

Project 6: Diversification and Sustainable Intensification of Production Systems in Dry Areas

Rationale

Within developing country dry areas, the majority of the rural population is involved in the agricultural sector with crops and livestock both contributing significantly to the livelihoods of the poor. In many areas, livestock and livestock products can make up 50% of items consumed and marketed. The development of agriculture and agriculture-related activities is a major driver of economic growth and food security. Moreover, farm households often comprise the largest segment of the private sector and, within these households, women are often major contributors of labor and management inputs for food production and post-harvest activities.

These areas have many features which are driving tremendous changes and also opening opportunities for improved and more integrated crop and livestock production systems for the rural poor:

- crops and livestock are main enterprises and staples for the rural poor
- many production systems are traditional with low inputs, high cultivation and little diversity
- populations are increasing and becoming more urbanized
- market demands for crop and livestock (mainly small ruminant) products are expanding greatly. This will encourage small farmers to shift their production targets from subsistence farming to market-oriented production.
- consumers and markets are becoming more discerning, especially in relation to animal diseases and product quality,
- agricultural intensification will be characterized by greater interdependence of livestock and crop enterprises
- farmers need to increase efficiency and diversify to target market opportunities
- degradation of landscapes and resources are threats to sustainability
- livestock have a crucial role to play in the maintenance and enhancement of the natural resource base
- widespread breakdown of peace and security with post-conflict rehabilitation dependent on agriculture

This is creating tremendous needs, demand and opportunities for better information and knowledge which will allow crop/livestock systems and landscapes to be more productive, profitable, integrated, diverse and sustainable.

Productivity of crops and small ruminant systems is still low in many areas and can be improved with better management and integration of crop and livestock enterprises. Livestock disease continues to be a major constraint to productivity and trade, with many countries lacking the capacity to deliver adequate animal health control. OECD markets are currently inaccessible to many countries due to sanitary restrictions.

Although natural resource constraints and the impact of climate change and conflicts in the dry areas can be severe, especially in the more marginal areas, there are many opportunities to develop agriculture and help combat poverty and improve rural livelihoods through, first, improving and intensifying productivity (lowering the yield gap) and diversifying management within existing crop and livestock systems and, second, diversifying widely outside existing systems.

The focus of this Project is based on the understanding that the products of research will be international public goods (IPGs) of use to dry areas beyond experimental sites or countries. This is reflected in the fact that the research projects are designed to generate outputs relevant across locations and international scales. Research will be undertaken in multi-site, community-based, participatory research networks which will generate technologies which are widely applicable across recommendation domains. Major IPGs will be verified technologies, published articles, modeling used for research prioritization and extrapolation of outputs to wider areas, and experienced/trained scientists with potential to be applied widely in other dry areas to solve problems and provide technologies for farmers confronted with similar constraints. Outputs from analytical research (e.g. market analysis, yield gap analysis) will also be relevant at local, regional and global scales.

The project addresses several of the CGIAR System Priorities (SPs). The project primarily addresses SP4D on sustainable agroecological intensification in low- and high-potential environments through its research on diversification options, crop management and integrated crop-livestock approaches, and SP3 focusing on increasing household incomes through high value crops and products and market integration of livestock production. The project will investigate opportunities for alternative income generation for rural communities, particularly for women through diversification and production of a range of high value crop and livestock products. The project also contributes to SP5, focusing on assuring market accessibility to the poor through products that strengthen the competitiveness of the poor.

The project contributes to alleviating poverty and increasing food security through an increased and sustainable supply of crop and livestock products, especially dairy products, to rural and urban consumers. Increased availability of milk and dairy products, particularly to urban centers, will contribute to higher incomes for poor livestock producers, create employment and improve the nutritional status of the poor, particularly women and children. Development of sustainable crop-livestock systems will reduce natural resource degradation while increasing productivity, and improve the availability and efficient use of feed resources. Improvements in livestock nutrition can increase productivity and reduce emission of greenhouse gases, especially methane. Sowing forages can reduce the grazing pressure on natural grasslands and help stabilize soil and reduce erosion by promoting ground cover. Forage legumes have an additional role in increasing soil fertility through their ability to fix atmospheric nitrogen.

Project description

The project focuses on enhancing income generating options for the rural poor from crops and livestock, especially small ruminants, by improving, intensifying and diversifying current agricultural production systems, sustaining the resource production base, increasing and diversifying outputs, improving the safety, quality and marketability of produce, adding value through agri-processing of primary products, and increasing the contribution of animal source foods to the diets of children, pregnant and nursing women. It aims to contribute to the development in rural areas of productive and sustainable systems that enhance livelihoods, generate opportunities for rural agri-business development and increased employment, and conserve the resource base. Approaches for improved, sustained, intensified, diversified and market-oriented production systems are in the areas of crop agronomy/management and small ruminant management focusing on:

- 1) Further developing crop and livestock technologies for dryland farming systems through:
 - characterization
 - markets, production and recommendation domains
 - better food and feed crop agronomy
 - establishment
 - cereal/legume rotations
 - crop, soil and water management
 - forage legumes in cropping systems
 - livestock-mediated nutrient cycling
 - better small ruminant production
 - feeding (forages, crop residues, feed blocks)
 - processing
 - disease management
 - marketing
- 2) Expanding crop and livestock species/variety options in dryland farming systems through:
Crop and forage rotation options:
 - alternative winter crops
 - oilseeds: safflower, canola, linseed
 - legumes: peas, lupins
 - cereals: oats
 - summer crops/forages with supplementary irrigation
 - grains: maize
 - forages: alfalfa, oats, berseem clover, dual-purpose cowpea
 - fiber: cotton

Livestock options:

- characterization, valuation, conservation and utilization of native small ruminant breeds (links with P1)
- peri-urban systems involving dairy production
- cereal and pulse straw with high nutritive value

3) Expanding crop and livestock management technology options in dryland farming systems through:

Crops

- zero-tillage
- stubble mulching
- agroforestry
- integration of crops, forages and small ruminants into horticultural tree-crop farming systems (olives, figs, grapes, pomegranate, almond, pistachio)

Small ruminants: change in production season for milk and meat products

4) Market-oriented diversification of high-value crops and technologies outside existing farming systems:

- dry-area fruits and nuts (olive, grape, pomegranate, fig, almond, pistachio, walnut, dates, cactus pear)
- high value vegetables (beans, peas, cowpeas, garlic, onion, tomato, eggplant, pepper, melons, cucumber)
- herbal, medicinal and aromatic plants (HMAPs) such as cumin, anis, nigella, coriander, saffron, mint and licorice.

Work on horticultural crops under 4) above is an expanding component with a focus on a few species, where ICARDA validates research and provides information, and in partnership with expert groups and directed by a consideration of crop characteristics (pro-poor, resource efficient, high water use efficiency, compatible with farming systems, available markets, high demand, limited alternative supply, high value-adding, high benefit/costs, neutral or positive environmental/gender/social impacts), ICARDA comparative advantage (proximity, knowledge of farming systems, center of origin, networks, research and training expertise, facilities) and horticultural issues/constraints (technical information, resources, extension systems, markets, capital, transport, regulations, post-harvest technology, price/quality competition).

The global IPGs generating nature of the project is portrayed in the flowchart below which summarizes the features and goal of the sustainable production systems-based research planned for Project 6.

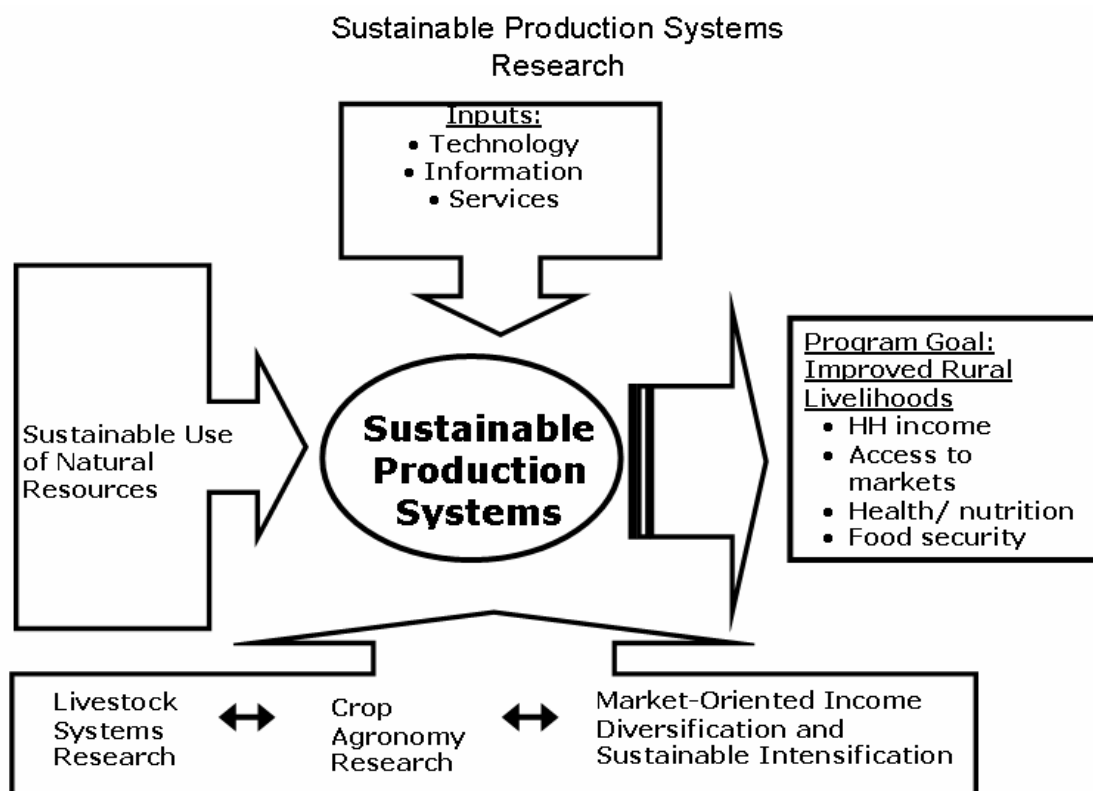
Planned Project 6 outputs are directed in the areas of understanding and targeting markets; improving, integrating and diversifying crop and livestock management and production; utilizing higher-value horticultural crops (including fruit, vegetables, medicinal and herbal plants) and forage species; improving harvesting and processing of products, especially milk from small ruminants; and capacity building of NARES. These outputs are directly related to the following CGIAR System Priorities and Millennium Development Goals:

CGIAR System Priorities

- 1C: Conservation of indigenous livestock
- 2A: Maintaining and enhancing yields and yield potential of food staples
- 2C: Enhancing nutritional quality and safety
- 2D: Genetically enhancing selected high-value species
- 3A: Increasing income from fruit and vegetables
- 3B: Increasing income from livestock
- 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas
- 5B: Making international and domestic markets work for the poor

Millennium Development Goals

- 1. Reduce extreme poverty and hunger
- 3. Reduce gender disparity
- 6. Combat ... and other diseases
- 7. Ensure environmental sustainability



Changes from Previous MTP

The current MTP differs from the MTP 2007-09 for MegaProject 4 as explained above. However, the following aspects remain the same and should be referred to from MTP 2007-2009:

- Descriptions of impact pathways for Outputs 1 through 5 are the same as those in MTP 2007-09.
- ICARDA will implement the activities in collaboration with partners consisting of NARS, development agencies, international institutes and advanced research institutions. Partners are listed in MTP 2007-09.
- Research approach to develop IPGs: The approach has not changed from that described in MTP 2007-09
- Partners' Roles: The roles of the partners as described for Output 1 applies to all other Outputs

Specific changes in Output Targets from the last MTP are listed as follows:

Output 1: The 2008 Output Target "Information on market constraints and opportunities for milk derivatives, value added crop products and forages documented and shared with NARS and other stakeholders' communities in Syria, Jordan, Tunisia, Brazil, Venezuela and Mexico", has been delayed to 2010 and reformulated because funding only became available in 2007.

As a result of plans to widen the scope of the diversification project, new Output Targets have been added related to horticulture and to studies and models aiming to understand yield gaps to promote outscaling research results to wider areas as recommended in the recent ICARDA EPMR

Output 2: The Output Target "To understand yield gaps using crop-soil simulation models, remote sensing (RS) /GIS and promote outscaling of research results to wider areas" has been added to 2009. In addition, Output Targets have been shifted from the previous MegaProject on Knowledge Management and Dissemination MTP 2007-09, as recommended by the EPMR (see *Overview*)

Output 3: The Output Target "Assessment of alternative feedstuffs and their impact on milk quality completed in West Asia (Syria)" was moved from 2008 to 2010 and reformulated because funding only became available in 2007

Output 4: The 2008 Output Target “Efficient post-harvest techniques and practices developed for date palm” has been moved to 2009 and 2010 because of a delayed start of the research project

The 2009 Output Target "New cost efficient procedures for management and feeding that do not affect the quality and organoleptic properties of processed products (yogurt and cheese) for dairy sheep in Syria" has been deleted as this will be addressed under Output 3 (2010 Output Target "Strategies for the use of alternative low-cost feedstuffs that maintain sheep milk quality").

As a result of plans to widen the scope of the diversification project, new Output Targets related to horticulture have been added

Output 5: A new Output Target has been added in 2008 due to a student placement in the Project Output Targets have been shifted from the previous MegaProject on Knowledge Management and Dissemination and new Output Targets related to horticultural crops and crop processing and postharvest handling have been added.

Outputs

The project goal, purpose, outputs, output targets and associated expected outcomes and impacts are provided in the attached Project Logframe. Where an Output Target contributes to a Challenge Program or a Systemwide/Ecoregional Program, this is indicated in the Project Logframe.

Below, each Output is described as follows: (a) the impact pathway, (b) the research approach to developing international public goods (IPG), and (c) the role of partner organizations.

Output 1: Analysis of market constraints and opportunities for value-added crop, livestock products in the dry areas

2.9 Relation to SP goals

The primary goal of **Output 1** is to achieve an understanding of markets and opportunities for value-added crop, livestock and horticultural products. Therefore, the Output responds directly to SP 3 specifically 3A & 3B “increasing income from fruits, vegetables and livestock production”, SP 4D “sustainable agro-ecological intensification” and SP 5B “making the markets accessible and favorable to the rural poor”. Such goals will be achieved through the generation of adequate information on markets, crop and animal diseases, health delivery systems and crop yield gaps, and through development and operationalization of back-up strategies and policies and to SP 3A Goal 2 “enhance production of selected fruit and vegetables through improvement of farming systems”, SP 3B Goal 2 “management of intensification of livestock production is improved to limit negative impact on the poor and the environment”, SP 4D Goal 4 “evaluate the production potential of high productivity systems and their constraints and trends”, and SP 5B **Goal 1** “enhance livelihoods and competitiveness for small producers and food safety for consumers in national and domestic markets and offset the negative impacts of global changes”.

2.10 Description of Impact Pathways: see MTP 2007-09 for MP4

2.11 Research Approach to Develop International Public Goods: see MTP 2007-09 for MP4

2.12 Partners’ Roles

ICARDA will implement the activities in collaboration with partners consisting of NARS, development agencies, international institutes and advanced research institutions. The names of partners are listed in MTP 2007-2009 under MP4.

- **ICARDA** in collaboration with partners coordinates the research implementation and contributes to consolidated analysis of information and cross-site syntheses, interpretation of research results and development of funding proposals. Promote knowledge exchange through workshops, ICARDA and ARI provide training to NARS and other collaborators to upgrade relevant skills.
- **NARS** take part in the planning and evaluation of research, testing technologies, collecting and assessing data in defined country research sites, preparing project reports and promotion of uptake of research findings.

- **Development agencies/NGOs:** These have a collaborative, indirect role contributing with collection of information and promotion of results/technologies.
- **International Institutes:** Directly assist with research methodology, data collection, analysis and reporting, and graduate training.

Output 2: Options to increase the productivity of agricultural systems in dry areas, and to diversify income generating opportunities available to rural households, and to mitigate the effect of natural and human caused disasters by diversifying cropping systems and increasing the quality and end-use value of crop products

2.1 Relation to SP goals

The primary goal of Output 2 is to achieve options for more productive, diverse and profitable cropping systems with safe and high quality products through improved agricultural practices based on balanced management of land and water resources. Therefore, Output 2 responds directly to the overall goal of SP 4 and specifically to SP D4 that aim to “promote sustainable agro-ecological intensification in low- and high-potential areas”. The output targets contribute to the following SP 4D specific goals: goal 2 “to protect the livelihoods of the poor livestock keepers in the low potential areas”; goal 3 “to identify domains of potential adoption and improvement of technologies for improving soil productivity, preventing degradation and for rehabilitating degraded lands”; and goal 4 “evaluate the production potential for high productivity system and their constraints “.

2.2 Description of Impact Pathways: see MTP 2007-09 for MP4

2.3 Research Approach to Develop International Public Goods: see MTP 2007-09 for MP4

2.4 Partners’ Roles: see Output 1

Output 3: Crop-livestock options to increase the productivity of livestock and to diversify and increase the quality, safety standards and value of their products, through improved feed supply, feeding, health and breeding practices tested with NARS and farmers in dry areas

3.1 Relation to SP Goals

The primary goal of Output 3 is to achieve options for more productive, diverse and profitable livestock production systems with safe and high quality products through improved crop-livestock options based on balanced management of land and water resources. Therefore, Output 3 responds directly to the overall goals of SP 2C “enhancing nutritional quality and safety”; and SP 3B “income increases from livestock”; and SP D4 that aim “promoting sustainable agro-ecological intensification in low- and high-potential areas”. The output targets contribute to SP 3B Goal 2” Management of the intensification in livestock production is improved to limit negative impacts on the poor and the environment”, SP 4D Goal 2 “protect the livelihoods of the rural livestock keepers in low potential areas”; and SP4D Goal 3 “to identify domains of potential adoption and improvement of technologies for improving soil productivity, preventing degradation and for rehabilitating degraded lands”.

3.2 Description of Impact Pathways: see MTP 2007-09 for MP4

3.3 Research Approach to Develop International Public Goods: see MTP 2007-09 for MP4

3.4 Partners’ Roles: see Output 1

Output 4: Options for adding value to crop and livestock products through improved post-harvest handling and processing accessible to NARS and farmers

4.1 Relation to SP Goals

The primary goal of Output 4 is to achieve options for adding value through improved processing and marketing of crop and livestock products responds. The output responds to the overall goals of SP 2C “enhancing nutritional quality and safety”, SP 3A & 3B “increasing income from fruits, vegetables and livestock”, and SP 5B “making the markets accessible and favorable to the rural poor”. The output targets contribute to the following SP 3A Goal 2”enhance production of selected fruit and vegetables through improvement of farming systems”, SP 3B Goal2” Management of the intensification in livestock

production is improved to limit negative impacts on the poor and the environment”; and SP 5B Goal 1” enhance livelihoods and competitiveness for small producers and food safety for consumers in national and domestic markets and offset the negative impacts of global changes”.

4.2 Description of Impact Pathways: see MTP 2007-09 for MP4

4.3 Research Approach to Develop International Public Goods: see MTP 2007-09 for MP4

4.4 Partners’ Roles: see Output 1

Output 5: 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).

5.1 Relation to SP Goals

The primary goal of Output 5 is the promotion of knowledge sharing/dissemination and capacity building through training in various aspects of crop and livestock improvement technologies and sustainable practices that are pro-poor and responsive to the needs of the dry area production systems. Also aspects of the output target the extension and upscaling of innovations, and the development of web-based expert systems. These output targets respond to the SPs IC, 2C, 2D, 3A, 3B, 4D and 5 B, and are related to the SP goals stated under Outputs 1 to 4 above. However the only explicit SP priority that relates directly to Output 5 could estimate as SP Area 5: “... facilitating institutional innovation to support rural poverty reduction

5.2 Description of Impact Pathways: see MTP 2007-09 for MP4

5.3 Research Approach to Develop International Public Goods: see MTP 2007-09 for MP4

5.4 Partners’ Roles: see Output 1

Project 6	Diversification and Sustainable Intensification of Production Systems
Goal	Improved rural livelihoods through productive and sustainable crop, livestock and horticultural systems that conserve the natural resources in dry areas.
Purpose	Improvement, intensification and diversification 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

Output Targets		Intended Users	Outcomes	Impact
Output 1: Analysis of market constraints and opportunities for value-added crop, livestock and horticultural products in the dry areas		Policy makers, researchers, extension systems, development organizations	Greater use by farmers and communities of relevant market information; communities develop organizations for increased access to markets and gain greater bargaining power	Better integration of small-scale crop-livestock systems; increased incomes and higher share of consumer prices obtained by producers
2008	Strategy for extending ICARDA's horticultural research, with special attention to high value vegetables, dry area fruit trees and medicinal and aromatic plants	R&D systems, farmers and other stakeholders (policy makers, planners etc)	Strategy integrated and used in planning of the R&D systems	Increased farmers' income from horticultural medicinal, aromatic plants; better use of land and water resources,
	Strategy for small ruminant research in the dry area	R&D systems, herders, farmers and other stakeholders (policy makers, planners etc)	Strategy integrated and used in planning of the R&D systems	Increased herders and farmers' income from small ruminant production; better use of land and water resources,
	Crop yield gap analysis using modelling and GIS technologies for selected countries in CWANA	R&D systems, farmers and other stakeholders (policy makers, planners etc)	Better understanding of the impact of yield gaps on cropping systems. Knowledge of cropping yield gaps integrated into R&D systems	Increased farmers income by use of better agronomic practices leading to more productive and profitable cropping system, more crop/drop
	Information on small ruminant diseases and health delivery systems that maximize marketing opportunities documented and shared with NARS and other stakeholders in dry areas (<i>with ILRI</i>)	R&D systems, farmers and other stakeholders (policy makers, planners etc)	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.
2009	Integrated analysis and assessment of constraints and potentials for conservation agriculture as an option to improve crop yield and sustain the production systems in the dry areas for selected countries in CWANA	R&D systems, farmers and other stakeholders (policy makers, planners etc)	Better understanding of conservation agriculture. Knowledge of conservation agricultural practices integrated into R&D systems	Increased farmers income by use of better agronomic practices leading to more profitable agronomic practices, resource conserving farming practices
	Information databases on sustainable production systems (both conventional and organic) of suitable vegetable crops and dry area fruit and nut trees, medicinal plants) for small scale production.	R&D systems, farmers marketing agents	Farmers and local communities develop organisations for increased access to technologies and market information	Increased farmers' incomes as a result of better use of marketing information and as a result of better use of information.

Output Targets		Intended Users	Outcomes	Impact
	Information data base on marketing potential and post-harvest handling/ processing of high horticultural products (fruits, vegetables, ornamentals, herbs and spices, medicinal plants) in targeted dry area regions	R&D systems , farmers marketing agents	Farmers and local communities develop organisations for increased access to technologies and market information	In creased farmers' incomes as a result of better use of marketing information and as a result of better use of information
2010	Cross-site analysis and synthesis of market constraints and opportunities for small ruminant products and forages that limit the link of the production with the market chain in dry areas	NARS, international organizations, policy makers, development projects, NGOs and farmers' communities in dry areas	R&D and farmer communities in selected dry area representative countries using information on markets for better orientation and market-targeting of production systems to capitalize on existing market opportunities	Improved institutional capacity for market-research orientation Diversified and increased rural incomes Increased rural employment in community-based agro-processing and marketing enterprises
	Information databases on soil profiles of dry area farming systems and GIS-remote sensing based spatial analysis of crop distribution and yield	NARS, international organizations, policy makers, development projects, NGOs and farmers' communities in dry areas	R&D and farmer communities in selected dry area countries using state of the art agronomic information and tools in sustaining and enhancing crop-livestock productivity	Improved institutional capacity for market-research orientation Diversified and increased rural incomes Increased rural employment in community-based agro-processing and marketing enterprises
Output 2: Options to increase the productivity of agricultural systems in the dry areas, 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, NGOs, relief and rehabilitation agencies	More productive, diverse cropping systems with more marketable and profitable produce; rehabilitated agriculture systems following conflicts and disasters	Increased crop production and incomes in dry areas by 2010
2008	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	Improved productivity and rural incomes from use of more sustainable production practices
	Barley, lentil and chickpea lines with improved micro-nutrient and market characteristics evaluated and disseminated	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.
	Improved intensive cash crop production packages for protected agriculture that use less water developed and promoted in partner countries	Researchers, extension agents, farmers, decision makers	Improved protected agriculture management practices available and taken up by farmers	Improved productivity and rural incomes from use of more profitable and water efficient practices
	Technical, institutional and policy options (TIPOs) for improved dairy goat production systems suitable for women in post-conflict dry areas identified and disseminated	Women's groups in target countries, extension and development agencies, and NGOs	TIPOs for improved goat production available for wider use	Improved family nutrition, increased goat productivity and family income

Output Targets		Intended Users	Outcomes	Impact
	Potential alternative livelihoods for poppy producers evaluated	R&D systems; poppy farmers; rural development agencies; international development agencies; NGOs.	Enabling policies and institutional support required to support the uptake of alternatives to poppy production identified by national and international agencies; Programs for out-scaling alternative livelihood options developed by NARS, NGOs, development agencies, etc.	Alternative livelihood options adopted by farmers, reducing dependence on illicit crop production and contributing to national objectives of eliminating poppy production.
2009	Improved crop management and better adapted crop varieties identified and promoted in Iraq	NARS and extension services; farmers	Improved varieties and management technologies available to producers	Improved productivity and rural incomes from use of more profitable and sustainable production practices
	Sustainable and ecologically sound IPM systems for date palm which reduce losses caused by major pests and diseases and improve quality and market value tested and developed	Date producers, NARS, extension systems	Sustainable production system for date palm with minimum use of agro-chemical and better production quality	Increased productivity and incomes for producers and better quality produce for consumers
	Tested options for enhancing the livelihoods of women in post-conflict areas	Women's groups in target countries, extension and development agencies, and NGOs	Women's communities access and use options for improved goat production	Improved family nutrition, increased goat productivity and family income
2010	Enhanced understanding of conventional and conservation tillage systems using zero-tillage with/without residues	NARS, extension systems, farmers, decision makers	Knowledge dissemination for better agricultural system	Improved rural livelihoods, reduced poverty ; enhanced and sustained soil use
	Zero-till systems for various cropping systems	NARS researchers, extension agents, farmers, decision makers	Knowledge dissemination for better agricultural system	Improved rural livelihoods, reduced poverty, enhanced and sustainable soil use
	Recommended practices for the production of high quality vegetable crops using good agricultural practices	Growers, NARS scientists, extension agents	Sustainable intensive production system for high quality vegetable crops	Improved livelihoods of small and medium sized producers
Output 3: Crop-livestock options to increase the productivity of livestock and diversify and increase quality safety standards and value of their products, through improved feed supply, feeding, health and breeding practices tested with NARS and farmers		NARS, development projects, NGOs, farmers' communities, and development projects in dry areas	Farming communities and R&D efforts use improved meat and milk production technologies based on the efficient integration of crop and livestock enterprises and better use of indigenous genetic resources	Livelihoods of smallholder crop-livestock producers is improved through increased and stable livestock (meat, milk), crop and soil productivity
2008	Improved cultivars of food-feed crops and pasture/forage legumes for small-scale crop-livestock farmers	Private and official seed enterprises, development agencies, NGOs	Dual-purpose cultivars of food-feed crops adopted by small-scale farmers	Livelihoods of small-scale crop-livestock producers enhanced through increased feed and livestock productivity

Output Targets		Intended Users	Outcomes	Impact
2009	A model for outscaling research outputs on small ruminant production/profitability tested in partner countries	NARS, development projects, NGOs and farming communities	A wider number of farmers using option tools and technological improvements to target markets and acceleration of technology adoption	Improved institutional capacity in community-based research Rapid means to achieve goals of improving productivity, income generation and economy activation in depressed regions
	Phenotypic and genetic (molecular) characterization of small ruminants along the Silk Route from Central to West Asia	NARS and policy makers	Indigenous goat diversity and interrelationships characterized and used in appropriate plans for their improvement	Small ruminant genetic diversity and adaptations known and preserved More sustainable, diverse and profitable crop and livestock production
	Options for diversifying feed resources and/or feeding systems of small-scale crop-livestock farms for efficient use of land, water, and nutrients in dry areas	Researchers, research managers, policy makers	More effective research and development actions targeted to small-scale crop-livestock producers	Sustainability of small-scale crop-livestock farms improved
2010	Strategies for the use of alternative low-cost feedstuffs that maintain sheep milk quality and safety	NARS, policy makers, development projects, NGOs and farming communities	Farmers and R&D efforts efficiently using available feed resources to reduce feed constraints and capture market opportunities in target countries	Enhanced feed base and livestock productivity in smallholder crop-livestock systems
	Transfer of integrated production system for spineless cactus as supplementary feed for livestock in dry areas	Livestock producers, NARS, , extension systems	Farmers and NARS aware of benefits of using spineless cactus as supplementary forage	Increased animal production and profitability through producing more forage with less water
Output 4: 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, and farm communities in dry areas	Better technologies for post-harvest handling of crop and livestock products	More profitable crop and livestock farming systems and better farm incomes
2009	Efficient post-harvest quality and value-adding processing packages for date palm developed and promoted in date producing countries	Date producers, NARS, policy makers and extension systems	Producers and processors using technologies to increase value and marketability of dates and date products	Investment and running costs of processing and packing houses reduced, profitability increased for farmers and processors, and quality increased for consumers
	Efficient post-harvest handling/ processing packages for high value horticultural products (fruits, vegetables, ornamentals, herbs and spices, medicinal plants) in targeted dry area countries	Small farmers, NARS, policy makers and extension systems	Producers and processors using technologies to increase value and marketability of horticultural crops	Profitability of farmers increased as result of reduced processing and packaging costs
2010	Multi-site synthesis of the results from partner countries of value adding options for small ruminant production	NARS, development projects, NGOs, farming communities, and private sector	Farm communities and R&D efforts using new production strategies that provide quality products demanded by consumers	Improved institutional capacity in milk processing and more profitable dairy sheep production

Output Targets		Intended Users	Outcomes	Impact
	Efficient post-harvest techniques and practices developed for date producers	Growers, NARS and extension systems	Producers and processors using technologies to increase value and marketability of dates and date products	Improved institutional capacity in date processing, increased profitability for farmers and processors, and increased quality for consumers
	Efficient and sustainable approaches for smallholder production of selected horticultural crops	R&D systems, farmers, marketing agents	Producers, NARS, extension systems using efficient and sustainable horticultural production technologies	Improved livelihoods of small farmers from as a result of diversification of crops and access to markets
Output 5: 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
2008	Twenty NARS researchers and extension officers from the dry areas trained in integrated crop-livestock production	Researchers, extension systems	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
	20 research and extension scientists from Iraq trained in crop improvement and management methodologies and technologies	Researchers, extension services	Increased critical mass of researchers with improved skills in the development of more sustainable and diversified crop production systems in Iraq	More sustainable, diverse and profitable crop production
	One Ph.D student completes supervised research in oil production of hybrid and open pollinated sunflower varieties and olives	Researchers, extension services, post-graduate students	Improved critical mass of researchers with better skills in the development of more sustainable and diversified crop production systems in dry areas	More sustainable, diverse and profitable oil production
	Two MSc students complete supervised research in aspects of diversification and sustainable crop and livestock production	Researchers, extension officers, post-graduate students	Improved critical mass of researchers with better skills in the development of more sustainable and diversified crop and livestock production systems in dry areas	More sustainable, diverse and profitable crop and livestock production
	Nine MSc students complete supervised research in livestock health and marketing issues (with ILRI)	Researchers, extension systems, post-graduate students	Increased critical mass of researchers with improved skills in small ruminant diseases, health services and marketing	More sustainable, diverse and profitable livestock production and marketing
	20 farmers, researchers and extension scientists trained in IPPM for cash crop production under protected agriculture	NARS and extension systems, farmers	Scientists and farmers with better knowledge of sustainable protected agriculture production technologies for cash crops	Improved rural livelihoods from adoption of protected agriculture

	Output Targets	Intended Users	Outcomes	Impact
	Regional network and discussion forum established for intensive cash crop and cactus production	Producers, extension systems, NARS	Increased interaction between technology generators and end-users to share experiences and promote adoption	Better adoption of new technologies and more production and profitability for livestock and intensive crop farmers
2009	20 NARS researchers and extension officers trained in integrated crop-livestock production	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
	10 researchers trained in aspects of diversification and sustainable improvement of crop and livestock production	Researchers, extension officers	Increased critical mass of researchers with improved skills in sustainable and diversified crop and livestock production systems in Central Asia	More sustainable, diverse and profitable crop and livestock production
	One MSc student completes supervised research in aspects of diversification and sustainable crop production	Researchers, extension officers, post-graduate students	Improved critical mass of researchers capable of developing more sustainable and diversified crop and livestock production systems	More sustainable, diverse and profitable crop and livestock production
	20 farmers, researchers and extension scientists trained in IPPM for cash crop production under protected agriculture	NARS researchers and extension officers, farmers	Scientists and farmers with better knowledge of sustainable protected agriculture production technologies for cash crops	Improved rural livelihoods from adoption of protected agriculture
	Web-accessible date palm expert system developed for crop management & handling	Growers, extension agents, NARS researchers	Information on improved date palm management readily available to users	Improved researcher and extension officer capacity and improved production and profitability for date palm growers
2010	Book on livestock production in dry areas of Latin America, including socioeconomic aspects and forage, range and flock production technologies	NARS researchers, universities and post-graduate students	Researchers in the region gain knowledge and access to a framework for problem solving in livestock production in Latin America	More sustainable, diverse and profitable livestock production
	20 growers, researchers and extension officers in post-harvest technology for date production	Growers, extension officers, NARS researchers	Growers, researchers, and extension agents with better knowledge of efficient post-harvest techniques and practices for date production	Improved production and profitability for date palm growers
	20 farmers, researchers and extension officers trained in IPPM and soil-less culture for cash crop production	Farmers, NARS researchers and extension officers	Scientists and farmers with better knowledge of sustainable protected agriculture production technologies for cash crops	Improved livelihoods from high quality products