

## **Megaproject 4: Diversification and Sustainable Improvement of Crop and Livestock Production Systems in Dry Areas**

### **Rationale**

Within dry areas majority of the rural population is involved in the agricultural sector. The development of agriculture and agriculture-related activities is now recognized as an engine for economic growth and food security.<sup>1</sup> Moreover, farm households often comprise the largest segment of the private sector in developing countries, and within these households women are often major contributors to the labor force, food production and post-harvest activities. This project focuses on creating new income-generating options for the rural poor by diversifying agricultural outputs, improving the quality of produce, and adding value through agro-processing of primary products.

Given the natural resource constraints in the ecoregion, especially in more marginal areas, productivity increases alone will not be sufficient to combat poverty and improve rural livelihoods. Innovative options are needed to diversify income-generating opportunities available to rural households and to respond to the expanding market demand for a diversity of crop and livestock products due to population growth, urbanization and changes in life styles and consumer preferences. Such options include diversifying and improving crop and/or livestock production systems, the utilization of higher-value plant species (e.g., medicinal, horticultural and herbal species), processing of livestock products, and increasing the quality and end-use value of agricultural commodities, both to improve food quality and nutrition in rural areas and add market value, at the same time generating opportunities for rural agri-business development and increased employment.

The project addresses these issues and contributes to the overall aim of developing productive and sustainable systems that conserve the resource base while supporting rural livelihoods in the dry areas. This project directly addresses the CGIAR priority area 3 of “enhancing incomes through agricultural diversification and value-addition linking the poor to markets.”

### **Target Ecoregions**

The project targets non-tropical dry areas, with a geographic focus on Central and West Asia and North Africa (CWANA). It also includes the Nile Valley (Eritrea, Ethiopia and Sudan) in the improvement of crop production systems, and the dry areas of Latin America for the diversification of small ruminant production options and adding nutritional value to barley used for food.

### **Project Description**

The project goal, purpose, outputs, output targets and associated expected outcomes and impacts are provided in the attached “Project Impact Pathway” matrix. Assumptions and external conditions associated with outputs, outcomes and impacts are listed in the introduction to the project portfolio.

Major elements of MP4 comprise:

- Research on household investment patterns and analysis of market opportunities for value-added crop and livestock products in dry areas.
- Investigation of options to increase the productivity of agricultural systems and to diversify income-generating opportunities available to rural households by both increasing the value of production of traditional crops through improved cropping system management and improved quality of end products, and by diversifying cropping systems to include higher-value crops (horticultural, oilseed, medicinal, and herbal), or through production under protected (controlled) environments such as greenhouses.

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<sup>1</sup> In this regard, ICARDA follows CIDA in defining agriculture as “the entire system that links the producers and consumers of food and non-food agricultural products, incorporating dimensions such as the production, storage, processing, trade and use of these products, the natural resource base, and the policy and regulatory environment that supports the system.” (*Promoting Sustainable Rural Development Through Agriculture - Canada Making a Difference in the World*. CIDA. March 2003)

- Development and evaluation of integrated pest management (IPM) options for cereals and legumes based cropping systems in different agro-ecological zones. Options include host resistance, crop rotation and other agronomic practices, chemicals, biological control and healthy seed.
- Evaluation of integrated feed-livestock systems to increase the productivity of livestock and to diversify and increase the quality and value of their products, through improved feed supply, feeding, and health and reproductive management practices.
- Investigation of options for adding value to crop and livestock products through improved post-harvest handling and processing accessible to NARS and farmers.
- Policy and institutional research to support diversification of income-generating options and their adoption by various target groups (men and women) including private sector links.
- Institutional strengthening and capacity building.

The project collaborates in a number of systemwide initiatives including the Systemwide Livestock (SLP) and IPM programs, HarvestPlus and the Challenge Program on Water and Food. The program shares a joint appointment with ILRI, addressing the impact of small ruminant diseases on market access and best-bet health delivery and other technology options for better market access in CWANA.

Intra-Center linkages with other megaprojects include:

- with MP1 in increasing the productivity of cropping systems through optimal on-farm water use;
- with MP2 on genetic resistance to pests and diseases and on development improved micro-nutrient and market characteristics of mandate crops;
- with MP3 on the management and optimal use of rangeland feed resources within integrated feed/livestock production systems;
- with MP5 on analysis of livelihoods, household investment patterns, and the socio-economic constraints to and market opportunities for diversification;
- with MP6 on upscaling and outscaling the knowledge generated by the project;

### **Users and Beneficiaries**

The main users are national research and technology transfer systems, policy-makers, and other institutions concerned with improving rural livelihoods.

The ultimate beneficiaries are farming and agropastoral communities, agri-processors, marketers and consumers of crops and small ruminants and their products.

### **Collaborators**

*National Programs:* National research and extension programs in Central and West Asia, North Africa, sub-Saharan Africa (Eritrea, Ethiopia, Mauritania, Sudan), South Asia (Pakistan) and Latin America (Mexico, Brazil and Venezuela).

*International and Regional Organizations:* AVRDC (The World Vegetable Center); FAO; IAEA (International Atomic Energy Agency); CIHEAM (International Centre for Advanced Mediterranean Agronomic Studies).

#### *Advanced Research Institutes*

- University of Adelaide, Australia; Centre for Legumes in Mediterranean Agriculture, Australia; Departments of Agriculture, Western Australia, New South Wales and Victoria, Australia.
- University of Natural Resources and Applied Life Sciences (BOKU), Austria.
- Agriculture & Agri-Food, Canada.

- KVL (The Royal Veterinary and Agricultural University), Denmark; Danish Institute of Agricultural Sciences (DIAS) and Risoe National Laboratory, Denmark.
- INRA-Rennes, France.
- JICA (Japanese International Cooperation Agency).
- Federal Institute of Technology (ETH), Switzerland.
- CABI Bioscience, UK; Natural Resources Institute, University of Greenwich, UK; and Macaulay Institute, UK.
- USA: University of California, Davis; Kansas State University; USDA-ARS, Sydney, Montana; Montana State University; Oklahoma State University; Purdue University; University of Vermont; USDA, Washington State University; University of Wisconsin-Madison; and USDA-ARS Aphid Laboratory, Stillwater, Oklahoma.

*Development Projects:* Dom Helder Camera (Brazil), Microwatershed-FRICO (Mexico), and Prosalafa (Venezuela).

### **System Linkages**

- ICARDA and ILRI share a joint appointment in implementing a project on small ruminant health and market opportunities in the Near East and North Africa.
- **Challenge Programs:** The project participates in the Challenge Programs on Water and Food and HarvestPlus (specific cooperation is indicated in the logframe).
- **Systemwide Programmes and other CG Consortia:** The project participates in:
  - Ecoregional Program for Central Asia and the Caucasus (*see separate narrative attached*).
  - Future Harvest Consortium for Rebuilding Agriculture in Afghanistan (FHCRAA).
  - Systemwide Livestock Program (SLP).
  - Systemwide Program for Integrated Pest Management (SP-IPM).

## MTP 2006–2008: Project Impact Pathway

<b>Project</b>	<b>MP4: Diversification and Sustainable Improvement of Crop and Livestock Production Systems in the Dry Areas</b>
<b>Goal</b>	Improved rural livelihoods through productive and sustainable crop and livestock systems that conserve the natural resources in dry areas
<b>Purpose</b>	Diversification and improvement of crop and/or livestock production options that reduce risk and increase productivity, product quality and income while conserving the natural resource in the dry areas

	<b>Outputs</b>	<b>Intended Users</b>	<b>Outcomes</b>	<b>Impact</b>
<b>OUTPUT 1</b>	Analysis of market constraints and opportunities for value-added crop and livestock products in the dry areas	Policy-makers, researchers, extension services, development organizations	Greater use of farmers and poor communities of relevant market information; local communities develop organizations for increased access of markets and gaining greater bargaining power	Better integration of small-scale crop-livestock systems and increased income and higher share of consumer prices obtained by producers
<b>Output Targets 2006</b>	Market constraints and opportunities for milk derivatives, value added crop products and forages identified in at least two countries in CWANA and Latin America  Small ruminant health constraints and animal health delivery issues affecting market access identified in West Asia, North Africa and Sudan ( <i>in collaboration with ILRI</i> )	Researchers, development projects, national research systems, extension services  NARS departments of veterinary services and other service providers	Mechanisms for out-scaling the adoption of milk and milk derivatives technologies; value-added crop products and marketable forage production  Increased flow of market information to small producers  Gaps in national and trans-boundary small ruminant disease control that affect access to domestic and export markets in target countries identified	Increased and diversified farm incomes from marketed products.  Increased rural employment in community-based agro-processing enterprises  Improved delivery of animal health services to small ruminant producers in target countries
<b>Output Targets 2007</b>	Marketing niches for value-added crop products identified and shared with NARS	Development projects, national research and extension services, farmers	Departments promoting, and farmers and communities using post-harvest technologies and accessing niche markets	Increased and diversified farm incomes from marketed products  Increased rural employment in community-based agro-processing enterprises

	Outputs	Intended Users	Outcomes	Impact
	Best-bet small ruminant health delivery and other technology options for better market access tested ( <i>with ILRI</i> )	Departments of animal production, health and animal trade, development organizations, national research systems, extension services, farmers	Enhanced regulation and control of animal health, improved animal health services and flow of market information to producers	Increased farm incomes from improved livestock health, production and market access Better quality and safe small ruminant products available to consumers
<b>Output Targets 2008</b>	Information on market constraints and opportunities for milk derivatives, value added crop products and forages documented and shared with NARS and other stakeholders	NARS, international organizations, policy-makers, development projects, NGOs and farmers' communities in CWANA and Latin America	R&D and farmer communities are using information on markets for better orientation and market-targeting of production systems to capitalize on existing market opportunities	Diversified and increased rural incomes Increased rural employment in community-based agro-processing and marketing enterprises
	Information on small ruminant diseases and health delivery systems that maximize marketing opportunities documented and shared with NARS and other stakeholders	NARS and farmers	Enhanced regulation and control of animal health, improved animal health services and flow of market information to producers	Increased farm incomes from improved livestock health, production and market access Better quality and safe small ruminant products available to consumers
<b>OUTPUT 2</b>	Options to increase the productivity of agricultural systems and to diversify income-generating opportunities available to rural households, by diversifying cropping systems and increasing the quality and end-use value of crop products	NARS researchers, extension officers, policy-makers, agribusiness, farmers	More productive, diverse cropping systems with more marketable and profitable produce	Increased crop production and incomes in CWANA by 2008
<b>Output Targets 2006</b>	Guidelines for and evaluation of integrated production and protection management (IPPM) practices for major cash crops under protected agriculture in the Arabian Peninsula and Afghanistan	NARS, private growers, commercial companies	Better technologies for horticultural production under protected conditions	More profitable horticulture and more available horticultural products
	Land suitability methodology and maps for crops in Central Asia	Researchers, development agencies	Better land evaluation and capability technologies	Better matching of crops and land in research and development

	<b>Outputs</b>	<b>Intended Users</b>	<b>Outcomes</b>	<b>Impact</b>
<b>Output Targets 2007</b>	Statistical methodologies for evaluating productivity trends in long-term cereal-legume rotations developed and transferred to NARS	NARS	Increased research capacities and knowledge of national researchers	Farmers benefit from recommendations generated by improved national research
	Improved agronomic management packages for olive, safflower and selected medicinal plants developed and promoted	Researchers, extension agents, farmers, decision-makers	Adoption of improved agronomic management by farmers in strong collaboration with policy-makers	More profitable and sustainable production practices adopted with increased income for improved rural livelihood.
<b>Output Targets 2008</b>	Agronomic and conservation tillage packages for various cropping systems assessed and promoted in West and Central Asia	NARS scientists and extension officers, farmers	Adoption of conservation tillage systems by farmers in wheat and cotton-based cropping systems in strong collaboration with policy-makers	More sustainable production practices adopted with increased income
	Evaluation and promotion of barley, lentil and chickpea lines with improved micro-nutrient and market characteristics	National plant breeders, public and private seed producers	Improved varieties available to producers	Improved nutrition of subsistence producers; improved farm incomes from higher-value market characteristics
<b>OUTPUT 3</b>	Crop-livestock technologies to increase the productivity of livestock and to diversify and increase the quality and value of their products, through improved feed supply, feeding, health and breeding practices tested with NARS and farmers in CWANA	NARS, development projects, NGOs, farmers' communities, and development projects in CWANA	Farmer communities and R&D efforts are using improved technologies for meat and milk production on the basis of efficient integration of crop and livestock enterprises	Livelihoods of smallholder crop-livestock producers is improved through increased and stable livestock (meat, milk), crop and soil productivity
<b>Output Targets 2006</b>	Improved cultivars of forage legumes and food/feed crops to diversify and enhance the feed base of CWANA smallholder crop-livestock producers	NARS, development projects, NGOs, farmer communities and development projects in CWANA	NARS, farmers and farming communities use improved forage crop cultivars to bridge feed gaps	Improved household income of smallholder crop-livestock producers through increased sale of fodder and higher meat and milk from better feeding
<b>Output Targets 2007</b>	Forage-livestock technologies that increase productivity of small-scale lamb fattening and peri-urban dairy producers involving least-cost feeding, health and reproductive management in West Asia	NARS, policy-makers, development projects, NGOs, farmers, and farming communities in West Asia	Farmer communities and R&D efforts using improved least-cost feeding and management technologies to enhance meat and milk productivity	Improved household income of smallholder crop-livestock producers through increased sale of meat, milk and fodder

	<b>Outputs</b>	<b>Intended Users</b>	<b>Outcomes</b>	<b>Impact</b>
<b>Output Targets 2008</b>	Assessment of alternative feedstuffs and their impact on milk quality completed in West Asia	NARS, policy-makers, development projects, NGOs and farming communities in West Asia	Farmers and R&D efforts efficiently using available feed resources to reduce feed constraints and capture market opportunities	Enhanced feed base and livestock productivity in smallholder crop-livestock farmers leading to reduction of poverty
	Models for integrated crop/range-livestock systems and their impacts on crop and livestock outputs and soil identified and pilot-tested in at least two countries in CWANA	NARS, policy-makers, development projects, NGOs, farmers and farming communities in CWANA	R&D efforts using option models for better integration of crop and livestock enterprises, and increased and stable land productivity	Improved livelihoods of smallholder crop-livestock producers through increased and stable livestock (meat, milk), crop and soil productivity
<b>OUTPUT 4</b>	Integrated pest management (IPM) options for cereal and legume based cropping systems in different agro-ecological zones developed and tested with NARS. The options include host resistance, crop rotation and other agronomic practices, chemicals, biological control and healthy seed	Farmers, plant protection specialists, NARS extension services, farmers	Better understanding and technologies for IPM available and taken up by farmers	Reduced losses and better crop production and quality giving better farm incomes
<b>Output Targets 2006</b>	Incidence, spread and severity of selected pests and diseases in CWANA assessed in partnership with NARS	Breeders, plant protection specialists	Better understanding and identification of major diseases and insect pests by NARS	Improved national and trans-boundary disease and pest control measures
<b>Output Targets 2007</b>	IPM components and their effectiveness in controlling major pests and diseases evaluated in at least seven pilot sites in selected countries in CWANA	Farmers, plant protectionists, extension services	Best-bet IPM options identified in each country	Improved farm production, productivity and income from application of IPM practices
<b>Output Targets 2008</b>	Effective IPM components and IPM systems identified and promoted at twenty on-farm pilot and farmers' field schools for several major pests in CWANA	Farmers, plant protectionists, extension services	Extension and uptake of better IPM options such as host resistance, crop rotation and other agronomic practices, chemicals, biological control, and healthy seed for different cropping systems and agro-ecological zones	Improved farm production, productivity and income from application of IPM practices
<b>OUTPUT 5</b>	Options for adding value to crop and livestock products through improved post-harvest handling and processing accessible to NARS and farmers	NARS, development projects, NGOs, farmers' communities, and development projects in West Asia and Mexico	Better technologies for post-harvest handling of crop and livestock products	More profitable crop and livestock farming systems and better farm incomes

	Outputs	Intended Users	Outcomes	Impact
<b>Output Targets 2006</b>	Impact of post-harvest handling on quality of conserved fodder assessed in at least two countries	NARS researchers, policy-makers	Better post-harvest fodder conservation and food legume storage promoted to farmers	Improved farm incomes from production and marketing of conserved fodder  Livestock productivity enhanced by availability of high value feed sources
<b>Output Targets 2007</b>	Production technologies for diversifying milk derivative products in response to market opportunities developed in CWANA and Mexico	NARS, development projects, NGOs, farmers' communities, and development projects in West Asia and Mexico	Farmer communities and R&D efforts using options for adding value to fodder crops and milk production	Livelihoods of smallholder producers improved through additional income from added value crop and livestock products
<b>OUTPUT 6</b>	Knowledge and information to enhance the diversification of income generation options and reduce risk through training, networking and access to information accessible to NARS and other stakeholders (producers, handlers, marketers, policy-makers)	NARS, farmers	Better trained researchers, extension officers and farmers	More productive, diverse and sustainable crop and livestock farming systems and higher farm incomes
<b>Output Targets 2006</b>	Eight workshops on protected agriculture production practices conducted in Afghanistan and Yemen	NARS researchers and extension officers, farmers	Researchers and extension officers with better knowledge of protected agriculture technologies and enhanced capacity to transfer technologies to farmers	Better establishment of protected agriculture production systems
	Four farmer field days on livestock and forage technologies organized in two countries		Researchers, extension officers and farmers with knowledge of better livestock/forage production systems	Improved small ruminant production and productivity
<b>Output Targets 2007</b>	Farmers' field schools for IPM established in two countries	Farmers	Farmers with better knowledge of IPM systems	Improved crop production and productivity; reduced use of chemical control measures
	International network on crop-small ruminant interactions established and an international workshop on integrated crop-livestock production organized	Researchers, extension officers, agribusiness	Better sharing of knowledge and networking of livestock scientists	Farmers benefit from improved livestock/feed research and development
	Training courses on green house installation and crop production under protected agriculture for farmers in Arabian Peninsula, Yemen and Afghanistan	NARS researchers and extension officers, farmers	Scientists and farmers with better knowledge of protected agriculture production technologies	Improved rural livelihoods from adoption of protected agriculture

	<b>Outputs</b>	<b>Intended Users</b>	<b>Outcomes</b>	<b>Impact</b>
<b>Output Targets 2008</b>	Three training courses on integrated crop-livestock production completed	Researchers, extension officers	Researchers and extension officers, with better knowledge and capacity to conduct research and advise producers on sustainable crop and livestock production practices	Farmers benefit from enhanced NARS research and development systems
	One hundred research and extension staff and twelve MSc/PhD students from CWANA trained in aspects of diversification and sustainable improvement of crop and livestock production	Researchers, extension officers, postgraduate students	Researchers, extension officers, postgraduate students with better knowledge in development of more sustainable and diversified crop and livestock production systems	More sustainable, diverse and profitable crop and livestock production