Development of Integrated Crop–Livestock Production Systems in Low Rainfall Areas of the Mashreq and Maghreb Regions (M & M Project)

MASHREQ AND MAGHREB PROJECT ACHIEVEMENTS AND LESSONS LEARNT FROM PHASES I AND II

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Flock management & on-farm feed production | Barley Production | By-products Feed Blocks | Cactus & Fodder Shrubs | Natural Pastures Enhancement & Rangeland Management

December 2007

ICARDA 1977-2007
International Center for Agricultural Research in the Dry Areas

IFAD INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT
International Fund for Agricultural Development

The Arab Fund for Economic and Social Development

IDRC International Development Research Centre
International Development Research Centre

CAPRi
CGIAR Systemwide Program on Collective Actions and Property Rights

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ABOUT ICARDA AND THE CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 15 centers supported by CGIAR. ICARDA's mission is to improve the welfare of poor people through research and training in dry areas of the developing world, by increasing the production, productivity and nutritional quality of food, while preserving and enhancing the natural resource base.

ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and the West and Central Asia and North Africa (CWANA) region for improvement of bread and durum wheat, chickpea, pasture and forage legumes, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national, regional and international agricultural research and development systems.

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Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

FOREWORD

In the low-rainfall areas of the countries in West Asia and North Africa (WANA), rural livelihoods are primarily based on agro-pastoral production systems in which small ruminants (sheep and goats) represent the principal economic output. These systems vary both within and between countries, from nomadic or semi-nomadic rangeland-based to mixed crop-livestock smallholder systems, with considerable interaction between the two. However, these systems face several constraints including insufficient rainfall, degraded rangelands and therefore acute feed shortages, poor livestock management practices, and inappropriate policy. As a result, the natural resource base continues to degrade and poverty continues to be widespread among herders and pastoralists.

To address these issues, ICARDA in collaboration with IFPRI and the national programs of eight countries (Iraq, Jordan, Lebanon and Syria in the Mashreq; and Algeria, Libya, Morocco and Tunisia in the Maghreb), and with financial support from IFAD, AFESD, IDRC, FEMISE, and CAPRi, initiated the first phase of a regional adaptive research program for the Development of Integrated Crop/Livestock Production in Low-Rainfall Areas of WANA, known as the «Mashreq/Maghreb Project» in 1995. A second three-year phase of the Project commenced in July 1999, aiming to achieve greater integration of multidisciplinary research by shifting to a community approach that involved far greater participation of stakeholders in adaptive research, technology testing and validation, as well as project planning and evaluation.

The Project approaches and methodologies were scaled out and institutionalized in the participating countries. A functional regional network was established. The spillover effect of the Project resulted in the adoption of its approach and methodologies by other national and international institutions.

The successes in the first two project phases prompted IFAD and AFESD to support a third phase of the Project aiming at scaling out the Community Development Planning approach and linking the Project activities with national development projects in order to realize higher impact on livelihoods in rural and agro-pastoral communities.

This document highlights the achievements and lessons learnt from the first two phases of the Project. We hope it will be useful to the countries in the region at both technical and policy levels, as well as to donors interested in improving the livelihoods of the pastoral communities in the region.

I would like to thank the national program managers and scientists and policy makers for their dedication and commitment, and IFAD, AFESD, IDRC, FEMISE and CAPRi for their valuable financial support and long-term commitment to livelihood improvement of the rural poor in the WANA region. Thanks are also due to IFPRI for a successful model of inter-center collaboration with ICARDA.

Mahmoud Solh
Director General

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The authors developed this synthesis based on M&M project publications including annual reports, monographs, bulletins, donors' reports, web sites, project evaluation missions' reports, IFAD Technical Advisory Notes (TANS), ICARDA, IFPRI and CGIAR reports and publications.

On behalf of ICARDA we would like to thank all those who contributed to the achievements of the project: We are indebted to the national coordinators who took the responsibility of managing and implementing the first two phases, and through them we would like to thank and appreciate the hard work and dedication of the technical and management teams in the eight countries, and the national institutions and their Directors for their support and the facilities they provided to project activities. The coordinators who served during the two phases are:

Algeria, Mr Ali Zegida, Dr. Mustapha Malki; Morocco, Dr. Mohamed El Mourid, Dr. Chriyaa, Tunisia, Dr. Ali Nefzaoui; Libya, Mr. Adnan Sbeita; Jordan, Mr. Qasem Mamdouh, Dr. Faisal Awawdeh; Syria, Mr. Yassin Sweidan; Lebanon, Dr. Salah Haj Hassan; Iraq, Dr. Baha El Rawi, Dr. Kamel Shideed.

The ICARDA project regional coordinators deserve thanks and appreciation for guiding the work, those are: Dr. Nasri Haddad, Dr. Mohamed Mekni, Dr. Habib Halila, and Dr. Mohamad El Mourid, and through them we would like to thank the regional offices staff in Jordan and Tunisia, and the staff in the ICARDA offices of Lebanon, Morocco and Syria for the continuous support they provided to the project.

Thanks is extended to our colleagues from IFPRI; Dr. Peter Hazel and the late Dr. Peter Oram, and to ICARDA/IFPRI scientists, Dr. Tidiane Ngaido and Dr. Nabil Chaherli, and for CIRAD, Dr. Veronique Alary.

We are thankful for the donors who provided generous support and long-term commitments to the project during the two phases. Special thanks are extended to Presidents of IFAD and AFESD, the Directors of IDRC, FEMISE and CAPRI, and to their dedicated representatives who guided the work and showed interest and support to the project; from IFAD Dr. Ahmed Sidahmed, Dr. Abdelmajid Slama, Dr. Rodny Cooke Dr. Mona Bishay, and from AFESD, Dr. Ismail El Zabri, the late Dr. Mervat Badawi and Mr. Samir Jarrad.

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The authors

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

AFESD	Arab Fund for Economic and Social Development
ARC	Agricultural Research Centre, Libya
CAP	Community Action Plan
CAPRi	Collective Action and Property Rights
CDP	Community Development Plan
CGIAR	Consultative Group for International Agricultural Research
CWANA	Central Asia, West Asia and North Africa
DASR	Directorate of Agricultural Scientific Research, Syria
FAO	Food and Agriculture Organization
ICARDA	International Center for Agricultural Research in the Dry Areas
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
INRA	Institut National de la Recherche Agronomique, Centre Aridoculture, Morocco
INRAT	Institut National de la Recherche Agronomique, Tunisia
INRM	Integrated natural resources management
IPA	Agricultural Research Center, Iraq
ITGC	Institut Technique des Grandes Cultures, Algeria
LARI	Lebanese Agricultural Research Institute, Lebanon
M&E	Monitoring and evaluation
M & M	Mashreq and Maghreb Project
NCARTT	National Center for Agricultural Research and Technology Transfer, Jordan
NGO	Non-governmental organization
NRM	Natural resources management
RRA	Rapid rural appraisal
TAN	Technical Advisory Notes
WANA	West Asia and North Africa

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

1 INTRODUCTION AND BACKGROUND

The countries of West Asia and North Africa (the Mashreq and Maghreb regions) (figure 1) are characterized by high population growth rates, large and rapidly increasing food deficits, highly variable income levels, and limited natural resources, particularly arable land and water. Climatic features, especially the low and variable rainfall, limit the options available to farmers. Economic growth, increasing urbanization, and the associated rising consumer demand are forcing changes in production practices that threaten the natural resource base of the region.

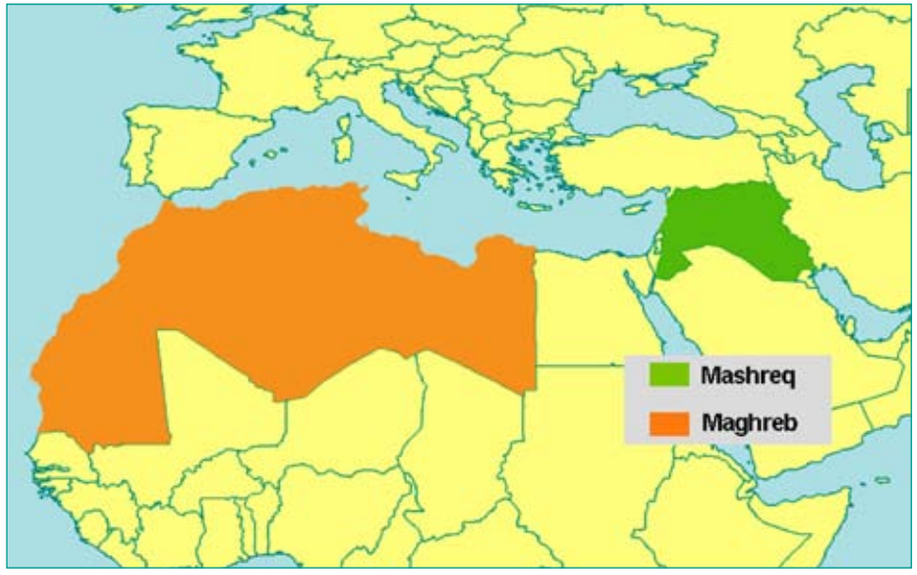


Figure 1. Map of the M&M region

Most of the rural population, particularly in the low rainfall areas, is poor, depends on agriculture for a living, and tends to supplement farm income with off-farm earnings or remittances from working in other countries. Some form of co-existence prevails between the livestock owners and the settled farmers (who themselves own some livestock).

In the low rainfall areas, small ruminants (sheep and goats) represent the principal economic output and constitute a large proportion of the income of farmers and nomadic or semi-nomadic herders. The region has experienced a substantial increase in animal numbers. Livestock producers have been

encouraged to increase flock sizes by the increased demand for animal products combined with the favorable price ratios between livestock products (live-weight, meat and milk) and barley, the principal livestock feed. Feed subsidies and other measures intended to mitigate the effects of feed shortages in drought years have provided further incentives to retain greater numbers of animals.

Expansion in flock size and flock numbers has been particularly noticeable at the drier end of the arable farming spectrum, where more native pasture lands are open to free grazing. The native pasture vegetation in these rangelands once provided a large proportion of the feed needs of the small ruminant population. Today, however, the natural rangelands can no longer provide such a high component of animal feed needs. As livestock numbers have grown, so has supplemental feeding, mainly of barley grain, straw, and industrial crop by-products. Not only is rangeland a resource insufficient to meet current demand, the absolute level of feed resources is falling due to overgrazing, removal of vegetation through plowing or for fuel wood, and soil erosion.

As livestock numbers have increased, so has the area planted to barley (Table 1). This has been achieved primarily by cultivating previously uncultivated marginal land and by replacing the annual fallow in barley areas with continuous barley cropping. However, such mono cropping is rapidly depleting soil fertility and stimulating the build up of pests and diseases. There are indications that barley yields in these systems are declining.

Table 1 Changes in population, numbers of sheep and goats, barley harvested area and barley yields, Mashreq and Maghreb regions, 1980-2005

	1980	1990	2000	2005
Population (million)	74.43	98.09	122.40	134.96
Sheep and goats (million)	76.84	81.52	82.52	85.18
Barley harvested area (million ha)	5.80	9.03	5.45	6.35
Barley yield (kg ha1)	979.9	703.7	573.3	811.3

For many governments, the problem of finding enough feed for the animal population is becoming almost as acute and politically significant as the food security issue. Despite the fact that the area planted to barley has expanded, yields in these areas are low and the domestic production of barley, the main livestock feed, has been unable to satisfy feed demands. The «feed gap» is increasingly being met by imported feeds.

Rapid changes in the global economic environment are leading to changes in the economic policies of the countries concerned. In the past, policy measures focused on objectives of food security, providing food for low-income urban populations at affordable prices while maintaining production prices at a level that provide incentives to farm producers. In many countries this has been achieved by controlling domestic markets and prices, resulting in complex, inefficient and costly systems of government transfers, subsidies, and support programs.

The countries of the Mashreq and Maghreb region are in transition. Integrating national economies into an open global market economy involves a complex process of institutional and structural change. The desired outcomes of policy reforms are no longer restricted to increasing productivity and protecting urban consumers; governments are increasingly recognizing the importance of environmental sustainability and equity considerations.

Rural populations in these less favored areas are often forced to pursue production strategies that, while meeting short-term requirements, are in the long-term destructive and unsustainable. Inappropriate policies regarding land use and the absence of secure property rights have exacerbated the problem. In most countries in the region, the traditional local institutions governing access to grazing lands have been disrupted, resulting in a system of «open access», but with no corresponding regulatory mechanism to control the extent and intensity of grazing. In addition to its unfavorable environmental impacts, there are indications that the decline in the productivity of the rangelands is contributing to poverty and out-migration.

Past and ongoing research has identified available, or potential, technologies and management strategies for developing improved crop/livestock production systems, based on the integration of local (on-farm) feed production combined with more efficient use of alternative feed sources, and the improvement of livestock management, health, nutrition and reproduction. However, adoption of such technological innovations has been slow.

Neither technical interventions nor policy adjustments alone will solve the problems. The development of productive and sustainable livestock-based systems in the semi-arid and arid areas of the Mashreq and Maghreb region requires action on several fronts. A program of adaptive research is needed that integrates research on policy and institutional alternatives with research on technologies and management practices. Such a program would provide policy and institutional support for the wider adoption of improved production

and resource management practices.

To address these issues the Mashreq and Maghreb (M & M) Project was initiated with the following objective:

The overall objective of the project is the development of productive and sustainable small ruminant based production systems, through the integration of feed and livestock production, both within and across arable and rangeland production systems. This will improve the incomes and welfare of farmers and pastoralists in the low rainfall areas of the Mashreq and Maghreb regions, while meeting national demands for small ruminant products and conserving the natural resource base.

The M & M Project first phase, initiated in 1995, was an adaptive research program for the development of integrated crop–livestock production in the low-rainfall areas (LRA) of West Asia and North Africa (WANA) (see Box 1). The project encompassed two sub-regions of WANA, the Mashreq sub-region, including the countries of Iraq, Jordan, Lebanon, and Syria, and the Maghreb sub-region, including the countries of Algeria, Libya, Morocco, and Tunisia. The project is implemented by the eight national programs, the International Center for Agricultural Research in the Dry Areas (ICARDA), and the International Food Policy Research Institute (IFPRI).

In the second phase of the Project, which began in 1998, technology transfer was accelerated through community level testing of technologies. At the same time, technologies moved between the cooperating countries, facilitated by a regional network established by the M & M Project.

The project was financially supported by the International Fund for Agricultural Development (IFAD), the Arab Fund for Economic and Social Development (AFESD), and the International Development Research Centre (IDRC).

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

BOX 1

Characteristics of the low rainfall areas in the Mashreq & Maghreb regions

High population growth rates, large and rapidly increasing food deficits, highly variable income levels, and limited natural resources, particularly arable land and water.

Inhabitants are the most poor, the most socially disadvantaged, the least politically influential, the most scattered and disfavored in terms of infrastructural and institutional support.

A large number of the small farmers in the region are deriving most of their family income from barley/livestock based systems particularly because of the flexibility barley could offer both as feed and/or food crop, and because sheep raising is quite profitable in the region as demonstrated by the high live-weight, meat and milk production to barley price ratios (20:1, 40:1 and 5:1, respectively).

Low and variable rainfall limits the options available to farmers. Economic growth, increasing urbanization, and the associated rising consumer demand are forcing changes in production practices that threaten the natural resource base of the region. Small ruminants (sheep and goats) represent the principal economic output and constitute a large proportion of the income of farmers and nomadic or semi-nomadic herders. Barley mono-cropping is rapidly depleting soil fertility and stimulating a build up of pests and diseases, and barley yields are declining. The «feed gap» is increasingly being met by imported feeds.

2 THE PROJECT CONCEPT AND APPROACH

2.1 The need for a new approach

The poor performance of research and development projects in the WANA region was highlighted in several forums and by many donor institutions. In addition, the experience learned from the IFAD/ICARDA supported regional research and technology transfer program indicated that any progress must, in the first place, be based on the demands and participation of the livestock producers as well as the political commitment and support of each country. Since the problems are mainly socio-cultural, any successful research program must be developed following a thorough examination of the social and the cultural implications. This is mandatory and pre-requisite for any commitment, and participating governments should understand, from the outset, that they are obligated to provide free access to all socio-economic information.

Thus, the research approach in the M&M Project is non-conventional and requires simultaneous and effective progress in all of its multi-disciplinary components, which could be broadly categorized as follows:

(1) Technology development and transfer, including (a) a livestock management component, relating feed production to needs and utilization, and improved productivity and fertility, (b) research and technology development to improve feed and fodder production throughout the arable sector as well as from rangelands and natural pastures, and (c) socioeconomic analysis of production systems and monitoring of technology transfer and adoption.

(2) Policy and institutional research, including (a) analysis of the impact and role of government policies in affecting crop and livestock production in the low rainfall areas of WANA, and particularly their effect on economic incentives for the sustainable use of land and range resources and on the alleviation of poverty, and (b) analysis of property rights issues and the role and effectiveness of local institutions in regulating rangeland use.

Although the two components are presented separately, considerable linkages exist between them. The project emphasizes a multidisciplinary approach that addresses issues from a socioeconomic, cultural, institutional, and policy perspective, intended to stimulate interaction among researchers, extension workers and policy makers within and across countries.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

A second notable feature is that both the policy and institutional research and the technology development involve collaborative and participatory work with farmers and livestock owners, encouraging closer interaction between scientists and their beneficiaries and ensuring that appropriate measures, both technical and economic, are developed.

Research focusing on the development of new technologies suitable for, and capable of, addressing the new forces of urbanization, increasing food consumption, international trade, etc. does not exist. This is confirmed by the low uptake of previous attempts for improvement. Therefore the major feature of the project will need to be its handling of the technical issues from the perspective of the socioeconomic, cultural, institutional, and political frameworks. The approach is extensively multidisciplinary and the research would follow from the start a pastoralists/farmers/livestock owner's managed approach.

2.2 Shift in the scale of technology testing to the community level (from Phase I to Phase II)

Greater integration was achieved through a shift in the scale of technology testing and adaptation. In the first phase, the project had focused on the testing and demonstration of technology components at the farm level, with the results being evaluated within the whole-farm context. In the second phase, technology testing and transfer shifted to testing and evaluating combinations (or packages) of associated technologies at the whole-farm/household level, and to working at the community level, involving the local private and cooperative sector as well as farm households. Utilizing the community modeling work initiated in the first phase assisted in identifying solutions that take account of the behavior of the community and how it manage its landscape.

The project builds upon the previous regional collaborative programs between ICARDA and the national programs, which had already made progress in testing and verifying improved technologies under farm conditions. The project evolved from a technology component testing program to one of integrated adaptive research, addressing issues from a technical, socioeconomic, cultural, institutional, and policy perspective, with the full participation of the intended beneficiaries and other stakeholders. This has been further facilitated by shifting to a community approach (Figure 2 and Table 2).

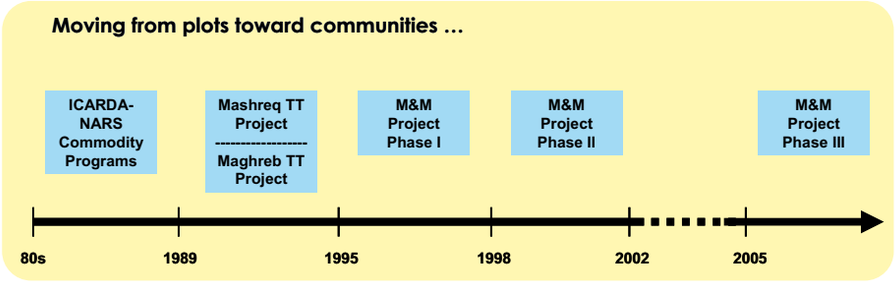


Figure 2. Development of regional collaborative programs between ICARDA and NARS

These developments in research concepts and approaches have involved intensive discussions and consultations between all partners involved, ensuring that there is a common agreement on the aims of the project and the way that it is implemented. The strength of the regional project comes from its multidisciplinary approach and the interaction between NARS (National Agricultural Research Systems), which has facilitated the transfer of technology and experience between countries.

The project emphasizes a multidisciplinary, research approach in addressing technical issues from a socioeconomic, cultural, institutional, and policy perspective, which requires inputs from a number of research institutes within a national program.

At the regional level, the multidisciplinary approach is supported by inter-country exchanges of material and results, which encourages complementarities and efficiency of research. In this way the project has established a multinational, multidisciplinary network among researchers from the eight countries participating in the project.

A summary of how the project evolved from one that focused on individual farmers to a community based approach is given in Table 2. Not shown in the table, but implied by it, is the evolution within the participating institutions from a top-down perspective to a more bottom-up approach, and the involvement of at least two learning cycles that span the timeframe of the project from 1995 to 2002. The first cycle focused mainly on diagnosis, building trust with the participating communities, social mobilization, and a change in the approach and perceptions of the research personnel. The second main learning cycle involved participatory, action research and action planning, empowerment of local institutions, and a focus on community based organizations and solutions. These learning cycles have been operating over different time scales and periods within the individual countries and communities.

Table 2 The evolution of the project to a community-based approach (from Phase I to Phase II)

	M & M I (working with individual farmers) 1995-1997	**M & M II (community approach) 1998-2002**
Definition of project boundaries	Scientists determined the technology boundaries (physical, social tastes, preferences, economic, institutional organizations, tenure, etc.) based on previous regional collaborative programs and surveys of constraints as perceived by farmers.	Communities participate in the definition of technology boundaries and institutional options (negotiated community action plans).
Definition of problems	Researcher led trials with farmers active in technology testing.	Community expertise (indigenous knowledge) is taken into consideration and communities decide on the options to be tested in their community.
Definition of the objectives	Objectives of farmers/community are mainly defined by scientists, based on their knowledge of the farming communities.	Community objectives (household livelihood strategies, constraints and opportunities) determine technology and institutional options.
Workplan development and implementation	Scientists define the work plan and implementation level (plot, farm level) in consultation with farmers.	Development of the work plan and implementation is negotiated with communities and the responsibilities are shared (Negotiated Action Plan and Community Development Plan).
Roles of teams and farmers	M & M teams made all the decisions based on their contacts with farmers, and in most cases provided all the inputs and monitored the process. Limited feedback from farmers.	Community institutions (local M & M committee) are in the driving seat.
Definition of success	Success is determined by the scientists using increased productivity as the sole indicator for success.	Success is determined by the community.
Information flow	Seldom is there feedback to the community; information stays in the hand of scientists or is disseminated farmer to farmer.	Feedback to the community is immediate and assured.
Human capacity building	More emphasis is given to technical staff.	More farmer orientated training programs. Traveling farmers' workshops
Overall approach	Approach focused on productivity at farm level.	Integrated problem-solving and decision-making at multiple levels.
Monitoring and evaluation	Done solely by scientists.	Active participation of communities in assessing the performance of options.

3 MAJOR ACHIEVEMENTS AND IMPACT

3.1 Participatory community approach

Farmer participation in technology verification and technology transfer is becoming increasingly important if sustainable adoption is sought and better technology modification and refining is to be achieved. Farmer participation research was mainly focusing on development and transfer of technology related to crops. Experience with crop–livestock integration and participation in system research is limited. Furthermore, available experience in farmer participation in agricultural research was drawn from the results achieved in a high-potential environment where returns from technology are high and risk is relatively low. Farmers under such an environment are usually willing to experience "participation". By contrast, low-production environments, such as the areas of the Mashreq and Maghreb Project, are subject to many constraints resulting from a fragile production system, high risk, and deteriorated resources. Under such conditions, it is difficult to secure farmer participation. The M & M Project developed a participatory community-based approach as one way to enhance such participation (Figure 3).

Why a community approach?

During its first phase, the period 1995 to 1998, the project focused on testing and demonstrating technology components at the farm level, with the results being evaluated within the whole-farm context. During the second phase, the project shifted the scale of technology testing and adaptation to the community level (Box 2). This approach is characterized by the following:

- Testing and evaluating combinations (or packages) of associated technologies at the community level, involving the local institutions as well as farm households.
- Resource based approach rather than a commodity based one is used, and this approach is implemented in a multidisciplinary and inter-institutional context.
- Utilizing community modeling in order to identify solutions that take account of the behavior of the community and how it manages its resources.
- Strengthening decentralization by transferring the decision making power to local actors.
- Farmers of the community are involved in monitoring the performance of technology and its adoption.

- The experience of the Mashreq and Maghreb Project (Box 2)
- The project implemented the participatory, community based approach according to the following set of steps.

BOX 2

The M & M Project community approach: empowering agro-pastoral communities

The overall aim of the M & M Project was to foster the integration of improved and sustainable crop and livestock production systems in low rainfall areas. The project addressed problems from a technical, socioeconomic, cultural, institutional, and policy perspective, with the full participation of the intended beneficiaries and other stakeholders. It supported the development strategy of selected communities, by addressing needs identified by the communities themselves.

In Phase I of the project (1995-1998), appropriate technology components were tested and demonstrated at the farm level, and the results evaluated within a whole-farm context. Phase II of the project was aimed at the community level. Two target communities were selected in each country. The communities were chosen to represent areas where production systems were either based on barley or rangelands, or were 'in transition' (e.g. evolving towards an irrigated system or an agro-industrial system, as a result of changes in government policies). The project's foundations were laid by multi-disciplinary national teams, which characterized the communities' environments and investigated the policy and property rights issues that existed in each area.

The project has made a significant contribution in terms of changing the paradigm of research and development in the dry areas. Valuable lessons have been learned, not only in making the transfer of new technologies more effective, and in developing new decision-making tools for policymakers, but also in the participatory processes that led to the communities developing their own 'Community Development Action Plans', the project's ultimate goal. The process began with researchers conducting RRA and PRA exercises in the selected communities, along with comprehensive surveys of selected households. These data, and the results from Phase I of the project, were then presented at a community workshop. This led to the communities deciding that some of the technologies developed during Phase I should be dropped, while others should be selected for community-level testing. The communities identified the technological, institutional, and policy options that would, potentially, be most beneficial to them, and that would also benefit from further research. These options formed the foundations of a 'Negotiated Plan of Action', developed by each community.

M & M Project Community Approach to Technology Transfer

3.1.1 Community selection

The most important and crucial step in the community approach is selecting the targeted communities. It requires meticulous work requiring the full participation of local authorities as well as the project team, and takes into consideration the achievements and lessons learned from the first phase of the M & M Project as well as the experience gained from other developmental projects in the region. This process of community selection involves the following three interrelated steps (Figure 3):

3.1.1.1 Criteria for community selection

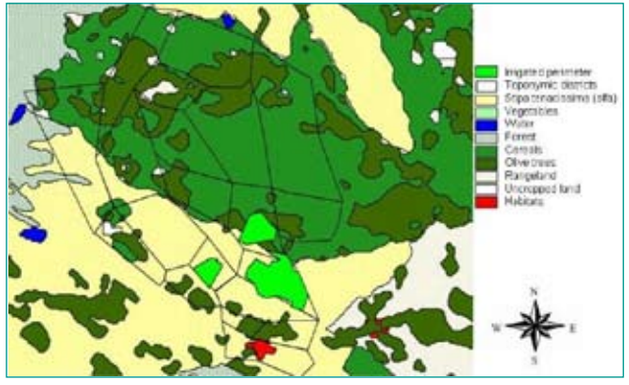
The main criterion is that selected communities should represent the low rainfall areas (LRA) and the targeted production system, have participated in technology generation, and have the potential to achieve noticeable impact linkages with development projects.

3.1.1.2 Process of community selection

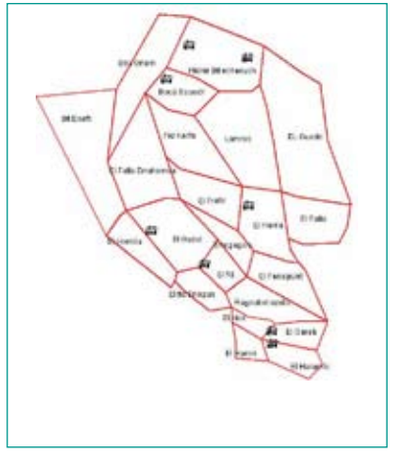
Several field visits and meetings with farmers and local institutions are made with the participation of extension system and agricultural authorities in the district/province in order to select communities that better represent the LRA using the above selection criteria.

3.1.1.3 Community characterization

Description of the main characteristics of the selected communities is the necessary condition for a successful implementation of the community based approach adopted by the M & M Project. Rapid Rural Appraisals are used to collect the baseline information and data related to the characterization of the selected communities.



Land use map, Zoghmar Community, Tunisia



Toponymic districts map, Zoghmar community, Tunisia

Figure 3. Example of a community map

3.1.2 Preparation of the community development plan

The main steps of the participatory process in preparing the community development plan (CDP) are presented following a practical, applied logic, although the stages are interdependent.

Based on field experience, five main steps in the participatory process could be distinguished. These are (Figures 4-5):

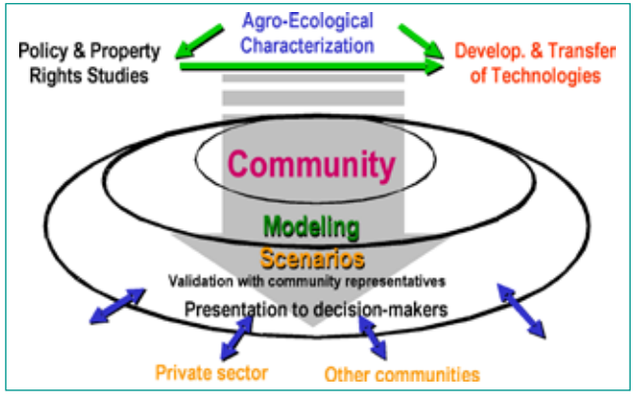
Step 1. Community characterization, (learning phase)
Step 2. Participatory planning,
Step 3. Promotion of local institutions,
Step 4. Participatory programming, and
Step 5. Implementation of the CDP and monitoring and evaluation (M&E).

The progress from one step to another follows a logical sequence except the step 'Promotion of local institutions' and that can be programmed according to the situation, however, this should happened before the last step (Step 5).

Figure 4. View of the community development plan preparation

Community Approach

As could be observed in the followinbg figure, the community approach is an integrated process starting with biophysical and socioeconomic characterization of the community, and developing modeling scenarios, that will be presented to decision-makers after its validation with the community, which will then be picked up and scaled out by different stakeholders.



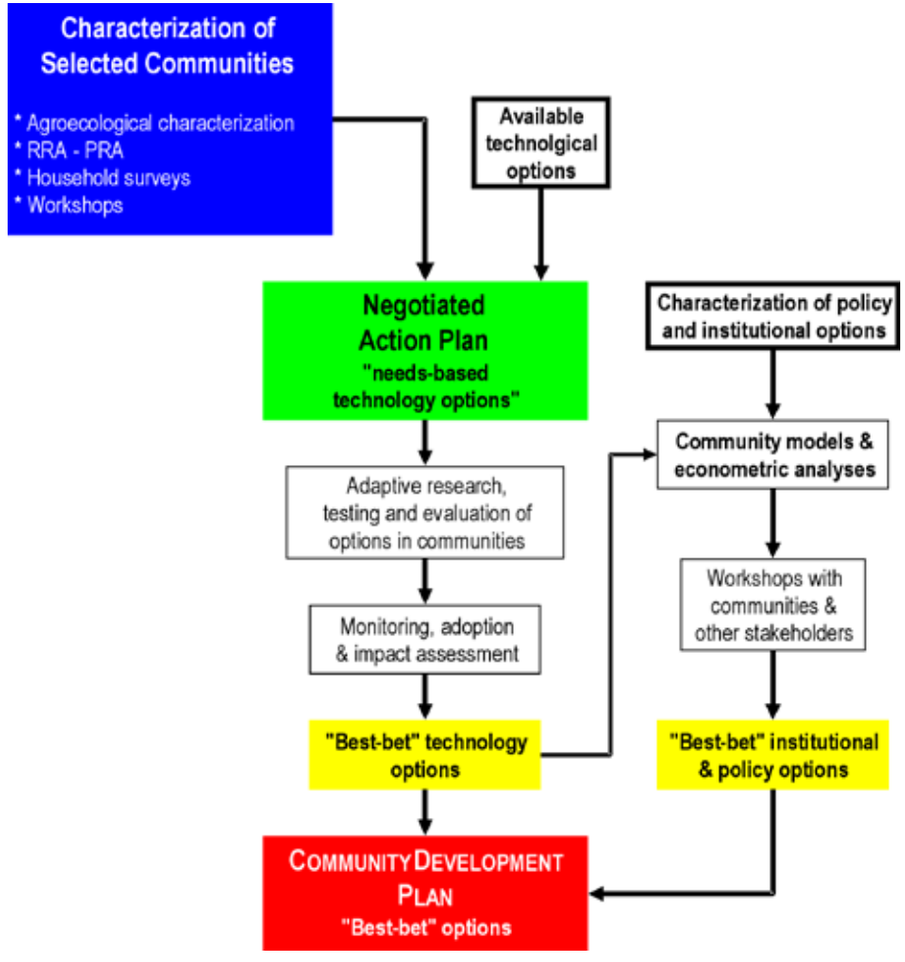


Figure 5. A schematic illustration of the five main steps in the participatory process

3.1.3 Mechanism of implementation

The process of implementation involves all project stakeholders and consists of the following steps:

A multidisciplinary team to work at the community level.

A community steering committee which includes a project facilitator and/or coordinator, a researcher from the project team, a local extension

worker, local community leaders, local agricultural authorities and local organizations/institutions.

The role of the project facilitator and/or coordinator is critical in integrating the activities of the specialized working groups. He is also responsible for securing the active and full participation of the local population in the implementation of the activities and for monitoring the adoption process of the technologies introduced.

Identify needs-based technologies and other intervention measures to tackle the main constraints hindering the development of the targeted communities.

The identification of the technologies introduced is based on the experience gained from the first phase of the project and the rapid rural appraisals, with full consultation with the farmers and sheep owners of the selected communities. However, there are two points of caution in this respect. First, some of farmers' demands and needs are beyond the reach of the project and may require decisions at the national level. Second, in introducing the project technologies into selected communities we should not give farmers high expectations, but we do need their enthusiastic participation.

Develop a methodology for monitoring and evaluation.

The community approach has achieved the following:

- Facilitated closer links with local and central governments and institutions.
- Initiated the enhancement of the bargaining power of the community in input purchasing and output marketing.
- Gave confidence to members that they could organize and manage activities Such as range management, cooperatives, and processing, with little or no support from the government.
- Gave the communities increased (collective) insight and vision with regard to the innovative conceptualization of development opportunities and options.
- Enabled some communities to qualify for loans by offering collective guarantees and securities, which they would not have been able to obtain individually.

Potentially, the growth (horizontal and vertical) of communities would most likely lead to the creation of pressure groups that should be able to achieve and gain more. That would depend on the evolution of an efficient

and dedicated management, on the emergence and sustenance of truly democratic communities, and on the development of self-confidence enhanced by progressive achievements.

The more policy and political support given to the process of community institutionalization, the more it will prove to be an effective vehicle for change and sustainable development.

There are indications that intra- and inter-country exchanges of visits between the communities may enhance the purpose and the process of institutionalization as well as the functional abilities of these institutions.

The community approach seems to be compatible with the intention and drive of many countries in the region to adopt decentralized forms and patterns of governance. The more policy and political support that is given by governments to these institutions, the more mutual gains and support can be realized. Since these communities provide the main platforms for socioeconomic models as part of the M & M program, the data generated by these models can provide invaluable guidelines for national planners. The models and the research results obtained from them may be further carried forward during the future program with the aim of drawing up guidelines for agricultural and rural development planning as well as for land and water use planning, marketing, and credit.

In some communities there might be conflicting interests and objectives, e.g. between crop and livestock farmers regarding the use of marginal communal land (Iraq). In Morocco, it is relatively easier to introduce the community approach in the barley/livestock system areas, where land is privately owned, than in the rangeland/livestock system where it is customarily owned and used. This is perhaps related to socioeconomic inequities, which may be difficult to reconcile.

3.2 Main achievements of the technology component

3.2.1 Increasing feed and forage production

Feed shortage is becoming an acute problem in countries involved in the Project. To overcome the problem, farmers usually expand their barley cultivation to the low rainfall areas, where yields are low and the production of barley has been unable to meet feed demands. As a result, the "feed gap" is being increasingly met by imported feeds.

The increasing tendency to import feeds (even hay) may be understandable to address the effects of drought or the transient shortage demands in the short to medium term, but, in the long term, it may prove to be catastrophic because it would encourage further expansion in animal production and hence over-stocking and over-grazing of limited pastures. Some countries may have to reconsider their cropping patterns with a view to maximizing crop residues if animal production has a clear comparative advantage, which would mitigate feed shortages.

The project has addressed the feed production shortages from two directions. One is to improve the on-farm feed production and crop management, and the other is to find alternative feed sources that could complement what is being produced on the farm.

3.2.1.1 Improvement of on-farm feed production and crop management

Barley and forage legumes, especially vetches (bekia), are the major fodder crops grown in the eight countries, in addition to oats and triticale, which are grown in the Maghreb countries (Figure 6).

New barley cultivars were selected by farmers and grown in demonstration fields. The cultivars included 'Rihane', 'Zenbaka' and 'Tadmor' in Iraq; 'Roho', 'Arabi Abiad' and 'SLB-6' in Jordan; 'Furat' in Syria; and 'Barjouj' and 'ACSAD 176' in Libya. Major emphasis was given to the production of hay from barley–legume mixtures, which are being used for hand feeding in periods of feed shortage. Also, direct grazing of dual purpose barley and vetches was an important practice in the eight countries, which has become one aspect of crop/livestock integration.

Growing forage legumes with barley in the rotation improves soil fertility and the sustainability of the production system. However, there is still considerable scope in most of the participating countries for applied research on the improvement of soil fertility and management, including a comparative analysis of the improvement with or without the introduction of the minimum tillage concept.

Figure 6. Sheep grazing bekia (vetch) field

Large scale demonstrations were implemented in the eight countries to show the participating farmers in the communities the potential of the improved barley and forage legume packages to produce high quality hay.

Improved seed production, especially of bekia, continued to be a major constraint to the expansion in the cultivation of this crop, except in Iraq and Syria where an adequate amount of seed is produced. However, some countries (Algeria, Morocco and Libya) were encouraging the emergence of an informal seed sector, where farmers produce seed to sell to other farmers with the assistance of the project.

- Improved barley productivity

  Barley is one important cereal crop in the dry areas of the West Asia and North Africa regions that receive 200 to 350 mm annual rainfall. It is grown primarily for livestock feed although it is also used for human consumption in North Africa. Yields of barley show wide fluctuation due to the variability of rainfall within and between seasons.

  The M & M Project conducted adapted research and technology transfer demonstrations on farmers' fields to stabilize and increase barley productivity while reducing the cost.

- Recommended technologies

  Improved varieties

  The selection and testing of promising barley lines, as well as widespread on-farm demonstrations of identified improved cultivars and production technologies, were done extensively within the Mashreq/Maghreb activities.

Figure 7. Demonstration of improved vs. local barley varieties

In field demonstrations conducted in Iraq, Lebanon and Tunisia, 'Rihane 3' showed a good performance when compared to the local variety grown by farmers in these countries. It gave a higher grain yield than the local variety in Tunisia and Iraq, but not in Lebanon. In spite of this, the Lebanese farmers were attracted to 'Rihane 3' because the variety is tall and lodging resistant whereas the local variety is susceptible to lodging and, therefore, would suffer from grain losses during harvesting. Other improved varieties have shown good results. In Syria the improved variety 'Arabi Abiad' ('Arta'), gave a yield increase of 38% over the local one (Figures 7-8).

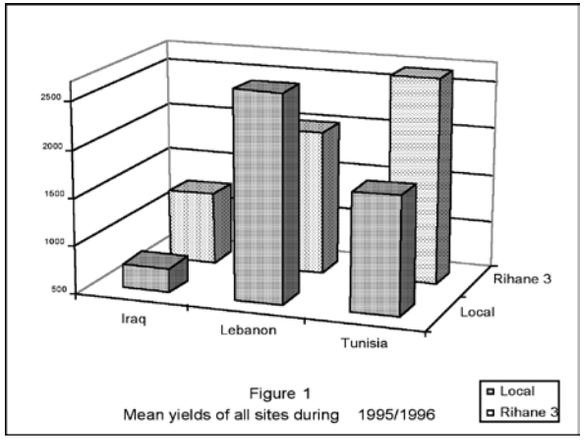


Figure 8. Comparison of mean yields of the barley variety 'Rihane 3' with the local variety at all sites

- **Management practices**

Use of fertilizer

Although the results vary from one country to another data, presented in Table 3, obtained in four M & M countries, illustrate the benefit obtained from the use of fertilizers.

Table 3 Effect of fertilizer application on barley yield in some M & M countries

	Grain(2) (kg ha-1)			Straw(2) (kg ha-1)		
	+F	-F	% Increase	+F	-F	% Increase
Iraq	427	123	247	-(1)	-	-
Lebanon	2270	1608	41	5805	4127	40
Morocco	1975	1761	12	3654	3330	10
Syria	1531	1115	37	-	-	-

(+F): Fertilizer applied; (-F): No fertilizer applied; (-): Not available
Figures are the means of all tested varieties and all testing sites within each country
The fertilizer used in Morocco was nitrogen.

The general conclusion across the Mashreq and Maghreb regions is that the use of fertilizer is beneficial to the barley crop. This is more striking in the Mashreq than in the Maghreb (Table 3). This is partly due the fact that only nitrogen (N) fertilizer has been used in Morocco, whereas a combination of phosphate (P) and N was used in the Mashreq countries. The use of phosphate

fertilizer for barley in the Maghreb is not a common practice, although data obtained in Libya during 1997/1998 show that an application of 92 kg ha^{-1} of P_2O_5 resulted in an increase of more than 20% in grain yield.

Optimizing seeding rate

Research in Syria has clearly shown that it is not necessary to use a seeding rate of more than 100 kg ha^{-1} (Figure 4).

A review of the results obtained during the period 1990 to 1997 indicate that using this lower rate (100 kg ha-1) resulted in an average increase in yield of 4%. This translated into an average return (or saving) of about 1508 Syrian pound ha^{-1} (Figure 9).

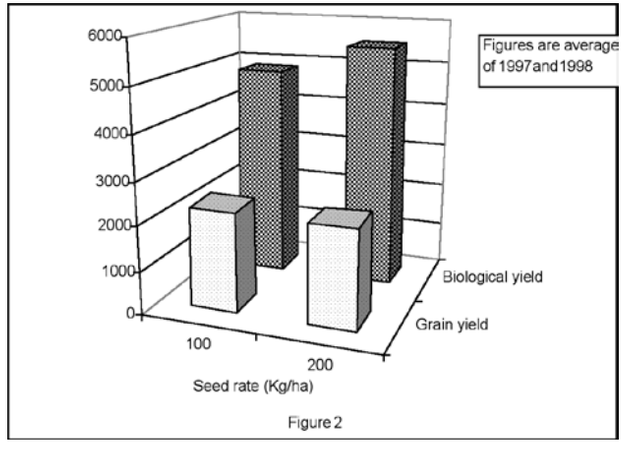


Figure 9. Average yields for a seeding rate of 100 and 200 kg ha-1

3.2.1.2 Alternative feed sources

Improving the nutrition of small ruminants in the participating countries by using alternative feed sources and feed supplements was an important objective in Phase II. Achievements realized in Phase I were efficiently utilized in Phase II, especially in the area of producing feed blocks from agro-industrial by-products and other alternative sources. Also, using urea as a protein supplement, or treating straw with urea, improves feed conversion and utilization. Moreover, spineless cactus has been introduced in several countries and has been used as an animal feed where there was shortage of natural vegetation.

Alternative feed sources were very important as a supplement feed during

Phase II because of a feed shortage resulting from the severe droughts. All the countries experience severe drought during two out of every three growing seasons. Some countries, such as Tunisia and Jordan, have had three consecutive years with severe drought, where the crops failed and the natural pasture became extremely dry. Under such conditions, alternative feed sources play a major role in rescuing the herders' flocks and their production proved to be a good strategy for mitigating the effects of drought, especially for the small producers.

- **Feed blocks**

Feed blocks produced from agro-industrial by-products were a major achievement of Phase I of the project. During that phase, one country, Iraq, was well ahead in this activity and was able to develop the technology within a short period of time, and to assist the other countries to produce feed blocks using their local by-products (Box 3).

During Phase II, feed blocks continued to be the major and most significant alternative feed resource, and an effective defense against drought.

By 1999, more than 20 feed block manufacturing plants were established by the private sector in Iraq, some of which were family enterprises producing and selling feed blocks. The quality of production was monitored by the M & M Project. Total production was around 37,000 tonnes, distributed among some 9,000 sheep owners (Figures 10-11).

Figure 10. Trends in feed block production and utilization in Iraq compared with the number of sheep owners (1994-2000)

In Jordan, three manufacturing units were imported from Iraq at the beginning of Phase II (in 1998) for large scale production of feed blocks.

The Jordanian national program locally fabricated two more units in 1999 and increased them to nine units in 2000. These were producing 55 tonne of feed blocks by the end of June 2000. The demand by farms continues to increase.

In Tunisia, two feed block units were fabricated in 1999, producing 10 tonnes of blocks in the two communities where the project was located. The project is promoting this activity through the local farmers' association.

Feed block production in Morocco started in cooperation with an NGO working in the project area. The research and development association has funded a community based feed block manufacturing unit in Sidi Boumehdi.

Algeria has moved faster in this area, where feed blocks were rapidly adopted and local investors build a feed block production unit. Banks around the project communities have shown interest in financing this activity.

In Lebanon, Syria and Libya, feed block production received a lot of attention from the communities. Training of farmers on the production of feed blocks was provided to encourage them to produce their requirements with the help of their families.

Phase II has been able to expand this technology to more countries and more farmers in each country, and has been able to introduce the feed block component as an integral part of the feed calendar of small ruminants in the region. Adoption of feed blocks by sheep owners is high in most of the participating countries.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

Figure 11. Feed blocks production became a successful commercial private business in ssome countries. The photo showed the production and disstributionof feed blocks manufacturing unit in Tunisia

BOX 3

Feed blocks: a strategic alternative supplement for small ruminants

Feed blocks are a solidified mixture of agro-industrial by-products used for supplementing poor quality roughages and native rangelands. They are considered as a catalyst supplement, allowing a fractionated, synchronized, and balanced supply of the main nutrients (i.e. energy, nitrogen, minerals, and vitamins) for animals. The value of feed blocks lies in their role as cost-effective supplements and as a means for preserving several high moisture agro-industrial by-products (e.g. tomato pulp, olive cake, etc.).

Although feed blocks are not new, the M & M Project revived interest in feed block technology as an option to be promoted among sheep owners in the vast semi-arid areas of WANA in order to improve animal performance and reduce their feeding costs.

In many WANA countries, hand feeding during winter time (November to January) is frequently practiced because of the shortages of grazing and green roughage. During this period the diet of sheep depends mostly on whole barley grain and stored straw. The introduction and use of feed blocks as a strategic supplement containing high energy ingredients, resulted in a significant replacement of barley grain and minimized the use of roughage and concentrates. Furthermore, work in Iraq has shown that feed blocks can be enriched by other ingredients to increase their efficiency. Results show that when cotton seed meal (as a source of by-pass protein) and vitamin AD3E are added to the basic formulae of feed blocks, considerable improvement in ewes' conception rates, lambing percent, and twinning percent can be achieved.

Additionally, the use of feed blocks in fattening lambs gave promising results and improved feed conversion.

Livestock owners have readily accepted feed blocks and the technology has rapidly spread through the countries involved in the M & M Project. It has been a major success in the region and has developed into a feed industry in Iraq where a large research effort is being invested in improving and adapting the technology to the semi-arid conditions of the country. The first private production plant in Iraq opened in June 1994 with a capacity of 4 tonnes per day and was followed by several other plants with similar outputs. Three feed block production units were imported from Iraq and set up in regional research centers in northern, central, and southern Jordan to produce feed blocks on a commercial scale. Their use was promoted heavily at farmer field days, on television, radio, and in the press. Training was offered to extension agents and farmers. A special effort was made to involve women, through partnerships with nongovernmental organizations (NGOs). Some 300 women took part in training and promotional events sponsored by this initial feed block project.

The use of feed blocks resulted in increasing sheep production efficiency by 32%. This improvement was achieved as a result of increasing reproductive efficiency and, thus, increasing the number of lambs born. Results showed that an additional meat production amount of 4.09 kg/ewe/year could be attributed to the use of feed blocks. Similarly, an additional milk production amount of 8.28 kg/ewe/year could be attributed to feed blocks. These additional meat and milk production amounts require a total intake of feed blocks of 116 kg/ewe/year in addition to the use of conventional feed resources (barley grain, straw, and green fodder).

As a spillover, countries other than those participating in the M & M Project have shown clear interest in the technology. Among such interested countries are Saudi Arabia, Egypt, Eritrea, and Turkey.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

- **Spineless cactus production**

Cactus (Opuntia spp.) is well adapted to the harsh environments of the dry areas. It represents a production option for farmers in dry areas, as food and feed, as well as for controlling soil erosion in slopes. Cactus has long been planted in the Maghreb countries (Tunisia and Algeria) and used as animal feed (Figures 12-13). However, in the Mashreq countries, it is not common, and is grown in limited areas for its fruits. Cactus is a unique feed source; it is available when no other feed sources are to be had (Box 4).

The second phase of the project has had a strong multiplier effect on the planting of cactus by transferring the experience of the Maghreb countries to the Mashreq countries (Jordan and Syria) and to Libya.

Figure 12. View of a cactus field used for both fodder and fruit production, Tunisia

Figure 13. Sheep fed on chopped cactus

Jordan started a national project for the promotion of spineless cactus production, and Syria started some activities in the planting of spineless cactus.

Tunisia and Algeria extended cactus plantations to the communities where the project is working. The project in Tunisia, in cooperation with the Office of Livestock and Pasture (OEP), has planted 360 ha of cactus in Zoghmar community, which survived in spite of the severe drought that prevailed then, when other crops failed.

The cactus was also used in rangeland rehabilitation along with other fodder shrubs. Where water harvesting and utilization techniques were applied, the productivity of the crop was substantially increased.

- **Urea-treated straw**

The treatment of straw by urea or ammonia usually improves the nutritional value of the straw by increasing its protein content, energy digestion coefficient, and the consumed quantities of straw. The technology is well established, but has not been adopted on a large scale by sheep owners. However, some countries, such as Tunisia, Iraq, and Libya, reported good progress in using urea treated straw. In Syria, the use of both ammonia and urea treated straw has been reported.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

BOX 4

Opuntia spp.: A strategic fodder for arid and semi-arid areas

Cacti are capable of high productivities in water stress regions, because of their high water use efficiency and their above ground productivity. Cacti species have different usages, as forage, vegetable, fruit, processed food, and for medicinal purposes.

Cacti as a fodder bank

The Opuntia species used for animal feeding are abundant, easy and cheap to grow, palatable, and can withstand prolonged droughts. Such characteristics make these species a potentially important feed supplement for livestock, particularly during periods of drought and seasons of low feed availability. The majority of Opuntia plant biomass is pad material rather than fruits and this can be fed to livestock as fresh forage or stored as silage for later feeding.

In Tunisia, under rain fed conditions, and with no fertilizer application, spineless cactus yields were between 20 and 100 tonne of cladodes per year, under an average rainfall of 150 and 400 mm per year, respectively.

Use of cacti for livestock feeding

Cactus is not a balanced feed and should, rather, be considered as a cheap source of energy. Cladodes have low crude protein content and consequently need to be supplemented by protein sources. They are also low in phosphorus and sodium. The combination of spineless cactus (Opuntia ficus indica var. inermis) with cereal straw is a nutritionally satisfactory solution for maintaining small ruminants in arid zones.

Generally cacti are highly palatable. The gut fill value is low, and, unusually, feeding cactus enhances the intake of fibrous feeds (straw). This result is extremely interesting because straw is the main feed source in the arid environment of the WANA. It is well established that, besides its low feed value, straw intake is low. Combining straw with cactus increases straw intake and, consequently, animal performances. Feeding cactus helps in resolving the problem of watering animals in an arid environment because of the high water content of cactus pads.

Poor quality roughage supplemented with cactus

Poor quality roughage may be supplemented with cactus. Indeed, the intake of straw increases significantly with the increase of the amount of cactus in the diet. Cactus is also a good supplement with ammonia or urea treated straw, since it provides the necessary soluble carbohydrates for the efficient use of the non-protein nitrogen in the rumen.

Atriplex a nitrogen supplement to cactus

The energy and nitrogen requirements of sheep may be matched using diets based on these two feeds. The level of cactus in the diet may reach up to 55% on DM basis, without any digestive side effects. It is advisable that small amounts of fibrous feed (straw, hay) be fed to the animals before the cactus. A better efficiency of the diet can be obtained if the mineral balance is improved.

3.2.1.3 Rangeland management and rehabilitation

This is a major component of the project. However, the successive severe droughts encountered by most of the countries seriously affected rangeland rehabilitation ventures, and using micro-catchement water harvesting interventions (Figure 14).

Figure 14. Planting fodder shrubs with water harvesting interventions, Jordan

The main activities implemented focused on rangeland rehabilitation by planting fodder shrubs, mainly Atriplex and cactus, inter-cropped with barley (Figure 15). The activities were implemented in the selected communities especially those communities associated with the rangeland/livestock based system.

Relatively large areas have been planted with spineless cactus in Algeria (3,600 ha) and Tunisia (360 ha), and a good start has been made in Morocco, Jordan, Iraq and Lebanon.

The progress in this component was slow because most of the work was started in the second or third year of the project, and because of the severe drought that prevailed.

Future work is expected to test and evaluate rangeland management and rehabilitation in connection with the land tenure status in the targeted communities. It is also noted that there are significant differences between the two sub-regions and between countries within a sub-region in this regard. Thus, different approaches may have to be considered.

'Best-bet' technical and institutional options have been identified by the project and are being evaluated in some countries

Figure 15. Planting Atriplex in alleys with barley, Morocco

3.2.2 Improving small ruminant productivity

The traditional, extensive production systems for small ruminants of the Mashreq and Maghreb are characterized by low livestock fertility, which is attributed to the harsh environment, poor nutrition, and low conception rates. Applied research in Phase II conducted with the owners of flocks of sheep has focused on improving the nutrition of the sheep using alternative feed sources and supplements, and improving fertility and reproduction through the use of improved rams and other interventions.

The strategy followed by the project is to reduce the cost of production by reducing the concentrates used in the animal feed, and by relying more on on-farm feed production and other alternative feed sources that are cheap and locally available.

Feed blocks have played a major role in small ruminant productivity improvement. Results have shown that high energy feed blocks introduced to two targeted communities during the lambing and lactation stages, gave significantly higher production over the control treatment.

The enrichment of feed blocks with micronutrients resulted in considerable improvement in ewe fertility (+28%) and the lambing percent (+36%). These results strongly support the importance of micronutrient supplements during

the sheep mating seasons, which usually coincide with cereal stubble grazing.

Advancing the breeding age of yearling Awassi ewes through feed block supplements resulted in 82% of the yearlings being successfully mated at the age of 12 to 13 months compared with the usual 16 to 18 months.

In Jordan, early weaning of lambs resulted in 14 kg of additional milk per head, which gave 3 Jordanian dinars per head extra income. Similar results were achieved in Syria.

The demonstration, with farmers' flocks in the Mashreq region, of treatments that promote estrus synchronization and super-ovulation, through the use of progesterone impregnated sponges and the PMSG2 hormone, have resulted in a substantial improvement in both fertility and twinning rates (Figure 16). Farmers have willingly adopted these innovations. Research on this technology has, therefore, been discontinued in these countries and wide scale demonstration and dissemination activities transferred to the national extension services. The Maghreb countries are utilizing the technology developed in their livestock improvement programs.

The project has developed a genetic improvement strategy to improve small ruminant productivity at the community level. Improved rams were introduced in order to reverse inbreeding effects and low growth rates. In Algeria, improved rams were introduced to 18 flocks and resulted in decreasing mortality from 16% to 4% and increasing twining by 20%. In Tunisia, the introduction of improved rams increased the average daily gains by an amount of 1 to 4.5 kg at 90 days. The number of farmers willing to use improved rams is increasing. Additionally, a community fair for best sheep was organized. The fair sought to create awareness among herders of the importance of selection and culling decisions in their flocks based on desirable, demonstrated traits, and also to introduce improved rams to them (Figure 17).

Using bekia hay as supplementary feed during the hand-feeding period substituted for 50% of the traditional concentrate feed without reducing the performance of ewes during pregnancy and lactation.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

Figure 16. Use of sponges to synchronize lambing, Zoghmar Tunisia

Figure 17. Fair in Zoghmar, Tunisia to select best rams

3.2.3 Monitoring of technology transfer, adoption and impact

Among the many factors which contribute to growth in agricultural productivity, technology is the most important. The rate of adoption of a new technology is subject to its profitability and the degree of risk and uncertainty associated with it. It is also strongly influenced by the capital requirement, agricultural policies, and the socioeconomic characteristics of farmers.

While the question of adoption or non-adoption is important, it is, however, the intensity of adoption which is actually the most critical criteria in the adoption process.

Producers benefit from the adoption of new technology through opportunities to lower production costs, either by increasing outputs from the same inputs or by maintaining the same output from reduced inputs. New technology, such as new crop varieties, may change the optimal levels of inputs used. Thus, an understanding of the effect of new varieties on input demand and productivity is crucial for a better understanding of the potential diffusion of the technology among farmers. Widespread adoption of new production technology also might be expected to have important market effects. Market level impact can then be estimated by aggregating the farm responses under assumed national adoption levels.

3.2.3.1 Adoption of improved barley technologies

The results of a farm survey of 250 barley farmers in Iraq show that all farmers who participated in the project demonstrations adopted an improved cultivar and/or fertilizer, whereas 37% of field-day attendees and non-participant farmers adopted fertilizers.

Farm size and profitability are the most significant factors affecting the three indicators of adoption, the adoption rate, the degree of adoption, and the intensity of adoption.

Similarly, a farm survey of 138 farmers in Syria showed that the use of improved technologies greatly increased among participating farmers and the rate of increased adoption was much greater among participating farmers than among non-participants. Factors constraining increased use of improved cultivars include lack of knowledge by the farmer about them, their availability, and preferences regarding grain color.

Likewise, 285 farmers in Jordan were interviewed to study the adoption of improved barley technology. The adoption rates were considerably higher among project participants than among farmers who did not participate. There was a considerable difference in technology use according to location, intended utilization of production, and source of household income.

The results of a farm survey of 88 barley producers in Morocco's Khouribga province show that the level of adoption of new barley varieties in the province is quantitatively and qualitatively higher than had been indicated in previous studies. Seventy-six percent of the farmers surveyed cultivated

new varieties, with 36% of their total barley area sown to such varieties. The major constraints identified by farmers were unavailability of seed and the high price of certified seed.

In Algeria, Tunisia and Libya, diagnostic surveys have been conducted in targeted areas, first to identify major constraints and, second, to assess farmers' attitudes toward technological packages developed by the project. In Tunisia, attention has focused on the adoption potential of an improved barley variety and sheep management and feeding techniques. In Algeria, absence of fertilizer use, absence of mechanization, high mortality in lambs and scarcity of feed have been identified as major constraints in the project area. More than 90% of the farmers interviewed expressed interest in new cultivars of barley. In Libya only 3% of farmers interviewed used improved barley varieties and of the remainder, only 30% were aware of the availability of improved varieties. Low adoption is attributed to lack of seed and information.

3.2.3.2 Adoption of improved animal production technologies

Sheep owners have been exposed to a number of new technologies in animal production in the Mashreq countries, such as the introduction of bekia in rotation with barley, the use of sponges and PMSG hormone, urea treated straw, agricultural by-product feed blocks, early weaning of lambs, and vitamin A injections. Nearly 500 sheep owners in the region were interviewed to investigate the level of adoption and identify constraints limiting the adoption of such technologies. The perception of farmers gave an insight into the types of constraints that are likely to limit the adoption of the six technologies tested, such as flock size, availability of inputs and the labor needed to apply the technologies. Results of a sample survey of 149 sheep owners in Iraq indicate that 94% of the participants in field demonstrations have used feed blocks at least once. The adoption rate is 36% among the attendees of field days. In contrast, only 4.2% of the non-participants have adopted the feed block technology. Production systems, availability of extension services, and flock sizes are important factors affecting the adoption of feed blocks.

In Jordan, the adoption rate of early weaning was 28.8%. All demonstration farmers adopted the technology. Among field-day attendees and non-participants, the adoption rates were 53% and 6.5%, respectively. Early weaning had an important impact on increasing milk production. As a result, a net additional revenue of 0.50 Jordanian dinars per head was obtained.

Similarly, an additional net revenue of 0.78 Jordanian dinars per head was associated with the use of the feed block technology.

The adoption rate of bekia was 28.5%. The type of participation in the technology development had an important impact on technology adoption. The adoption rate was 48% among the demonstration farmers, 40% among field-day attendees, and 13% among non-participants.

3.2.3.3 Adoption of Atriplex alley cropping (barley–Atriplex)

To determine the rate of adoption of alley cropping in the study area and what factors were important in the adoption process, a farm survey of some 100 farmers was conducted and revealed that the technology had spread to nearly 1650 hectares (24%) in Irzaine (Morocco) in the four year period (1999/00 - 2002/03). The area planted to Atriplex has increased annually by 6% and rate of adoption of the technology was 33%. Most of the farmers said they heard of this new technology through the extension service in Morocco and from neighboring farmers.

The rate of adoption depended on three factors, the size of the farm, the size of the flock, and the subsidy that the development project offered to those who adopted the technology.

- **Farm size and adoption**

  Farmers with small farms (less than 20 hectares) are relatively less willing to sacrifice their arable land to planting Atriplex. The adoption rate among these farmers was 59%. However, 90% of the farmers with medium sized farms (between 20 and 40 hectares) and 100% of the farmers with large farms greater than 40 hectares adopted the new technology, which means that Atriplex alley cropping will be adopted at lower adoption rates in areas that are predominantly characterized by small-size farms.

- **Flock size and adoption**

  The larger the flock the more willing the farmers were to adopt the new technology. Farmers who do not own any small ruminants did not adopt the technology, whereas close to 50% of those with small flocks (less than 40 head) adopted the technology. Almost all the large flock farmers (with an average of 104 head) adopted the technology.

- **Subsidy and adoption**

  Most of the farmers had accepted the subsidy provided by the development project which encouraged the adoption of Atriplex alley cropping. The net impact of the subsidy was to increase the area devoted to Atriplex by 79%. This means that the technology adoption rate would fall from 33% to 3% had the price subsidy not been offered to the farmers. This realization has important policy implications for those governments that are trying to spread this technology in their countries. It is worth noting that such subsidies are not cash payments to farmers, they are the costs of implementing the technology (land preparation, transplants, irrigation, maintenance) and include the expenses of staff involved in technology dissemination. These are incentives which have encouraged farmers to invest in productive resources, and thus are more effective in improving rural livelihoods on a sustainable basis compared to direct feed subsidies. Such investment decisions are very important for the development of these marginal environments, given the fact that public and private investments are negligible in the dry areas of the region, which are the hot spots of poverty in CWANA.

3.2.3.4 Impact of improved barley technologies

A cross-sectional survey of 495 barley farmers in Iraq was conducted to evaluate the farm-level impact of improved barley variety. A Cobb-Douglas production function was estimated to study the impact of varietal technology on total factor productivity. The estimates show that the total factor productivity of an improved cultivar is about 19% higher than that of the local barley cultivar. That is, given the same level of inputs, the yield advantage of the improved variety over the conventional variety is about 19%. The yield advantage of the improved cultivar increased to 43% in more favorable environments. The yield advantage is the magnitude of the neutral upward shift in the barley production function resulting from the introduction of the improved variety. Since the shift in the production function is of a neutral type, it implies that the improved cultivar gives a higher output per unit of input than the local variety.

To study the economic impact of the improved cultivar on the supply of barley and the demand for variable inputs, an indirect, normalized profit function within the framework of duality theory was specified and estimated. The impact of the improved barley cultivar on the demand for seed, fertilizer, machinery, and labor is then calculated from the derived factor demand functions. It is clear that the use of the improved cultivar will increase the demand for seed by up to 23%, for fertilizers by up to 22%, and for machinery and labor by up to 29%. This means that the use of the improved cultivar requires higher input levels compared to that of the local

variety. These results have important policy implications in that the supplies of seed, fertilizers, machinery, and labor should be increased to the levels of the new demands in order to increase the efficiency of barley production under rain fed conditions in Iraq. The estimated price elasticity showed that output support price policy is more effective in increasing barley production compared to subsidizing input prices, such as seed and fertilizers. Similarly, the impact of output support on input use was more effective than the combined or separated effects of subsidizing seed and fertilizer prices.

To assess the market-level impact of improved barley varieties, gross research benefits were calculated using an economic surplus model for 24 years (1977-2000). The internal rate of return (IRR) is computed. With the exception of Morocco, which is a large country and has an IRR of about 70%, all the countries have returns on barley research investment of lower than 50%. Iraq and Jordan have an estimated IRR of 41% and 43%, respectively. The IRR is 37% for Syria, 39% for Tunisia, and 32% for Algeria.

3.2.3.5 The impact of Atriplex alley cropping (Barley–Atriplex)

- **Impact on barley grain and straw yield**

  A comparison of farm survey data showed that fields that were planted with Atriplex resulted in a 31% higher barley grain yield and a 97% higher barley straw yield when compared to a barley/fallow system. However, these numbers could be a result of a combination of several factors and not just of planting Atriplex. However, in trying to separate these effects it was found that given the same level of inputs, the grain yield advantage of planting Atriplex over the barley/fallow system was 17%. Similarly, there is potential to increase the straw yield almost two-fold with Atriplex alley cropping instead of the traditional barley/fallow system. For livestock holders, the increase in straw yields is particularly important because they usually allow their flocks to graze on the barley stubble after harvest. With Atriplex alley cropping their flocks will have more to eat for the same amount of inputs.

- **Impact on flock size**

  If farmers feel secure that they will be able to feed their animals, they will not hesitate to increase their flock size. Atriplex is a good risk mitigation strategy for those farmers who are thinking of increasing their flock size, because, during a drought season, the sheep can graze on Atriplex shrubs. An increase in flock size is usually a sign of an increase in the wealth of the farmer.

Results showed that between 2001 and 2004 all farmers increased their flock size. Researchers attempted to isolate the effects of the technology and removed the variables that could have also caused an increase in the flock size, such as three years of favorable weather conditions and better flock management. The researchers developed a regression model and found that 25% of the increase in the number of small ruminants among those who adopted the technology could be attributed to the use of alley cropping. This represents a significant increase in the physical capital, which is the main source of wealth for farmers in the region.

- **Impact on feed resources and feeding cost**

  Farmers usually supplement their animals' diets with purchased feed - wheat bran or sugar beet pulp - at a high cost. However, those who have adopted Atriplex alley cropping were able to reduce their dependence on these purchased resources. It was found that those who adopted the technology reduced the consumption of sugar beet by 23% and wheat bran by 90%. On average, this translates to a 33% reduction in feeding costs due to Atriplex, though the results vary with the flock size. The feeding costs were reduced by 30% for those with small flocks, and by 70% for those with large flocks.

- **Internal rate of return**

  The Internal Rate of Return (IRR) of a technology is the break even interest rates which equate the benefits and costs streams of investments in planting Atriplex. The IRR will be around 29% for Atriplex alley cropping, which is much higher than the commercial interest rate of 10%. It seems that this technology has the potential to significantly affect poor farmers in the West Asia and North Africa region. Farmers are able to reduce feeding costs, improve their yields, and own more animals without increasing their costs. Now, the focus is on scaling out this technology to other countries using this study as a guide to target those farmers who would most benefit from planting rows of Atriplex shrubs in their fields of barley.

3.2.4 Exchanging technologies between countries

Phase II focused not only on national efforts in technology transfer to farmers, but also on the transfer of technology between countries, taking advantage of the networks established through the regional programs. Each country has, in the past, focused independently on different technologies depending on its agro-ecological characteristics, farming systems, resource

endowments, and the priorities of its national research program. Some countries have a comparative advantage in the development of various specific technologies. Taking advantage of the networks established through the regional programs, these results are transferred to other countries. In this way, not all research activities need be conducted in all countries. If a proven technology is available in one country, it can be transferred directly to on-farm participatory adaptation and testing in other countries.

Several technologies were exchanged among countries during the two phases of the project. Those which seem to have an impact are as follows:

- Cactus from Tunisia to Jordan and Syria in the Mashreq region, and to Algeria in the Maghreb.
- Feed block privatization and machinery from Iraq to Jordan and to other Maghreb countries.
- Synchronization of breeding, early weaning, increasing prolificacy, from Jordan to other countries.
- Agro-ecological innovation from ICARDA and Morocco to other countries involved in the project.
- Improved vetch and barley parents from ICARDA to the participating countries.

The M & M Project concept was considered as a model for the development of the agro-pastoral ecosystem and integrated resource management in the low rainfall areas. Therefore, the concept was used by IFAD in the development of a number of new projects. These included:

- IFAD rangeland projects in Central Asia and Pakistan (Barani), and the
- IFAD project proposal in central Tunisia (Tatuoina).

3.3 Main achievements of the policy and property rights research

The policy and property rights component was a major component of the M & M Project Phase II. Research on policy and property rights environments was conducted in some countries. A summary of the achievements is presented below.

3.3.1 Policy research

Community models were developed to evaluate the effects of different policy reforms and technologies on community welfare and resource allocation. This included an innovative decision making tool for conducting

ex-ante analyses of the potential effects of technical, policy, and institutional options. The decision support tool is a bio-economic model designed to represent farmers', herders', and household behavior. It indicates the probable ways that different members of a community will respond to the introduction of a new technology, resource management strategy or policy reform, and the effect of these responses on productivity, incomes, income distribution, and the sustainability of the natural resource base. The tool links activities at different scales, from macroeconomic reforms to the behavioral response of farmers at the community level. This is one of the key instruments used in the Integrated Natural Resource Management approach.

Community modeling, along with multi-market and public policy discussions, has resulted in a shift from emergency relief efforts by governments, towards more investment in feed blocks, improved rams, and increased fertility, more drought tolerant plants, and other technologies to improve livestock production.

The project focused on the development and diffusion of technologies rather than purely on research. Thus, NARS and their partners did most of the diffusion work. The similarity of agro-ecologies and production systems was a major factor in the ease of diffusion and transfer of technologies between countries. Economic analysis of options was added to the project at a later stage, but ideally it should have been part of the initial diagnostic study. This work revealed the importance of policy and common property or access rights as key enabling factors for the uptake and diffusion of technologies.

The policy research focused on the development of community models to evaluate the effects of different policy reforms and technologies on community welfare and resource allocation. The models were built for three communities: (1) Sidi Frej (Algeria), Mkaifteh (Jordan), and Ait-Ammar (Morocco). This is an innovative decision-making tool for conducting ex-ante analyses of the potential effects of technical, policy, and institutional options. The IFPRI/ICARDA team received additional funding from IDRC and FEMISE to support model building. The following scenarios were tested and compared to the baseline scenario (S0):

- removal of the subsidy on the major feedstuff by 20 to 30% (S1),
- reducing the output price subsidy on the major crops and livestock products by 20 to 25% (S2), and
- a simultaneous combination of S1 and S2 (S3).

- **Algeria**

  The model of Sidi Frej evaluated the effects of the removal of price support and input subsidies and the introduction of cactus. Different scenarios were tested. The removal of input subsidies reduced income by 2.6%, while the reduction in output support reduced income by 21.5%, while the combined policies would result in a 21.3% income shortfall. However, equity is improved in Sidi Frej with a Gini coefficient moving from 0.23 to 0.15. Farmers also increased the areas devoted to crop production, which could limit the development of cactus growing and result in the degradation of the environment. This tool will be very important for the implementation of the different options being considered by the Algerian government following the selection of the community as a pilot site for the government's fight against poverty.

- **Jordan**

  The Jordanian government developed and implemented a major reform policy in 1996 that called for removing feed subsidies. The first phase of the project evaluated the sector-level effects of these reforms. The community model in Mkaifteh evaluated the effects of the reforms on the community. As a result of the subsidy removal, large-flock holders tended to reduce their flock size by 18%, whereas farmers holding small flocks tended to allocate more land to barley and double the herd size. Landless, small livestock holders tended to reduce livestock numbers and rely more on off-farm activities. Farmers who integrated crop and livestock activities in a more balanced way were less affected by the policy changes than the other farm groups. Reduced feed subsidies have a substantial negative impact on farm revenues. The total wealth of small farmers decreased by 14%, while it went down by only 9.7% for crop/livestock farmers. The wealth of cereal farmers decreased also by 7.4%. In contrast, the removal of output support affected more cereal farmers than livestock farmers. On average, there will be a 14% drop in farmers' wealth as a result of output support removal. The reform also contributed to land use changes and the extension of cropping in more marginal areas.

- **Morocco**

  The model of the Ait-Ammar community evaluated various feed block formulae, drought-management policy options, in terms of feed subsidies, and credit, and institutional options with respect to access and use of the common rangeland.

Feed blocks

The model identified two feed block recipes that provided the highest profits. The introduction of feed blocks had implications in terms of crop and livestock production, and input use. Farmers responded by changing their feeding strategies and the volume and composition of their flocks. First, there was a reduction in the purchases of bran and industrial concentrates, hinting at a lower reliance on the market and more crop/livestock integration on the farm. Second, as a response to changes in the demand for feeds, farmers adjusted by producing more barley and soft wheat and reducing their durum wheat land allocation. Third, sheep production shifted more towards reproduction than fattening, as suggested by the increase in ewe numbers and, consequently, in the numbers of young animals.

Drought relief program

Results showed that changes in the volume of available feed could lead to substantial increases in community income by up to 11% compared to the baseline situation. By raising the current limit of 500 tonne for the community of Ait Ammar, substantial changes, in terms of production and income, could be obtained. This change in policy would not only affect the levels of income and production, but would also have important implications on resource conservation. The simulations with a higher volume show a clear drop in the shadow price for the common rangeland, hinting at less pressure for this heavily degraded resource.

Rangeland taxation

The model simulations were relative to the management and protection of the common rangeland. A tax or fee based system, in which taxes are re-invested in the community, were investigated using two schemes; (1) fixed fees regardless of the amount of dry matter collected, and (2) using differential taxes depending on the level of intake. Moreover, various levels of taxation were explored. Results showed that the application of a fixed fee does not affect the behavior of farmers, which highlights the importance of this resource in the feeding strategy and the absence of a less costly alternative. However, the imposition of a differential fee according to intake leads to a significant reduction in the utilization of the rangeland. Farmers with medium size holdings will increase areas devoted to crops and reduce their use of rangelands, while small and poorer farmers do not seem to substantially reduce their usage of the

rangeland. As a result, income levels of the latter were negatively affected by the taxation scheme.

These different simulations show the scope for using the models in determining the best bet technical, institutional, and policy options in the elaboration of the community development plans. Furthermore, they will assist in the out-scaling of the community approach to other communities.

3.3.2 Property rights research

The Mashreq and Maghreb (M & M) property rights research seeks to identify appropriate property rights and rangeland management institutions that promote the efficient, equitable, and environmentally sustainable use of land under the different agro-climatic and socioeconomic conditions found in the low rainfall areas, as well as identify conditions under which more formalized institutions are appropriate. The property rights research was divided into two phases. The first evaluated property rights, their evolution, current trends, and their impact on resource management to characterize the environment under which rural actors make their production and resource utilization decisions. Research was articulated around 4 themes:

- Evolution of land tenure policies regarding agriculture and livestock production.
- Transformation of tenure regimes of selected M & M study sites.
- Land use disputes and their resolution.
- Social and resource management roles of local institutions.

Following these reviews, Rapid Rural Appraisals (RRAs) were conducted in four focus countries (Jordan, Morocco, Syria, and Tunisia). A total of 41 communities were surveyed from which 15 were selected for the second phase property rights research.

The second phase of the property rights research investigated the links between property rights, tenure security, productivity, investment, and technology adoption strategies of rural households in the M & M Project sites. This was undertaken using surveys, including household, field, and crop level analysis. The research was carried out in each of the four focus countries.

A specific component, entitled 'Community and Household Level Impacts of Institutional Options for Managing and Improving Rangeland Management in the Low Rainfall Areas of Jordan, Morocco, Syria, and Tunisia' was funded by Collective Action and Property Rights Program (CAPRi). The project

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

aimed to provide policy makers, local communities, and researchers with a better understanding and assessment of the likely economic, social, and environmental consequences of the different institutional options for managing and for improving rangelands. This would be achieved by describing and analyzing the successes and failures of rangeland management options, and evaluating the factors that contributed to these successes or failures at the community level. By involving national and international researchers, policy makers, and community members in the planning, implementation, and dissemination phases of the research process, the project sought to create a dynamic of continuous collaboration. Both rural appraisal techniques and household survey techniques have been applied in the study. What follows are highlights of the major findings.

3.3.2.1 Rangelands

The property rights research focused on rangeland policies and the different management options that were tested under each policy framework. Studies were conducted in Jordan and Syria under conditions of state ownership. In Jordan, three range management options were introduced, government grazing reserves, herder driven cooperatives, and common use rights of formerly tribal pastures. The survey results showed that herder driven cooperatives were the best options in that they reduced household feed expenditures by 21%. State grazing reserves increased feed expenditures by 30%. The Syrian case is an example of informal individualization of rangelands into family grazing sites following the ban on cultivation in 1994. These rangelands did not revert to the Bedouin for common use, but some of them are now planting exotic shrubs, like Atriplex, to maintain their claims.

Under the privatization framework, studies were conducted in Morocco and Tunisia, although the approaches differed. In Tunisia, the privatization process was faster in Central Tunisia, where tribal lands were allocated to tribal members, while in the south, tribal management systems continue to prevail in extensive rangelands. In central Tunisia, three institutional innovations were introduced. These were community cooperative reserves, co-management between communities and forest services of remaining community pastures, and private ranges. In Southern Tunisia, traditional management prevails, but the government intervened in some of the pastures to improve the resource base and water availability. The results showed that co-managed rangelands and private ranges contribute more to the reduction

of feed costs than actual tribal management or cooperatives.

In Morocco, the privatization process focuses on tribes, which can register and claim title to their land resources in the name of their tribes, but perpetual use rights are granted to members on arable rain fed lands and private property on irrigated lands. There are large disparities between pastoral communities in Morocco. In the High Atlas, communities have all year and spring pastures (agdals), whose access and use are regulated by tribal systems. In the Middle Atlas, the availability of water has favored the extension of cropping and appropriation of large areas. However, there are common pastures that are degraded and some of these are classified as forests and are under state management. Since 1990, the Moroccan government, with funding from IFAD, introduced institutional innovations in the Oriental by reorganizing the tribes into cooperatives to improve the management of their pastures. Results of the survey suggested that the tribal systems in the High Atlas and cooperative management in the Oriental were the best options and contributed more to the reduction of feed expenditures.

The results of the different studies were presented at an international conference for farmers, policy makers, and researchers, jointly organized by CAPRi, ICARDA, IFPRI, the Tunisian Ministry of Agriculture, and ILRI. The evaluation of the different rangeland management options provides a framework for identifying the potentially best options for the management of rangeland in a given policy framework which would guide the reform process.

3.3.2.2 Croplands

Research was also conducted in Tunisia on the effects of property rights in a long-term analysis. In the two selected communities, Nouayel and Zoghmar, five types of land rights were observed. These included titled lands, privately owned lands but under extreme co-ownership, individualized tribal collective lands, state domain lands, and rented lands. Eighty households were interviewed. The propensity for making land improvement was higher on titled and state domain lands (33% and 31% more) than on the rented fields. As to the level of investment, farmers invested in all their fields regardless of the land rights. However, they invested more on planting trees and digging wells on the state, titled, and tribal lands - $2897, $2871, and $2771 per ha from 1970 to 1999. On the privately owned fields that are under extreme co-ownership, farmers invested just $1658. These results suggest very marginal differences between state, title, and tribal lands when

it comes to the level of investment, as most of the lands are individually owned. Similar patterns of investment were found regarding input use.

The results of the analyses suggest that the contribution of tenure variables in the farmers' demands for credit was marginal even when they had title. The most important determinant for credit demand was education. Household heads with primary, secondary, and university education demanded 5%, 6% and 18% more credit than non-schooled farmers.

3.3.2.3 Gender and property rights

Research is being conducted, in collaboration with the University of Guelph, Canada, to assess the increasing role of women in household livelihood strategies. The preliminary results of the surveys show that amongst 3,300 households, education was the most important factor that helped women to avoid becoming laborers. However, family size was an important variable that sometimes forced women to work as laborers.

3.4 "Best bet" packages of technical, institutional, and policy options (TIPOs)

With the participation of community members and other stakeholders, considerable progress has been made in the development of packages of "best-bet" technical, institutional, and policy options (TIPOs). The technologies that were evaluated and considered in the packages include:

(1) On-farm feed production for alternative feed sources, with the introduction of fodder shrubs and cactus.
(2) Feed blocks, produced from agro-industrial by-products, successfully demonstrated as an integral part of the feed calendar of small ruminants.
(3) Feed block technology offers a good potential for micro-enterprise development.
(4) New varieties of barley, oats, vetch and triticale adapted to harsh environment.
(5) Improved small ruminant management practices to enhance the quality of the breed, fertility, lambing rates, and early weaning.

The selected combinations or 'packages' of associated technologies were then tested by farm households, with the involvement of the local private and cooperative sectors, as well as other institutions and stakeholders, such as local extension services, agricultural authorities, and NGOs. Because each

community assumed ownership of, and responsibility for, its own Plan of Action, the role of the M & M Project's national teams was capacity building and the facilitation of this evaluation process. To help the community, by sharing experiences across all eight countries, a project facilitator was installed in each village. The facilitator's role was to channel important information into the community and to channel feedback to the project. The M & M teams monitored the evaluation process in order to devise corrective measures and/or make adaptations, if necessary.

As well as assisting in the adaptive testing of the technologies, researchers prepared community land suitability maps, after completing detailed agro-ecological characterization studies, and conducted policy, institutional, and monitoring surveys. As part of the institutional analyses, researchers identified existing community and higher level institutions whose involvement could be beneficial to the project communities (Tables 6 and 7). Representatives of these institutions were, in some cases, elected to sit on the Community Steering Committees set up by the communities (with help from the M & M Project). The project also assisted target communities in establishing new informal and formal organizations to facilitate and support the uptake of new technologies or management strategies. For instance, in Lebanon, specialized cooperatives for livestock producers were set up.

Researchers assessed the adoption and impact of the various technologies, and carried out econometric analyses. Innovative bio-economic community models were developed to evaluate the technologies and to assess the potential impacts of policy reforms on both the community's welfare and on different farm types.

All these analyses helped the project's researchers identify packages of tested and adapted 'best-bet' technological, institutional, and policy options. These options, and the project's results, were presented to the communities in further community workshops. The communities chose the options they thought were most appropriate, and used them as the foundation of a 'Community Development Action Plan'. Each community's plan can be used both to steer its own development and communicate its needs to development and government agencies in the future.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

Table 6. Technical, institutional and policy options (TIPOs) tested in the M & M Project in order to develop appropriate options

Technical	Institutional	Policy
Barley Vetch Feed blocks Cactus Small ruminant management	Crop land tenure Rangeland management Water management	Market liberalization Drought management policies Credit
Community modeling Impact assessment Econometric analysis		

Table 7 Production systems used by participating communities and options chosen by them for community level testing within the Mashreq and Maghreb Project.

Production Systems	Selected Communities	Options: Technological	Options: Policy*	Options: Institutional
Barley-based system	Ain-Talawi (IRQ) Al-Harsh (JOR) Deir El-Ahmar (LEB) Wadi Hai (LIB) Sidi-Boumehdi (MOR) Zoghmar (TUN)	Improved cultivar Fertilizer use Dual-purpose barley varieties Feed blocks Forage crops Animal husbandry	Price policy Seed Production Credit Drought relief program	Identification and creation of institutional mechanisms that would best help in implementing the community Development Action Plan
Range-land-based system	Mtoussa (ALG) Mahalabia (IRQ) Mkaifteh (JOR) Ghadama (LIB) Ait-Ammar (MOR) El Mahmoudli (SYR)	Cactus plantations Fodder shrubs Feed blocks Alley cropping Water harvesting Animal husbandry	Price policy Fodder-plant production Support for alternative feed use Credit Drought-relief program	
System 'in transition'	Sidi Fredj (ALG) Nweyel (TUN) Um El Amad (SYR) Aarsal (LEB)	Improvement of current cropping systems Introduction of new crops Feed blocks	Price policy Support for development of the new system (if sustainable) Credit	

* Examples: price policy-liberalization of prices, subsidies etc.; seed production-policy to make seeds of improved crop varieties more accessible to resource-poor farmers; drought-relief-importing barley for feed, subsidizing food prices, and digging wells.
ALG = Algeria; IRQ = Iraq; JOR = Jordan; LEB = Lebanon; LIB = Libya; MOR = Morocco; TUN = Tunisia; SYR = Syria.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

3.5 Gender analysis and women in development

In rural areas, women play a determining role in household food security and income generation. So far, however, this role has received little attention from researchers and policy makers. Clearly, a great deal of effort remains to be deployed to strengthen gender mainstreaming and alleviate the important gender inequities and gaps prevailing in the region. Nevertheless, the M & M Project has been able to introduce this subject into the program agenda and raise awareness among members of the research/development community and policymakers that women are a key to sustainable rural poverty alleviation. The program initiated pilot activities aimed at assessing the women's role in food production and household food security,

The work on the role of women in development was implemented in Jordan, Morocco, Syria, and Tunisia (Figure 18). The research focused on identification and description of the role of women and men in agricultural production, and production related constraints. Also, the researchers tried to assess the perception of the women and men on the technologies introduced by the program, especially those related to livestock production improvements. Furthermore, based on the research results, some interventions were introduced by the project, which targeted women.

Figure 18. Women in Zoghmar community (Tunisia) discusssing their role and priorities in improving their household income

Studies under the M & M Project have revealed the important fact that women are not only confined to domestic and para-domestic activities, but a number of them, depending on the socio-cultural and family aspects in each country, have access to agricultural and/or pastoral land and many of them have demonstrated their farming and livestock herding and production abilities.

In Zoghmar in Tunisia, the results of the rapid rural appraisals (RRA) showed that women played a major role in agricultural activities, including livestock farming, carrying and cleaning, poultry farming, and rabbit breeding. Women and girls spent a long time collecting wood from the mountains to be used for heating and cooking, which contributes to rangeland degradation and creates an additional load on the women.

The project has introduced some activities that targeted women, such as producing oven covers to save energy and reduce the amount of wood used for heating. It also introduced an income-generating activity (rearing of rabbits) for six girls in the same community.

In Morocco, the project team had several meetings with women in one of the communities. Income generating activities for women were prepared during the third year of the project in close collaboration with an Italian NGO. These activities involved chicken and turkey rearing (for meat and eggs). This constitutes a considerable source of income for women in many regions. The activities included training interested women from different villages of the community at the NGO headquarters.

In Jordan, the M & M Project has become involved in gender issues since last season, and a gender team (female researchers) was established. The team prepared a work plan on technology transfer through women in the communities (the same procedure as was followed with men).

The gender team made good progress in activating the gender issues. A questionnaire sheet was developed to identify the educational levels of rural women, the use of woman workers in agriculture, and the constraints that women face in the communities under study.

Three women's workshops were held in Jordan at the Al-Harsh, Mkaifteh, and Bowedah Gharbeh communities in July 2001.

As can be seen, the work on the role of women in development has just started; therefore, the achievements are modest. However, awareness of the role of women in rural development is increasing. More attention should be given to training and capacity building among women leaders.

The program should consider other options in developing community based micro-finance schemes to support and stimulate small scale, female managed, processing enterprises and to assist in the emergence of rural women's processing and marketing associations.

3.6 Human capacity development

The M & M Project promoted a human resources development approach to building the capacity of local populations to plan and manage local development.

- **Breaking down the barriers between research and extension**

  On-farm research teams, comprising researchers and extension workers, are the critical link. Extension agents are working with research scientists and farmers in technology development and transfer. The extension workers are trained in the new technologies and approaches to conducting on-farm research.

- **Addressing the needs of target clients**

  The diagnosis of farmers' conditions and needs is the basis for setting priorities and planning research. Informal and formal surveys, on-farm trials, meetings, field days, and other special events all provide opportunities for researchers to learn from farmers. RRA and on-farm diagnosis trials have been used to assess farmers' needs and target the technology transfer.

- **Capacity to transfer relevant technology**

  By developing on-farm research programs, researchers have taken on new responsibilities to work with farmers. Flexible recommendations resulting from on-farm research are adjusted to suit local variations in agro-ecology and socioeconomic conditions.

- ***On-the-job training: improving farmers' skills***

  Farmers are directly trained in the new technologies by research scientists in the presence of extension workers. The farmers, therefore, learn directly the advantages and difficulties of the technologies. This has speeded up adoption of technologies by the farmers who then, themselves, become trainers.

Figure 19. Farmers-technical staff travelling workshop

- **Farmers' traveling workshops: Farmer-to-farmer transfer of technology**

  Farmers' traveling workshops within a country, or in the region, have been an innovation of the M & M Project. Through these workshops farmers learn about other farmers' conditions, production systems, and the technologies they have adopted. This facilitates adoption of new technologies throughout the region (figures 19-20).

Figure 20. Farmers-technical staff travelling workshop

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

- **Farmer participation**

  The project recognized the need for greater participation by farmers, not only in the testing and evaluation of new technologies, but also in problem identification and research planning, in order to ensure that the technologies and management strategies developed by the project are appropriate for the circumstances of the intended users.

Figure 21. Farmer demonstrated to other farmers and techniciaans the steps involved in «urea straw treatment» technology

- **Specialized technical staff training**

  The project implemented several specialized training courses for the staff to improve their skills and update their knowledge, providing them with the new information and methodologies needed for the implementation of project activities. Study tours and scientific visits were also conducted.

Figure 22. Training technical and extension staff on straw urea treatment technology.

In Phase II, 14,389 farmers, technical staff, and extension workers participated in the different activities (Table 8 & Figures 21-22).

Table 8. Numbers of farmers and technical staff who participated in Mashreq & Maghreb Project Phase II activities

Activity	Country									
	Algeria	Iraq	Jordan	Lebanon	Libya	Morocco	Syria	Tunisia	Total	Percent
Field days	350	283	425	200	752	650	3890	255	6,805	47
Work-shops	120	644	452	105	12	583	339	150	2,405	17
Training	165	178	428	80	42	820	159	450	2,322	16
House-hold surveys	120	100	882	200	47	500	450	558	2,857	20
Total	755	1,205	2,187	585	853	2,553	4,838	1,413	14,389	100

3.7 Regional cooperation and networking

The program has developed mechanisms to enhance regional activities and exchange of expertise and experiences. These have included regional/sub-regional workshops, seminars and training, farmers' traveling workshops, transfer of technologies and management practices between communities

and sub-regions, exchange of expertise between countries, and backstopping from ICARDA/IFPRI (see Table 9).

- **Regional and sub-regional workshops, seminars and training**

  The program has organized many workshops, conferences, seminars, and training courses, where the results of the project were presented, shared, and discussed. They covered all aspects of the technology development and transfer, policy, and institutional options for the low rainfall areas. These meetings brought together, from the eight countries and ICARDA/IFPRI, scientists, extension agents, farmers, policy-makers, and NGOs. More than 750 people participated in these regional activities.

- **Farmers' traveling workshops**

  The transfer of technology does not occur only through researchers. Exchanges of knowledge and experience also take place between the farmers directly. Regional "traveling workshops" for farmers are an innovative mechanism introduced by the project. In these traveling workshops, usually organized by ICARDA, national and international researchers involved in the regional program, travel together to observe and discuss the results of program activities in the field. This provides an opportunity for the researchers and farmers from different countries to exchange information and experiences.

  The M & M Project has now extended this approach to include farmers. In these "farmers' traveling workshops," farmers from different M & M Project countries/communities travel together to a particular country to acquaint themselves with and discuss the program activities occurring there. This provides a forum for farmers from different countries to exchange their experiences and ideas on the technologies used, in the presence of researchers, thus providing much valuable feedback to the program research and technology transfer components. In some cases, farmers have adopted technologies or management practices that they observed in farmers' fields in another country.

- **Exchange of expertise between countries and backstopping from ICARDA/IFPRI**

  The program has established a network between scientists in the eight countries as well as with ICARDA and IFPRI that has enhanced institutional linkages and has been largely responsible for the regional integration of the program. Exchanges of expertise between countries have taken place

in many fields. For example, one can cite the help of Moroccan scientists to Algeria in the area of community modeling, the help of Iraq to most countries in the area on impact assessment, and the help of Tunisia to Libya and Algeria in the animal nutrition and feeding calendar.

The following table summarizes the regional activities that were conducted during the second phase of the project. The table shows that 71 regional activities were implemented during the five year period involving 752 participants.

Table 9. Summary of regional activities conducted during the 1998–2002 seasons

Activities	Number of activities	Number of participants
Regional and sub-regional activities	10	100
Individual training	8	11
Workshops, seminars, conferences	24	454
Backstopping and visits	23	31
Meetings	6	156
Total	71	752

3.8 Spillover project findings

The project technology and approaches spread out within each country, among the participating countries in the project, and the countries of CWANA. Some of the examples that demonstrate the spillover of the project approach and technologies are summarized in what follows.

- **Feed block technology**

  Livestock owners have readily accepted feed blocks and the technology has rapidly spread through the countries involved in the M&M Project. It has been a major success in the region and has developed into a feed industry in Iraq where a large research effort is being invested in improving and adapting the technology to the semi-arid conditions of the country. The first private production plant in Iraq opened in June 1994 with a capacity of 4 tonne per day and was followed by several other plants with similar outputs. By 1997, 21 plants were producing more that 24,000 tonne of blocks, distributed to more than 6000 sheep owners. In Jordan three feed block manufacturing units were imported from Iraq in 1998 for the large scale production of feed blocks. Local fabrication of units has started in order to respond to an increasing demand for feed blocks.

In Tunisia, community based feed block units started in1999 to produce tomato pulp and olive cake based feed blocks and 10 tonne have been already distributed to community members. In Morocco, an NGO and Agricultural Cooperatives are involved in the production of feed blocks.

A further spillover occurred in that, countries, other than those participating in the M & M Project, have shown clear interest in the technology. Among these are Saudi Arabia, Egypt, Eritrea, Turkey, and Uzbekistan.

- **Spineless cactus technology**

  Cactus, which is well adapted to the harsh environments of the dry areas, especially when combined with water harvesting techniques, represents a productive feed option for farmers in the dry areas, as well as providing a means of protecting the natural resource base by controlling soil erosion, particularly on sloping land.

  As a result of the project, the experience of the Maghreb countries in cactus production and utilization as a feed was transferred to the Mashreq countries in addition to Libya and Mauritania in the Maghreb. Exchange of experience, knowledge and expertise achieved within the Mashreq and Maghreb project had a strong multiplier effect.

- **Participatory community approach**

  Farmer participation in technology verification and technology transfer is becoming increasingly important when introducing new technology. The Mashreq & Maghreb Project developed a community based approach to enhance such participation.

  The approach is characterized by testing and evaluating technologies at the community level and strengthening decentralization with farmers' involvement in monitoring the performance of technology and its adoption.

- **The approach was used by:**
  - IFAD in Tunisia in the PRODESUD Project, Tataouine, in which 47% of the project funds are for communities who manage the funds,
  - by the Algerian Agency for Steppe Development for 16 agro-pastoral communities within the National plan for agricultural and rural development
  - by the Ministry of Agriculture of Jordan for the elaboration of the Agriculture Strategy in 2003,
  - by BARANI development project in Pakistan.
  - The approach was also used by the IFAD project on Community Based

Integrated and Market Oriented Feed and Livestock Production in Central and South Asia in Kazakhstan, the Kyrgyz Republic, and Tajikistan.

- **Policy and property rights research**

The policy and property rights research carried out by the project contributed to the increased understanding by agricultural scientists and national policy makers of the role of agricultural policy and property rights in the technology development and introduction process. The project also played an important role in shifting to the extension mode of community organization and the strengthening of the regional network of economists. These contributed to accelerated diffusion of new technologies and increased spillover between countries according to project participants and national government officials. The work created awareness of the importance in shifting from the welfare emphasis of drought relief with feed subsidies to a new emphasis on productive investment. This created increased demand from agricultural scientists for better linking of the technology, policy, and institutional issues in the community models developed in this project. The activity contributed to a series of new projects for rangelands which donors are now funding.

- **Property rights and investment in the low rainfall areas**

Many institutional reforms were promoted in West Asia and North Africa (WANA) to enhance the performance of rural households and communities. Existing property rights systems in the rural areas constrain agricultural development.

Land tenure systems in WANA countries are a blend of Islamic, colonial, and post-colonial land policies. Institutional solutions were perceived as important policy instruments for providing incentives and enhancing the ability of rural households to manage and sustain their resources.

The governments of Morocco and Tunisia prioritized privatization as the major instrument for promoting rural development, by granting private rights to both tribes and individuals. A partial privatization approach was mainly applied in Jordan and Lebanon. Here, the state retained land ownership while the beneficiaries were granted use rights.

Agrarian reform was the most widespread instrument used to promote equity and agricultural development, and was implemented in Algeria, Iraq, Libya, and Syria. Many poor farmers and herders received lands, and were organized into cooperatives to facilitate their access to credit and inputs.

Results from Jordan, Morocco, and Syria, based on surveys, showed that present land tenure systems provide enough incentives to farmers to invest in enhancing the productivity of their lands. In donor funded projects (IFAD), studies and analyses, following the approach developed by the M & M Project, were conducted in Morocco (East, Middle Atlas, High Atlas), in Tunisia in the rangelands, in Jordan in the Badia, and in the Kyrgyz Republic in the rangelands. Awareness was raised at the policy maker level in these four countries.

3.9 Publications

The M & M Project gave strong emphasis and support to publications, knowledge generation, and dissemination materials. The project produced a wealth of information in different publication forms, aiming to enhance the exchange of experiences and to speed up the dissemination of the information generated. It also sought to up-scale project findings to the regional, national, and international levels. Following are the main publications produced by the project during Phase I and Phase II. These are available and accessible, to those interested, from the project management and from ICARDA and IFPRI. Most of these documents are available on internet web sites.

- Country progress and annual reports;
- Country brochures and extension bulletins;
- Project newsletter;
- ICARDA and IFPRI annual reports and special publications and web sites;
- Project website;
- Technical Advisory Notes (TAN) published by IFAD;
- Proceedings of international, regional and national conferences, workshops and seminars organized by the project;
- Reports of project evaluation missions;
- Minutes of technical meetings and project steering committee meetings;
- CGIAR publications;
- Reports of specialized studies on technical, policies and socioeconomic related issues published by the project;
- Articles in local newspapers and magazines;
- Specialized video films;
- Journal articles.

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Achievements and Lessons Learnt from Phases I and II

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4 LESSONS LEARNT

4.1 Lessons useful to national governments and national programs

The project has developed a range of tools and methodologies that are being widely used by government institutions and other projects operating in the dry areas. The project has provided information on the effects of different policies and institutional changes and is contributing to policy reforms in the rural areas. Some of the countries have initiated a pilot phase for institutionalizing the community approach; however, there is a need to institutionalize this approach within the national system.

Governments have shown increasing interest and enthusiasm for the approach and its applied strategy. They have been particularly encouraged by the wide acceptability of the approach by the stakeholders. The demand for replication and continuity expressed by several communities is, in itself, an indication of the opportunities for horizontal and vertical expansion.

In most of the countries participating in the M & M Project there seems to be an obvious need for re-adapting the extension services as well as the technical expertise to the community approach and to the main objectives of the program. An exchange of visits between country teams is beneficial and may be further intensified. The integrated nature of the program activities would require broad-minded workers with adequate knowledge and insight, not only into the purely technical aspects, but also the social, policy, and institutional dimensions. This may call for retraining and for the organization of well prepared curricula.

For governmental efforts to succeed in the sustainable development of their agricultural natural resources, governments should consider the integration of technical, policy, and institutional issues in addressing these resources.

An institutional framework that addresses the low rain fall areas is urgently needed to provide the enabling environment for the development of these areas.

Community participation in the development programs is a key factor in the success of such programs. This participation should be considered at the planning, implementation, and monitoring and evaluation stages.

Incentive schemes and drought mitigation strategies are important elements for the sustainable development of the LRA, especially the rangeland/livestock

dominant production system where communities are poor, resources are limited, and drought seasons are common.

Multi-disciplinary, inter-disciplinary, and multi-institutional teams proved to be essential in conducting research related to integrated natural resources management (INRM) and, therefore, should be considered by the national research centers in their research work.

Some technologies developed by the project have been very successful and widely adopted. These are mainly technologies associated with on-farm feed production (barley and vetch), alternative feed sources (feed blocks and cactus), and livestock management, all of which are easily adopted and integrated into the production systems of individual farmers.

Other technology options that require high levels of investments or collective action are unlikely to be widely implemented without removal of constraints or the development of appropriate local institutional support. Property rights (tenure rights, use, and access to land resources) have emerged as a critical factor for investment in resource management.

Access to markets (for both inputs and outputs) and added-value products will enhance household incomes. The project has introduced innovative mechanisms, annual fairs and competitions, to present community products and new marketing avenues.

The project served as a bridge between communities, government services, and NGOs to promote the development of the selected communities. National teams worked with their communities to develop proposals and get funding for priority actions.

The private sector should be encouraged to invest in the project activities, which will be rewarding for the investors and the community. Some of the areas that could be covered include, feed block manufacturing, improved seed multiplication, especially of forage legumes, and crop mechanization.

4.2 Lessons useful to ICARDA, IFPRI, and donors

A substantial amount of knowledge has been accumulated from the different communities in the region that will assist in guiding future research and development efforts. The coordinated regional approach of the project has facilitated exchanges of knowledge and experiences between the national teams. Individual countries have taken the lead in the development of specific methodologies, technologies or institutional options that have then

been rapidly transferred to the other national teams in the project.

Good progress has been made within the policy component of the program in a few countries, but has lagged behind in others. This is particularly true with regard to property rights, land and water use strategies, marketing and credit. The program sustainability objective would never have been achieved without the full and integrated support of these policies and their underlying institutions.

The participatory approach has been given much attention, but the scope is still wide and open for more emphasis on cooperative and community participation, especially in activities, such as land use and range management, marketing and finance, purchase of inputs, and even in processing.

An impressive achievement of the program has been the organized participation of women, not only in the adoption of technological packages, but also their keen interest in a variety of income-generating activities. Due to certain socio-cultural factors, women of the Mashreq seem to show more aptitude to be forthcoming, with sufficient self-confidence. They have expressed their interest in collective and cooperative processing of milk and other activities. Any future programs should place an emphasis on the gender issue and consider options for developing community based microfinance schemes to support and stimulate small scale, women managed, processing enterprises and to assist in the emergence of rural women's processing and marketing associations.

The regional dimension of the program is one reason for its success. Inter-regional cooperation and inter-country interaction and exchange of experiences resulted in a fast transfer of new technology and widened the scope of the researchers and farmers involved in the program. Therefore, the integrity of the regional component should be maintained and strengthened.

Overall Phase I contributed favorably to all the IFAD supported investment projects in Algeria, Jordan, Lebanon, Morocco, Syria, and Tunisia, and contributed effectively to the national programs in Libya and Iraq. For example, such achievements were reflected in the transfer of technologies and in the training of farmers and professionals in the implementation of relevant activities directly impacting farmers in Jordan, Morocco, Lebanon, and Iraq. The community and sector models developed in Jordan and Syria are expected to be of direct benefit to the on-going appraisal process of their development projects in the region.

The institutional and financial sustainability of such projects at the national level is always at risk after the project is completed and the donor funding is utilized. Therefore, a strategy for institutional and financial sustainability of the activities should be considered during project document preparation, and should be endorsed by the governments of the participating countries.

The experiences of Phase I and II indicated the variability of the countries in their technical capabilities, available resources and institutional set ups. This variability should be considered in the project document preparation and in the development of the work plan.

A monitoring and evaluation system, with proper performance indicators, should be part of any future projects to ensure proper and timely implementation and to assess the project impact. This system should be part of the project documentation.

5 FROM PHASE I AND II TO PHASE III

The successes that were achieved in the project's first and second phases encouraged donors, governments, and executing research centers to develop and support a third phase. The third phase will befit from the experiences gained in working with agro-pastoral communities and scale up the project approach to reach more communities and build a model for the sustainable development of the low rainfall areas and the livestock/rangeland based system.

The new project will benefit resource poor communities in agro-pastoral systems of the dry areas of Mashreq and Maghreb by generating opportunities for improving livestock productivity thereby enhancing rural incomes and livelihoods. In particular, it will focus on seeking opportunities to overcome natural resources constraints and promote the decentralization of responsibility and authority for natural resources management, with a clear emphasis on community management of common natural resources.

The approach that has been developed in the Mashreq and Maghreb Project is intended to produce, with the participation of community members and other stakeholders, agreed "Community Development Action Plans" (CDAPs) consisting of a package of "best-bet" technical, institutional, and policy options for implementation at the community level.

The proposed project aims to build on the experience and results gained from the community level testing and evaluation of technology and management

options within the Mashreq and Maghreb Project, to assist communities in implementing these CDAPs and to disseminate the approach to other development programs in the region.

- **Project Objectives**

  Goal: The overall objective is the development of productive and sustainable agro-pastoral systems that conserve the resource base and support rural livelihoods in the dry areas of the WANA region.

  Purpose: The immediate objective is to provide technical, policy, and institutional options to facilitate the rural communities' roles in improving and sustaining their livelihoods and agro-pastoral resources

- **Key Project Activities**

  The project will achieve its purpose through four major complementary components of activities. The integration of these four components is illustrated schematically in figure 23 and 24.

  (1) ***Packaging and disseminating the community approach:*** The community approach developed by the Mashreq and Maghreb Project has been recognized as a highly innovative and valuable product of the project. However, the complete approach consists of a variety of individual tools, methodologies, and mechanisms that have been developed over the duration of the project. These need to be assembled into a unified, «user-friendly» package that can be readily utilized by other researchers, projects and programs.

  (2) ***Implementation of community development action plans (CDAPs):*** The CDAPs are likely to vary according to the different production systems, the priorities of each community, and the existing institutional structures of each community. Implementation of these plans will vary by country depending on the priorities of each community, the community's existing institutional structures, the needs for institutional and policy adjustments and support, and the agencies (research, extension, NGOs, development programs) involved in implementation of the plans.

  (3) ***Targeted research. Further specific, applied, and adaptive research, testing, and evaluation will be needed, in areas such as:*** Emerging constraints; new options to introduce, or incorporate into CDAPs; options for communal management of rangeland resources; and strategies for risk management and drought mitigation.

(4) ***Development of social, environmental, and economic (SEE) indicators.*** Make available SEE indicators to decision-makers and other stakeholders utilizing the baseline information collected during the Mashreq and Maghreb Project.

- **Project outputs**

It is expected that the new project will generate the following outputs:

- A community approach is packaged and used by development agencies.
- Identified technical, institutional, and policy options are validated and procedures are developed.
- New technical, institutional, and policy options are developed to address emerging issues.
- Social, environmental, and economic indicators are made available to decision-makers and other stakeholders.
- Local, national, and regional integration and human capacity are strengthened.

- **Criteria for project implementation**

The following criteria were identified as pre-requisite for project implementation in all countries:

- The project target areas are the low rainfall areas (LRA equates to less than 250 mm).
- The project will address the livestock/rangeland based production system.
- A strong linkage should be developed with an IFAD/AFESD or other nationally funded development projects. A Memorandum of Understanding (MOU) has to be signed between the project and the development project at the national level.
- The project will be implemented by multi-institutional and inter-disciplinary teams. Therefore, involvement of other relevant institutions, such as extension departments, universities, local NGOs, and the private sector is essential.
- The potential for success should be considered in the project implementation.
- The gender dimension should be considered in the project planning and implementation.

- **Thematic working groups/research networks**

Three thematic groups (research networks) will be established to enhance cross-country collaboration and sustainability of activities after project completion. These groups would comprise:

- Group 1. Community approach institutionalization and community development plan.
- Group 2. Knowledge generation and dissemination for improved and sustainable livelihoods of agro-pastoral communities.
- Group 3. Participatory social, economic, environment, and poverty indicators and impact assessment in agro-pastoral systems.

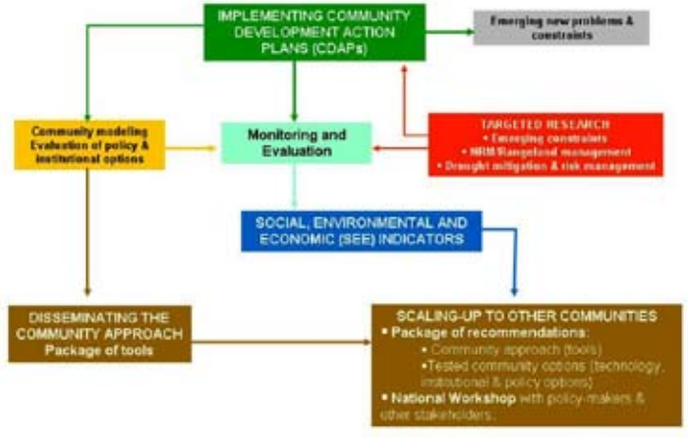

Figure 23. Schematic representations of progam components

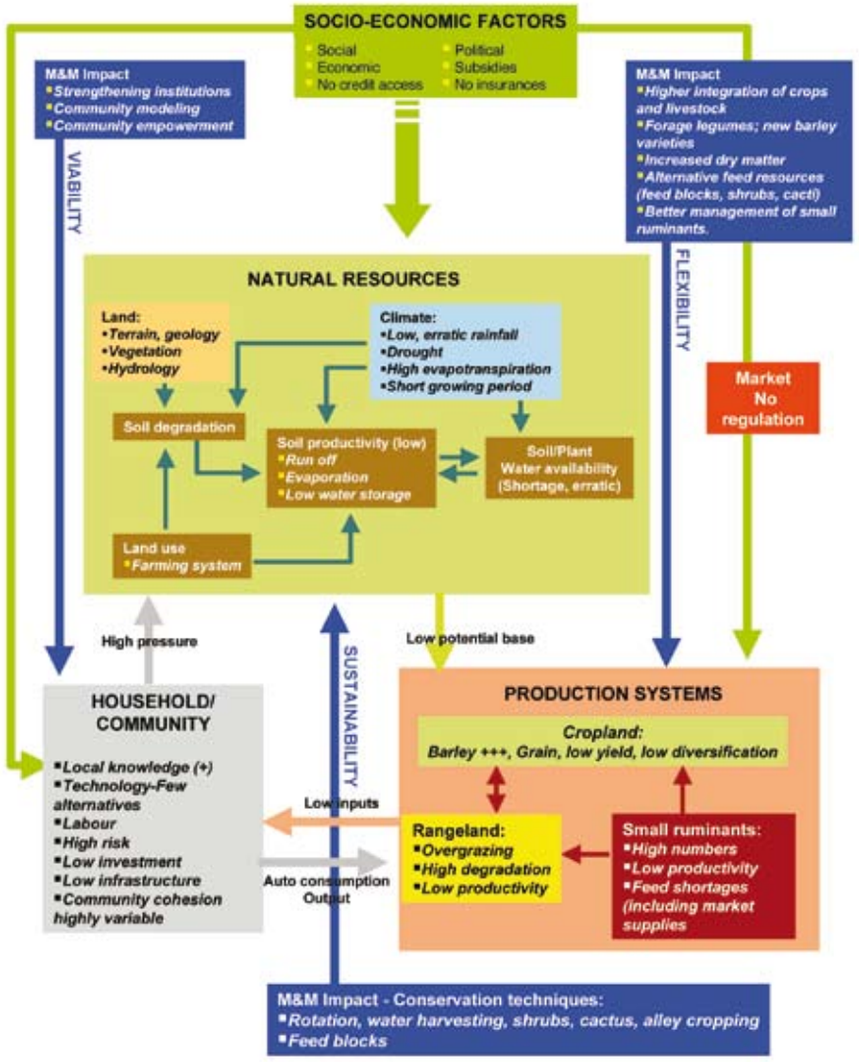

Figure 24. Community Approach for the Dry Areas Developed by Mashreq/Maghreb Project (Phase II)

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

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- Barley-Based Production Systems Under Semi-Arid Conditions: Can Barley Productivity Be Improved?
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- Opuntia spp.: A Strategic Fodder for Arid and Semi-arid Areas.
- Community Approach to the Development of Integrated Crop/Livestock Production in the Low Rainfall Area.
- Feed Blocks: A Strategic Alternative Supplement for Small Ruminants Raised Within Crop-Livestock Systems Under Semi-Arid Conditions.
- The Mashreq/Maghreb Project: A Good Mechanism To Promote Training And Exchange Of Experiences and Expertise.

Mashreq and Maghreb Project
Achievements and Lessons Learnt from Phases I and II

Electronic documents available for downloading:

- Workshop Summary: International Conference on Policy and Institutional Options for the Management of Rangelands in Dry Areas (pdf 198 KB).
- Examining the 'Critical Triangle' of Growth, Poverty Alleviation and Environmental Sustainability in Morocco Dry Lands: A Community Modeling Approach (pdf 312KB).
- Micro-Level Impacts of Price Policy Reforms on Income, Equity and Environmental Sustainability in Low Rainfall Areas of WANA (pdf 144 KB).
- The Impact of IFPRI on the M&M Project in North Africa and the Middle East (pdf 455KB).
- Technical Workshop on Methodologies, Organization, and Management of Global Partnership Programmes (pdf 49 KB).
- Institutional Options for Rangeland Management in the Mashreq and Maghreb Countries (pdf 39 KB).
- The Impact of Institutional Options for Rangeland Management in Morocco (pdf 82KB).
- Empowering Rural Communities for Better Management of Desert Collective Rangelands - From Concept to Implementation (pdf 161 KB).
- Rangeland Management Options and Sheep Feeding Strategies in Syria (pdf 82 KB).
- Community and Household-Level Impacts of Institutional Options for Managing and Improving Rangeland in the Low Rainfall Areas of Jordan (pdf 223 KB).
- Policy and Institutional Options for the Management of Rangelands in Dry Areas (pdf 193KB).
- Partnership with Local Communities: The Mashreq and Maghreb Community Approach for the Dry Areas (pdf 150KB).
- Completion Review Mission Report (CRM) (pdf 183 KB).

Project reports and publications

- Annual and progress reports
- Project news letter
- Newspapers articles and video films
- Journal Articles
- ICARDA and IFPRI reports and articles

ABOUT M&M PROJECT

Project implementation & participating institutions

The project is being implemented by the following partners:

- the eight countries of the Mashreq and Maghreb regions,
- the International Center for Agricultural Research in the Dry Areas (ICARDA), and
- the International Food Policy Research Institute (IFPRI).

Activities are coordinated by the following designated national coordinating institutes, each represented by a National Coordinator:

- IPA Agricultural Research Center, Iraq
- LARI (Lebanese Agricultural Research Institute), Lebanon
- NCARTT (National Center for Agricultural Research and Technology Transfer), Jordan
- DASR (Directorate of Agricultural Scientific Research), Syria
- ITGC (Institut Technique des Grandes Cultures), Algeria
- INRA (Institut National de la Recherché Agronomique, Center Arido-culture), Morocco
- ARC (Agricultural Research Center), Libya
- INRAT (Institut National de la Recherche Agronomique de Tunisie), Tunisia

Partnerships

The project involves a wide range of partnerships among:

- National agricultural research institutes and universities (NARS)
- Non-Governmental Organizations (NGOs)
- The private sector
- Extension services
- Farmers and end-users
- Policy makers
- International research centers, and
- Donors

Donors

- International Fund for Agricultural Development (IFAD), Italy
- Arab Fund for Social and Economic Development (AFSED), Kuwait
- International Development Research Center (IDRC), Cairo
- Ford Foundation (Cairo office)