gives farmers or representatives of big farms the opportunity to

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play an active role in the evaluation and multiplication of lines that are candidates for release.

In 2000 the on-farm trials of winter wheat were established in the form of demonstration plots at nine sites in three regions of Uzbekistan—Khorezm (2 sites), Jizzak (4 sites) and Kashkadaria (3 sites). The research was carried out in different types of agronomic environments in terms of water and fertilizer availability. Yields ranged from 3 to over 7 t/ha under irrigation, and 2 t/ha in rainfed conditions. A total of 15 varieties, including 'Dostlik,' were tested.

The main concern of scientists was to select varieties with a reliable genetic resistance to diseases such as yellow rust. 'Dostlik' had significant advantages in some regions and zones in this regard.

The season was extremely dry in Uzbekistan, with precipitation not enough for grain production. Crop

failure was widespread in the rainfed areas. The variety 'Dostlik' performed similar to, or rather better than local standard 'Sanzar-8' in rainfed conditions. At the Galal-Aral Branch of Andijan Research Institute of Grain, it outyielded the standard variety by 16%, and by up to 31% in a *shirkat* farm in Khorezm region.

Yellow rust was noticed in some districts of Jizzak region where the crop had been irrigated four times and where high doses of mineral fertilizers had been applied. While the yield of 'Dostlik' was 12% higher, there was also severe lodging. The variety therefore, cannot be recommended for favorable agricultural conditions (full irrigation and a high level of soil fertility).

But when farmers have limited water resources and fertilizers, the variety 'Dostlik' is most appropriate for wheat production. National officials recommended that the trials continue and be extended to sites in Karakalpakstan, Tashkent, Sir-Darya,

Buhara, Surkhandarya, and Samarkand regions, and Fergana valley.

On the basis of the on-farm trials and demonstration plots, the first in-country cereal traveling workshop was organized by the Uzbek Scientific Production Center for Agriculture and ICARDA. The objective of the workshop was to improve the skills of the research and development staff of national agricultural research/development organizations to conduct on-farm trials and demonstrations. These would include field days and dissemination of research results to facilitate the rapid transfer of new varieties and technologies to farmers' fields. A total of 42 representatives took part in the workshop, taking the opportunity to meet with colleagues and discuss the issues of new varieties, seed multiplication and the transfer of new technologies.

For the 2000/2001 season, there will be activities on demonstration plots in all regions in Uzbekistan. Local specialists and farmers are interested in selecting and testing the new

wheat varieties because they urgently need to identify lines which are tolerant to diseases and resistant to lodging. And they understand that these activities serve other important targets—seed multiplication, the commercial production of promising varieties and lines, and the wider goal of securing food self-sufficiency. ■

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Vetches and Chicklings...

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In Uzbekistan, selected lines of improved forages were tested at four locations, with yields varying from 0.6 to 1.4 t/ha for vetches and from 0.7 to 1.9 t/h for chicklings. *Vicia narbonensis* and *Vicia panonica* showed high resistance to cold at an altitude between 1800 and 2000 meters above sea level. Grasspea (*L. sativus*), planted in farmers' fields, won acceptance from farmers for its drought tolerance and high yield.

In Kazakstan, common vetch lines produced up to 1.1 t/ha, and grasspea up to 2.0 t grain /ha. Both common vetch and grasspea showed high levels of adaptation, and yields higher than the local landraces. In Armenia and Azerbaijan, as well as in Georgia, selected lines of vetches and chicklings showed good drought tolerance.

The introduction of vetches and chicklings to replace fallow after cereals increases the production of feed resources, and subsequently the carrying capacity of the land, in a sustainable manner. Organic matter and the nitrogen status of soil is maintained,



Testing of promising vetch lines from ICARDA for their adaptation in the Almalıbak area, Kazakstan.

the physical conditions of soil are improved and pests and disease can be more effectively controlled.

Rangeland also benefits as the increased availability of forage legumes helps to reduce the problem of overgrazing. ■

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Spring Barley 'Mamluk' Excels in Armenia

Tests on a new variety of spring barley, 'Mamluk,' showed its suitability for cultivation in the foothills and mountainous zones of Armenia, under both irrigation and rainfed conditions.

Armenia's limited area for crops, about 483,500 hectares, makes it necessary to use each bit of that land effectively, in order to produce food for people and feed for animals. Spring barley is Armenia's second most important crop (after winter wheat), growing on 75 to 100 thousand hectares, in foothills and mountainous zones, at 1,200-2,400 meters above sea level. Average grain yield varies from 1.1 to 1.5 t/ha. Used for feed and malt production, barley grain is in brisk demand in the markets.

The National Barley Improvement Program of Armenia is based on the use of local landraces, promising new varieties, accessions from different republics of the former Soviet Union and new germplasm from ICARDA. But the program faces severe budgetary constraints.

In the light of these constraints, Armenian barley breeders have adopted a dual policy. First, they have developed new varieties by full breeding practices, starting from making targeted crosses. This approach has long-term goals—the first practical results might not be achieved until after 8 to 10 years of successful activities.

The second approach offers a breakthrough in research and an early impact on farmers' welfare. It consists of collaborating with ICARDA and using the most promising lines developed by the Center, and testing and moving them to commercial production. The situation in Armenian agriculture demands this approach. Farmers are in urgent need of new varieties, suitable for different agro-economic environments.

During the post-independence period, regular breeding activities were interrupted many times for economic

and political reasons, and the first task was to restore a gene pool and to test it in different soil-climate zones. A study of spring barley from ICARDA nurseries started in 1996, and 185 accessions

were tested. Some of them were identified as a source of valuable characters and used in the crossing program.

The collaborative barley program between ICARDA and the Krasnodar Research Institute of Agriculture led to the development of spring barley varieties 'Mamluk,' 'Rubicon,' and 'Stimul.' These were tested in different environments to determine the most suitable technologies for their cultivation. Testing was carried out under rainfed and supplementary irrigation conditions, and with and without fertilizer applications. Results were above expectations, showing tremendous variability in adaptation.

Data from three years of testing (1997-99) showed that the variety 'Mamluk' had a significant advantage, especially in rainfed conditions. Its yield advantage over the best standard line, 'Nutans115,' was 18.5% under natural soil fertility and 27.2% with fertilizers. 'Mamluk' therefore emerged as the chosen variety.

Being early-maturing, 'Mamluk' showed a good response to fertilizers and irrigation, ranking first in grain productivity with yields up to 4,470 kg/ha. Its grain is plump and well shaped, with a 1,000-kernel weight of 40-55 g. 'Mamluk' has a very fast initial growth vigor, quite strong straw, and it matures 5-7 days earlier than



Barley breeders from CAC and Turkey evaluate spring barley variety 'Mamluk' at Krasnodar, May 1999. From left to right: Dr T. Bessonova, Kyrgyz Institute of Agriculture; Dr V. Shevtsov, Barley Breeder, ICARDA; Dr H. Tosun, Central Research Institute of Field Crops, Turkey; and Dr A. Petrosyan, State Variety Testing Center, Armenia.

By

**A. Petrosyan, V. Shevtsov,
R. Kazaryan and S.P.S. Beniwal**

standard lines. The broad adaptation of 'Mamluk' to different soil-climate conditions will help the establishment of seed production in Armenia's different zones.

In the 2000 crop season, ICARDA provided the Armenian Scientific Center for Agriculture and Plant Protection with 200 kg of super-elite seed of 'Mamluk' from Krasnodar, for on-farm trials and demonstration plots. Experiments were set up in three climatic zones located on different altitudes. In a season that was extremely dry, the on-farm verification trials confirmed the superiority of the new variety. It performed especially well due to its early maturity and drought tolerance. The results demonstrated that the new variety is highly suitable for different local environments.

On the basis of these positive results, the variety 'Mamluk' was recommended for release and cultivation in the foothills and mountainous zones of Armenia, both for rainfed and supplementary irrigation conditions.

The task now is for a seed multiplication program to be speedily imple-

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ICARDA and ILRI Launch a Feed Resources Project in the Caucasus

By Mustapha Bounejmate
and Mohamed Saleem

1. Increasing feed resources and efficiency of utilization
2. Conservation and utilization of ruminant genetic resources under new production conditions
3. Policy options to create enabling environments for improved small-holder production and markets.

With many livestock in the Caucasian countries suffering from chronic under-nutrition, ICARDA and ILRI have joined hands to step up the production and enhance the quality of feedstuffs.

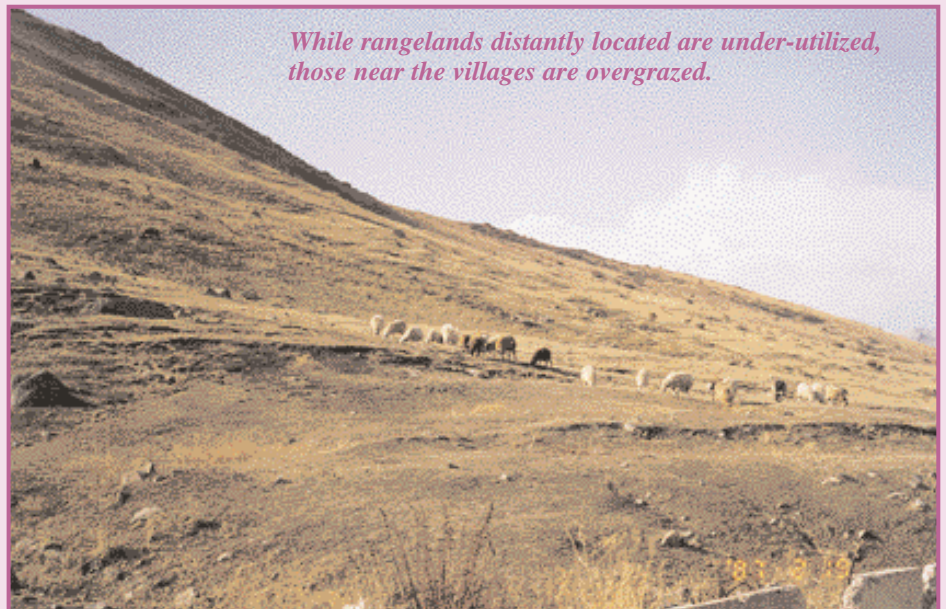
In June 2000, ICARDA and ILRI launched a new one-year project "Improving feed resources in the Caucasus" to support efforts to restore adequate feed production. The project's overall objective is to identify and tar-

The transition to non-centralized economies has had a dramatic impact on the livestock sector of the Caucasian countries. Lack of feed-stuffs to meet the nutritional demands of livestock is now one of the major problems for farmers in Armenia, Azerbaijan, and Georgia. A decade ago, guaranteed inputs from State Government, plus favorable agroecological conditions, had led to a flourishing output of feed. But output has now been seriously affected.

In the reorganization following the end of Soviet rule, livestock ownership was transferred from the State and cooperative farms to individual farmers who significantly reduced their livestock numbers. But enough feed is still not available and the livestock that remain are suffering from chronic under-nutrition.

The maintenance of infrastructure has also been seriously affected since 1991. Many buildings and farm constructions, formerly used as barns and for storing forage, are now dismantled or abandoned. Lack of rotational grazing is leading to overgrazing near villages.

In response to this situation, ICARDA and ILRI (International Livestock Research Institute, based in Kenya) sponsored a regional consultation in May/June 1999 to develop a livestock research agenda for Central Asia and the Caucasus. Participants identified three priority areas for research into livestock development in the region:



While rangelands distantly located are under-utilized, those near the villages are overgrazed.



Many buildings and farm constructions, formerly used for barns, forage storage and silos are now dismantled and abandoned.

get technologies for feed production and utilization in crop-livestock systems, in order to improve productivity and natural resources management.

Specific objectives include reviewing technologies and feeding practices in livestock systems, suggesting mechanisms for transferring them, undertaking field tests for suitable forages to enhance the base for winter-feeding, and providing on-the-job training in forages and rangeland.

To implement the project, ICARDA and ILRI undertook a mission to Armenia and Georgia in October 2000, to hold stakeholders' meetings and to identify sites for on-farm activities.

The main points that emerged were:

- From the different presentations it was evident that the three countries are facing similar problems with regard to livestock development, but that the impact on farmer livelihoods varies from country to country.
- Privatization is providing new opportunities as well as creating unprecedented problems for both farmers and national economies.
- New markets, freedom to choose the type of enterprise, and potential for profit making, give rise to new opportunities. But lack of experience in responding to these new markets, the problem of obtaining higher cost inputs after subsidies were removed, the decline of livestock numbers and shortage of feed and land fragmentation, are all causing problems for farmers.

Privatization has created a range of livestock keepers—commercially oriented farmers who have “inherited” the former State Farms, and individual farmers who keep limited numbers of livestock in their backyard for subsistence purposes.

Three main factors have contributed to the feed shortfalls both in quality and quantity. First, the degradation of common meadow/pasture lands due to neglect and unregulated use after the change from the Soviet system. Secondly, pasturelands located at some distance from a farm are under-utilized because of the inability of farmers to transport their livestock. Thirdly, there has been a decline in the sown or cultivated pasture areas and productivity of these areas.

While more and better feed is need-



Most pastures and meadows in the Caucasus are degrading due to neglect and un-regulated use after the change from the Soviet system. From left to right: Mohamed Saleem (ILRI), Mustapha Bounejmate (ICARDA), Khialov Sharhvald (farmer, Georgia), and Gogotur Agladzle (Vice-President, Georgian Academy of Agricultural Sciences, Pastures and Meadow Specialist, Georgia), examine one such degraded pasture.

ed, other strategies are also required to meet farmer needs. Appropriate types of forages and management techniques are needed to cater for different farm sizes, ecologies, seasonal needs of livestock and farmer resources.

The need for low-input technologies was repeatedly mentioned during the mission. Renovating common grazing lands and improving feed production from sown areas were considered a priority. And the need for technologies that use more of the industrial wastes was identified.

New research may not be needed in all cases—rather it may be organizational changes to consolidate farm units and encourage voluntary farmer associations to invest in machinery and inputs. There is a need for more farmer education through model farms and support services to create greater awareness of ways to improve feed-stuffs.

Stakeholders' Meeting

A significant feature of the mission was a joint meeting in Tbilisi with senior level scientists and policy makers from Azerbaijan, Armenia and Georgia to arrive at a collective agreement of a work plan for the ICARDA/ILRI project up to June 2001.

The participants appreciated the

idea of a regional approach initiated by ICARDA/ILRI. Each country committed itself to contributing to this regional effort, and to activities during a preliminary phase to cultivate multi-institutional collaboration to address the feed improvement and utilization problems in the three countries.

Each country will now undertake detailed surveys and documentation of feeding practices at the farm level, with different production scenarios ranging from individuals to farm associations, from subsistence to commercial levels of operation.

A second study will be undertaken in each country to analyze and document all commodity-oriented feed technologies that have been developed and were in use during the Soviet era, and their applicability in the changing production circumstances. Some of the technologies may be considered “new” in areas where they were not used before.

Based on these studies, each country will develop a detailed proposal to be implemented with ICARDA/ILRI, to seek funds from donors. ■

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New Production Horizons for Sheep Farmers in Uzbekistan

Sheep farmers in Uzbekistan were badly hit when the collapse of the centralized economy led to severe disruptions in their supply and marketing network. But a collaborative venture between the country's scientists and ICARDA is giving them new hope.

Karakul sheep is the source of livelihood for more than two million people living in desert areas of Uzbekistan. This breed, which is well suited to produce valuable meat, milk, wool and high quality pelts, under the fluctuating climates of the country, has proven to be the appropriate choice to reclaim the production potential of the country's extensive deserts. Karakul also has a significant role in the national agricultural output, as it contributes up to 20% of the total meat produced in the country. In the past its relevance was even higher because of the large volumes of pelts exported to the Soviet Union and European markets. The relevance of the breed is reflected by the creation of a special research organization devoted to this particular breed and its associated environment, the Karakul Research Institute, with a Union mandate, during Soviet times.

The disintegration of the Soviet Union at the start of last decade led to the advent of a tremendous crisis that affected the rural economy of Uzbekistan. Karakul sheep farmers confronted the disruption of all elements in the supply-marketing chain on which they depended. Basic production inputs were difficult to obtain, basic services that supported production such as breeding supporting schemes disappeared and prices stagnated with no incentives for farmers to sell.

In the mid-1990s ICARDA approached the national research organizations of Uzbekistan to initiate a research collaboration geared to understand the on-going socioeconomic processes and changes dictated by the application of new economic reforms, and propose the implementation of strategies to help overcoming production problems confronted by small-



Management of Karakul sheep is an important collaborative activity between Uzbekistan and ICARDA. Dr. S. Yusupov (of Uzbekistan), left, and Dr. Luis Iniguez (of ICARDA) examine the Karakul lambs born to screened ewes for larger conformation and skin area.

By S. Yusupov

ruminant farmers. ICARDA liaised first with the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts of Samarkand, and its fruitful research collaboration with this Institute has been growing with time.

Focusing on Karakul sheep, a first project funded by the USDA/ARS that began in 1996, was followed in 1999 by a second project on "Integrated Feed and Livestock Production in the Steppes of Central Asia" with support from the International Fund for Agricultural Development (IFAD). The new project complemented the preliminary steps taken in identifying production constraints and systems, with the development of an on-farm network, active participation of farmers, and the further strengthening of the Karakul Institute. The region of Nurata, a representative area in the territory of the Karakul sheep, was selected as the site to implement on-farm studies and test technologies. At this site, close interaction between farmers and researchers to solve production problems is taking

place along with new hopes for linking their production systems to market opportunities.

Towards the improvement of production systems with a market-orientation

ICARDA in collaboration with the Karakul Sheep Institute introduced in Nurata an interesting participatory problem-solving research planning methodology based on the identification of main production constraints and the formulation of research interventions, geared not only to understand the very nature of the production constraints, but also to help mitigate production problems. The planning of activities primarily focused on products that have an opportunity in the local markets. Major activities were framed into the following research components in 2000:

Studies on markets and socioeconomics of the production systems

- Market research allowed the identification of seasonal and regional opportunities for the products produced in Nurata, a key condition to reorient the production systems, while the characterization of typologies of production systems and their monitoring is helping to understand the evolution of changes in the sheep farming sector. The former strengths of the Institute in biophysical sciences are now benefiting from new approaches in the area of socioeconomic research.

On-farm interventions for productivity improvement

Adequate utilization of feed resources, increasing the production of the feed base and improving the condition of the resource base:

- On the basis of past research and experience, scientists at the Karakul Sheep Institute, in collaboration with the Uzbek Livestock Research Institute of Tashkent, compiled a set of 17 promising technologies that have been systematically introduced and tested in the on-farm network to overcome production constraints. These technologies that involve aspects of range management, forage production and flock management and production, will be constantly updated and adjusted during the lifetime of the project.
- Range production is being monitored and the changes in biomass production are associated with changes in production variables including bodyweights and reproduction traits through the monthly production monitoring of flocks. With farmers' involvement, the pro-

Scientists of the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts assessing range production in Nurata, Uzbekistan.



duction monitoring identified the needs of strategic supplementation and feeding during winter in farms having low production levels of biomass recorded during this period.

- Specific range interventions to improve the conditions of the production base took place in Mustakilik farms in Nurata with the establishment of 8 stripes, each having 25 m width and 1.5 km length, covering an area of 295 ha. Key species in range rehabilitation were used, such as *Halloxylon aphyllum*, *Kochia prostrata*, *Eurotia ceratoides* and different combinations of *Salsola*, *Agropyrum* and *Atriplex*. The testing of planting of seedlings vs. transplants of 4-year rooted shrubs was part of techniques used for promoting rapid range rehabilitation.
- Scientific collection missions were organized to collect valuable native

germplasm with forage value and potential for further interventions in range improvement and rehabilitation. Over 100 collected species are now being multiplied and will be transferred to farmers' rangelands in 2001.

- A 12-hectare demonstration plot of intensive production of forage was established on a farm, to capitalize areas having water supply from local drainage and artesian wells. The idea behind this is to increase the production of forage for winter-feeding. Species under test involve triticale, oats, alfalfa, sorghum, sainfoin, sesame, and chickpea.
- A new initiative geared to the utilization of non-conventional feeding strategies is assessing the potential of mulberry trees as supplementary forage for small ruminants. Large areas of Uzbekistan possess mulberry trees for the production of silkworm. The utilization of leaves is seasonal and occurs during the month of May, after which the leaves are left unused. The possibilities to produce an additional cut in September-October for supplementary feeding will be tested in 2001. It is also hoped that in 2001 cactus material will be tested in the on-farm network.

Efficient livestock production by applying adequate flock management practices integrating nutrition, reproduction, breeding and animal health

- Strategic feeding is capturing the interest of farmers. Older pregnant Karakul ewes with lower weights at the end of the fall could be very impaired and eventually may not survive the winter conditions, in particular if winter is severe. In fact, farmers from Nurata suffer from these losses by the end of winter. Ewes strategically supplemented at the start of the winter season not only ended this critical period with 8 kg more weight than control unsupplemented ewes but also an excellent condition for lambing and sustaining their lambs in spring. This result is encouraging farmers to look more carefully for means to

store forage for winter and utilize more efficiently the stored forage.

- A market-oriented flock of Karakul sheep is on test in Nurata. Animals with large conformation were screened in Diamond Sur and Zarnalla Karakul flocks to constitute a flock with ewes 7 kg heavier than control ewes. Consistently the lambs born to screened ewes had larger skin areas, were heavier, grew faster and performed with lower mortality rates than the control lambs. The difference suggests a higher milk production potential among screened ewes, a condition to be tested before this flock could integrate a breeding scheme in Nurata.
- Early weaning associated with fattening of sheep is becoming familiar to farmers who are progressively adopting this practice as a means to enhance income, recover early-weaned ewes for the next breeding season and help reduce spring overgrazing.
- Efforts have also started to explore the capacity of Karakul to produce milk. If Karakul lambs are to be used for pelt production, then ewes could be milked for enhancement of income.

Building capacity

Scientists at the Karakul Sheep Institute consider that ICARDA's efforts in establishing an effective interaction with farmers to implement on-farm interventions was the most important contribution to institutional strengthening. Other important facets of institutional strengthening in 2000 included:

- The development of specific workshops for farmers, and promoting their active participation, in on-farm interventions.
- The training of the Institute's scientists at ICARDA in the area of range and forage production, and local training to improve computer and English skills.
- Hosting of a regional workshop on feeding strategies in Nurata and participation in two regional workshops on socioeconomic research (Kazakhstan) and range methodologies (Turkmenistan), which helped

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Management of Genetic Diversity of Small Ruminants in Central Asia and the Caucasus

Integrating genetic improvement of small ruminants with simple breeding programs and market-oriented production strategies could help to revitalize the management of flocks and increase income of livestock farmers in Central Asia and the Caucasus.

Old chroniclers and world travelers wrote captivating fantasies of the vastness of the steppes, endless rugged ranges, unthinkable creatures roaming the prairies of the ancient Silk Road of which the Central Asia and the Caucasus was an important part. This vast area, extending over 2,700-3,000 km between West Asia and China and Mongolia, links the Mediterranean with the Pacific coasts of Asia through a mosaic of ecosystems that harbor a wealth of plant and livestock diversity. The region itself is the center of origin and diversity of many domesticated species, sheep and goats among them.

In the harsh and fluctuating climate of the region, specialized breeds of sheep and goats have emerged as a result of natural and artificial selection to serve the needs of pastoralists and populations. During the Soviet era, this wealth was supplemented with synthetic wool breeds that resulted from cross-breeding programs to suit the production of large state-owned farms.

There are today about 39.8 million heads of sheep and goats, dispersed over nearly 254 million ha of rangelands, and at least 30 indigenous breeds of small ruminants, in addition to the various improved synthetic breeds.

Following the breakdown of the Soviet Union (SU), the collapse of support services and disruption to markets, the livestock sector lay devastated. In Kazakhstan, for example, nearly 97% of the national sheep flock, amounting to 36 million heads before the dissolution of the SU, was lost in less than a decade. Fragmentation of stocks has occurred as a result of the privatization



Wool sheep in the foothill steppes of Kazakhstan where ideal conditions exist for enhancing lamb production to meet the high demand in the urban markets.

and dissolution of large holdings. And the lack of organized breeding programs made it difficult for farmers to obtain improved stock.

ICARDA and the NARS of CAC countries, with the financial support of USDA and IFAD, launched a research strategy in 1998/99 to help mitigate the problems confronted by the livestock sector, and improve management of the region's small-ruminant genetic diversity. The strategy follows a natural resource management approach and considers that markets are the driving force for improving small holder livelihoods.

The strategy contemplates:

- Diversity characterization, assessing how diversity suits farmer livelihoods, and production strategies to cope with production constraints.
- The reorientation of production systems on the basis of potentials and

By Luis Ñíguez

market possibilities.

- Access of farmers to improved sources of germplasm.

Characterization of breeds

Documentation on the characterization of breeds of the Soviet Union period was the first task that ICARDA undertook. This information, compiled by senior scientists from the eight participating countries, will soon be published electronically on the Internet, in the form of a photograph-illustrated

document containing information on breeds with potential for production under new emerging markets.



Flock of Caucasian sheep and goats in Azerbaijan, a region that is known to be a domestication center of small ruminants.

Among the breeds characterized are Gissar sheep from Tajikistan and Uzbekistan—the largest of the region's breeds; the breeds of goats for cashmere and mohair production from Kazakhstan and Kyrgyzstan; the different Karakul strains from Kazakhstan,

Uzbekistan and Turkmenistan; and sheep and goat breeds with milk production potential from the Caucasus.

ICARDA also initiated a modest effort to characterize the genetic resources on-farm, in order to assess the suitability of breeds under current production scenarios. This work will be complemented by further actions in the Caucasus in collaboration with the International Livestock Research Institute (ILRI), led by Dr Ed Rege, with the support of the CGIAR's Systemwide Livestock Program. It involves a monthly production monitoring of breeds for at least two lambing/kidding seasons, and recording the production system types associated with those breeds.

ICARDA's plan will also involve the study of genetic relationship among breeds. The focus will be on the genetic differences among different fat-tailed sheep and goats that serve farmers along the Silk Road, including their domestication and dispersion throughout this route.

Production orientation

In addition to recent market studies, the on-going characterization of breeds is providing key information for the reorientation of production systems in the region. A University of Wisconsin-Madison (UW) team, led by Dr Dave Thomas through the Global Livestock-



Dr Ibragimov from the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts, Samarkand, Uzbekistan, holding a 92 kg 2.5-year-old Gissar ram. Gissar is the largest sheep breed of Central Asia and the Caucasus.

Collaborative Research Support Program of USAID (GL-CRSP), recently introduced a new sheep genotype to the foothill environments of Kazakhstan. This genotype could help to repopulate the regional flock and meet the demand for lamb in local markets.

ICARDA, in partnership with UW-Madison, will extend and test the suitability of this technology in appropriate regions of Kyrgyzstan and Uzbekistan. The aim is to provide alternatives to wool production in traditional wool areas where production has stagnated due to lack of incentives—a reflection of extremely low wool prices.

Production stagnation is also apparent in the Karakul sheep industry which used to supply pelts to the large Soviet Union market. Following the collapse of this market, a search for alternative outlets is underway. ICARDA and its collaborators at the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts, together with the Agricultural University of Turkmenistan, are evaluating milk production in Karakul sheep. ICARDA, UW-Madison and local NARS are also testing improved dairy sheep germplasm that could add value and provide alternative income.

In late 2000 ICARDA invited Dr Joaquin Mueller, a known specialist in fiber and wool production improvement from the National Institute for Agricultural Technology (INTA) of Argentina, to assess the potential for cashmere and mohair production in Kazakhstan and Kyrgyzstan. Dr Mueller stressed the importance of quality and competitiveness, as well as production, for products aimed at export markets. He said that “despite favorable international prices for mohair, cashmere and fine wool, most farmers in Kazakhstan and Kyrgyzstan obtain only a fraction of international market values. Sometimes the achieved prices do not compensate for production and harvest costs. There are many factors impeding access to international prices, including unfavorable marketing procedures, excessive intermediation, and fiber quality deficiencies. A comprehensive and tedious but inevitable task is needed to adapt production and marketing procedures to competitive standards.”

Dr Mueller added: “The message for Central Asian fiber producers is that while during Soviet times empha-

sis was on bulk production, today and in the foreseeable future quality will determine market possibilities and price level.” According to Dr Mueller's assessment, a well-structured plan involving adaptive research and the active participation of farmers is needed to develop sustainable and quality production protocols and a simple but continuous breeding program. This could provide an attractive alternative for specific ecoregions in both countries.

Access by farmers to improved germplasm

After the dissolution of the Soviet Union the livestock production sector received minimal support in terms of research and technology transfer. Breeding programs virtually disappeared. A few elite flocks were rescued by concerned scientists and institutions, for example, the Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts.

There is a tendency to consider that solutions will lie in reimplementing or revitalizing efforts to keep the elite flocks under the control of state organizations, and build expensive facilities for artificial insemination or introduce improved germplasm without a well-designed breeding strategy. ICARDA and its partners are exploring the possibility of integrating simple breeding programs into market-oriented production improvement strategies, focusing on flock management, nutrition and health, and with farmers having a leading role in the genetic improvement of the flocks.

Based on the experience of INTA in Patagonia, Argentina, Dr Mueller suggests that a simple program, for instance for mohair improvement and marketing, integrating genetic improvement with improvement of on-farm shearing, skirting, classing and collective fiber auction is the way to establish a sustainable program that will allow small farmers to directly benefit from improved germplasm. Dr Mueller says that “these schemes will require initial investments in training of farmers and extension officers, but progressively become cheaper and independent.”■

Dr Luis Iñiguez is Small-Ruminant Scientist at ICARDA, Aleppo, Syria.

Improved Land and Water Management Boosts Wheat Production in Turkmenistan

ICARDA and Turkmenistan scientists are together developing appropriate agricultural techniques that would assist farmers in making an efficient use of the available land and water resources to boost their wheat production.

Wheat has been one of the major agricultural crops in Turkmenistan for many centuries. Its share in the country's crop structure is a high 700,000 ha, approximately 38% of the total irrigated land area. However, extensive farming puts a heavy stress on available land and water resources. Lack of knowledge and skills among farmers in appropriate agricultural techniques such as water-conserving tillage and irrigation methods also undermine the productive use of this diminishing natural resource base.

A joint research team consisting of scientists from ICARDA and Turkmenistan is working to develop advanced technology in water-conserving tillage and appropriate irrigation schedule, with a view to increase water productivity and reduce production

cost and soil fertility loss. The traditional pre-sowing tillage used in Turkmenistan in wheat is moldboard plowing at a depth of 30-32 cm. This requires a heavy use of irrigation water. The ICARDA/Turkmenistan team of scientists analyzed soil moisture content and other soil properties at an experimental site. They also tested the following four pre-sowing soil tillage treatments with appropriate irrigation rates and schedules: moldboard plowing to 30-32 cm depth (control), moldboard plowing to 20-30 cm depth, chiseling to 15-16 cm depth and disking to 10-12 cm depth.

Research results indicated that disking to a depth of 10-12 cm was the most effective way of saving water.

Although winter wheat yields were similar (5.4-5.7 t/ha) using the four pre-sowing tillage treatments, water

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and E. Khankuliev

consumption with the disking method was 3,380 m³/ha compared with 4,402 m³/ha with the moldboard plowing system. Thus, water-conserving tillage technology saved about 23% water and helped improve irrigated lands and water-salt regime. Eventually, this translates to improved water productivity, increased production, and reduced soil and fertility loss through erosion. Even assuming that 50% of the 700,000 ha of the irrigated wheat area adopts a production system that includes chiseling or disking, at least 357 million m³ of water will be available to irrigate more land and improve its productivity. ■

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Deep and shallow plowing made no significant difference in wheat yields in Turkmenistan, but shallow plowing saved water that could be used to irrigate more land to increase overall wheat production.

Innovative Irrigation System for Higher Yields with Less Water in Kazakhstan

Under an alternate furrow irrigation scheme, water productivity in Kazakhstan increased by over 80% compared with traditional furrow irrigation for field crops in Central Asia.

Irrigated agriculture is the norm in Arys-Turkestan Canal (ATC) area in the south of Kazakhstan. This arid area of about 60,000 hectares is characterized by an extreme continental climate. Most crops in this area are grown with irrigation. Cotton is a key crop. But relatively low air humidity in summer, plus significant evaporation over the amount of rainfall (1:7), result in the secondary salinization of the irrigated lands.

During the Soviet era, 490 vertical wells were installed with the dual purpose of meeting the water deficit during the vegetative period of crop growth, and to serve as drainage wells to relieve roots from both salinity and water table build-up. The system provided 120–150 million m³ of groundwater annually for irrigation.

At present, however, this system is not functioning. The volume of water in Bougoun Reservoir—the main source of irrigation water in the ATC zone during the vegetative period—is not sufficient for the irrigation of 60,000 hectares. The reservoir's storage capacity is 370 million m³ of water with an average salt concentration of 500 mg/l total dissolved solids (TDS) or electrical conductivity (EC) equal to 0.8 dS/m.

Under the ICARDA/Kazakhstan collaborative "On-Farm Soil and Water Management Project," research activities were initiated in 1999 on the development of soil, water, and crop management technology in drainage-impacted areas. This research aims to sustain soil and improve water productivity and agricultural output in the ATC zone and elsewhere with similar hydrosalinity conditions.

To achieve these objectives, advanced irrigation technologies, such as alternate furrow irrigation, have been introduced and tested at an experimental 50-hectare plot. The idea was to compare these alternatives with the



An alternate furrow irrigation experiment in Arys-Turkestan canal area in Kazakhstan.

**By F. Karajeh,
V. Mukhamedjanov,
and F. Vyshpolskiy**

traditional furrow irrigation system that is widespread in the region. Results of the first two years (1999 and 2000) research have shown that this alternative technology is much more effective than traditional surface furrow irrigation.

The volume of water applied during the two years was 2,317.5 m³, compared with 4,600 m³/ha in the traditional furrow. The alternative irrigation scheme helped to reduce water losses caused by surface runoff, deep percolation and evaporation. The result was increased water productivity—defined as yield divided by applied irrigation water plus annual precipitation.

Water productivity increased during the two years of research from 0.45 to 0.83 kg of cotton/m³ water. This resulted in an improvement, over the traditional scheme, in water productivity by 83% and saving of irrigation water by 48%.

The increased use of shallow groundwater for sub-irrigation contributed to these results. A sluice-regu-

lator was installed that enabled groundwater containing about 1,000 mg/l TDS, with a salinity of 1.5 dS/m, to replenish soil moisture to the root zone during the second part of the vegetative growth period. During the rest of the year, the sluice-regulator is used to prevent any rising of shallow groundwater level.

The research results have shown the significant potential of alternative irrigation schemes and technologies, as well as appropriate temporal groundwater management.

Assuming this technology is applied to the area of about 60,000 ha, and farmers were able to reduce their applied irrigation to achieve a 25% water saving over the traditional furrow practice, the existing cotton yield should be maintained and at least 57 million m³ of irrigation water annually freed for other beneficial purposes. ■

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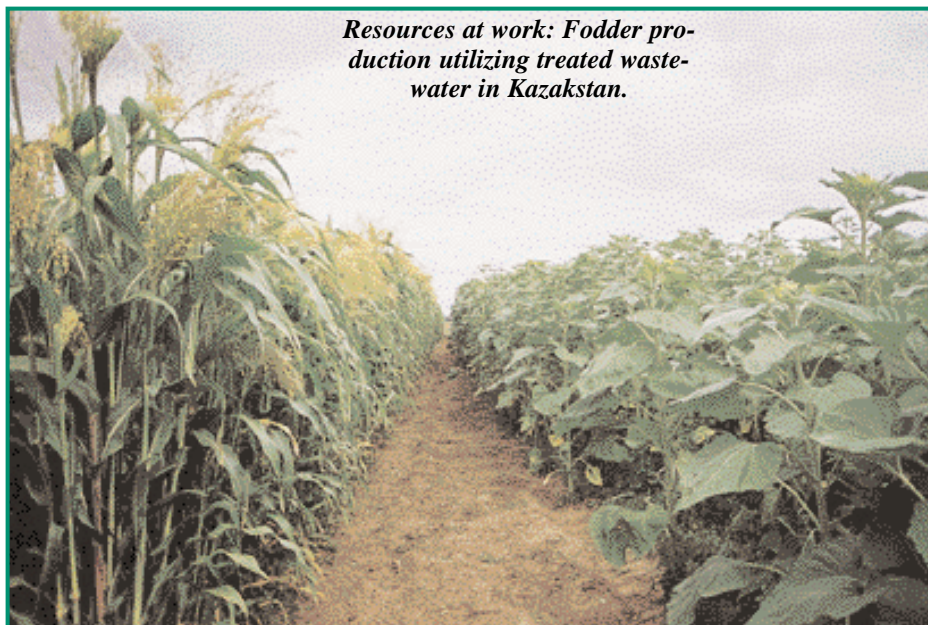
Rational water-resource use, and the protection of water from pollution, has become crucial in dry areas where water is scarce. Research at the Kazakh Research Institute of Water Management, Kazakhstan, in collaboration with ICARDA, has shown that treated wastewater can be used with success to irrigate crops. With this method, high yields can be obtained even if very limited chemical fertilizer is applied to crops, since the wastewater itself contains nutrients. The utilization of wastewater from Almaty City could have a positive impact on the environment of the whole Ily intermountain depression area.

The origin of wastewater from Almaty City is 88% municipal and 12% industrial waste. After mechanical and biological treatment, the treated wastewater flows to a collector at Sorbulak which has a capacity of 1,022 million m³ and a surface area of about 62 km². Sorbulak is one of the largest sites in Central Asia where marginal water is being collected and discharged. The system of collection and disposal is very similar to other places in the region.

The Sorbulak collector has the potential to irrigate 45,000 ha of land in hot dry zones with treated wastewater discharge, creating conditions which are favorable for grain, industrial and fodder crop production as well as tree plantations. The land must be irrigated strictly along scientifically proven methods that provide for environmental safety of agricultural production, and maintain the ecological balance of the natural resource base.

Over the last few years, the major constraint to livestock development in Kazakhstan is the lack of feed. The area under crops has decreased by 51%; it is therefore sensible to stimulate fodder crop production by using treated wastewater.

This type of system needs to include appropriate crop rotations to ensure a balanced animal diet. In an experiment on five-course crop rotation, started at a pilot site, green-mass yields of fodder crops were 74.8 t/ha for topinambur (Jerusalem artichoke); 62.5 t/ha for Sudan grass; 47.91 t/ha



Resources at work: Fodder production utilizing treated wastewater in Kazakhstan.

Using Wastewater for Agriculture

Treated wastewater is being used to irrigate crops in Kazakhstan, making farmers happier and benefiting the environment.

for sweet sorghum, and 45.43 t/ha for maize. The yield of Jerusalem artichoke's tubers was 43.3 t/ha. It is possible to get 2 to 3 cuttings of hay from sorghum and Sudan grass.

Making use of treated wastewater from the Sorbulak collector for fodder and other industrial crop irrigation will improve both the quantity and quality of crop yields and provide people with locally produced wood for fuel and other purposes. It will decrease pressure on the collector and help to protect both the Ily River and groundwater from pollutants. It will also generate more job opportunities for the people living in the area.

Soil data obtained in two years of experiments show neither a salinity buildup nor a significant accumulation

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of heavy metals in the soil. The project is investigating the impact of these results on crops, soil, people and the environment.

In 2001, research on the biological resources in Sorbulak Lake will be initiated to assess the potential of utilizing fish species for fish meal production to help meet the deficit of animal protein in livestock diet.

In conclusion, using treated wastewater for irrigation will help to facilitate the sustainable development of feed and livestock production at farm level of Sorbulak district. This will eventually contribute to an improvement in people's living standards and to the economy as a whole. The technology could also be applied in areas outside the region. ■

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Global Warming and the Rangelands

In a degraded state, Central Asia's rangelands stand to add to the problems of global warming. Improved and well managed, they could be an important sink, helping to reduce carbon dioxide emissions into the atmosphere.

Central Asia's rangelands, covering an area of about 262 million hectares are home to over 50 million people—nearly 20 people per square kilometer. The region as a whole remains highly dependent on livestock production from these natural rangelands. While continuing to be important for farm livestock husbandry and animal feed production, these lands face the problem of overgrazing. This is changing vegetation dramatically within a radius of two to three kilometers around watering points, leading to desertification and loss of vegetation.

Degradation of rangelands reduces their capacity to assimilate carbon dioxide (CO₂) from the atmosphere by their vegetation for photosynthesis, and thus contributes to global warming. Rational management and improvement of these rangelands will not only increase their productivity to satisfy the growing need for feed for livestock, but will also allow them to act as a sink for CO₂ and help in reducing the global warming.

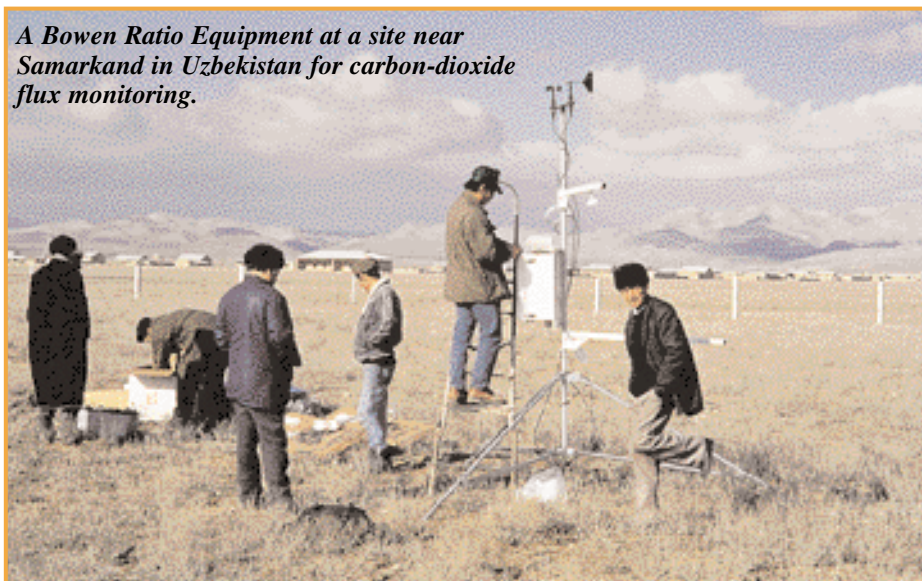
Launching of a collaborative Carbon Flux research project

In collaboration with Samarkand State University and Karakul Research Institute of Uzbekistan; Turkmen Institute of Deserts, Flora and Fauna; Kazakh Institute of Grain Farming; and CRSP and USDA Forage and Range Research Laboratory, ICARDA initiated a pioneering Carbon Flux research project in 1997 to understand the role of rangelands as a carbon sink in Central Asia. In this collaborative project, scientists from Uzbekistan, Turkmenistan and Kazakstan, together with their partners from Universities of Utah, South Dakota and California,

The project seeks to determine the role of rangelands in the global carbon cycle, and to test the utility of carbon dioxide flux technology for assessing the productivity of the various rangeland ecosystems. Flux refers to the net movement of CO₂ back and forth between the surface (soil and plants) and the atmosphere.

The measurements of CO₂ exchange between rangeland and atmosphere were made on good condition rangeland sites in Central Asia. The sites include diverse environments, from steppe and semi-deserts to desert

A Bowen Ratio Equipment at a site near Samarkand in Uzbekistan for carbon-dioxide flux monitoring.



By
Mukhtor Nasyrov

Davis, USA, and ICARDA established a network for the purpose of measuring CO₂ fluxes.

Project objectives

There are four specific objectives of the project:

1. What role do Central Asian rangelands play in the carbon cycle? Are they a sink for atmospheric CO₂?
2. Is CO₂ flux correlated to climatic or ecosystem characteristics, and are the relationships strong enough to allow their wider extrapolation?
3. What influence do land management activities, such as grazing and plowing, have on rangeland CO₂ flux?
4. Do direct measurements of CO₂ flux provide an accurate assessment of primary productivity?

rangelands (Fig. 1). For taking the measurements, the project makes use of a technology called Bowen ratio systems. Several years of field and laboratory experiments have shown the suitability of Bowen ratio techniques for rangeland conditions in Central Asia.

A Bowen ratio unit looks very much like a weather station. Bowen ratio systems at three measurement sites in Central Asia (Karnap, Uzbekistan; Karrykul, Turkmenistan and Shortandy, Kazakstan) were installed during early spring for the 1999 growing season. Field data for CO₂ fluxes and associated micro-meteorological characteristics were collected continuously at 20-minute intervals. These data were routinely transferred electronically to Logan, Utah, for processing into five-day segments. The segmented data sets were subsequently used to calculate daily integrals of CO₂ flux. These data were analyzed at South Dakota State University to eval-

uate the relationships between micro-meteorological characteristics and rates of CO₂ flux. These relationship will be used to develop predictive models of CO₂ flux for each site.

Project achievements

Activities during the 1999 growing season resulted in the successful measurements of CO₂ fluxes at all three sites. A net of 698 g of CO₂ per square meter per day was assimilated in 1999 during the growing season in the sagebrush-ephemeroïdal semi-desert system in Uzbekistan. Similar positive net CO₂ fluxes were recorded at the other two sites during the same growing season. Given the vast area of rangelands, this rate of carbon assimilation can turn Central Asian rangelands into a significant CO₂ storage sink, and they can greatly contribute to reducing the global warming. This makes the rehabilitation and management of Central Asian rangelands all the more important.

In addition to these results, the project also provides a spin-off in terms of human resource development. Scientists from all measurement sites in Central Asia are now able to maintain and fully operate the Bowen ratio system. Some of them received excellent training at Universities of Utah and California, Davis, in data processing and modeling. The project continues into the 2001 growing season. ■

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Schematic map of major natural zones of Central Asia: 1, meadow steppe; 2, typical steppe; 3, dry (desertified) steppe; 4, sagebrush-saltwort-ephemeroïdal desert (mostly northern); 5, shrub desert, often sandy (mostly southern); 6, ephemeroïdal foothill semidesert/desert; 7, mountain steppe; 8, alpine/subalpine meadow and mountain forest; 9, high mountain semidesert/desert; 10, alluvial ecosystem. Also, included in the map is a solid dark line, which depicts the general border between "northern" and "southern" deserts; (11) the broken lines; (12) depict country boundaries. CO₂-flux measurement locations are indicated as A, Shortandy site, Kazakstan (typical steppe); B, Karnap site, Uzbekistan (foothill semidesert); and C, Karrykul site, Turkmenistan (shrub sandy desert).



New Production Horizons ...

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to establish scientific interactions with colleagues from other Central Asian countries.

- Participation of Uzbek scientists in international conferences.
- Participation of Uzbek farmers in a traveling workshop in Jordan, Syria, and Turkey.
- Facilitating and promoting the pro-

jections of the Karakul Sheep Institute by stimulating the publication of scientific and informative articles. A book describing 100 range species of Uzbekistan is about to be released and a publication on the characterization of breeds in Uzbekistan is in preparation.

The Uzbek Research Institute of Karakul Sheep Breeding and Ecology of Deserts of Samarkand firmly believes that all these activities will

help in creating the conditions to enable the Karakul sheep farmers to improve their livelihoods and make a vital contribution to their local and national economies. ■

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Agriculture Sector in Uzbekistan

Increased agricultural production is an important aim of reforms in Uzbekistan. With increasing farmer awareness of the issues involved, living standards are improving.

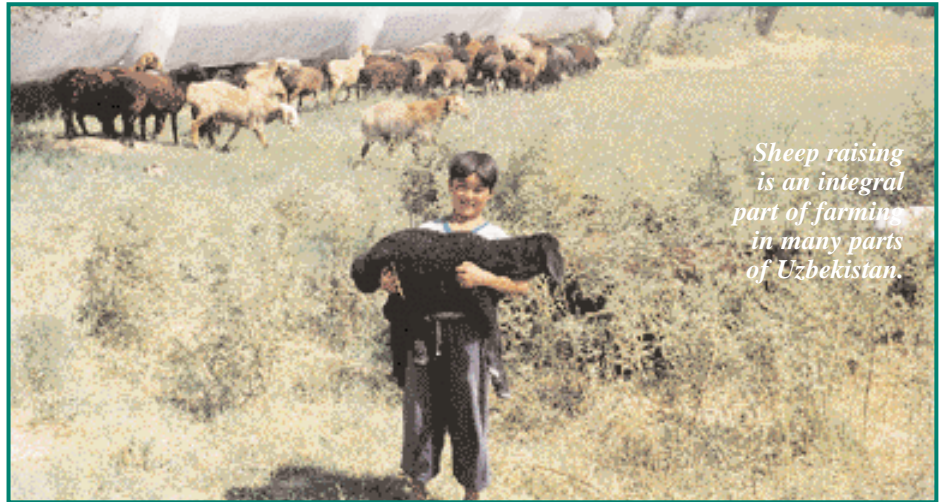
Agriculture is the leading sector of Uzbekistan's economy, contributing more than 40% of production assets, providing 60% of employment, more than 44% of national income and 70% of traded goods, and producing 90% of the food. It is the base for agro-industrial production and for the development of other leading branches of industry, and it earns valuable foreign currency. The social, economic and political stability of society depends on the agricultural sector.

There is an urgent need to develop small farm enterprises based on family ownership and inter-family enterprises. The Farm Law, which was adopted in 1998, strengthened organizational, social and agro-economic mechanisms to help small farm units.

According to this law, farming units can be established on a competitive basis, with land allotted to farmers for a period of 10 to 50 years. Farming units with livestock production must have at least 30 head of animals. For arable farming purposes, farmers are entitled to a certain minimum area of land, depending on the crop—at least 10 hectares, for example, for farmers growing cotton and grain. At least one hectare of land is allocated for horticulture, viticulture, vegetable production and similar farming enterprises. The aim of the reforms is to increase agricultural production in the country.

By January 2000 an area of 665,700 hectares of land had been allotted to farmers and some 31,090 farms were functioning. The average farm size has reached 21.4 hectares in 2000 in contrast to 8.7 hectares in 1993. More than 176,500 full-time and 19,500 hired workers were employed on these farms. About 40% had livestock—chiefly cows, sheep and goats, poultry, and horses and camels. Milk, eggs, raw cotton, cereal crops, potato, vegetables and melon are the main products.

State support to farmers, including assistance in upgrading farmers'



Sheep raising is an integral part of farming in many parts of Uzbekistan.

By
Tulkun Farmanov

skills, plays an important role in the development of their farms. At the start of 2000 a regulation came into force on issuing micro-credits from commercial banks for the development of farms and other small enterprises.

Commercial banks can loan farmers up to 50% of the total amount they need to invest in purchasing livestock, poultry and planting material.

To meet the requirements of the "National Program of Staff Training," and the process of speeding up reforms in agriculture, a large-scale program on training, developing and upgrading the skills of farmers and agricultural specialists has been running since April 1999.

"Centers for Training and Information Provision for the Farmers," attached to the Tashkent Agro-Commercial College, Tura-Kurgan and Samarkand Mechanical and Economic Colleges and Turtkul Agro-business College, have been equipped with modern information technology hardware, manuals, and handbooks on methodology and practices.



Ziadulla Farmanov examines the quality of wheat grain after harvest.



Above: Farmer Ziyadulla Farmanov (back row, fourth from left) with the team of his workers at his farm.

Short-term training workshops have taken place at the Tashkent Center for farm managers and agricultural specialists of Tashkent, Sir-Darya and Jizak regions. At Tura-Kurgan Center a workshop was organized for farmers in Namangan, Fergana and Andijan regions, at the Samarkand Center for those in Bukhara and Navoi regions, and at Tutkul Center for farmers of the Karakalpakstan Republic and Khorezm region. Training materials included manuals, bulletins, practical handbooks, magazines and newsletters, and films showing recommendations on improved farming practice.

About 5,000 people were trained in 139 workshops in 2000, including leaders and farm specialists, *shirkat* (cooperative farming unit) specialists, and officials of the Regional and District Association of Peasant and Farming Units. Valuable new skills were acquired, covering business plan development, accounting, leasing, loans and taxes, and legal matters. The focus was on small and medium-sized enterprises. During the workshops, farmers were asked for their opinions, suggestions and recommendations on the best ways of developing farming units.

A Fund attached to the Ministry of Finance was established at the beginning of 1999 to provide timely advance payments and settlement for the products delivered by farmers to the State. This helps to coordinate the activities of the Ministry of Finance, banks, purchasing organizations, producers of agricultural commodities and companies providing services and delivering machinery and spare parts.

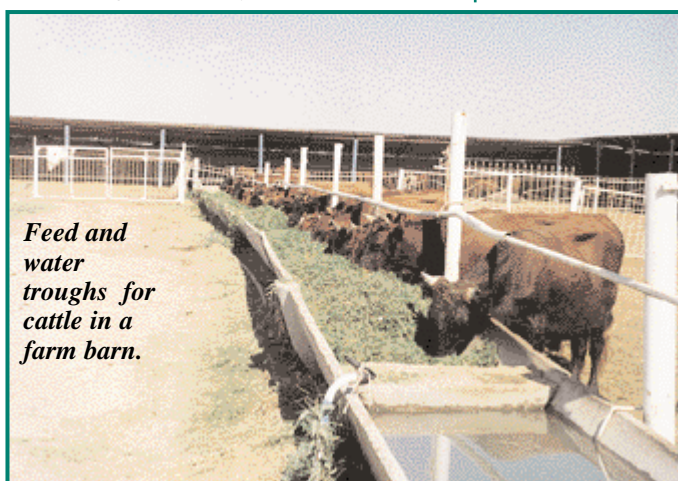
"Pakhta Bank" and "Galla Bank" are the major agents of the Fund for financing cotton, grain and rice production, purchasing and processing. The Uzbekistan Association of Cotton Industry and Cotton Marketing, (Uzkhlopkopromsbyt) and the Uzbekistan State Joint Stock Company for Grain and Bread Production, (Uzkhleboproduct) are agents for selling cotton, grain and rice.

Since independence, there have been significant changes in organizational structures which provide services for agriculture, such as inputs, repair and engineering services. In addition to changes in State bodies, a joint public-private sector venture has been estab-

lished to service imported machinery. During 1995-1997, 180 Machinery and Tractor Enterprises were established and were functioning at district level in all the regions. During 1999 these enterprises rendered services to farms totaling 22.1 billion Sum (US\$1.3 million).

In the transition period, many agricultural enterprises have not been able to make significant investments to intensify the production process. There is an urgent need to strengthen the role of leasing agreements, in order to create an opportunity for additional private investment to support domestic commodity producers.

A Government resolution on "Measures for Provision of Agricultural Machinery for Rural Areas on the Condition of Leasing," aims to further the supply of highly productive agricultural machinery to farms, and to establish conditions for developing domestic agricultural machinery. The participation of leading foreign companies is envisaged. The Resolution also aims to improve the repayment mechanism for tractors and harvesting machinery.



Feed and water troughs for cattle in a farm barn.

Modern agricultural machinery, produced by domestic enterprises with foreign company involvement will be delivered to *shirkats* for leasing over a 7-year period. This should assist the development of leasing activity in 2001-2007. Under the terms of the leasing, 85% of the cost of harvesting machinery and tractors will be funded by a State holding company, and 15% will be paid in the form of advance

Farm workers stack lucerne (medicago) hay bails for animal feed to be used specially during winter.



payment by area associations of Machinery and Tractor Enterprises, agricultural cooperatives and farms.

Preferential loans for farmers are important during the transition period in order to encourage efficient utilization of land, and to strengthen the incentive to establish financially sustainable enterprises.

To simplify and unify the taxation system, a unified land tax was introduced in January 1999 for producers of agricultural commodities. This tax replaces nine central and local taxes and fees. The unified tax is applied to the land area allotted to the farmer for usage or leasing for farming. Tax rates for land have been established in the form of a fixed fee per unit of land area, taking location, quality and access to water into account. The tax is

charged independently of a farmer's end results. This again encourages farmers to increase output and improve efficiency of land utilization.

Within a short period of 10 years, the changes have given strong confidence to the farmer as owner and master of his land under the market

economy. Farmer awareness of economic issues is developing, and it is leading to an improvement in socio-economic standards of the people of Uzbekistan. ■

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Central Asian Farmers Benefit from West Asia Visit

A "Traveling Workshop" gave farmers and scientists from Central Asia a valuable opportunity to meet their counterparts and see farms in West Asia in action.

A group of 10 farmers, farm managers and scientists from the Central Asian countries, (Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan), spent two weeks in Jordan, Syria and Turkey, in July 2000, to see market-orientated farming systems for themselves. The visit was part of the IFAD-supported "Integrated Feed and Livestock Production in the Steppes of Central Asia" project.

By Mekhlis Suleimenov

Khanasry research station, they saw small-ruminant management research in action.

The delegation was then received by the Secretary General of Jordan's Ministry of Agriculture, Mr Mazen Khasawneh, who gave an overview



Visitors from Central Asia with a Jordanian farmer at the milk processing cooperative facility.

of the country's livestock industry and its contribution to the national economy. He answered questions on livestock numbers and productivity, breeding programs and veterinary service, forage production and feed supplies, taxation policy, interest rates and stocking rates, and milking technology for small ruminants and camels. Visitors were impressed by the way Jordan has developed its apple industry, moving from net importer to net exporter of the fruit.

In a visit to the Jordanian Cooperative Corporation, the Central Asian farmers and scientists were keen to know about cow milk productivity, cow fertility rates, milk pro-



A Turkman farmer (holding a lamb) with a Syrian farmer at the latter's farm house.

ductivity, cow fertility rates, milk pro-

The group consisted of private farmers from Turkmenistan and Kazakhstan; a private farmer and a manager of a large farm from Kyrgyzstan; two directors of restructured large farms from Uzbekistan; and directors of livestock research institutes in Kazakhstan, Uzbekistan, and Kyrgyzstan.

In Jordan the group was hosted by the National Center for Agricultural Research and Technology Transfer and briefed by its DG, Dr Abdel Nabi Fardous and other senior officials. The questions posed by the visitors reflected the problems they encounter in their own countries. They were interested in knowing the strength of government support to agricultural research and pleased to hear that it is substantial, 90% of the total budget of the Center.

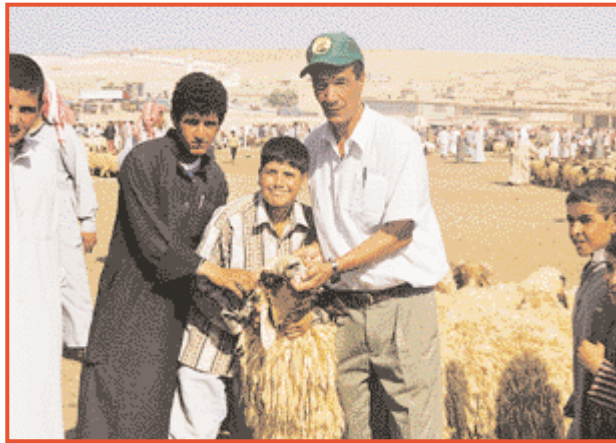
The visitors were amazed to learn that scientists are not involved directly in extension service issues and that farmers do not pay for technology transfer. They were impressed to hear that 35 university professors have been involved in the Center's research projects. Visitors also saw the technology to make feed blocks from agricultural by-products and, at



Central Asian farmers and scientists visiting the Sheep Unit at ICARDA's headquarters in Aleppo, Syria.

cessing and, most important, about profits. During the visit to a milk processing cooperative in Eder they tasted *jamid*, the product known in Central Asia as *kurt*. An intensive in-barn sheep operation was also visited.

From Jordan the group traveled to ICARDA, Aleppo, in Syria, where it saw forage and small ruminant projects, feeding systems and animal science laboratories. The visitors were particularly interested in the constituents used in making the feed blocks, length of the milking period and the milk productivity of sheep and goats. They were also taken to the Steppe Directorate nursery at Odami. They called on a sheep farmer and were shown Atriplex-barley rotation on marginal land at Khanasser. The Central Asian farmers were



A Turkman farmer at the livestock market in Aleppo.

El-Bab, the visitors asked how the farmer had fared during the long drought. He replied that one of his actions was a significant cutback of his flock, from 250 to 100 ewes. There were questions about revenue, sheep management, milk productivity and fertility of ewes, early

weaning and animal health management, as well as about feed production and purchase. Finally the host was asked what will happen if the drought continues. Most probably, there'll be no livestock left, was the answer.

In Turkey the delegation was welcomed by the Assistant Director of the Central Institute of Field Crops in Ankara, Dr Aydan Ottekin. The program included a visit to the Kargaly village-range rehabilitation area in Polatly region. Rotational grazing—the application of fertilizers followed by a rest period—had tripled the productivity of this range.

The visitors were surprised to see a quite large State farm in Polatly with 22,500 ha of land—surprised because there is a general understanding in Central Asian countries that State farms existed only in the Soviet system. Most of the scientists were happy to learn that this State farm is rather efficient, producing certified seeds and breeding livestock for farmers. The participants were impressed by healthy and happy looking sheep and cattle on the farm.

Questions covered input and output prices, variation of meat and wheat prices during the year, agricultural policy, the role of the government, crop yields and livestock productivity, methodology of sheep breeding, artificial insemination and conservation of semen. One question on marketing suggested that this is not yet a priority area for scientists from the former Soviet Union.

A visit to TEMA's range rehabilitation area in Bolu-Seben village was found particularly interesting. TEMA is the Turkish NGO that unites scientists, farmers and other interested groups in the country to combat land degradation. Its activities include the



Central Asian delegation on a range rehabilitation site in Turkey.



Central Asian visitors watch sheep milking on the farm of Mr Abu-Hassan in El-Bab, Syria.

shocked to see the extremely harsh conditions of steppe in Syria, aggravated by the severe drought of recent years. "If this is steppe," said one of the group, "then what is desert?"

The program included visits to the on-farm Dairy Sheep Adaptive Research Project in El-Bab and to Aleppo's livestock market where the traditional foods of local farmers were sampled. Later the visitors had the opportunity to watch the milking of Awassi ewes and to taste the milk products, *ayran*, yogurt and cheese, which they found delicious.

In a house visit to the key farmer participating in the ICARDA project in

Who were in the group of visitors?

Farmers:

Mr Sazak Ymamgulyev and Mr Hydyrguly Sapargulyev (Turkmenistan); Mr Zheniskul Zhakipbekov (Kazakhstan); Mr Tohir Holtoyev and Mr Fazlitdin Akhmedov (Uzbekistan); M Stanbek Sultanov and Mr Azamat Tukeyev (Kyrgyzstan).

Scientists:

Dr A. Ombayev (Kazakhstan), Dr S. Yusupov (Uzbekistan) and Dr A. Ajibekov (Kyrgyzstan).

fencing of a degraded range to implement rotational grazing for sustainable range management, assisting in the provision of forage seeds for reseeding rangeland, and producing more forage crops on the cropland. The lack of

Integrating Science and Agricultural Production in Turkmenistan

Among a range of activities, the productivity of biomass has more than doubled on experimental farms in Turkmenistan, low-cost feed has been developed and farmers are learning how the banking system works.

With ICARDA's cooperation, the IFAD-supported "Integrated Feed and Livestock Production in Steppes of Central Asia" project is being carried out successfully in Turkmenistan. The project, which began in the country in October 1999, is being executed by scientists at the Turkmen Agricultural University, the Research Institute of Livestock Breeding and Veterinary of the Ministry of Agriculture, and the National Institute of Deserts, Flora and Fauna of the Ministry of Environment, in collaboration with ICARDA scientists. Two farms in Geok-Tepa Etrap district are serving as experimental sites for project activities, which are based on the program of reforming the agricultural sector proposed by the President of Turkmenistan.

This program embraces social and economic development, improvement of livestock production, range rehabilitation, rational use of soil moisture, on-farm fodder production in deserts, utilization of local natural resources for sheep feeding during fattening, production of sheep products, and animal health and prophylaxis.

In the transition to a market economy, new conditions of farm management have required farmers to understand basic economics. Under the project, two farmers have studied how the banking system works, how loans can be obtained to help in the processing of milk into dairy products, and how these products can be marketed.

A feed production technology was employed under which an area of 25 hectares was planted with maize,



Turkmenistan scientists, Prof. Omar Redjepov (fourth from left) and Dr Eziz Khankuliev (right) at a soil tillage and water management experiment site at Akhal station, near Ashgabat, with Dr M. Suleimenov (left), Dr F. Karajeh (second from left), Prof. Dr Adel El-Beltagy (DG of ICARDA, third from left), Dr S. P. S. Beniwal (third from right), and Dr Jitendra Srivastava (from the World Bank, second from right).

By
S. Kherremov

sorghum, alfalfa and barley, and irrigated with wastewater. Drainage water was collected and used to irrigate range plants. This activity increased the productivity of above-ground biomass in the rangelands by 260%.

The production of salt-resistant plants (halophytes), irrigated with reused drainage waters, allowed a feed reserve to be built up in the ranges where sheep are kept in winter. This extra reserve of feed is a useful insurance for farmers in desert areas.

Other activities included a veterinary-disease survey on the range area of 240 hectares, the development of a rangeland map, and of a rational system of seasonal grazing.

A low-cost feed has been developed, consisting of cereal straw and cotton stems, mixed with grass meal

and concentrates. This can be successfully used for fattening culled ewes and young stock after weaning (4 months). Several diets were developed for fattening of sheep. Sheep fattening with low-value feeds decreases the number of non-productive sheep and releases range resources.

Sheep farmers were provided with recommendations on early mating and winter lambing that allowed them to use green vegetation more effectively and increase productivity, including gains in animal liveweights. Durable methods of on-farm sheep management were developed, including the best

ecological ways to identify adequate mating and lambing time.

When mating is in September, ewes are more fertile and their productivity is higher as they still have a good weight. The lambing comes in February and ewes recover their live weights rapidly, providing a lot of milk and good feeding for the lambs. Lambs born in February are stronger and healthy, and better able to eat vegetation which is rich in vitamins and mineral substances. They are also less likely to be infected with disease. Early insemination and late lambing has been found to be expedient and profitable.

Scientists and veterinary specialists are surveying the parasitic diseases on individual farms and developing appropriate control measures. On the basis of collected materials, certain treatment and prophylactic activities are being carried out.

The appropriate management of the project by ICARDA and its strong

linkages with scientists of Uzbekistan, Kazakstan, and Kyrgyzstan is helping the project to be successfully implemented. Traveling workshops, meetings, and consultations organized by ICARDA have been part of this collaboration. One such meeting that promoted closer collaboration was the meeting of the CGIAR Collaborative Research Program Steering Committee in the Turkmenistan capital, Ashgabat City, 30 May to 1 June 2000.

In June 2000 a regional workshop

of the project was held in Ashgabat. Scientists from Kazakstan, Kyrgyzstan, Uzbekistan and Turkmenistan took part and discussed issues associated with rational utilization of range resources. Scientists from Turkmenistan were invited to participate in workshops and meetings held in Tashkent, Samarkand, Almaty, Syria, and Turkey. Two farmers, H. Saparkuliev and S. Ymamkuliev, took part in a traveling workshop organized in Turkey, Jordan and Syria, which was very useful in

gaining knowledge and information on successful farm management in market conditions.

In collaboration with ICARDA, the integration of science and agricultural production is continuing and acquiring new strengths. ■

Dr S. Kherremov is Dean of the Faculty of Veterinary Science at Turkmen Agricultural University, Ashgabat, Turkmenistan.



'Mamluk' Excels in Armenia

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mented. Armenian extension service specialists plan to buy a big quantity of elite seeds from the originator institute (Krasnodar), with financial support from international donors. The prompt introduction of 'Mamluk' into farmers' fields requires 50 tonnes of original

seeds in order to start seed multiplication on specialized farms.

Armenia's cooperation with ICARDA promises new directions to achieve rapid success in developing new barley lines that would meet the acceptance of farmers in the country. ■

Dr A. Petrosyan is Head of the State Committee for Variety Testing, Ministry of Agriculture, Armenia; Dr V.

Shevtsov is ICARDA's Senior Barley Breeder at the ICARDA-CAC Regional Office in Tashkent; Dr R. Kazaryan is Head of Seed Production Department, Research Center of Crop Husbandry and Plant Protection, Echmiadzin, Armenia; and Dr S. P. S. Beniwal is Regional Coordinator of ICARDA-CAC and Head of the Program Facilitation Unit of the CGIAR-CAC Program, Tashkent.

Central Asian Farmers...

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experience in Central Asia about environmental issues, the role of NGOs and activities to raise public awareness, was recognized by the group.

In Chankyry district the delegation visited the Agriculture Directorate and were acquainted with livestock production, milk processing and range rehabilitation projects.

Commenting on their experience from the traveling workshop, Prof. S. Yusupov, Mr T. Holtoyev and Dr F. Akhmedov said: "The workshop gave us a thorough insight and analysis of activities in West Asia. ICARDA scientists showed us, with concrete examples, what is needed to make farming work on harsh rangelands, in severe climatic conditions."

In view of these participants, the following points were of particular importance:

- The personal interest of farmers in the success of the enterprise.
- The value of professionalism.
- Private ownership of production.
- Proper and rational use of ranges,

the organization of range rotation and range improvement activities.

- The organization of wholesome feeding of animals through the use of various by-products, vitamins and mineral additives.
- The use of state-of-the-art technologies of animal husbandry management (early lambing, early weaning and fattening of lambs).
- Targeted work to increase fertility, maturity and productivity of animals.
- The use of mini agricultural machinery.
- The processing of outputs into final products by farmers.
- Availability of markets and farmers' awareness of them.
- Availability of a contemporary settlement system.
- The opportunity to interact and exchange knowledge and experience.

"Based on what we observed during our visit, it seemed to us that successful enterprises work together into cooperatives, associations, etc., they have access to land, water, soft credit and

insurance systems, have close links with scientists and introduce scientific developments into their farming. Also, that range use legislation exists and that the State supports rangeland, water supply, road construction and other efforts to improve infrastructure."

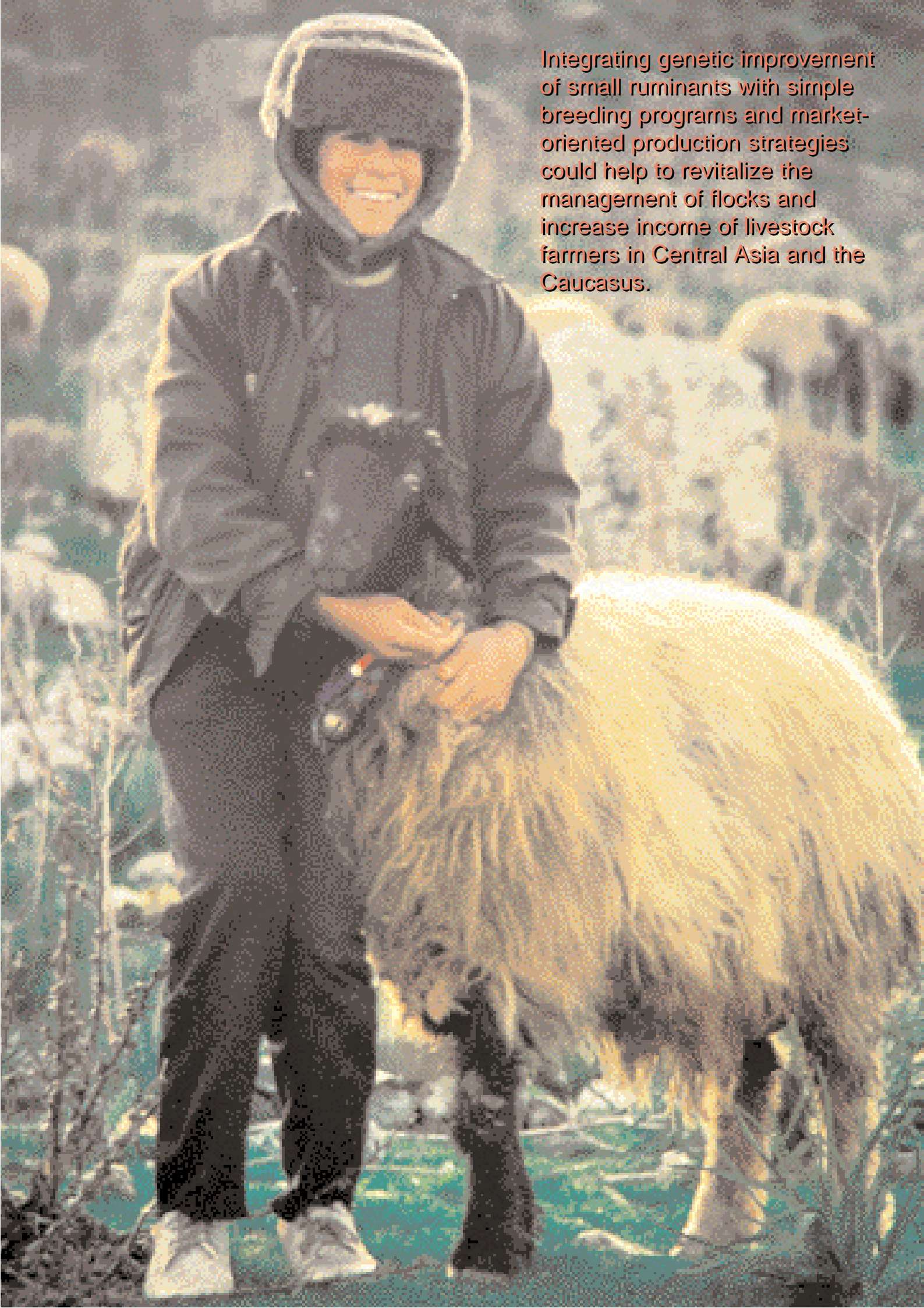
All the Central Asian visitors were grateful to the workshop organizers from ICARDA (Drs L. Iniguez, M. Bounejmate, M. Suleimanov and S.P.S. Beniwal), who contributed to a successful dialog among the farmers from the two regions. The organizers encouraged participants to share experiences and gave them the opportunity to speak out and comment on the problems that were discussed. Especially excited were farmers who were traveling abroad for the first time. It was a good opportunity for scientists, farm directors and farmers from the four countries to interact and exchange knowledge. Everybody went back home happy and full of ideas after a very enjoyable and useful trip. ■

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ICARDA's Regional Programs



Bringing scientists together for a sustained partnership is a key part of ICARDA's role in alleviating poverty and securing food supplies in its mandate area. Seven regional programs, six in Central and West Asia and North Africa (CWANA) and one in Latin America, act as a mechanism for resource use effectiveness, eliminating duplication of effort, balancing activities according to the identified needs of each country, exploiting spillover of research from one region to another and, more importantly, for providing a research continuum and a long-term vision of the impact of ICARDA's work.

A woman wearing a dark, hooded jacket and dark pants is smiling and holding a small, dark-colored lamb. She is standing in a field with several other sheep in the background. The scene is outdoors, likely in a rural or mountainous area. The text is positioned in the upper right corner of the image.

Integrating genetic improvement of small ruminants with simple breeding programs and market-oriented production strategies could help to revitalize the management of flocks and increase income of livestock farmers in Central Asia and the Caucasus.