Diversification and Sustainable Improvement of Crop and/or Livestock Production Systems in Dry Areas (MegaProject 4)

Small Ruminant Production in the Dry Areas

Introduction

Small ruminant (SR) production contributes to the livelihood of resource-poor producers in the dry areas and develops in a context influenced by two critical trends: (i) expanded market demand for livestock products leading to productivity and income improvement opportunities, and (ii) feed shortages reflecting water scarcity, exacerbated by the rangelands' progressive productivity decline. Moreover farmers are intensifying their production systems and counterbalance feed shortages with enhanced crop-livestock interactions. Market-oriented research is also needed to help farmers to overcome production problems, increase productivity and re-orient/diversify production. The search for suitable production strategies should anticipate global changes that are expected to impact the dry areas. In this context, knowledge of how animal genetic diversity suits market opportunities and products under more constrained conditions is also needed and is expected to orient the rational exploitation, management and conservation of animal genetic diversity. In response to these needs, in 1998 the project formulated a market-oriented strategy focused on: research on market opportunities and production constraints, technology development with a market orientation, including capture of value addition, and research on biodiversity to match the breed's potentials to those of the production base and markets. This strategy emphasizes active participation of farmers, NARS and ARIs; multidisciplinary work, and successful fund-raising to allow implementation of the strategy.

Achievements

Markets and market opportunities for livestock and livestock products was initiated

- Market opportunities for livestock products were identified in some countries of CWANA and Latin America (LA) and a research framework was introduced to national partners.
- In CAC, an IFAD-funded project on production reorientation and diversification of systems in stagnation due to lack of markets (case of wool and pelts) was successfully implemented. A second phase of the project will start in April, 2006.
- In Syria two successful on-going market-oriented projects supported by Japan and the Austrian University of Natural Resources and Applied Sciences (BOKU), respec-

tively, contributed to improvements in milk processing systems, including capture of added value and improvements in fattening systems. A processing plant was installed in the Center to support community-based research.
- A portal for a Virtual Information and Communication Center for SR in LA was created.
- Research to change the breeding patterns of Awassi sheep in Syria to target out-of-season production was successfully conducted.

Research on meat and milk product quality was introduced to the Center
- The effect of unconventional and conventional feeds on the organoleptic properties of meat and milk processed products was evaluated.
- An epidemiological study was conducted in Northern Syria to assess the incidence of brucellosis in the flocks. Management strategies to reduce this health threat were proposed.

Participatory tools were introduced in small ruminant research
Participatory tools were introduced and the first training course on the subject was organized. Associated methods were implemented in Syria, CA and LA.

Animal genetic resources in CWANA were characterized
Research on phenotypic and molecular SR breed characterization involving on-station and on-farm evaluations was introduced in ICARDA. On-station characterization of SR breeds of West Asia and North Africa (WANA) and Central Asia and Caucasus (CAC) co-funded by SGRP-IPGRI and CAC USDA respectively, was documented and risks to diversity assessed. Two books on the subject in WANA were published and a third book on CAC is in press. The genetic differences among Awassi sheep ecotypes in Syria were screened. The effect of market and consumer trends on genetic diversity in Tunisia and steps necessary for rescue and market insertion of the Sicilo-Sarde sheep was assessed.

Restricted project funding was increased
The project was successful in raising funds for restricted projects, namely: Market insertion in LA (IFAD-US$1 million), Dairy Sheep Production in Northern Syria (Swiss-US$60,000), Improvement of Dairy Sheep Production Systems in Syria (Japan-US$150,000), Markets and Breed Diversity and Re-insertion to Markets of Sicilo-Sarde Sheep in Tunisia (USDA-US$45,000), Genetic Diversity Research (ICWG-GR/IPGRI-US$40,000), Crop-livestock Interactions in Central Asia (IFAD-US$1 million), and Virtual Information and Communication Center in LA (IFAD-US$120,000) .

Strengthened capacity of partners and skills of staff through training and information exchange
- Over 50 NARS scientists from CAC and LA were trained in improved livestock production methods. The same numbers of farmers were trained in technologies to improve productivity including 2 farmer-to-farmer exchanges which induced farmers to production diversification. One PhD student was trained.

- Two Junior Professional Officers (JPO) supported by DANIDA and three JPOs supported by JICA exchanged knowledge with other project partners and staff.
- Four project staff members were trained in progesterone analysis (Hohenheim and Wisconsin-Madison Universities), Gas Test Method (Hohenheim University), feed evaluation (Macaulay Institute), milk processing (Wisconsin-Madison University) and sensory analysis (BOKU) which led to a significant improvement of ICARDA's research capabilities.

Current Activities

- Market studies on fattening and milk products (Syria and Jordan) and effect of market and consumer trends on breed diversity in Tunisia.
- Market opportunities for SR products and market induction in Brazil, Mexico and Venezuela.
- Community based research on crop-livestock interaction technologies and production intensification management in Syria, Tunisia, Brazil, Mexico, Venezuela, and Central Asia.
- Continuation of project on Production Diversification: Fattening Systems in Syria, Jordan and Tunisia.
- Strategic research on out-of-season production of milk and traits associated with milk production for population screening of highly producing ewes.
- Characterization of Syrian Jabali and Baladi goats.

Future Plans

- Quality studies of processed milk products as affected by sheep diets and intensive management.
- Community-owned, decentralized and participatory breeding plans to allow farmers access to sources of improved animals in LA and Syria.
- Valuation of breeds to secure better exploitation of genetic diversity for sustainable improvement of farmers' income in relation with markets.
- Continuation of studies concerning adaptive traits of sheep and their potential use in feeding systems.
- Molecular characterization of SR breeds along the silk route.

The current and future activities are implemented in partnership with NARS, other ICARDA MPs (MP2, 5 and 6), and regional and international (BOKU-Austria, JICA-Japan, Macaulay Institute, ILRI) research and development institutions.

Small Ruminant Health – Improved Livelihoods and Market Opportunities for Poor Farmers in the Near East and North Africa (NENA) Region

Introduction

Livestock keeping, particularly small ruminants, is critical to the livelihoods of poor livestock keepers in the Near East and North Africa (NENA) region. Available information indicates that the human population in the NENA region increased by 43% between 1983 and 1997 and is expected to double by the year 2020. This trend has not been accompanied by an equal increase in food production, particularly from livestock sources, so that current demand for livestock exceeds domestic supply. Urbanization and the change in dietary habits and lifestyle of a large portion of the inhabitants have significantly increased the demand for meat and milk. In response to this, a significant shift has occurred from extensive traditional systems to more intensive mixed crop-small ruminant or small ruminant fattening systems. These shifts in production and other trends have adversely affected poor small ruminant farmers, because of both greater pressure on their resource base and competition for veterinary, marketing and other services with more market-oriented medium to large scale livestock entrepreneurs. Disease continues to be a major constraint to productivity and trade, which severely affects the livelihoods and development prospects of smallholders and also limits the supply of safe meat to developing country consumers. Lack of effective disease control, poor access to veterinary services, high cost of drugs and lack of skills in mounting effective disease surveillance and reporting, further compound this state of affairs.
The purpose of this project is to contribute to improved livelihoods of poor farmers in the NENA region through research targeted at improving small ruminant health resulting in increased productivity and enhanced access to local, national and regional livestock markets. The project is designed to provide action-oriented research results at two levels. At the local level, the emphasis is to better understand the delivery and adoption of animal health and other livestock services to poor farmers, and constraints to local market access by the poor. At national and regional levels, the overall objective is to increase market efficiency and access by poor farmers through research into marketing constraints (policies, reducing transaction costs such as transportation and taxes) and decreasing the threat of market exclusion/disruptions due to the occurrence and associated sanitary regulations of small ruminant diseases.

Achievements

- A Research Methodological Framework (“value chain pathway”) has been developed and field-tested in 2005. The method uses a participatory approach to obtain information from communities and other stakeholders involved in the production and marketing of small ruminants and has already been applied in the four project countries, Jordan, Syria, Sudan and Tunisia.
- Nine M.Sc. students (3 in animal health and 2 in marketing in Sudan, 1 in animal health in both Jordan and Tunisia, and 1 in marketing in both Syria and Tunisia) have been trained.

- Two groups of staff (18 in 2004 with 14 from Sudan and 2 each from Jordan and Syria; and 14 in 2005 with 9 from Sudan and 2 each from Jordan, Syria and Tunisia) have been trained in livestock market assessment for a period of two weeks.
- Two groups of graduate students (11 and 15) have been trained in selected topics in veterinary epidemiology in Sudan.
- Fifteen veterinarians were given one day training in methods of epidemiological surveys and data collection in Jordan.

Current Activities

Identifying health and market constraints are the action research activities for 2006. Further characterization of animal health delivery systems and disease risk assessment in the project countries are being addressed currently by research teams in each country.

Future Plans

The intention is to replicate achievements of this project in other countries of the WANA region; hence additional funding would be required to extend the project beyond 2006.

Improvement in Pasture and Forage Production in the Dry Areas

Introduction

The livestock sector contributes between 15–50% of the agricultural GDP in many countries in the dry areas of CWANA. About 80-90% of the livestock, especially ruminants are owned by rural smallholders who depend on their animals for food, cash, transport and manure. Demands for meat and milk are expected to double in the region over the next 20 years in response to population growth and urbanization, offering opportunities for poor livestock keepers to build assets and improve their livelihoods. However, chronic feed deficits in the region resulting from diminishing grazing resources and desertification constrain increased livestock production, thus preventing poor farmers from benefiting from the growing markets. To reduce the feed gap, farmers are adopting crop and livestock management practices such as continuous cropping and overgrazing of rangelands that are degrading the environment and resulting in reduced crop and livestock outputs and an actual increase in the feed gap. Integrated crop-and-livestock production strategies are needed to provide more food and quality feed without degrading the plant, soil and water resources. Such options include cereal-legume rotations, water-efficient forage crops, manure management to improve soil productivity, saline and sewage water irrigation for forage production, and integration of forages into tree-fruit systems for feed and soil conservation. The project aims at developing and testing with farmers sustainable forage-based options to increase yields of crop and livestock outputs and to diversify income generation opportunities in smallholder crop-livestock systems. The primary beneficiaries are smallholder crop-livestock farmers, peri-urban meat and milk producers, and farmers without livestock who pro-

duce seeds or fodder for the emerging markets. The main users are national researchers, policy makers, and others concerned with improving rural livelihoods. The project focused on development of cereal/legume rotations to improve and/or replace the traditional rain-fed cereal/fallow or cereal/cereal rotations, forage seed production and capacity building of national partners in close collaboration with forage breeder in MP2 during the period under review. The current project leader joined ICARDA in June 2003.

Achievements

Contributed to knowledge and methodology on pasture/forage systems in dry areas

- Farmer-participatory approaches for the evaluation of forage legumes were demonstrated and used to select high-yielding and frost-tolerant forage crops – *Vicia sativa, V. narbonensis* and *Lathyrus sativus* lines.
- Improved cereal/legume rotations that increased cereal grain and livestock product yields and soil nitrogen content by 10-20% relative to farmers' cereal/cereal or cereal/weed fallow rotations were developed and disseminated to farmers in Syria, Lebanon, Jordan and Iraq.
- A multiple-cropping technology based on a rotation of triticale, oats and fodder pea with maize with potential to produce 50% more grain and fodder yields than farmers' practice was developed and demonstrated in Uzbekistan.
- A low-cost machine for harvesting seeds of herbaceous and shrubby forage legumes was designed and demonstrated in Syria and Lebanon. The machine increased farmers' interest in fodder seed production and resulted in the availability of quality seeds.

Promoted human resources development and knowledge dissemination

The project offered an opportunity for knowledge sharing which led to the following achievements:

- About 50 research and extension staff, including 2 PhD and 3 M.Sc. students, 15 policy makers and more than 200 farmers were trained.
- Two professional networks were established to enhance knowledge sharing: Dryland Pasture, Forage and Range Network and the Oat and Vetch Network.
- The Dryland Pasture, Forage and Range Network Newsletter was published by ICARDA and distributed to partners in Africa, Asia, Australia, Europe, and North and South America.
- Training and extension materials on forage production and use for livestock feed were developed and used in group and individual training.
- Two workshops on forage production and use for research and extension staff and policy makers were organized: *'Production and Cultivation of Forages for Irrigated and Rain-fed Areas in Central Asia'* June 2001, Kyrgyzstan; and '*Lathyrus sativus* as a Food/Feed Crop in Africa and Asia', November 2004, Syria.
- Best-bet technologies for improving feed resources in crop-livestock systems in the Caucasus countries (Armenia, Georgia and Azerbaijan) were documented.
- A 3-week JICA-funded training course for 25 participants from Iraq, Syria and other selected CWANA countries on *'Integrated Crop and Livestock Production in the Dry Areas'* was held in June 2005. Similar courses will continue through 2009...

Current Activities

Current project activities are implemented in collaboration with scientists from other ICARDA MPs and Units, national and private research and development institutes in CWANA, and other sister CGIAR centers to increase the potential impact. On-going activities include:

- Analysis and publication of data from completed trials in Syria and Lebanon.
- Farmer-participatory evaluation of elite forage legumes in Afghanistan, Syria and Lebanon.
- Development of forage systems to reduce the early-spring and winter feed gaps.
- Selection of high-yielding improved feed/food crops.

In addition, the project manager:

- Will continue to co-ordinate the short-term course on 'Integrated Crop-Livestock Production' funded by JICA and organized by ICARDA.
- Serve as co-supervisor for graduate and undergraduate students' dissertation research.

Future Plans

Shifts

- The project focus will be expanded to include irrigated crop-livestock systems where market-oriented smallholder dairy, fattening and fodder production predominate.
- Research-for-development linkages will be developed with the World Agro-forestry Center and International Livestock Research Institute to initiate activities on development and testing of agro-silvo-pastoral systems.
- Closer inter-disciplinary linkages will be established with the crop-breeder, socio-economic, genetic resources and water groups at ICARDA.

Research-for-development focus

- Screening of traditional and non-traditional annual and perennial forage crops for high water productivity.
- Use of marginal water (saline and sewage) irrigation for fodder production.
- Cropping and nutrient management options to optimize feed from food/feed systems.
- Forage systems to reduce feeding cost in small-scale dairy and fattening enterprises.
- Investigation of agro-silvo-pastoral systems to improve productivity and reduce environmental degradation.
- Assessment of economic and environmental impact of fodder innovations.

Agronomic Management of Cropping Systems

Introduction

The productive potential of cropping systems within a given environment depends on plant genetics and management of soil, water, and crops. No matter how good new crop cultivars might be, they will not achieve their potential and will usually not bring appreciable increases in yields unless they are well managed. If production is to be sustained in the long term, attention must also be paid to the appropriate management of the soil

in which crops grow. Achieving increased sustainable production is the focus within this project and has the following medium-term objectives: 1) develop an understanding of physical, biological, and environmental principles, which underlie and control the productivity and sustainability of cropping systems with respect to soil characteristics and water and nutrient dynamics through quantification of crop species, crop sequencing, crop residue management, minimum/no-till soil management, soil fertility and pest management and their effects on soil quality, soil water storage and use, carbon sequestration and long-term productivity of the soil resource; 2) develop strategies for efficient, productive and sustainable management of soil, water and nutrients in cropping systems; and 3) provide INRM data for the development and/or refinement of methods for the extrapolation of research findings in space and time in collaboration with NARS/ARIs.

Achievements

- Two workshop proceedings were published under the Center-wide initiative on Optimizing Soil Water Use (OSWU) as part of Soil, Water and Nutrient Management Program of CGIAR in WANA and Sub-Saharan Africa regions in collaboration with ICRISAT.
- In dryland areas of Iran, many on-farm demonstrations were conducted in five major provinces through training and participation of extension officers and farmers; these showed and promoted wide uptake of timely applications of low-input crop-soil management technologies which can give 2-4 times yield increases over the farmers' practice.
- ICARDA's Network on Conservation Agriculture in Central Asia tested and promoted tillage systems; stubble management technologies were tested and promoted in a Mediterranean-type environment in relation to crop yield and soil moisture, fuel use efficiency and sustainability of cropping systems.
- Long-term cereal rotation technologies in the Mediterranean region were developed and refined. For example, a long-term crop sequence management trial and long-term monitoring system were established in cooperation with the Egypt national program for input-use efficiency, sustainable production systems and conservation of natural resources.
- Management alternatives for improved durum and bread wheat production under supplemental irrigation for water use efficiency were promoted in a Mediterranean environment in the highlands of Iran and Turkey.
- Improved knowledge of water-use and water-use efficiency of chickpea, lentil and faba bean under rainfed and supplemental irrigation in a Mediterranean environment was gained and disseminated.
- Prospects of safflower (*Carthamus tinctorius*) production in dryland areas of Iran, Lebanon, and Syria were elaborated.
- Agronomic practices for improving water-use efficiencies in winter-grown wheat for drought-prone Mediterranean-type agriculture were identified and promoted in collaboration with the University of Wagga in Australia.
- Contributed to knowledge on organic matter and nutrient distribution following con-

servation tillage, straw management and compost application under Middle Eastern dryland conditions.
- Trained two PhD students and strengthened the capacity of NARS research and extension staff in agronomic research in collaboration with NARS.

Current Activities

- Agronomic management of field crops (e.g. wheat, barley, food legumes, oilseed crops and medicinal plants) in relation to tillage and residue management, sowing date, supplemental irrigation, fertilizer use, and weed control, including parasitic weeds of legumes and their interactions in crop rotations in collaboration with NARS.
- Improving barley productivity in dry areas (220 mm mean annual rainfall) by use of phospho-gypsum application for improving soil physical and chemical characteristics.
- Economic use of renewable nutrient sources and improved nutrient use-efficiency in agricultural systems.
- Development of productive and sustainable soil management practices including: minimum tillage, crop rotation, cover crops, and residue management strategies and developing soil quality indicators and indices to assess the sustainability of soil management practices.

Future Plans

- Rainwater management to understand soil properties controlling water movement into and through the soil to improve water productivity.
- Community-based participatory research in pilot areas to assess on-farm effects of long-term cropping sequences and their associated management options on soil chemical, physical and biological properties, productivity, and efficient use of rain and irrigation water and other inputs.
- Study systems dynamics using a multi- and inter-disciplinary integrated natural resources management approach,
- Institutionalize on-farm adaptive research with farmers' participation for increased production, while conserving natural resources.
- Use of crop, soil and water simulation models to allow integration of existing knowledge to facilitate decision making at different levels, and to develop recommendation packages.

Research in Sustainable Alternatives to Opium Poppy Cultivation in Afghanistan

Introduction

Afghanistan has been the world's major supplier of illicit opium for a decade. The production and processing of narcotic drugs distort the economy and jeopardize the security and stability of the region as well as the development of Afghanistan. With the assis-

tance of the international donor community, the government of Afghanistan has adopted a national drug control strategy with the objectives of reducing poppy cultivation by 70% in 5 years and complete elimination in 10 years. However since the livelihoods of a significant number of rural Afghans currently depend on growing opium poppy, sustainable alternative livelihoods must be found. Without such alternatives, there would be substantial increase in poverty resulting from the elimination of the opium economy. More than two decades of conflict and neglect in Afghanistan have left the country's agricultural research and extension institutions devastated. The capacity and facilities currently available are inadequate to respond to the challenge of finding viable alternatives to an entrenched economy based on an illicit crop. In response, a 3-year program, Research in Alternative Livelihoods Fund (RALF) Program, financed by DFID (UK) and managed by ICARDA, was launched in January 2004. RALF circumvents the lack of institutional capacity in Afghanistan by involving research institutions outside Afghanistan such as other CG Centers, UK and US universities, international NGO's, as well as the Afghan Ministry of Agriculture, Animal Husbandry and Forestry (MAAHF) and Afghan universities. Expected outputs of the RALF Program are: a competitive mechanism for funding relevant and innovative applied research projects; recommended technologies and support services tested and available for implementation; and improved capacity for applied research and extension in MAAHF, NGOs and universities. The outcome of RALF will be licit alternatives to opium production that are practicable in the socio-economic environment of Afghanistan and that are accessible to rural poor. The beneficiaries will be the predominantly poor farming population and casual laborers who currently depend on the illicit activity of growing poppy for their livelihood. We anticipate the use of this research in other similar agro-ecologies in the dry areas in the future.

Achievements

A competitive mechanism for funding applied research projects was put in place

- The fund was disbursed through Requests for Proposals (RFP's). Project selection was made through an autonomous Project Review Panel. There were two rounds of RFP's. Twenty proposals were received and seven were accepted for funding by the Panel in the first round. Twenty one proposals were received and four accepted in the second. Thus, a total of 11 projects were funded under three themes - crop diversification and post-harvest value addition, 7 projects; forage /livestock, 2 projects; and socio-economic analysis and intervention, 2 projects.
- A website was created for the RALF program.
- An electronic database was created.
- A RALF Steering Committee comprised of DFID, ICARDA and Ministry of Agriculture, Animal Husbandry and Food (MAAHF) staff was established.
- Three workshops/symposia were organized.

Current Activities

Capacity building: The program is contributing to MAAHF capacity building by involving the senior management in project selection, in program review, and in activities in the field such as research monitoring and evaluation.

Development of linkages: Linkages have been established with the Faculty of Pharmacy at Kabul University and the Faculty of Agriculture at Kabul, Nangarhar, Balkh and Herat universities. Efforts are underway to strengthen the teaching and research capabilities of these institutions. Linkages are being strengthened with the following institutions involved in research on medicinal plants including the extraction of the active ingredients for food, pharmaceutical and cosmetic uses: Khorsasan Science Research Park, Mashhad, Iran; Department of Medicinal Plants, Research Institute of Forestry and Rangeland, Tehran, Iran; The GTB Group of Industries, Kashan, Iran; and Qarshi Herb Research Centre, Hattar, NWFP, Pakistan

Identification of promising livelihoods alternatives: Saffron has the promise of being an alternative to opium poppies in Herat Province. Therefore, the project will undertake the following studies: saffron production and processing, farm economics of saffron producers, survey of domestic markets in Herat and Kabul, and establishment of saffron producers associations.

Future Plans

- The project on marketing of livestock and livestock products has been completed. The recommendation of this project will be disseminated in Dari and Pushtu languages.
- Field monitoring of the projects will continue in provinces that were not covered in 2005.
- A communication strategy will be developed.
- Alternative sources of funding will be explored.