IMPACT ASSESSMENT DISCUSSION PAPER NO. 19

IMPACTS OF IFPRI/ICARDA POLICY AND PROPERTY RIGHTS RESEARCH ON THE MASHREQ AND MAGHREB PROJECT

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October 2003

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ACKNOWLEDGMENTS

We are grateful to IFPRI for the opportunity to visit four countries to learn about the Mashreq and Maghreb (M&M) Project. IFPRI/ICARDA Research Fellow Tidiane Ngaido arranged the itinerary, traveled with us, and was always available to answer our questions and provide project documentation. Former Research Fellow Nabil Chaherli traveled to Jordan from Turkey to meet and brief us on his activities in the project. Project scientists, farmers, and public officials were very gracious with their time. Many of their names are listed in Appendix 2. In this group, we are especially thankful to the national M&M coordinators who spent substantial time with us, including Kamil Shideed (by phone-Iraq), Faisel Awawdeh (Jordan), Abdelouahid Chriyaa (Morocco), Mohamed Mouafak (Syria), Ali Nefzaoui (Tunisia), and Salah Haj Hassan (Lebanon). We especially appreciate Jim Ryan's management and his comprehensive comments and suggestions on the first two drafts of this report. We also appreciate the comments and suggestions of the two reviewers of this draft, Were Omamo and Thomas Nordblom. Any errors or omissions in this report are the responsibility of the authors.

ABSTRACT

The main contribution of the IFPRI/ICARDA economists was to increase understanding by agricultural scientists and national policymakers of the role of agricultural policy and property rights in the technology introduction process. The IFPRI/ICARDA economists also had an important role in the organizational activities of the project, specifically the shift to an extension mode of community organization and the strengthening of the regional network of economists. These two activities contributed to accelerated diffusion of new technologies and increased spillover between countries according to project participants and national government officials.

Direct economic activities within the project included a greater emphasis on drought resistant plants and other agronomic innovations in anticipation of drought. Subsidies on feeds have not been entirely eliminated but this new emphasis on productive investments in the drylands departed from the welfare emphasis of drought relief with feed subsidies.

Moreover, the modeling in this agricultural policy activity has stimulated an increased demand from agricultural scientists in the M&M project for better linking of the technology, policy and institutional issues in the community models developed in this project. Technology introduction has also created a demand for more marketing research to identify and develop new markets for the drought resistant plants and lower fat sheep being successfully introduced in this M&M project.

The property rights research identified the breakdown of federal institutions attempting to substitute for the traditional tribal controls in the rangelands and identified the problem of the increasing dependence of herders on purchased feeds. To respond to the common property problem of adequately controlling the intensity of use of the rangeland pastures several institutional alternatives were recommended. The project helped identify what the new institutions need to do to be successful.

The M&M project and especially the IFPRI/ICARDA economic component made inputs into a series of new projects for the rangelands, which donors are now funding. Further analysis of the performance of new institutions for the rangelands is a logical next step in the evaluation of property rights.

1. INTRODUCTION

The Mashreq and Maghreb (M&M) project unified and continued two separate projects in North Africa (Maghreb) and the Middle East (Mashreq), which took place from 1989 to 1994. The International Fund for Agricultural Development (IFAD), the principal funder for the antecedent projects, requested that IFPRI become involved in the new unified project for the region to provide input on agricultural policy and property rights. The principal orientation of both the original projects and the new unified project was on technology diffusion. The national agricultural research organizations in the respective countries implemented the economic studies [1] with IFPRI/International Center for Agricultural Research in the Dry Areas (ICARDA) coordination and technical inputs.

To evaluate the contributions of the economists, we were requested to: (1) document the *outputs* from the economics input; (2) articulate the *outcomes* from these outputs; (3) identify the *policy responses* from the outputs and outcomes; and (4) measure the ultimate *impacts* in quantitative terms, where feasible.

The first section of this report presents the methodology employed, describes the site and status of economic analysis before the M&M project started. The next five sections highlight inputs from IFPRI/ICARDA covering respectively outputs, outcomes, policy responses, and impacts. The last three cover IFPRI/ICARDA performance, lessons learned, and conclusions.

Appendix 1 defines the technologies used or transferred and provides background on the agricultural policy and property rights issues. Appendix 2 gives the names and titles of the people interviewed. Appendix 3 presents some of the activities and publications associated with the IFPRI/ICARDA economists.

[1] The project was designed for the international centers to provide their technical inputs upon request. There was continuous interaction between the national and international centers in this project, according to field interviews with the national coordinators.

2. METHODOLOGY

There were three components to the Terms of Reference on Methodology: (1) review documentation of the program; (2) visit selected countries and interview partners, stakeholders, and beneficiaries to elicit their perceptions of the influence and value of the program, especially the agricultural policy and property rights work, and to gather other data relevant to the evaluation as appropriate; and (3) prepare a joint report for the IFPRI Impact series.

In June 2002, the two authors of this report traveled to four of the eight M&M countries (Jordan, Morocco, Syria, and Tunisia). We conducted field interviews with program participants, beneficiaries, and government officials in these countries and interviewed the national coordinators of two other countries (Lebanon and Iraq). Only Algeria and Libya were not covered. We also visited IFPRI and ICARDA, the two international centers involved in this project. We interviewed partners, stakeholders, and beneficiaries (see Appendix 2), as instructed in the Terms of Reference.

The interviewing procedure in the four countries was essentially the same. We spent the first day with the national implementers of the project. These professionals were from the national agricultural research program and in Jordan were supplemented with university professors. On the second day, we interviewed farm groups and visited farm sites. On the third day, we interviewed public officials.

Most of the discussion during the first two days was on the progress of technology introduction, the main concern of most involved. We interviewed groups of farmers, with M&M staff leading a general discussion first, and then asking farmers specifically about the benefits of the program. On the third day, public officials gave feedback on overall project functioning, focusing on technology introduction and community organization rather than on the impact of the economics program. We asked public officials and program scientists specific questions about the economic component, but the discussion switched to technologies. Most of the information about contributions of the economists came from directors of the M&M program in the four countries we visited plus Lebanon (he joined us) and from the national economists.

The international centers and the individual country programs provided extensive documentation. Since most project staff and the public-sector evaluations concentrated on technology issues, the documentation was very important to ascertain the economic-program impact as well as to supplement and clarify the feedback received in the interview process. (References cite all the documents reviewed.)

3. PROJECT SITES, STATUS OF ECONOMICS ANALYSIS BEFORE THE M&M PROJECT

Rainfall and land ownership differentiate regions of the drylands. The principal area of concern to the M&M project was the zone with less than 400 mm rainfall (Hazell et al. 2002). The rangeland area for this region was defined as less than 200 mm of annual rainfall (Rae et al. 2002).

Significant differences depended upon type of *de facto* ownership of the land, with a mix of three observed in the country: private, collective, and public sector. Where the land was at least partially privatized, either *de facto* or *de jure*, technology options were considered first. Where there was collective or public ownership, the common-property problem was first on the agenda.

FAO divides the dryland economic systems in North Africa and the Middle East into two main categories:

- *Dryland Mixed*, which has 150 to 300 mm of rainfall. This represents 4 percent of the land area and 14 percent of the population in the region[2] (Figure 1); and
- *Rangeland*, the pastoral system with 23 percent of the land area and 9 percent of the agricultural population and rainfall below 150 mm.[3]

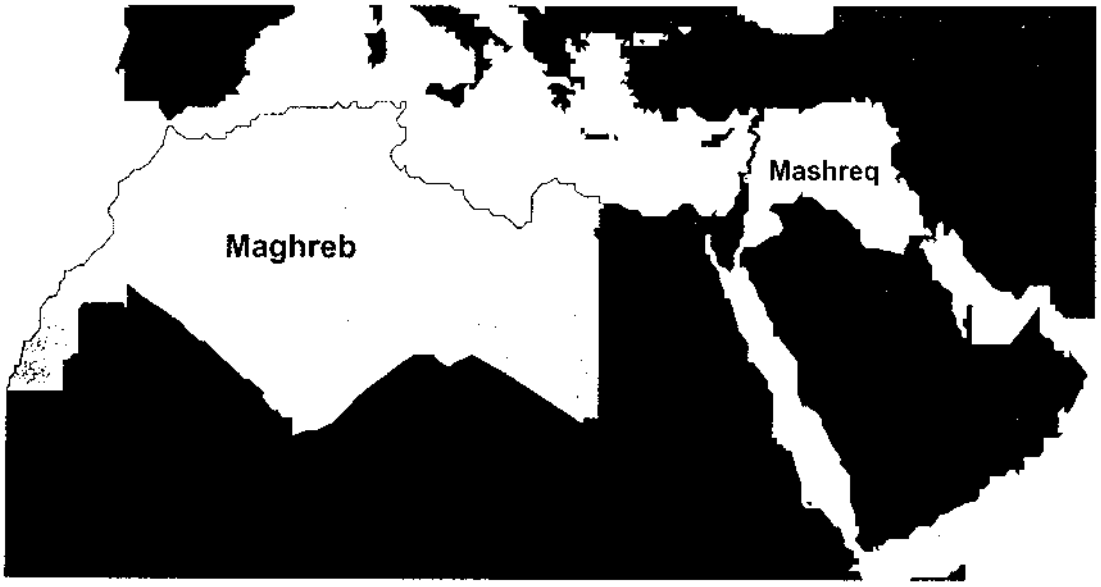
The two systems are often linked by the migration of animals, with approximately 21 million people engaged in agriculture (Dixon et al. 2001, pp. 89–90).

Both of these systems have a concentration of rural poverty. However, there is a backlog of technologies available (see Appendix 1) with substantial potential for their introduction into these regions. The critical research question of this and the two previous projects was: How can these technologies be more rapidly extended into the farmers' fields? By the mid-1990s, the diffusion process onto farmers' fields was only in the initial stages, prompting a reevaluation of the approach by the donor, IFAD (ICARDA 2001; see also Boxes 3 and 4 for summaries of the crop and livestock-diffusion processes to date).

[2] The FAO (Food and Agriculture Organization of the United Nations)-defined region included more than the eight countries of the M&M project. Also included in the FAO region were Egypt, Saudi Arabia, the countries in the lower part of the Arabian peninsula, and Iran.

[3] Project papers identified the relevant zone for this project as the area below 400 mm (Hazell et al. 2002). Other review articles classified the rangelands as having rainfall less than 200 mm (Rae et al. 2002).

Figure 1. The Maghreb and Mashreq regions



Three program innovations were made for the new M&M program (1995–2002):

1. Livestock, specifically sheep and goat production, became a central focus of the program. Thus, the whole farming system was incorporated into the technology development and diffusion strategy.

2. A larger number of countries was included. With the general similarity in agroecologies and cropping systems and the different comparative advantages in research systems, enlarging the project was expected to facilitate the spillover of technologies among regions and between countries in the M&M region.

3. To accelerate diffusion, economic analysis was added. Distorted policies and insecure property rights were thought to be the major factors constraining introduction of proposed technologies and management strategies. Getting the policies right and handling the common-property or open-access property rights were considered to be enabling conditions for technology introduction (Ngaido et al. 1999, p. 3). The IFPRI/ICARDA role was to lead the economic analysis in these areas for the M&M project.

4. IFPRI/ICARDA INPUTS

To implement the project, IFPRI hired two new Ph.D.s in 1995, made them joint staff members of IFPRI and ICARDA, and placed them in ICARDA at Aleppo, Syria. Nabil Chaherli focused on policy aspects and developed the multimarket and community models. Tidiane Ngaido was responsible for the property-rights component of the project. Their initial job definition was to develop research in collaboration with national economists.

After the Amman conference of 1997, there was a substantial change in the M&M project and in the roles of the IFPRI/ICARDA economists. At this conference, the decision was made to modify the extension process. The new project would work with communities rather than with individual farmers. Community meetings would be held to define the needs and aspirations of the villagers.

Community members gathered at group meetings were requested to define their priorities. Health and roads were the original priority areas of most communities, rather than agricultural technologies. The project attempted to put the communities in touch with other agencies specializing in these functions. Then, as priorities in agriculture were defined, the project attempted to respond to them.

As the communities were able to participate in the technology priority definition and introduction process, the speed of the diffusion process was expected to be more rapid.[4] However, with limited resources and increased organizational requirements, this shift to community rather than individual extension activities meant that the program only included two or three communities per country[5] (ICARDA 2001).

Organizing extension activities with community rather than individual meetings was not a new technique. It came from the community-development movement of the 1950s and 1960s and was extensively used in the integrated rural development projects of the World Bank and other donors in the 1970s and 1980s. Nevertheless, in these M&M rural areas farmers greeted this community-based extension organization with enthusiasm. Community organization was a definite break from the top-down-directed development common to this and other projects in the region.

After 1997, the responsibilities of IFPRI/ICARDA personnel expanded. Staff also became organizers and promoters of the community extension technique. Tidiane Ngaido, in addition to conducting the property rights research, became the manager of the

[4] As indicated previously, two of the national coordinators said that the community technique accelerated the diffusion process. The diffusion process clearly began in the earlier projects. There were insufficient data to analyze the differences before and after the shift to community organization.

[5] This community organization became a central feature of the project. It also reduced coverage or geographic scope of the project on the national level. The Director of Research of ICARDA used the term teacup project to refer to the limited geographic effects.

policy and property rights component of the M&M project as well as of ICARDA's MTP 4.3 on policy and public management in the dry areas of Central and West Asia and North Africa. Nabil Chaherli estimated that in the second phase of the project, he spent 75 percent of his time on organizational activities to facilitate this innovation. As a result of these activities, the technology-diffusion process accelerated, an outcome emphasized in discussions with national coordinators in Tunisia and Jordan. (For documentation on the diffusion process, see Abdelrahman and Al-Karablieh 2002; Al-Karablieh and Abdelrahman 2000; Bendaoud et al. 2001; Chriyaa and Mzouri 2001; Shideed 2002a,b,c).

The IFPRI/ICARDA economic inputs can be divided into two components:

- Model and analytical development in the early phase (1995–97), with continual diffusion and elaboration of this work in collaboration with other economists in the second phase (after1997); and

- IFPRI/ICARDA contributions to the shift in priority definition and extension techniques.

5. OUTPUTS

There were four direct outputs from IFPRI activities:

- National and international workshops,
- Publications,
- Training, and
- Assistance to partner agencies.

The international workshops, especially those in Amman, Marrakech, and Hammamet, were pivotal activities that brought collaborators from all over the region and enabled them to debate results and project modifications. High-level national people attended the workshops, which helped build a regional network of agricultural scientists, economists, and public policymakers.

The Amman workshop in 1997 led to a decisive shift in extension tactics and a big morale boost to the project. As explained previously the coverage for extension was reduced to two or three communities in each country and IFPRI/ICARDA staff activities were reoriented to respond to this shift in extension strategy.

In the Hammamet meeting (2001), researchers reported econometric results on rangeland feeding for four countries: Syria (Ngaido et al. 2001); Tunisia (Elloumi et al. 2001); Morocco (Herzinni et al. 2001); and Jordan (Al-Karablieh et al. 2001). Total cost for purchased feeds was estimated for the individual countries. Reductions in purchased feed costs were considered to be indicators of more efficient systems because the herders were more intensively utilizing the range or other by-products.[6]

The individual country papers for Hammamet 2001 provided substantial details on management systems, flock size, and land degradation.[7] The country studies[8] generally indicated increased degradation; higher settlement, especially permanent settlement with a reduction of transhumance; increased substitution of barley cultivation for herd migration (Ngaido et al. 2001, p. 2); and increased animal numbers. Researchers clearly documented the limitations of federal controls on the rangelands. Governments and donors have begun discussing new proposals for community controls on common property management, community organization, and different roles for the state. The meeting helped to focus interest in national governments and among donors to renew

[6] Since there would be different prices for other inputs and outputs between systems, total purchased feeding costs were not considered to be a very good efficiency measure by the authors of this report.

[7] Rangeland degradation was attributed to overgrazing, uprooting of shrubs, plowing the rangelands for cereal crops, and planting to establish land claims (Jordan study; Al-Karablieh et al. 2001, p. 2).

[8] These results for the different countries were based on sampling from the drylands beyond the two-community project area.

programs for the rangelands. It was a very important arena for exchanges between scientists and national policymakers.

Table 1. Principal international workshops associated with the M&M project

Tunis, Tunisia, 2002, Impact Assessment Workshop for Maghreb Countries
Aleppo, Syria, 2002, Agriculture, Environment and Human Welfare in West Asia and North Africa
Marrakech, Morocco, 2001, Technical, Policy, and Institutional Options
Oujda, Morocco, 2001, Sustainable Management of Agro-Pastoral Resources[9]
Hammamet, Tunisia, 2001, Policy and Institutional Options for the Management of Rangeland
Hammamet, Tunisia, 1998, Policy and Property Rights
Amman, Jordan, 1997, Agricultural Growth, Sustainable Resource Management, and Poverty Alleviation in the Low Rainfall Areas of West Asia and North Africa
Aleppo, Syria, 1997, Property Rights, Collective Action, and Technology Adoption

The Tunis workshop was the first systematic effort to compare the different country experiences in adopting new technologies. Indicators were estimated to document the extent of new technology introduction including the diffusion of cactus, new barley and vetch cultivars, feed blocks, and improved rams (Shideed 2002b).

In addition to facilitating the interaction of national and international center scientists, another objective of the workshops was for farmers to travel and see what was being done in other countries. A summary of activities and participants is presented in Tables 2, 3, and 4. In Phase I (1995–98) alone, 12,069 people participated and in Phase II (1999–2002), another 14,389 participated.[10]

Since the IFPRI/ICARDA economists were heavily involved after 1997 in organizational activities for the workshops, they deserve some of the credit for this training activity. The IFPRI/ICARDA economists devoted much of their training activity to the further development of a regional economics network in the eight countries. There is now substantial interaction among economists and other scientists in this project.

[9] This workshop was an ICARDA, Swiss Development Corporation, and INRA project outside the main scope of the M&M project. Since there were numerous M&M speakers and a large number of presentations from the workshop are cited, it was practically an M&M event. This regional workshop was a good example of the economic issues being put on the table by the M&M project and carried over and emphasized in this agronomist-dominated event (see Bounejmate and El Mourid 2001).

[10] Deducting the 2,991 trained in 1998 (Table 2) from the 14,389 in Table 4 undoubtedly grossly overstates the numbers actually trained. "Participated" would be a better word here.

Table 2. Number of farmers and technical staff who participated in the Mashreq/Maghreb Project Phase I activities

Activities	1995	1996	1997	1998	Total
Field days/demonstrations	1,753	2,238	2,561	1,846	8,398
Workshops/study tours	259	337	287	865	1,748
Training farmers, technical staff	524	546	573	280	1,923
Total	**2,536**	**3,121**	**3,421**	**2,961**	**12,069**

Source: ICARDA 2002, p. 19.

Table 3. Summary of regional activities conducted during 1998–2002

Activities	No. of events	No. 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**

Source: Haddad and Eltom 2002, p. 30.

Table 4. Number of farmers and technical staff who participated in Mashreq/Maghreb Project Phase II activities

Activity	Countries									
	Algeria	Iraq	Jordan	Lebanon	Libya	Morocco	Syria	Tunisia	Total	Percent
Field days	350	283	425	200	752	650	3,890	255	6,805	47
Workshop	120	644	452	105	12	583	339	150	2,405	17
Training	165	178	428	80	42	820	159	450	2,322	16
Household 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**

Source: Haddad and Eltom, 2002, p. 28.

The fourth principal output from this project was the build-up in capacity of the national agricultural research organizations to undertake and utilize economic analysis. Prior to this project, there was little incorporation of economics into the earlier M&M project outside of Morocco and Iraq. Field interviews revealed that Morocco, Tunisia,

Jordan, and Iraq were using the agricultural policy models[11] developed by Chaherli and his collaborators.

In Jordan, Morocco, Syria, and Tunisia, scientists and policymakers interviewed actively discussed the importance of new initiatives for resolving the open-access problem on the rangelands. The public officials interviewed in the four countries were generally aware of the need to resolve the open-access problem before trying to introduce technological change on the rangelands.

[11] The community models are programming farm models aggregated to a community model with a risk adjustment. There were constraints to satisfy income distribution and natural resource management objectives. In Iraq, there was use of multimarket models by the national coordinator (Shideed and Chaherli 1997).

6. OUTCOMES

There were two main direct outcomes of the project:

- Further evolution of a network of economists in the region; and
- Increased financial support for project activities and for related projects.

In Tunisia, Veronique Alary, a French economist funded by CIRAD, and Mohamed Elloumi, a Tunisian with an M.S. in Agricultural Economics from France, are collaborating with Emad Kharablieh, an economist at the University of Jordan, who earned his Ph.D. from Kiel University in Germany. A. Laamari, M. Boughlala, and A. Herzenni, the Moroccan social scientists in the M&M project, have been collaborating with both IFPRI economists and with Moroccan agricultural scientists. Economists in the national programs are working together under the leadership of K. Shideed, program leader for Iraq, to evaluate the impact of the new technologies being introduced. This between-country collaboration of economists on farm-level projects did not exist before. The country director of Tunisia emphasized the critical role of IFPRI/ICARDA Research Fellow Tidiane Ngaido in developing the capacity of his national program to do economic analysis and to obtain additional resources.

An indirect result of the economics component was improved diffusion of new technologies, especially the spillover between countries due to the program's emphasis on training and on movement of scientists and farmers between regions and countries. The national coordinators in Jordan and Tunisia underscored the rapid spillover of forage-production practices from North Africa to the Middle East and of livestock-production practices from the Middle East to North Africa.

Syria and Jordan have imported cactus technology from North Africa. The other M&M countries have been encouraging feed-block manufacture, piloted in Iraq. The M&M project in Iraq has been very active with regional and traveling workshops and their consultants have visited Jordan, Tunisia, and Syria to disseminate this feed-block technology (Shideed 2002c, pp. 1–2). These exchanges are a very important feature of the M&M program since it is increasingly difficult for national research and extension systems to develop, adapt, and diffuse all the technology options available in the world.

IFPRI/ICARDA economists supplemented IFAD's and the Arab Fund for Economic and Social Development's base grant of US$3 million with approximately $500,000 from seven different donors, including the World Bank, the International Development Research Centre (IDRC), the Consultative Group on International Agricultural Research (CGIAR), the Ford Foundation, the European Union, and the British Embassy in Syria.

The IFPRI/ICARDA economists' most impressive achievements may be their support to the community organization of the M&M project and furthering the evolution of the economists' regional network. The IFPRI/ICARDA economists are appreciated across the region for their help in operationalizing the program, organizing workshops

and seminars, and strengthening the community of economists across North Africa and the Middle East.

Other projects have imitated the community organizing and technology features of the M&M project. One measure of the IFPRI/ICARDA economists' contributions is the large number of follow-on projects, documents, and consultancies. Here are a few examples:

- Ngaido participated in the development of the Jordanian and Syrian rangeland programs.
- The Barani project in Pakistan, which was funded by IFAD, followed the M&M organizational approach.
- Ngaido worked with the team that developed the Tataouine (Tunisia) project, which was also funded by IFAD.
- In Morocco, following IFPRI/ICARDA and collaborators' associated economic research, an Italian NGO took over the feed-block unit tested by the M&M project and then analyzed agrarian land ownership and development priorities
- In Algeria, the public sector took over the M&M pilot project as a model and extended the approach to 16 communities.

IFPRI/ICARDA economists have been very good fundraisers for their own activities and have also helped national programs obtain funding. The Tunisian Program Director, Ali Nefzaoui, repeatedly expressed his appreciation for IFPRI/ICARDA contributions to training and future project development.

7. POLICY RESPONSES

On the policy side, the M&M project is a micro project doing macro analysis. There are many other public-policy pressures on the government and sources of economic inputs into macro policy. Hence, attribution of policy change to this project is difficult.

Nevertheless, the community modeling, the multimarket work, and the resulting public-policy discussions in the workshops have to be given some of the credit for the gradual shift in most M&M countries from emergency relief through feed subsidies to stimulating investment in the drylands system, specifically in drought-tolerant plants, feed blocks, and improved rams and other technologies to increase the productivity of sheep. Different combinations of these technologies were observed in all four countries visited.

During the last decade, feed subsidies were used as a principal instrument to support dryland herders and to enable them to maintain their sheep stocks in dry years. Since most of the last decade has been dry, public costs have been high and in most countries the sheep/goat stocks have substantially increased. Public officials do not regard letting part of the sheep stock die or not supporting herders with public interventions as options.

Income-distribution effects of these subsidies were regressive within agriculture. The ongoing expansion of barley and grazing into more marginal lower-rainfall regions also had adverse environmental consequences (see Appendix 1).

Some of the feed subsidies are still in effect as governments respond to the chronic drought crisis. However, the emergence of a positive strategy before the drought to increase productivity is an evolution of public policy.[12] Clearly, some of the credit for focusing a program more on production alternatives than on responding to welfare-relief aspects of the drought should go to the agricultural scientists in the national M&M projects as well as to the national and IFPRI/ICARDA economists, who helped shift public-policy attention to the drylands from the almost exclusive concern with higher-rainfall and irrigated regions.

Some evidence of the impact of IFPRI/ICARDA economists on policy is that, in Jordan, the Minister of Agriculture reported in an interview that he and previous agricultural ministers had consulted with project economists working on the community models when decisions were being made on the feed subsidies. Tunisia also followed, on a large scale, the same policy of shifting to subsidies on productive perennial crop investments rather than depending upon feed subsidies. The program director of the M&M project had access to the higher levels of the government and was influenced both

[12] These need to be temporary subsidies since there will be resource-allocation distortions from them. At least, the focus is on avoiding the future effects of droughts rather than only on emergency response after the droughts to keep animals from dying.

by the community modeling of his own economists and his ties to the wider M&M project.

Morocco, Tunisia, and Jordan[13] have been phasing out the drought subsidies but giving investment subsidies to drought-resistant perennials, especially spineless cactus and atriplex, rams, and other practices (Ngaido et al. 2002, p. 32). The M&M project emphasized the technology potential of these perennials and other innovations. The IFPRI/ICARDA and national economists pointed out the inefficiency and regressivity of these welfare-justified feed subsidies. These economic inputs were apparently important in this change in emphasis to investment subsidies.[14]

Earlier, it was noted that getting agricultural policy right and an institutional response to the common-access problem were expected to be enabling conditions for introducing technological change and attaining long run increases in farmers' incomes.[15] What evidence is there about whether these two operating assumptions are correct?

In the cropland zones, new technologies are being introduced across different policy regimes. Field interviews in all four countries reported pressures to reduce the role of the state in the economy by eliminating parastatals and reducing price distortions. In Jordan, the pace of technology introduction seemed to be more rapid than in Syria, which has been slower to liberalize its economy.[16] In contrast in the more centralized Tunisia, technology introduction apparently was more rapid than in Morocco, but this progress occurred where land had been privatized. In the cropland regions,[17] the new technologies are entering a wide array of policy regimes with no discernible pattern related to agricultural policy.

Agricultural-policy change does not seem to be a necessary enabling condition for the new technology diffusion. The relationship may even work the other way around, with technological change leading to more interest in development of input and product

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[13] In Morocco, a large number of other economists were involved in evaluating these agricultural policy issues. In interviews in Tunisia and Jordan, public officials gave more credit to economists associated with the M&M project for their contributions to the policy analysis.

[14] Note also that feed subsidies are normally phased out in normal rainfall years and reinstituted in adverse ones. With increased production from drought-resistant plants, pressure for reinstituting feed subsidies in adverse rainfall years will be reduced.

[15] Besides increasing small-farmers' incomes, the goal also was to maintain or improve natural resources.

[16] This is mainly a qualitative judgment based upon interviews in the two countries and the literature review. Impact studies in Syria have been undertaken by ICARDA, by national economists in Jordan, and an overall review from the workshop on impact analysis by the national coordinator for Iraq (Tutwiler et al. 1997; Abdelrahman and Al-Karablieh 2002; Al-Karablieh and Abdelrahman 2000; Shideed 2002a,b).

[17] Generally there also are collective rangelands on the more marginal soils in these cropland areas. The analysis on the rangelands, that follows, also applies to how these collective lands were handled.

markets and then to agricultural-policy reforms. In a recent Morocco workshop (Ngaido et al. 2002, pp. 29–30), one conclusion was the need to focus more on marketing potential of the new technologies being introduced, including the export market for cactus fruit (Algeria and Tunisia) and the domestic market for processed sheep milk (Jordan and Syria).

On the rangelands,[18] there is some evidence that resolving the collective-access or common-property problem is a prerequisite for introducing technological change.[19] Again, evidence is only fragmentary. Public control of rangelands has often been frustrated. For example, herders have broken into some of the 23 reserves to rejuvenate pastures in Jordan. One minister of agriculture reversed the rules and allowed open grazing in these reserves. Another administrator of one reserve allowed 10 times the permitted grazing and completely depleted the pasture. In Syria, there are many regulations for the rangeland and apparently more control of illegal barley production or wells.[20]

Conceptually, farmers would not be expected to make investments in perennial plants (cactus and atriplex) or in water-harvesting techniques if they could not capture the income streams from them. In one tribal region in eastern Morocco, atriplex was planted (Herzenni et al. 2001, p. 31). This was an exception since there was almost no report of planting these bushes in the communal land holding areas (Herzenni et al. 2001, p. 31).

In contrast, in Syria and Jordan, big operators from either the capital or from dominant ethnic groups in the rangelands have obtained de facto ownership in the rangelands by planting barley, border rows of barley, or some plant barrier to delimit a privatized grazing area. In Syria, a legal ban on crop cultivation on the rangelands was passed in 1994 but site holders have resisted losing their staked claims by planting drought-tolerant bushes (Ngaido et al. 2001, pp. 2, 10).

Collective property rights and controls have been eroded by economic growth and, frequently, the state. There have been various types of state intervention in many of these countries, including Iraq, Jordan, Morocco, and Syria, to handle over-exploitation of water and grazing resources.

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[18] From approximately 100 to 200 mm of rainfall is the steppe or rangeland. Nomads or transhumants have traditionally settled this area. Now most of the nomads are gone but there still is a dependence on the transhumants. There is periodic movement to the range by both transhumants and the semi-sedentary producers but this movement is becoming more difficult over time (Appendix 1).

Even in the higher-rainfall regions outside of the privately cropped areas, there are collectively grazed areas under community control. As noted previously, the ability of communities to control their members or to negotiate with other communities on collective lands or where they overlap has declined substantially over time.

[19] Also on the croplands, Ngaido et al. (1999) showed that more secure tenure is statistically associated with more rapid diffusion of inorganic fertilizers.

[20] It was impossible to verify this so this may just reflect that officials were not prepared to talk about these violations.

Federal-government ineffectiveness in managing natural resources at local levels has been documented frequently. Since public intervention is often regarded as an attempt to take over traditional rangelands, public activities — including reserves for rebuilding the pasture and forests — are frequently resisted or violated. Local institutions often are able to develop rules and regulations (Ngaido and Kirk 2002, pp. 4–5). The decentralization process is designed to improve management of resources by giving more authority at the local level (Ngaido and Kirk 2000, p. 4). The literature has increased on the process of devolution[21] or the return to some type of local control from state control.

Negotiation techniques and participation in community organization successfully utilized on the croplands in this project are an important example of community decisionmaking for the rangelands. Community organization and participation have frequently occurred on the slightly higher-rainfall croplands (150–300 mm annually), where most property is private and most of the communities in the M&M project are located. But the use of community organization and participatory decisionmaking has not improved diffusion on the rangelands.

One principal recommendation from the IFPRI/ICARDA research is that the power to control rangeland management be returned to the communities. With the failure of state initiatives in many countries, there is new interest in community control, management, and customary tenure systems. Cooperatives could be formed based upon ethnic divisions.[22]

Would collectivization (or privatization) combined with more active involvement of some state agencies, on a contractual basis, lead to improved long-run resource utilization and reduced degradation (Ngaido 2000, pp. 317–318)? This is the new institutional proposal to be tested in the rangeland development programs funded by IFAD and other donors.

The inability of the state to control local behavior in the rangelands has already been recognized as a regional problem. Where tribal systems are already working, as in the Atlas Mountains of Morocco and in southern Tunisia, it would be useful to study their use of sanctions and their ability to control degradation of the rangelands (see Box 1). In most regions, tribal controls are historic. Since the times of tribal control, herd size has gotten much larger. But the sanction ability of the tribal groups to control herd size has been decreased by the intervention of the public sector and/or by the economic growth of the society.

There are a few regions, such as the Atlas Mountains, where tribal sanctions to control access are still effective. Unfortunately, few new technologies were being

[21] "Defined as the shift of responsibility and authority for resource management from the state to nongovernmental bodies …" (Ngaido and Kirk 2000, p. 3)

[22] In interviews, many public officials discussed the failures of cooperatives. They can be taken over by a few large farmers. In some countries, they have been used as a governmental tool. In this case their services are treated as governmental largesse rather than something that must be financed by the group.

Box 1. Explanations for rangeland degradation

Rangeland degradation has increased during the last century following colonial rule (Pinstrup-Andersen et al. 1997). In the Maghreb, rangeland decreased by 10 to 13 percent since the mid-1970s. Only 20 percent of the remaining rangeland is considered satisfactory (Pratt et al. 1997).

Encroachment of crop production onto the rangeland increased after the development of crop mechanization and appropriation of common land by some powerful farmers. Wood collection for heating and cooking is an important source of rangeland degradation. In Morocco, each family uses four tons of wood per year for this purpose. The number of small animals grazing on this rangeland has doubled since 1950 while the rangeland area has dramatically decreased and been degraded (Pinstrup-Andersen et al. 1997).

Farmer behavior has been explained by four factors (Pinstrup-Andersen et al. 1997; Pratt et al. 1997):

1. High prices for cereals and subsidized input prices, especially for fuel, that encouraged farmers to extend mechanized cereal cultivation;
2. High tariff protection of imported meat, credit for truck and water tankers, untargeted subsidies for feed distributed on a per-animal basis under drought-relief programs, and other incentives to farmers to keep more animals on the rangeland for longer periods;
3. Inadequate property rights, which open the rangelands to uncontrolled cultivation and overgrazing; and
4. Population pressure.

The authors found this analysis dated. Many of the economic distortions are being changed. The use of subsidies and other incentives differs greatly between countries. Fuel is not always subsidized. It is heavily taxed in Morocco. Most input subsidies are now rare as a result of the structural-adjustment programs. Credit for trucks is not subsidized. In Morocco, the feed subsidy under drought-relief programs has had a minimal effect on forage units available to farmers (Laamari et al. 2002). In contrast, Morocco taxes feed imports. However, high tariffs on imported meat have an important impact on the number of animals.

Hence, the authors of this report assert that the principal reason for this degradation is the open-access to rangelands. Due to high meat prices, it is profitable to produce more meat. With high feed prices (in particular, for barley), the pressure on rangelands is high and encroachment is encouraged. The substitution between bought feed and rangeland feed decreases with a high feed price. With a lower barley price, it will become less profitable to produce barley in marginal lands; this will then reduce the attractiveness of encroachment.

The appropriate policy is to reduce tariffs on both meat and feed and solve the open-access problem. However, reducing the meat price will lower farmers' incomes, which increases out-migration. Reduction of tariffs on meat should be a long-term goal and should be done in parallel with tariff reduction on animal feed and with increasing productivity in order to maintain farmers' incomes.

introduced there. It still is not known whether this collective institution would be effective in enabling technological change.[23] Hazell (2000) points out the lack of success stories in collective management systems.

[23] Herzinni et al. (2001, pp. 31, 37) report "the Central High Atlas enjoys a state of equilibrium but at a low level of development." In contrast in the tribal rangelands of the Eastern region, atriplex has been planted.

Can these tribal institutions be rebuilt, as around cooperatives, so they can reduce herd sizes and recover their sanction powers? Do the ethnically based co-ops have the ability to control powerful individuals within the community and from the capital? Will this devolution lead to increased diffusion of new technologies? There is still no evidence from this project to respond to those questions.

Nevertheless, there is an emerging consensus that this common-property problem has to be resolved before technological change can be successfully introduced on the rangeland. Unless someone has the power to fence and maintain ownership rights, who will plant drought-resistant plants or will improve the pasture? The technological components of a rangeland strategy are well known (Appendix 1). For the rangeland, the required strategy revolves around increasing productivity of pastures and sheep, reducing the production of barley[24] and controlling the drilling of wells for crop or tree production. Influential producers frequently both produce barley and drill wells illegally (Abu-Shai, personal communication, 2002).

There are excellent regional experimental results in Jordan for the use of phosphorous fertilizer on the indigenous pastures of the rangelands. These follow the Australian experience since the 1920s of recovering the native legumes of clovers and medics. Also in Morocco, the livestock development agency experimented with dropping phosphorus and improved grass seeds onto the rangelands from airplanes. Cactus and atriplex can also be introduced in the rangelands if some water can be made available in the initial establishment stage. There are many water-harvesting techniques that can be introduced or updated from traditional practices (Oweis et al. 2001).

The critical problem is management of the common-property resource to prevent overgrazing and to enable producers or tribal groups to benefit from intensification. In some areas, as in the Atlas Mountains of Morocco and the southern region of Tunisia, tribal systems still control grazing and other activities.

In Jordan, some public officials believe that, if intensification of herding practices (such as corralling at night and stables) can be introduced along with other productivity measures, herders could be encouraged to reduce herd sizes. For sanctions, the public sector might have to supplement or reinforce the tribal organizations, at least at the start of the process, to control very influential people, including high government officials and local chiefs. Whether these people can be controlled by either the tribal groups or the public sector is an important question. Intensification by using fallow-restoration techniques, phosphorus, drought-resistant plants, water harvesting, and other measures will depend upon resolving this organizational/institutional problem.

[24] At some rainfall level in the rangeland, barley becomes a marginal crop even for forage. Unfortunately, one way of obtaining de facto ownership of rangeland in many of the M&M countries is to plant barley there.

Two solutions are proposed for the common-access problem:

1. Reinstitute or strengthen community control by helping to form cooperatives, supporting them with public-sector help in training, and providing sanctions. There is a very mixed history of the success of cooperatives in the region so it is necessary to understand the factors associated with successful cooperative development.

2. Facilitate the movement to privatization, as in central and northern Tunisia. Privatization secures investments made by farmers and encourages them to make more investments. The risk-management effects formerly achieved by moving herds can be approached by farmer diversification and some public support. A serious income-distribution problem is associated with this strategy. With collective management, who makes the investments and how are the benefits divided? Returning to traditional-type institutions will not eliminate the need for rapid technological change on the rangelands. Technological change on the rangelands is expected to become the main source of growth and sustainability in this new environment of higher human and animal densities. So the institutional requirement now is to create incentives and/or sanctions to facilitate a more rapid technological change.

Another alternative to a return to collective or community control is to encourage continued privatization of the rangelands. In the dynamic context of creating incentives to rapidly introduce technology and rights over the new rents from technology, the examples seen in this project and in the literature are from privatized systems rather than from collectively managed ones.

Private holdings would need to be large to make a reasonable income in these low-resource regions. Income-distribution consequences of the division of the rangeland are already a difficult public-sector problem. Herders, especially the larger herders, are increasingly becoming farmers in both the cropland and the rangeland areas in many of the M&M countries. One de facto way of obtaining private land in the rangelands is to plant barley strips around it. As larger herders and influential outsiders become sedentary, less pasture areas are left for the other herders. This results in the increasing marginalization of the smaller operators, who then become more dependent upon off-farm work (Ngaido 2000, p. 310).

From the Ngaido papers there are two general recommendations: (1) move away from a reliance on state control, and (2) obtain community participation in allocation of user rights on the collective land. The process of institutional evolution leading to technological change is just beginning in the rangelands. IFAD is presently investing substantial resources in the rangelands. These can be laboratories for evaluating institutional changes to facilitate technological change. Box 2 lists requirements to which institutional innovation has to respond.

Box 2. Requirements for new institutions to manage the rangelands

1. ***Respond to pressure from larger animal stocks and increased population on the rangeland***. Flock sizes have become larger in the past two decades with the continuing subsidization of feeds in the drought years. On the cropland, there is a definite movement to more intensive sheep production, improving nutrition and health, and increasing prolificacy (multiple birth) investments. Many farmers will want to graze seasonally on the rangeland, so rangeland control is a more difficult problem than in the past. Improvements will need to involve more rapid technological change as well as convincing herders that they can produce smaller flocks more efficiently and profitably if they do it more intensively.

2. ***Develop effective sanctions for enforcing conservation rules***. The ability of ethnic groups to apply traditional sanctions to control behavior of their members has declined over time with economic modernization and/or governmental intervention. Such techniques as shunning or even throwing members out of social groups have less force as economies develop. Moreover, many in the rangelands do not accept public control and regularly violate public rules and/or reserves.

3. ***Control those powerful individuals now violating controls or reserves.*** Influential individuals at the national and local levels have become more adept at violating national or community controls and do this on a large scale since they have large flocks. This was identified as a serious problem in all four countries in which interviewing took place.

4. ***Develop incentive structures for introducing yield-increasing technologies.*** Rapid technological change enables a response to increased herd sizes and rangeland degradation. But first a method to divide the increased income streams resulting from technological change has to give incentives to individuals or groups to make the required investments. This is an especially important objective when collective control is set up; its importance is generally not mentioned in the papers cited on collective control.

The economics program of IFRPI/ICARDA brought this issue of common access to the forefront of policy discussion on the rangelands and to a wider circle of agricultural scientists and public policymakers in the region. On the policy side of rangeland development, IFPRI/ICARDA economists helped to lay out the institutional alternatives and some concrete measures for evaluating them. They also contributed to recognition among national program scientists and donors that new institutional alternatives and substantial technological potential are available for these rangelands. The Tunisia national M&M project takes pride in the development of the Tataouine project. IFAD is also funding the Badia project in Syria, a new rangeland project in Central Asia, and the Barani project in Pakistan.

In summary, where agricultural policy was basically input subsidies, only the most doctrinaire proponent of structural adjustment would argue for eliminating them. Governments continue using feed subsidies in adverse weather years. On the cropland areas of the drylands, technological change has progressed well and encouraged other changes in markets. These changes will lead to farmer pressures for better supporting agricultural policies.

On open access, there is some evidence that technological change will not be possible without first resolving this problem. With present and new development projects in the rangelands, institutional structures will need to be evaluated for their ability to resolve conflicts, to introduce technologies, and to improve welfare of their members.

Institutional and technological innovations were discussed all over the region in meetings with public officials. So there has been an evolution of policymaker views moving away from a principal or even an exclusive concern with state control to new institutional ideas of some type of local management and more awareness of the potential importance of technological change on the rangelands.[25]

The question remains whether any system will be able to control the powerful individuals from regional ethnic groups and/or from the capital who have moved into the power vacuum and appropriated resources for themselves, thereby often accelerating the degradation process. A second important issue is that technological change will exert pressure for continuing institutional change, pushing even a collectivized system toward privatization.

[25] Several public officials commented that the state would still need to help on the sanctions given the greater pressure on the land now and the expected failure of traditional sanctions, especially on powerful figures in the ethnic group and the capital.

8. IMPACTS

The M&M project defined impact as reducing poverty, improving food and nutritional security, sustaining livelihoods of the poor, and enhancing the natural environment. The IFPRI/ICARDA activity in this project was focused on agricultural policy and property rights. So the first question here is the direct effect of this activity on project impacts. There were also indirect effects from the IFPRI/ICARDA activity. Here the more complicated question is how the overall project performed and the IFPRI/ICARDA contribution to that performance with respect to the above impacts.

The research on agricultural policy helped focus concern on investment in productive assets, especially the drought-resistant shrubs, rather than on feed subsidies. Policy analysis estimated the costs to the region and society of the subsidies and other macro policy alternatives.

Box 3. Diffusion of crop technologies in the M&M project

This synthesis of the diffusion of crop technologies in the M&M project is based upon an analysis of the earlier Mashreq project in Jordan (Tutwiler et al. 1997), the preliminary results from the impact analysis undertaken by economists within the M&M project (Shideed 2002a,b), and from intensive interviews with national coordinators and program scientists (see Appendix 1 for details).

Diffusion of new barley cultivars was progressing well during the two projects preceding the M&M project, as were feed blocks in Iraq and the introduction of spineless cactus in Tunisia. The M&M project accelerated the introduction of drought-resistant plants, cactus, and atriplex, and facilitated their introduction into Middle Eastern countries (Jordan and Syria).

In Tunisia and Algeria, introduction of these drought-resistant plants accelerated. Similarly, the M&M project had a large role in the movement of the feed blocks into other M&M countries, especially Morocco and Tunisia (Shideed 2002c). An important contribution of the project was to accelerate spillover or the movement of technologies between countries.

Diffusion of new barley cultivars continued with more adaptation investments by national scientists and consequent new cultivars. New forage legumes (vetch in Jordan and Tunisia; vicia and medics in Iraq) also were being introduced into the project area (Shideed 2002a,b). Increased fertilization was also introduced.

Investment in diffusing water-harvesting technologies was neglected (Oweis et al. 2001; also conversations with Oweis). Many traditional water-harvesting techniques are well known by the dryland population, can be performed outside the crop season, and are generally very labor intensive. A series of adaptations of traditional or new techniques can be undertaken during the crop season, and have greater absolute effects on yields than traditional techniques. Introduction of water harvesting or supplementary irrigation would have a large complementary effect on other new inputs, including fertilizer and new cultivars (Shapiro and Sanders 2002).

There is now some evidence that the diffusion of technological change was not conditional upon agricultural-policy change in the privatized cropland regions. Across countries, the rates of diffusion do not show any relation to the differences in policy approach. However, successful technology diffusion has now increased the demand for

other economic activities, such as development of the product market and improved functioning of the input markets.[26]

The overall question for the M&M project is how technology diffusion proceeded. The project accelerated introduction within and between countries of new barley and forage legume cultivars and of the feed-block technique and facilitated the rapid introduction of the drought-resistant plants (cactus and atriplex), especially their movement into the Middle East. A notable underinvestment in the project was the failure to promote water-harvesting techniques.

For livestock technologies, the introduction process of improved rams was accelerated in all the countries interviewed. The M&M project also facilitated the diffusion of knowledge by scientists of intensive reproductive practices of the Middle East. However, there was much less acceptance by farmers/herders in North Africa of these practices than of the drought-resistant plants in the Middle East.

There is a fundamental difference in final demand for the products from sheep in the two regions. Milk is a very important product in the Middle East but not in North Africa, where the predominant uses of sheep are for wool and meat. Hence, the herders in North Africa were not as interested in more intensive practices, such as early weaning and increased prolificacy.

The need for new markets for different livestock products is being strongly pushed from the bottom up by the farmers' groups, especially in the more intensive production area (Syria and Jordan). Here farmers' groups asked for government support in milk processing and cheese manufacturing at the local level. Identifying and facilitating the entrance to new markets is expected to become an important economic activity in the national programs.

In North Africa, farmers could be aided to get higher prices for lamb by some combinations of price discrimination for higher quality or more processed products, by avoiding sales at seasonal or between-year lows, and by utilizing the market power of larger sales potential and greater information, as with cooperatives. The price-discrimination potential for the leaner and other higher-quality sheep could make this new breed much more interesting to farmers.

The above discussion of technology diffusion of livestock practices was focused on the cropland region, where the producers have annual crops and access to rangeland for their flocks (Box 4). Of the 16 sites of community-technology introduction engaged in by the M&M project, only two were exclusively rangeland sites (ICARDA 2001,

[26] The farmers in the M&M meetings in both Syria and Libya were able to verbalize their need for new markets for milk and cheese. The national coordinator in Tunisia was very anxious to develop new markets for other cactus products, as were several of the economists in Jordan. Seed-market requirements were being produced by the national research organizations but the need for independent producers will soon become clear as the demand expands.

p. 24). These exclusive rangeland sites included one site in Algeria and one in Libya. The project concentration has been in the croplands.[27]

Box 4. Diffusion of livestock technologies in the M&M project

Even in the cropland area, livestock was a principal activity and livestock technologies were being diffused. Besides the cropland, these regions also have communal rangeland. Most of the project activity in the diffusion sites was in cropland regions or regions categorized as both cropland and rangeland (ICARDA 2001, p. 24).

Introduction of new rams preceded the project and was accelerated by project activities. The diffusion of synchronized weaning, hormone treatments for prolificacy, and early weaning were introduced in Jordan and were extended to the other countries in the project.

Where there was less-intensive sheep production, as for wool and meat rather than milk (North Africa), there was less demand for these technologies (Moroccan team member interviews). Nevertheless, the veterinarians and animal scientists of the Middle East made a wide range of their innovations more common knowledge and began the diffusion process for these more intensive sheep-production techniques in North Africa.

All four countries interviewed had public reserves in the rangelands where regeneration by fallowing was being attempted. Fencing of the public reserves was often not respected by the local inhabitants. Outside of Morocco, there was little focus on increasing the productivity of rangeland pastures, such as phosphorus application to regenerate natural legumes. Clearly, the open-access problem has to be resolved on the rangelands before these innovations can be successful.

What was the economics contribution for the rangelands? The economics analysis concentrated on property rights. There was substantial input from economics in conceptualization and documentation of the difficulties of the present institutional approaches with an emphasis on the failure of state controls.[28] The economics program provided some evidence that the institutions controlling open access were not functioning very well and therefore, indirectly, that institutional change was a prerequisite for successful technology introduction.

By providing another look at the rangeland institutional problem, the indirect effect of the economic analysis was to encourage donors to fund new projects based upon the bottom-up community organization being practiced in the M&M project. These new projects then can test various institutional innovations. The consequent impacts of these new institutional approaches upon technology diffusion, herder incomes, and the environment will then be very important for economists to measure well in future projects.

[27] In the croplands, landholding is privatized so there is no need for concern with the open-access problem.

[28] There is also increasing evidence of the environmental degradation from the institutional failures and increasing crop and animal pressures on the rangelands (Box 1 and Appendix 1).

9. IFPRI/ICARDA PERFORMANCE

The IFPRI/ICARDA economists along with other M&M professionals encouraged the policy shifts to input subsidies, especially on perennial drought-resistant plants and other long-term investments. This appears to be a more productive long-run alternative than the response to continuing droughts by subsidizing feeds. The IFPRI/ICARDA economic input also identified the importance of new institutional approaches to the open-access problem on the rangelands. This insight and the successful community organization experience helped to build donor momentum for a series of other projects wholly or partially oriented to the rangelands.

As an indirect effect (see the Impacts section) the IFPRI/ICARDA economics program can take some of the credit for the overall success of the project in achieving technology diffusion and for some of the success in obtaining continued funding through new development projects, especially for the rangelands.[29] Other projects imitated the organizational and technology features of the M&M project. Several of these have already obtained funding.

IFPRI/ICARDA economists are also appreciated across the region in the national M&M teams for their help in operationalizing the programs, organizing workshops and seminars, facilitating training, and encouraging multidisciplinary and multiagency collaboration.

The success of IFPRI/ICARDA economists in increasing the demand for economic analysis may be their most impressive achievement. They played a big role in the evolution of a community of economists across the two regions of North Africa and the Middle East. This role is clear from the workshops and in the large number of jointly authored papers cited in the References and Appendix 3.

[29] One indicator of IFPRI economists' contributions can be seen in the large number of follow-on projects, documents, and consulting work (Appendix 3).

10. LESSONS LEARNED

1. ***Making the national programs the implementers of technology introduction projects — with international centers as consultants — worked very well in giving pride of ownership, confidence, and project success.*** One principal contribution of IFPRI/ICARDA economists was to work in teams to facilitate the build-up of the national programs in their ability to deliver services and to obtain new donor-supported projects. The M&M project is demonstrating the scientific maturity of many of the national research programs in their ability to implement field programs involving diffusion and continuing adaptive research. Team performances in Tunisia and Jordan were especially impressive.

   The M&M project is increasing the interest of other agencies in technology diffusion in the drylands due to the successes of the concentrated efforts of multidisciplinary teams in the national agricultural research institutions.[30] In these national M&M projects, not only are several scientific disciplines working together but there is also much wider participation from many different groups in the society than in most projects. This participation included farmers, research and developmental agencies such as extension, local leaders, and NGOs.

2. ***Community organizational techniques to obtain bottom-up response in project orientation appeared to result in more rapid technology diffusion than previous individual-farmer approaches***. The big innovation for the region stressed by IFPRI/ICARDA economists and public officials was the community-organizational technique for diffusion. This was generally considered to be more effective than traditional extension techniques. But none of the extension services or more production-oriented divisions, such as the public agencies for livestock development, had plans for incorporating the community approach into their extension approach. Shifting the method of doing extension is a large step for an institution probably requiring retraining of its basic staff. Impact would be when this technique was moved from the pilot-project stage to national implementation.

3. ***Agricultural scientists requested better integration of technology and economics in the modeling activity once they understood what the economists could do with modeling.*** The IFPRI/ICARDA economists were not specifically asked to integrate the technology and economic components of the M&M project. In retrospect that probably needed to be part of their original mandate. A group of the scientists from this last international workshop in Hammamet urged more continuous interaction of economists with agricultural scientists not only to improve the data but also to encourage broader ownership of the economic modeling (Ngaido et al. 2002, p. 34). This organizational evolution into identification with importance of the modeling and demand for the regular input

[30] This was most forcefully stated in the interviews with public officials in Tunisia.

from economists by agricultural scientists is an impressive achievement of the economics program. The community models can be easily adapted to respond to questions about this integration and the agricultural scientists collaborating with the economists are increasingly asking them to use the models in this way.[31]

Some of the critical questions for this modeling are: What are the actual or potential effects on farm incomes of the different technologies introduced or to be introduced? What are the constraints to their introduction? What feasible policy or institutional changes would increase the rates of diffusion and how much effect would these changes have on farmers' incomes? What are the combined effects on farmers' incomes from technologies and feasible policy and institutional changes? All of these questions revolve first around the technologies. This analysis is most relevant for the cropland region. For the rangelands, the main focus remains the institutional changes to handle open access while encouraging technological change (see Box 2).

4. ***Successes of the technology diffusion, especially of drought-resistant plants and breeding stock with different quality characteristics, demonstrated to agricultural scientists and economists the need for marketing research to accompany technology introduction.*** A series of marketing innovations are associated with the technologies introduced. These marketing innovations to increase farmers' incomes include price differentiation for a higher-quality product, such as leaner lambs in Tunisia; alternative markets for cactus fruit; and the importance of increased market power for farmers from collective negotiation. Getting these options functioning, documenting their potential to increase farmers' incomes, and accelerating diffusion will be important activities for economists working with the technology introduction programs.

5. ***The private sector failed (market failure) to move into certain critical activities undertaken by the public sector before structural adjustment.*** The most pressing market failure for the drylands is the collapse of quality seed production since the private sector has not picked up this activity for many commodities (for examples in a different region, the Horn countries, see Sanders and McMillan 2001). Seed production in the drylands can become profitable without economic distortions, but often the pump needs to be primed to demonstrate potential markets to the private sector. Strategies to encourage evolution of private-sector participation will be required to maintain the diffusion process for the new technologies. New barley and forage legume cultivars will not continue to be introduced if the seed sector does not evolve.

[31] The Morocco M&M project has done a large number of these diffusion, impact, and efficiency (technical and economic) studies. Morocco invested much more than the other countries in the economic human capital of its personnel. Jordan worked on the economics of the new technologies with an M&M economist and used more sophisticated approaches with excellent contributions from two University of Jordan economists.

11. CONCLUSIONS

The biggest contribution of the IFPRI/ICARDA economists was the indirect one of organizational support to the national programs, facilitating the new community-organization method of diffusion of new technologies and encouraging a broader-based collaboration within the national societies. The rapid spillover of new technologies between countries was impressive and demonstrated the success of the project emphasis on training, workshops, and scientific (and farmer) interchange. The additional funding the economists were able to attract also broadened field research of the project. The economists helped build confidence in the national teams. The continuing fieldwork on the rangelands and the success of the community organization in the croplands spurred donor interest in a substantial expansion of rangeland projects in the region and outside the region.

On enabling conditions: Clearly, the elimination of feed subsidies was not a precondition for technology diffusion. This policy suggestion to eliminate feed subsidies comes more from structural-adjustment orthodoxy. The feed subsidies benefited principally the larger herders but governments in the region considered them to be welfare measures. Economic analysis did have a role in encouraging more support of productive investments in the drylands rather than relying only on support for feeds after the drought.

An initial operating hypothesis was that the M&M countries would need to get policy right before technology would be introduced. On observing different country performance in the drylands, successful technological introduction was not noticeably influenced by differences in agricultural policy. Rather, successful technology introduction appeared to be an enabling condition for bottom-up support for developing new markets and ultimately changing agricultural policy.

In contrast, for the rangelands there was some conceptual and empirical support that unless there was a resolution of the open-access problem, technological change would not be successfully introduced there. Nevertheless, there was a new enthusiasm by donors for working in the rangelands. This resulted from the successes of community organization in the project and the continuing dialogue as from the workshop in Hammamet on new institutional alternatives for the rangelands.

For future economics work on the croplands, there was clear pressure from other national and international scientists for better integration of the technology and economics in the ongoing modeling. Shifts in modeling to focusing on how to accelerate the diffusion process and avoid the price collapses of rapid technological change were emphasized at the workshop. This change in model emphasis would make IFPRI/ICARDA inputs much more useful in future collaboration with other international centers.

IFPRI/ICARDA demonstrated the ability to play a supporting organizational role to national programs in the M&M project. Making policy change a secondary rather than a primary research focus is expected to lead to an increasing demand for IFPRI/ICARDA inputs. Many other international centers would also like to know first how technology diffusion rates could be accelerated and then secondarily how to complement that with changing policies and institutions. This is in contrast with the belief that agricultural policy change is the prerequisite for technological change.

As the diffusion process continued, farmers and other agricultural scientists as well as economists recognized the need for more work on markets. There was initial stress on the product market, especially for livestock products and alternative uses of cactus. An important field in economics could result from direct intervention by economists working in development agencies to help markets evolve in ways to benefit farmers by receiving higher prices and buyers by receiving a higher-quality farm product at the appropriate times.

Many countries are shifting from strong centrally-controlled economies to market-driven ones where the state plays a regulatory role. In market economies, entrepreneurship and contracts become the driving forces with the government only keeping the playing field level by regulating market abuses and helping evolve contract law. This is not a simple transition, as the last decade in the former Communist countries has demonstrated. Economic theory is also not much help on how the transition takes place, particularly the growth of institutions plus the legal and social underpinnings for a market system. There is much to learn from fieldwork about the evolution of a market system.

The other important part of market analysis to support programs such as the M&M project is to find new methods to avoid private market failure. For 20 years, donors and economists have been obsessive about state-sector failures. Now economists have to rapidly turn attention to one of the principal concerns of economists before 1980, private-sector market failures. This is especially important in sustaining the introduction of new cultivars in the drylands — cereals, forage legumes, and drought-resistant plants — through the evolution of private-sector seed industries. Many of the important crops of the drier regions are presently orphan crops. The public sector is decreasing seed production and the private sector is not presently interested. The public sector will need to step in with a plan to expand both supply and demand and with the development of economic incentives to encourage the entrance of the private sector thereby enabling the public sector to phase out over time.

Public-sector support and/or imaginative incentives will be necessary to convince the private sector that activities on the drylands can become profitable.[32] Other input markets that will need to function better on the drylands are the fertilizer and credit markets. The most serious problem will be in water markets as countries, such as Jordan,

[32] There are successful examples of profitable new activities in semiarid Kenya, such as the introduction of new cultivars of pigeon peas along with the simultaneous increase of their exports (Sanders and McMillan 2001).

continue to deplete underground water and farmers/herders defy public regulations on well-drilling.

For the rangeland, IFAD and others need to be convinced that their large new projects will depend not only upon technological change but also on a series of institutional innovations in the various projects that need to be monitored, evaluated, compared, and contrasted to see how they respond to the four requirements laid out for new institutions (Box 2). The most important requirement will be the ability of the systems to set up incentives for technological change and to allocate returns from this activity. An evolution towards privatization is expected.

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Appendix 1

TECHNOLOGY COMPONENTS OF THE M&M PROJECT

Authors' intervention: The M&M project was a technology-diffusion project. The inclusion of IFPRI/ICARDA economists in the M&M project was expected to accelerate diffusion. To adequately evaluate the impact of IFPRI/ICARDA in accelerating diffusion, baseline data on diffusion would have been needed to separate the IFPRI component (the attribution problem). There were some diffusion studies before the M&M project but most of the diffusion work was just beginning in 2001–02. The national coordinator in Iraq, K. Shideed, is leading this activity.

What needs to be done to accelerate this technology diffusion process is based on the interviews, project documents, and previous experience of the authors.

A. Critical Structural Changes in Dryland Agriculture

Over approximately the last two decades, there were two very important changes in the drylands of North Africa and the Middle East:

(1) The continuing movement of barley into more marginal rainfall regions, which is often deplored by environmentalists. Economists argue the importance of economic distortions in providing incentives. Agronomists point out the advantages of barley in recent drought years. This argument is reviewed, as barley is very important to dryland farmers.

(2) The shift from itinerant to sedentary livestock production and to an increasing concentration of larger producers with greater capability in moving their herds around and in buying supplementary feed stocks.

To understand the demand for barley cultivation, it is important to remember the alternative uses of barley. In the last decade, farmers reported continuing drought years; and some farmers report getting minimal or no grain production from barley in seven to nine of the last 10 years. Public officials talk about farmers maximizing biomass[33] production rather than cereals. With the expansion of barley area for the increasing flocks of sheep and goats, barley has also been moving into the more marginal rainfall regions even where the public sector is trying to prevent that expansion (Ngaido et al. 1999, p. 3).

Barley has a strategic position in low rainfall crop areas since it has multiple uses:

- Cereal for human consumption;

[33] Farmers need not only total forage production but they also have requirements for the seasonal availability of forages.

- Its grain and straw can be stored between seasons and even for more than one year;
- It can be used in wintertime as forage (*deprimage*); and
- It gives herders more flexibility for their feeding calendar even with the very low yields resulting from pushing barley into marginal rainfall zones.

Before designing incentive or legal systems to reduce the cultivation of barley, it is necessary to identify alternative activities that fulfill similar roles or at least maintain farmer/herder incomes. This IFPRI/ICARDA economic analysis continually suffered from an inability to combine technological (agronomic and animal science) factors with the economic analysis. The failure to understand the critical agronomic and diversification roles of barley in these systems is an example of the pressing need for more technology inputs into the modeling.

The second major shift in the region is the movement from itinerant to sedentary livestock production. One historic method for coping with rainfall variability has been moving the herd so that nomads and transhumants dominated the population of the rangelands. This mobility had been extensive and for long distances. These movements are becoming more difficult and infrequent because of the establishment of boundaries between states, the political development within each state, and the appropriation of the rangeland by individuals. As these movements are reduced, herders shift to alternative feed sources or alternative mobility sources, such as the trucks increasingly used by larger herders. As feeding and movement become more capital-intensive, differences between small and large herders become greater. In Morocco, one study indicated that small herders used supplementation for four months and large herders for nine months (Ngaido 2000, p. 316).

The political and social developments in these areas have shaken the authority of the community over individuals. More and more decisions are made individually without any consultation among community members. The livestock system in dryland areas has changed from the traditional system to a market-oriented system with an extension of cultivated land and sedentarization of the population.

Nomadism has basically disappeared and the complementarity between different areas with different ecological and weather characteristics is disappearing. For example, from a majority after World War II, currently only 3 percent of Jordan's rangelands population are nomads and 20 percent are transhumants[34] (Qudah 2002). Sheepherders are increasingly becoming sedentary. This is associated with more forage production, greater dependence on purchased feeds, and a desire to keep children in school.

The political power of communities is declining because of growing central government power and social change. Treaties between communities, which allow for herd movements, are less enforceable. There is a "clear diminution of transhumance, reduction of displacement itinerary, and limitations of frequented sites" (Bechchari

[34] Transhumants move in a regular cycle and generally have a home base in one of the regions.

2001). Larger operators can still practice transhumance by moving their herds with trucks and often planting barley on the areas between the steppes and the cropland.[35]

Transhumance has always been a basic component of the rangeland systems since the range typically provides feed for only three to four months (Ngaido 2000, p. 300). To the extent that access to grazing the cropland residuals in other regions and other grazing rights are reduced, the herders will have to rely on other solutions, such as moving out of the rangelands, intensifying production there, and importing feed blocks and other feeds. Responses to this pressure are higher incidence of disputes, environmental degradation, and the increasing dependence of pastoralists on the markets for feedstuffs (Ngaido 2000, p. 300).

Adequate animal nutrition is a chronic problem. It also varies seasonally and between years, becoming critical in drought years. In general, animals (sheep and goats) are poorly fed for energy and in protein. Animal production is low and their health is not good. In summer, the feeding ration is of low food value, including straw, crop residues, and cactus. During this period, animals lose weight. The gains from the previous period are often lost during the summer (Chriyaa and El Mzouri 2001). This summer period is critical for the productivity of the herd; hence herders are increasingly practicing feed supplementation.

During drought years, the situation is more drastic. During the whole year, herders need to feed their animals while most feeding sources become scarce. Farmers react by destocking their animal herd, diversifying the sources of animal feed and stocking grains and straw. While the price of feedstuffs soars in a drought, animal prices collapse, putting a large income squeeze on herders and often leading to rural/urban migration.

In most regions even where privatized, the privately farmed region is combined with a collectively utilized rangeland. The animal feed comes from a variety of sources and varies seasonally and between years. These sources include: (i) rangeland, (ii) feed crops produced at the farm level, (iii) feed bought outside the farm, (iv) crop residues at the farm level, and (v) off-farm residues.

The importance of rangeland in feeding animals declined as the availability of rangelands was reduced, as the soils were degraded, or as rangelands became more inaccessible due to increased population concentration. In Morocco, 36 percent of forage units (FU) at the national level come from grazing the rangeland. This rises to between 70 and 90 percent in the oriental steppes, and to 50 percent in the mountains (El Gharbaoui 2001).

[35] Transhumants spend the winter and spring in the rangeland and then graze the crop residuals in the summer. Semi-sedentary sheep producers stay in the crop area in the winter and move to the range in the spring. Both tend to have larger flocks than the sedentary producer. For the sedentary producer, the crop activity is more important than the livestock activity.

There are important differences between the responses of small and large farmers to within and between-season drought (Box 5). Small farmers have more difficulty in responding to dry periods. The feed available in rangelands is shrinking. They are not able to move to other areas. They do not have enough financial leverage. Their incomes are low. Their survival strategy is based on getting as much as possible from the available rangeland, destocking in dry years, and marketing behavior that can include selling off the best animals and/or selling at periods of low prices.

Large farmers cultivate and appropriate as much land as they can from the common rangeland. They practice long-distance movement for their herds, often facilitated by truckers looking for free forage units (FU) in other regions. They utilize feed supplementation and manage their herds in more modern ways of matching their production calendar with the market calendar (Aid el Adha, annual Muslim feast with a traditional killing of a sheep). They are able to store forage from one season to another and from one year to another because they are well equipped with trucks, water tankers, and farm machinery. They are able to mobilize capital for these operations.

Herders are not the only practitioners of livestock activities. In Ain Oussara, Algeria, 34 percent of livestock owners are herders while 25 percent are government employees (Kanoun and Kanoun, 2001). Thus, capital is moving from outside the community and is putting increasing pressure on the rangelands.

B. Crop and Bush Technology Introduction for the Drylands

An important phenomenon taking place in the drylands of North Africa and the Middle East is the changing urban-consumption patterns associated with higher incomes, especially the shift from the cereals to a higher-quality diet with more animal products, fruits, and vegetables. As the demand for higher quality diets increases and as governments reduce their subsidies, the incentive to increase production of various types of forage, fodder crops, and feed blocks will increase.

The central part of the technology-introduction process in the M&M countries will be to respond to increased demand for feeds. There has been development of new barley cultivars, of new forages including vetch and forage peas, also new cultivars of oats, forage sorghum, and of drought-resistant forage plants, such as the spineless cactus and atriplex.

With increasing flocks of sheep and goats, barley production is becoming increasingly important in the Middle East and North Africa. The principal feeds for small ruminants are from barley. In Jordan, barley passed wheat in area in the early 1990s (Tutwiler et al. 1997, p. 488). Yields have been stagnant or have decreased in the region and are presently around 1 metric ton per hectare. The production increases had to come from area expansion.

Box 5. Farm and Public-Sector Responses to Drought

Over time, farmers have developed a strategy for dealing with drought risk. This strategy is based on diversifying their sources of income, including off-farm work and agricultural processing, by stocking or destocking their animal herd, and by diversifying their sources of animal feed (Hazell and Chaherli 2001, p. 87).

To reduce the impact of drought, most governments of the region have developed relief programs. The intended goal is to keep farmers in business, to reduce the effects of collapsing prices of animals during a drought, and to reduce incentives for farmers to emigrate to the cities. The components of these programs are: (1) distribute subsidized animal feed, (2) organize animal-health campaigns to avoid spread of diseases, (3) set up public works for distributing wages to affected rural people, (4) reschedule loans, and (5) invest in irrigation infrastructure and drinking water for humans and animals.

These programs have been partially effective in alleviating poverty and in avoiding the decimation of herds or sharp income losses from selling herds at the collapsed prices of drought years. These programs are criticized for their high burden on budgets, their sustainability, and for their effect on building-up herds and then making herders more dependent on outside sources of feed. Also, the principal beneficiaries of the subsidies on feeds are large herders, including government officials. Unfortunately, subsidies build up strong lobbying groups and can make farmers dependent on them. Subsidies also send inappropriate signals to farmers, leading to overstocking of animals and consequent overgrazing and soil degradation on the rangelands.

More market-oriented solutions have been proposed to give farmers the right signals and to reduce market distortions. Private insurance against drought and early drought warning are the main propositions (Hazell 2000, pp. 95–99). Unfortunately, neither is expected to be of much help. Without high levels of public subsidy, the private insurance business will not be profitable for three reasons: (1) Drought hits most farmers at the same time. (2) The probability of risk has been very high over the last decade, for many regions 40 to 70 percent, according to farmers and public officials. The premium to be paid would need to be a high portion of each year's income. For private insurance programs to exist, some public support would probably be necessary, as in developed-country agriculture. (3) At the stage of technology development of climate forecasting, early drought forecasting cannot help either farmers or policymakers much.

How to respond to drought? Government relief programs in drought years are very important for helping farmers to stay in business and to reduce rural/urban migration. The more efficient way, and least distorting to long-run resource allocation, is to develop programs to target the most vulnerable portion of the population. Labor-intensive public works can create temporary jobs and distribute incomes to people living in the affected areas.

These public works can be targeted toward rural infrastructure (roads, schools) and to improve feed availability, such as by planting cactus and shrub trees, and making water-harvesting investments. In this way, the simultaneous goals of supplementing low-income farmers to survive and to obtain supplementary feed for their animals are achieved.

One risk is to induce farmers to overinvest in, for example, sheep-milk production in Jordan and Syria or cactus fruit in Tunisia. Therefore, an important complementary policy is to undertake product-marketing studies to expand the markets and to anticipate price collapses. Also policies such as export incentives and import tariffs, become important.

Significant diffusion of improved agronomy practices in barley production — use of inorganic fertilizer, higher seeding rates, seed drilling, and early seeding before the first rains — and improved cultivars were reported in the projects preceding the M&M

project[36] (Tutwiler et al. 1997, p. 488). In the lower rainfall regions (below 300 mm), demonstration trials and adoption were principally inorganic fertilizer and new cultivars (Tutwiler et al. 1997, p. 498). The new technology introduction was strongly associated statistically with participation or observation of the project demonstration trials for barley. The basic problem with barley production in the last decade has been insufficient rainfall for grain formation.[37] Even with the collapse of the grain harvest, barley still provides forage for sheep and goats. Barley production has been rapidly increasing but flocks have been growing even faster. It has been necessary to increase production of other feeds. There is both a quantity requirement of increased feeds and the seasonal availability problem.

Given the continuing drought, a central concern is the response to adverse rainfall years. Most of the governments involved in this project have been subsidizing feed grains. One effect is a continuing build-up of sheep stocks, making sheep production even more dependent upon alternative sources of grain besides grazing. As these countries reduce their subsidies on feed grains, especially barley, there will be even greater demand for feed alternatives, such as cactus, atriplex, and improved forages including vetch and forage sorghum.

A principal focus in the M&M project in the last three years was to introduce drought resistant plants, especially spineless cactus and atriplex. Once established, these plants have substantial drought tolerance. To establish them, water-retention techniques are being utilized with both cactus and atriplex. Tunisia had a subsidy both for establishment costs and for the opportunity costs of time required for establishment.

Tunisia has a long history of substantial area in cactus, estimated as high as 600,000 hectares by the program leader in the Tunisia project. Cactus needs approximately three years to establish. It survives on as little as 50 mm of rainfall if well distributed. Cactus with spines is very common for fencing all over Morocco and Tunisia. In Tunisia, the spined cactus is burned to handle the spines and then fed to animals. The animals prefer the burnt spiny cactus to the spineless varieties but this is an extremely labor-intensive practice. Cactus has a very low feed value and needs to be supplemented with other feeds.

Research on cactus goes back to a Tunisian scientist after WW II, but rapid extension of the spineless cultivars has occurred in the last decade. Research on alternative uses is well advanced with Mexico leading on this and over 50 products[38]

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[36] There was a high complementarity of the practices of utilizing inorganic fertilizers and new cultivars. Multiplier effects of the combined technologies are substantial. Traditional practices are to use landrace cultivars with no fertilizers, lower seeding rates, and planting after the first rains and without the seed drill (Tutwiler et al. 1997, pp. 488, 492).

[37] As stated earlier, farmers in the project estimated the probability of grain failure from 40 to 70 percent.

[38] One parasite on cactus is systematically developed in Mexico and used as a red dye, primarily for lipstick production.

developed. Cactus serves as an important insurance crop in adverse rainfall years. Developing alternative markets would increase its economic value in normal and good-rainfall years.

Many farmers develop supplementary irrigation and then plant olive or other trees, such as pistachio (Syria). There will be marketing problems with expansion of olive production. Opening up markets for quality oil and getting into the European Union (EU) or other developed-country markets will be important in the future. The EU has periodically had lakes of surplus olive oil. Olive cakes are an important by-product and are often incorporated into the production of feed blocks.

Beside supplementary irrigation, some farmers have used a series of water-harvesting techniques. Bench terraces (*jessours*) are traditional in some of the rangelands of Tunisia. Other technologies to harvest water or better use irrigation are depressions dug around the olive trees and an increasing utilization of drip irrigation as the tubing and filtering equipment has become less expensive. Contour ridging is increasingly done with the plowing. Contour dikes are being introduced and sometimes combined with ditches to bring the water into cisterns or reservoirs for later utilization in irrigation or in watering of sheep. Partial blocking of the wadis is also done for flooding in direct irrigation (Oweis et al. 2001).

There are substantial gains to putting more emphasis on better water harvesting than on irrigation. Legal and illegal wells draw down the water table and often bring salt to the surface. Jordan's water availability per capita is one of the lowest in the world at 170 cubic meters/person/year. Farmers in Jordan often ignore the public requirements and prohibitions on well drilling. In the Jordan valley, there are an estimated 180 illegal wells and 500 illegal ones in the rangelands. There is a proposal to buy these wells from farmers but the asking high prices are high (Qudah 2002).

All technologies in the M&M countries need to be analyzed for their impact on the scarcest resource, water. The necessary start in that direction is first to use the water available efficiently. With better land preparation, plowing, and ridging on the contours, some of these water-harvesting techniques are already being utilized. But water-retention techniques need to be systematically expanded. There is substantial potential for further expansion of the contour dikes with and without trenches for water collection. Where there are hillsides nearby, as in the Moroccan villages in the project, the contour dikes leading to trenches and then emptying into reservoirs may offer substantial potential for handling torrential rains (Oweis et al. 2001).

One practice that has been successfully used in regional experiments is using phosphorus to recover the natural legumes, especially trefolius clover and the medicagos of which alfalfa is one species. This use of phosphorus in the rangelands increases the water-holding capacity of soils, as does higher plant density and almost any agronomic improvement to fertility (Shapiro and Sanders 2002).

Basic economics is that the scarcest resource here is water, so water harvesting needs to be more aggressively pursued before or in place of supplementary irrigation. Supplementary irrigation can draw down the water table and draw up the salt in lower levels of the soil. With more water, the return is increased and the risk reduced for farmers to shift to more intensive practices, especially fertilizing barley and vetch.

C. Sheep/Goat Technology Introduction for the Drylands

In addition to increased forage production discussed above, a series of other technologies are being introduced by the M&M project to increase the productivity of sheep and goat production. These include feed blocks, urea added to the straw, introduction of improved rams, synchronization of breeding, hormone shots to increase twinning, early weaning, shifting to higher quality meats, and introduction of further value-added processing such as local milk and cheese production.

The feed-block technology of acquiring industrial raw materials and compressing them into blocks that have high nutrient value and can be stored, has been known since the 1930s and was elaborated by the International Livestock Center for Africa (ILCA) (now ILRI). The M&M countries generally have the industrial raw materials to take advantage of this processing technique. The feed blocks store for several years and are a much more concentrated nutrient than grazing and the other forages. The raw materials can include olive cakes, tomato by-products from processing factories, wheat bran from milling, and sugar processing by-products.

The feed-block technology was intensively developed in Iraq after the first Gulf War with the rapid development of private-sector activity in response to an embargo. The capital cost of the machine is not high. Many small firms, each producing one to three tons of feed blocks, have entered the industry (Shideed, personal communication, 2002). From Iraq, this technology has been diffused to other countries in the region. The rapidity of the uptake depends upon the availability of industrial by-products and availability and prices[39] of alternative feeds.

Some of the industrial by-products of agricultural processing are neither easy to transport nor easy to store, so there are substantial advantages to feed blocks for reducing transportation costs and increasing storability. The advantages of feed blocks are: (1) the production technique is very simple and can be implemented at the community level; (2) feed can be stored without losses for long periods; (3) vitamins can be added easily; and (4) feed blocks can be a protein supplement.

This technology can help farmers respond to the seasonal and between-year shortages of feed. It uses by-products from agroindustry and residues; these will increase the value of primary activities associated with residue production. The agricultural by-

[39] The tendency of many countries in the region is to subsidize barley or even hay imports in drought years, as Tunisia did in 2002. For much of the drylands in the M&M region, three of the last four years and seven of the last 10 have been drought years.

products are generally produced in irrigated and relatively higher rainfall areas; therefore, the cost of transport is higher to the drylands than in these regions. Feed blocks can be made in small-scale operations so there are also potential income-distribution advantages in the manufacturing process.

Since the earlier project in the two regions (1989-95), rams [40] with improved characteristics as part of their breeding have been sold by the public sector at subsidized prices or with other incentives. In Tunisia, these rams were introduced to overcome chronic problems of in-breeding (specifically low birth rates and high mortality) and to produce higher-quality meat. In Jordan, the objectives were higher twinning with more rapid growth and increased milk production.[41] In the Middle East, there is a preference for the Awassa sheep with its concentration of fat in the tail and high-quality meat unless overfed. These sheep are also good milk producers.

Beside improved rams and improved forage availability and quality, an important innovation throughout the Middle East is synchronization of lambing in spring when more feed is available from crop residues.[42, 43] This is done by two methods: (1) rams are separated from the flock, except at breeding time; and (2) with sponges, hormones are applied to bring the ewes into heat. Both techniques were observed in community visits. In Jordan, the technique was combined with hormone shots to increase the probability of twins. The sponge technique has become very popular in Jordan, Syria, and Iraq according to the meetings with the farmers (herders).

In Jordan, early weaning was introduced. Lambs are partially weaned after one month and fully weaned after two months with this practice. They are fed supplemental feeds, and milk production is substantially increased. This practice is successfully diffusing in Jordan but has not been successful in other M&M countries. Two other important livestock practices are the use of urea with straw introduced into Jordan in the early 1990s and promoted in the M&M project in North Africa later. The use of vitamin A has also been promoted.

In general, the Middle East countries, especially Jordan, Syria, and Iraq, have been stronger in livestock management; much of the innovation and subsequent diffusion to North Africa has come from them. A very important product of the M&M program has been accelerating the spillover process by increasing travel, including farm visits and workshop by national program staff and farmers. Many of the more intensive

[40] The introduction process was accelerated during the M&M Project.

[41] The Morocco M&M project was not interested in many of these technologies, such as early weaning, since sheep are primarily utilized for meat and wool production. Morocco has large cattle stocks for milk and meat production.

[42] In Israel there has also been identification of the gene in Awassa associated with twinning. All of these techniques to increase the productivity of sheep assume that more feed will be available.

[43] Again, the Moroccans in the M&M project were not interested and preferred to space lambs out over the season.

reproductive technologies have not generated as much interest in North Africa where sheep and goats are residual grazers and produce meat and wool. The most intensive-production techniques are associated with the production of milk and cheese and there is much more interest in these activities in the Middle East.

In both Syria and Jordan, farmers, especially women, expressed interest in developing further processing of milk and cheese. In both countries, farmers said that the government rather than the private sector should take responsibility for this activity. Introducing more value-added to present production activities is a high priority activity, according to the public sector in Syria and Jordan.[44]

D. Components of a Development Strategy for the Drylands[45]

This strategy is targeted to improve the income of low-income farmers of the drylands in a way that sustains natural-resource utilization. The main source of income is livestock (sheep and goats). Increasing and stabilizing farmers' incomes mean increasing productivity and reducing animal capital losses in drought years. Increasing productivity of the system is achieved by better integration of all sources of animal feed, adapting the production cycle to the market, and smoothing animal feeding availability over time (seasons and years). If the open-access problem is resolved on collectively owned lands, the possibilities will be greater for improving animal-feed production on the rangelands (shrubs, cactus, enclosures, phosphorus, and water harvesting).

Some specific activities for the drylands (croplands and rangelands) are:

- Reduce economic distortions, especially those against dryland areas, including elimination of tariffs on feeds. Reduce the protection level for the products of irrigated areas and high-rainfall areas. Target subsidies to encourage investment in sustainable resource management.
- Dryland area livestock is in competition for purchased animal feed with poultry and cattle production. Dryland animal production competes with other livestock activities in the country in both input and product markets. Policies toward the other animal species, in particular tariff levels, are important to this dryland strategy. Any policy reform of distortion reduction needs to be viewed in a comprehensive, general-equilibrium way.
- Supplementation is important to maintain animal capital during drought years and to improve animal productivity. Periods of lack of animal feed, as in summertime, cause loss of weight gained during the previous period. Eliminating tariffs on animal feed will encourage supplementation.
- With a lower barley price, it will become less profitable to produce barley on marginal lands, reducing the attractiveness of barley encroachment.

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[44] Unemployment is estimated at 13 percent for Jordan and higher for Syria. One governmental objective in both countries is to reduce rural/urban migration.

[45] This final summary statement on development implications for the drylands and the range of their options was written by Hassan Serghini, who has spent much of his professional time in the last 20 years worrying about these types of issues.

- Invest in rangeland by planting to increase long-run feed availability at the farm and community level. Planting cactus and shrub trees need to be priorities of this strategy. This "live" animal feed can be stored at almost no cost and used when there is a lack of animal feed during dry seasons or dry years. This practice would produce more forage units and improve the sustainability of rangelands. Developing markets for alternative uses of these drought-resistant plants is likely to facilitate their adoption by increasing their expected profitability.
- With prices of animal feed reduced to the level of world prices and the introduction of the forage bushes (cactus and atriplex) plus enclosures on the rangeland (recovery of the pasture by fallowing), there would be less pressure to distribute subsidized animal feed. With forage bushes, the need for extra bought animal feed will be decreased so farmers will be able to stabilize their herd size. This stability will have a positive effect on poultry and beef markets. This investment will allow farmers to be less dependent on government relief programs.
- Drought-relief programs should be oriented to investment in public-works programs rather than subsidizing animal feed. With these programs, small farmers can get salaries from public works and survive drought years as well as making investments to reduce the future effects of rainfall variability.
- The open-access institutional problem needs to be resolved in the rangeland. There is an urgent need for defining ownership (private or collective) over the rangeland to reduce encroachment on common land and to encourage investment in more intensive livestock production on the rangeland. Creation of cooperatives and privatization of common land are the main solutions recommended in the region. Probably a combination of these solutions should be studied more carefully before implementing them.
- The introduction of appropriate regulations and taxes on the misuse of natural resources would be of great help. However, the problem is the implementation of those regulations and taxes.
- Promote rural infrastructure, specifically roads, education, training, and water harvesting. Compared to other regions, government-investment levels in these areas are low. Government will have to scale-up its investment spending in these areas.
- Market agricultural products of these areas such as cactus, olives, and medicinal plants, and improve access to input services and credit for technology introduction. Obtain price differentials for improved quality of meat.
- Diversify economic activity: Irrigation (vegetables and tree crops) and water harvesting, cactus, forage shrubs, planting drought-tolerant tree crops (olive trees), introduction of new animal species (ostrich and gazelle), introduction of phosphorus. Develop non-farm activities, such as rural tourism, mountain tourism, agroindustries (milk, wool, and handcrafts), and industrial activities related to rangeland production (alfa, thyn, and armoise).

Appendix 2

PERSONS INTERVIEWED

ICARDA (International Center for Agricultural Research in the Dry Areas), Syria

Mohan C. Saxena, Assistant Director General, Aleppo, Syria
William Erskine, Assistant Director General (Research), Aleppo, Syria
Ahmed Amri, Agro-Biodiversity Regional Project Coordinator, Genetic Resources Unit, Amman, Jordan
Aden Aw-Hassan, NRMP, Acting Program Leader in Economics, Aleppo, Syria
Elizabeth Bailey, Project Officer, International Cooperation
Mohamed El Mourid, North Africa Regional Coordinator of the M&M Project, Tunis, Tunisia
Samuel Kugbei, Economist, Seed Unit, Aleppo, Syria
Malika A. Martini, Socio-Economics and Gender Analysis, Natural Resource Management Program, Aleppo, Syria
Ahmed Mazid, Agricultural Economist, Natural Resource Management Program, Aleppo, Syria
Theib Oweis, Water Management Specialist, Natural Resource Management Program, Aleppo, Syria
Rahmouna Khelifi Touhami, Research Fellow, Natural Resource Management Program, Aleppo, Syria
Veronique Alary, Researcher from CIRAD (France)

IFAD (International Fund for Agricultural Development), Rome

Near East and North Africa Division, Program Management Department

Abdelmajid Slama, Director
Abdelhamid Abdouli, Country Portfolio Manager
Khalid el Harizi, Country Portfolio Manager
Mylene Kherallah, Regional Economist

Livestock and Rangeland Systems, Technical Advisory Division

Ahmed E. Sidahmed, Technical Adviser/Focal Point

IFAD Evaluation Team of the M&M Project

Nassri I. Haddad, Leader for Evaluations of IFAD Plant Breeding and Plant Genetic Resources, Jordan University of Science and Technology, Faculty of Agriculture
Ali Eltom, Development Planning, Investment and Policy Economist, Cairo, Egypt

IFPRI (International Food Policy Research Institute)

Environment and Production Technology Division

Peter Hazell, Director
Nabil M. Chaherli, formerly joint hire of IFPRI and ICARDA to provide economic backstopping to the M&M Project; Policy Economist, Koc University, Istanbul, Turkey

Tidiane Ngaido, Research Fellow
Peter Oram, Consultant

Director General's Office

James G. Ryan, Consultant, Impact Assessment

Iraq

Kamil Shideed, Coordinator of M&M Project, also coordinator of impact studies for the eight countries, IPA Agricultural Research Center, Baghdad.

Jordan

National Center for Agricultural Research and Technology Transfer (NCARTT)

Abdel Nabi Fardous, Director General, Soil and Irrigation Specialist

M&M Project Members

Faisal Awawdeh, National Coordinator, M&M Project, Animal Science
Khaleel M. Abu-Swai, Livestock Specialist
Samia Akroush, Economist for the M&M Project
Enad K. Al-Kharableih, Team Leader, Policy Component Phase II, University of Jordan
Asad R. Abu Al Ragheb, Ministry of Agriculture, Breeder
Raeh Badwan
Amer S. Jabarin, Team Leader, Policy Component Phase I, Dept. of Agricultural Economics and Business, University of Jordan
Raul Nasser, University of Jordan
Karim Nesheiwat, Team Leader, Property Rights Component Phase I
Laith M. Rousan, Assistant Dean, Faculty of Agriculture, Jordan University of Science and Technology

Ministry of Agriculture

H.E. Mahmoud Dowairi, Minister of Agriculture
Baker Qudah, Director, Rangeland Dept., Ministry of Agriculture, Soils Specialist
Qasem Mamdouh, Director, Administration of Extension and Rural Development
Eideh Kaied, head of the local cooperative

Lebanon

Salah Haj Hassan, Coordinator, M&M Project, First Phase

Morocco

Ministry of Agriculture, Rural Development and Water and Forest Crop Production Division

Nadah Driss, Acting Director; Chief, Industrial Crop Division
Benyassin Abderrahim, Chief, Cereal, Legumes and Forage Division
Hda W. El Baghati, Coordinator, Cereal Programs

Teaching, Research, and Development

Mustapha Berrada, Director
Oulahboub Akka, Chief, Extension Division
Mohamed Achahboun, Chief, High Education and Research Division

Land Management Directorate
Mohamed Milourhmane, Director

Livestock Production ─ Directorate
Boutouba Abdfachid, Chief, Service of Pasture Studies
Salinoun Adelatif, Chief, Service of Livestock Feeding
Said Bara, Director, Provincial Division of Agriculture in Khouriga
Frej Chenak
Ahmed Ben Touhami, Chief, Division of Nutrition

Provincial Direction of Agriculture in Khouribga
Said Bara, Director

INRA (Institut National de la Recherche Agronomique) — Rabat
Kamal Mohamed, Secretary General, INRA
Idrissi Abdelmajid, Division of Information and Training
Boutouba Abdrachid, Animal Production
M. Zouttane El Madani, Chief, Programming Division

INRA ─ Settat
Abdelouahid Chriyaa, Director of M&M Project, Forage and Livestock Specialist
Nassif Fatima, Sociologist, M&M Project
Ahmed Herzenni, Anthropologist, M&M Project
Mohamed El Gharous, Chief, Center of Food Science
Ait Lhaj Abderrahmane, Agricultural Economist
Mohamed Boughlala, Agricultural Economist
Abdelali Cammari, Agricultural Economist
Laamari Abdelali, Chief, Dept. of Agricultural Economics
Mohamed Moussaoui, Agricultural Economist

Syria
Mohamed Mouafak, National Coordinator of M&M Project
Hassan El Ahmed, Deputy Minister of Agriculture
H. Al Askar, M&M Project
Bassam Berri, Head, Extension Department in Hama
Majd Jamal, Director General, Commission for Scientific Research
Riad Kassem, Director of International Collaboration
S. Nasser, M&M Project
Adnan Sharaf, Director of Agricultural Extension
Haitam Abou Touk Rifai, Director, Agriculture and Agrarian Reform in Hama

Tunisia
INRAT (Institute of Agricultural Research in Tunisia)
Ali Nefzaoui, National Coordinator, M&M Project; Director of Research and Chief of Laboratory for Animal Production and Forages
Sonia Bedhiaf, Livestock Genetics, M&M Project

Mohamed Elloumi, Economist at INRAT
Hichem Ben Samel, Animal Nutrition, Laboratory of Livestock and Pastures
Mohamed Salah, Geneticist
Hichem Ben Salem, Animal Nutrition, Laboratory of Livestock and Pastures
Salah Selmi, Economist, Superior School of Agriculture

Ministry of Agriculture

Mougou Abdelaziz, President, Institute for Agriculture Research and High Education, Ministry of Agriculture
Badi Ben Awasuan, Director General of Agricultural Planning
Moncef Elomrani, Director, Sidi Bouzid Agriculture Region

Livestock Production ─ Directorate

Salah Chouki, Range Improvement Specialist
Ben Rhouma Hechmi, Director of Feed Resources
Mohamed Souissi, Range Management Development

Farmers' Groups in Jordan, Morocco, Syria, and Tunisia

In each country, farmers involved in the M&M project were interviewed individually and in groups of 15 to 45.

Appendix 3

PROJECT PUBLICATIONS RELATED TO OR DIRECTLY FROM THE ECONOMICS PROGRAM AND ASSOCIATED ACTIVITIES OF IFPRI PERSONNEL

Outputs of the M&M Policy and Property Rights Component

Books/Proceedings

Chaherli N., P. Hazell, T. Ngaido, T. Nordblom, and P. Oram. 1999. *Agricultural growth, sustainable resource management and poverty alleviation in the low rainfall areas of West Asia and North Africa*. Proceedings of the International Conference, 2–6 September 1997, Amman, Jordan. Feldafing, Germany: DSE.

Chapters

1. Chaherli N., P. Hazell. T. Ngaido, T. Nordblom, and P. Oram. Executive summary, pp. 6–13.
2. Pinstrup-Andersen, P., P. Hazell, and P. Oram. Growth, poverty and the environment in the low rainfall Areas of West Asia and North Africa, pp. 62–73.
3. Moussaoui, M., L. Lachaal, B. Thabet, L. Mahfoudhi, A. Jabarin, and T. Nordblom. Impacts of market reforms on the low rainfall Areas of West Asia and North Africa, pp. 74–100.
4. Ngaido, T. with contributions from M. Abbassi, A. Baalbaki, M. S. Bachta, M. Boughlala, P. Hazell, A. Khnefis, M. Mustapha, F. Nassif, C. Nasser, K. Nesheiwat, T. Nordblom, and N. Redjel. Land improvements and sources of income in low rainfall areas of the Mashreq and Maghreb region: Do property rights matter?, pp. 101–138.
5. El-Mourid, M, and M. Moussaoui. The experience with drought management policies in WANA, pp. 139–157.

Posters

1. Moussaoui M., R. Doukkali, Chaherli, N., and M. Bendaoud. Agricultural policy reforms and market liberalization effects on the economy of the low rainfall areas of Morocco, pp. 176–181.
2. Bendaoud, M. M. Boughlala, N. Chaherli, M. Moussaoui, B. Boulanouar, and E. El Mzouri. A community model for evaluating the impact of policy, technology and property rights changes in the low rainfall areas of Morocco, pp. 182–187.
3. Bachta, M., and B. Thabet. Community modeling in Tunisia, pp.188–192.
4. Lachaal, L., B. Thabet, and L. Mahfoudhi. Multi-market modeling analysis of agricultural policies in Tunisia, pp.193–198.
5. Shideed, K. The impact of support price policies on cereal production in Iraq, pp.199–201.

6. Shideed, K., and N. Chaherli. Multi-market modeling analysis of agricultural policies in Iraq, pp. 202–208.

7. Jabarin, A., and N. Chaherli. Assessing major agricultural policies in low rainfall areas of Jordan: A multi-market modeling approach, pp. 209–214.

8. Nassif, F., M. Boughlala, and T. Ngaido. Land policies, property rights and long-term land improvements in the low rainfall areas of Morocco (El Brouj District, Province of Settat), pp. 220–228.

9. Bachta, M., and M. El-Abassi. Property rights analysis and investment in the low rainfall areas of Tunisia, Sidi Bouzid Governorate, pp. 215–219.

10. Neshiewat, K., T. Ngaido, Q. Mamdoh, N. Haddad, Y. Mohawesh, and E. Kurishat. Property rights and land improvements in the low rainfall areas of Jordan, pp. 229–233.

11. Ngaido, T., Y. Sweidan, S. Nasser, A. Khnefiss, A. Minla-Hassan, H. El-Ashkar, and A. al-Attr. Property rights, long-term land improvements and income shares in the low rainfall areas of Syria, pp. 237–245.

12. Nordblom, T., S. Nasser, M. Bendaoud, T. Ngaido, F. Shomo, J. Rae, G. Arab, N. Murad, N. Chaherli, and G. Gintzburger. Range rehabilitation and land tenure security in Syria: Objectives and components of a community model.

13. Rae, J., G. Arab, K. Jani, N. Murad, T. Ngaido, and T. Nordblom. Socioeconomics of shrub plantations in Syria, pp. 248–254.

14. Redjel, N., and M. Malki. Land tenure regimes in the Algerian steppe rangelands: The present situation and the future challenge, pp. 255–260.

15. Sbeita, A., S. Khair, S. Maltim, A. Shmakhy, M. Idrissi, S. Oshen, S. Hemmaly, G. Shetwi, and S. Haraga. Rangeland development in Libya, pp. 261–267.

16. Baalbaki, A., H. Hassan, G. Fren, M. Goush, H. Hameih, H. Jaafar, A. El Rami, I. Harfoush, T. Takash, and M. Hameih. Transformation of property rights institutions in Lebanon, pp. 268–273.

Book Chapters

1. Herzenni, A., A. Laamari, and M. Boughlala. Les options institutionnelles et la gestion des parcours. In *Gestion durable des resources agropastorales*, eds. M. Bounejmate and M. El Mourid, pp. 129–134. Aleppo, Syria: ICARDA, 2001.

2. Ngaido T., and M. Kirk. 2001. Collective action, property rights and devolution of rangeland management: Selected examples from Africa and Asia. In *Collective action, property rights, and devolution of natural resource management*. Feldafing, Germany: DSE, 2001.

3. Also, Ngaido T., and M. Kirk. 2000. Collective action, property rights and devolution of rangeland management: Selected examples from Africa and Asia. ICARDA Social Science Papers No. 10. Aleppo, Syria: ICARDA, 2001.

4. Ngaido T., T. Nordblom, G. Gintzburger, and A. Osman. 1998. A policy shift toward sustainable resource development in the Mashreq and Maghreb countries. In V.R. Squires

and A.E. Sidahmed (eds.), *Drylands: Sustainable Use into the Twenty-First Century.* Rome: International Fund for Agricultural Development.

5. Ngaido, T. 1999. Can pastoral institutions perform without access-options? In *Property rights, risk, and livestock development in Africa*, eds. N. McCarthy, B. Swallow, M. Kirk, and P. Hazell, pp. 296–325. Washington, DC: IFPRI.

6. Also, Ngaido, T. 2001. Can pastoral institutions perform without access-options? ICARDA Social Science Papers No. 9. Aleppo, Syria: ICARDA.

7. Ngaido, T. 1997. Accounting for customary land and institutional policies: The example of Niger. In *Proceedings of the rural development international workshop*. Rome: FAO.

8. Ngaido, T. 1999. Is there a going back? Attempts to restore customary tenure institutions in Niger. In *Land policy-tenure rights in development cooperation: Challenges and opportunities: Proceedings of the Forum on Land policies in Bonn, Germany, Nov. 18, 1998.* BMZ Special No. 2 (January).

Conference/Workshop Papers and Posters

1. Al-Karablieh, E., T. Ngaido, L. Roussan, F. Awawdeh, S. Akroush, K. Abu Soui, N. Al-Jouhari, and E. Ghraibeh. 2001. Community and household level impacts of institutional options for the managing and improving rangelands in the low rainfall areas of Jordan. Paper prepared for International Conference on Policy and Institutional Options for the Management of Rangelands, Hammamet, Tunisia, 6–11 May.

2. Malaki, M., N. Redjel, and J. Boukheloua. 1997. An overview of agricultural policies in post-independence Algeria: The case of rangelands.

3. Redjel, N., J. Boukheloua, and M. Malki. 1997. The pastoral society education as a warranty for the sustainability of rangelands development.

4. Arab, G., T. Ngaido, T. Nordblom, G. Gintzburger, and R. Tutwiler. 1998. Impact of cultivation, human and sheep population on Syrian rangelands: The case of the Jub Al Jamaa community before and after the cultivation ban in 1994. Developed poster presented at International Workshop on Poverty Mapping, 14–16 October, Arendal, Norway.

5. Bendaoud, M., N. Chaherli, and M. Moussaoui. 1998. Examining the critical triangle of growth, poverty alleviation and environmental sustainability in Morocco's drylands: A community modeling approach. Paper presented at First World Congress of Environmental and Resource Economists, Venice, Italy, 25–27 June.

6. Boughlala, M., T. Ngaido, and F. Nassif. 1998. Tribal use rights or private rights? Effects of property rights on land improvements, productivity, income generation in low rainfall areas of Morocco. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–29 November.

7. Chaherli, N. 2000. Policy research and decision support tool for technology evaluation. Technical advisory note for workshop organized by IFAD and ICARDA, Aleppo, Syria, 28–29 February.

8. Chaherli, N., and M. El-Said. 1999. Impact of the WTO agreement on agriculture in MENA. Paper prepared for workshop "Preparing for the WTO 2000 Negotiations: Mediterranean Interests and Perspectives" organized by Economic Research Forum for the Arab Countries, Iran and Turkey (Cairo), the World Bank, and Instituto Affari Internazionali (Rome), held in Cairo, Egypt, 14–15 July.

9. Doukkali, R., M. Moussaoui, M. Bendaoud, and N. Chaherli. 1998. Trade liberalization, domestic price reforms and income transfers in Morocco. Economic Research Forum for the Arab Countries, Iran and Turkey, fifth annual conference, Tunis, Tunisia, 31 August–2 September.

10. Hazell, P., and T. Ngaido. 2001. Policy and institutional approaches for the sustainable development of the low rainfall areas of the Mashreq and Maghreb countries. Paper prepared for Rabat Ministerial meeting, July.

11. Hazell, P., T. Ngaido, and N. Chaherli. 2002. Policy and institutional options agricultural growth, poverty alleviation and environmental sustainability in the dryland areas of the Mashreq and Maghreb countries. Paper prepared for workshop on Agriculture, Environment and Human Welfare in West Asia and North Africa, ICARDA, Aleppo, Syria, 5–7 May.

12. Herzenni, A., A. Laamari, M. Boughlala, and T. Ngaido. 2001. Institutional options and pastoral communities in Morocco. Paper prepared for International Conference on Policy and Institutional Options for the Management of Rangelands, Hammamet, Tunisia, 6–11 May.

13. Jabarin, A., M. Salem, R. Swaiti, N. Chaherli, and Q. Mamdouh. 1998. Community model for the Falha community in Jordan. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–28 November.

14. Jabarin, A., N. Chaherli , and Q. Mamdouh. 1997. Assessing major agricultural policies in the low rainfall areas of Jordan: A multi market modeling approach. Paper presented at Policy and Property Rights Workshop, Hammamet, Tunisia, 26–29 November.

15. Chahlerli, N., Rachid Doukkali, Mohamed Moussaoui, and Mohamed Bendaoud. 1998. Trade liberalization, domestic price reforms and income transfers in Morocco. Paper prepared for the Fifth Annual Conference of the Economic Research Forum for the Arab Countries, Iran and Turkey, Tunis, Tunisia, 31 August–2 September.

16. Nassif, F., M. Boughlala, and T. Ngaido. 1998. The decision-making environment of rural producers in low rainfall areas of Morocco. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–29 November, 1998.

17. Nefzaoui, A. 2001. Options de gestion des parcours et stratégies des agro-pasteurs du centre et Sud Tunisien. Paper prepared for international conference on Policy and Institutional Options for the Management of Rangelands, Hammamet, Tunisia, 6–11 May.

18. Nesheiwat, K., and T. Ngaido. 1998. The decision-making environment of rural producers in low rainfall areas of Jordan. Paper presented at Policy and Property Rights workshop in Hammamet, Tunisia, 26–29 November.

19. Ngaido, T. 2001. Rangeland management options and sheep feeding strategies in Syria. Paper prepared for international conference on Policy and Institutional Options for the Management of Rangelands, Hammamet, Tunisia, 6–11 May.

20. Ngaido, T., K. Neshiewat, Q. Mamdoh, Nasri Haddad, Eman Kurish, and Yasser Mohawesh. 1998 Meeri or mulk (Arabic for "registered user rights" and "property rights"): Effects of property rights on land improvements, productivity, income generation in low rainfall areas of Jordan. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–29 November.

21. Ngaido, T., Y. Sweidan, A. Minla-Hassan, S. Nasser, A. Khnefis, T. Nordblom, and P. Hazell. 1998. Land improvements, productivity, and income generation: Effects of property rights in low rainfall areas of Syria. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–29 November.

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24. Also, can be found in the Internet on "Technical Advisory Notes: IFAD Agricultural Technologies for Rural Poverty Alleviation." (www.ifad.org/lrkm/tans/8.htm) — Chaherli N., P. Hazell, T. Ngaido, T. Nordblom, and P. Oram, 1999, Agricultural Growth, Sustainable Resource Management and Poverty Alleviation in the Low Rainfall Areas of West Asia and North Africa. Proceedings of the International Conference, Amman, Jordan, 2–6 September 1997. Germany: DSE; and Nassif, F., M. Boughlala, and T. Ngaido, 1998, Farmers and communities in low rainfall areas of Morocco: their decision making environment. Paper presented at the Policy and Property Rights Workshop. Hammamet, Tunisia, 26–29 November 19.

25. Ngaido, T. 2001. Institutional options for rangeland management in the Mashreq and Maghreb countries. Paper prepared for international conference on Policy and Institutional Options for the Management of Rangelands, Hammamet, Tunisia, 6–11 May.

26. Ngaido, T., and N. McCarthy. 2002. Managing externalities and improving pastoral production and livelihood strategies. Paper prepared for regional workshop on Land Issues in Africa, Kampala, Uganda, 29 April–2 May.

27. Ngaido, T., K. Nesheiwat, Q. Mamdoh, Y. Sweidan, A. Minla-Hassan, S. Nasser, A. Khnefiss, and T. Nordblom. 1997. The adoption of M&M technologies in the low rainfall areas of Jordan and Syria: Fertilizer and seed rates in dryland barley production systems. Paper prepared for workshop on Property Rights and Collective Action and Technology Adoption, Aleppo, Syria, 22–25 November.

28. Salem M., A. Jabarin, and N. Chaherli. 1998. Feed subsidies and price support in Jordan: Efficiency and equity considerations. Paper presented at Policy and Property Rights workshop, Hammamet, Tunisia, 26–29 November.

29. Rae, J., G. Arab, K. Jani, N. Murad, T. Ngaido, G. Gintzburger, and T. Nordblom. 1996. Socio-economics of shrub plantations in Syria. Paper presented at regional training workshop on native and exotic fodder shrubs in arid and semi-arid zones, Hammamet, Tunisia, 27 October–2 November.

Workshop Summaries

1. Knox, A., S. Babu, and T. Ngaido. 1998. Workshop summary of international conference on Strategies for Poverty Alleviation and Sustainable Resource Management in the Fragile Lands of Sub-Saharan Africa. EPTD workshop summary Paper No. 7.

2. Ngaido, T., T. Nordblom, P. Hazell, P. Mueller, N. Haddad, and M. Mekni. 1997. Summary report of property rights workshop, held in Amman, Jordan, November 6–13, 1996.

3. Ngaido, T., N. Chaherli, and M. El-Mourid. 2002. Summary of workshop on Technical, Policy and Institutional Options for the Developments of Communities in the Dry Areas. EPTD summary paper No. 12. Washington, DC, IFPRI (Draft).

4. Ngaido, T., N. McCarthy, and M. Di Gregorio. 2002. Workshop summary of international workshop on Policy and Institutional Options for the Management of Rangelands in the Dry Areas. CAPRi discussion paper. Washington, DC: IFPRI.

Refereed Journal Articles

1. Chaherli, N., P. Hazell. T. Ngaido, T. Nordblom, and P. Oram. 1998. Conference on agricultural growth, sustainable resource management, and poverty alleviation in the low rainfall areas of West Asia and North Africa. *Agriculture and Rural Development* 32 (March): Supplement.

2. Ngaido, N., F. Shomo, and G. Arab. 2001. Institutional change in the Syrian rangelands. *IDS Bulletin* 32:4 (October): 64–70

3. Solh, A, T. Amri, T. Ngaido, and J. Valkoun. 2003. Policy and education reform needs for conservation of dryland biodiversity. *Journal of Arid Environments* 54 (1, May): 5–13.

Consultancy Reports

1. Ngaido, T. 2000. Tenure issues on pastoral projects in Africa. Paper prepared for World Bank, Africa Division, Washington, DC, August.

2. Ngaido, T. 1997. Property rights institutions and rangeland development in Jordan. Appraisal report on property rights prepared for IFAD, July.

3. Ngaido, T. 1997. Land tenure and rangeland development: Evaluation report for the Badia Rangeland Development Project in Syria. Appraisal report prepared for IFAD, December.

Rapid Rural Appraisal Reports

1. Boughlala, M., F. Nassif, and T. Ngaido. 1996. Rapid rural appraisal of 10 communities in the El-Brouj sub-district.
2. Neishewat, K., Q. Mamdouh Sweity, A. Jabarin, M. Salem, and T. Ngaido. 1996. Rapid rural appraisal report for 10 communities in the dry areas of Jordan.
3. Bachta, M., and M. Abassi. 1996. Rapid rural appraisal report for 12 communities in the Sidy Bouzid governorate.
4. Sweidan, Y., A. Khnefiss, A. Minla-Hassan, and T. Ngaido. 1997. Rapid rural appraisal report for 12 communities in the dry areas of Syria.
5. Nefzaoui A., M. Elloumi, S. Selmi, S. Chouki, N. Nasr, and H. Jallouli. 2000. Rapid rural appraisal report for the communities of Bir Amama, El-Khima, Ouled Zid, Ouled Farhane (Sidi Bouzid and Gafsa). Report prepared for project on 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, June.
6. Herzenni A., A. Laamari, and M. Boughlala. 2000. Impact des options institutionnelles de gestion des parcours sur les communautés et ménages pastoraux des régions à faible pluviométrie. Rapid rural appraisal of the selected communities for the project on 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, June.
7. Awawdeh, F., L. Roussan, S. Akroush, K. Abu Soui, N. Al-Jouhari, and E. Ghraibeh. 2000. Community and household-level impacts of institutional options for managing rangelands, May.

Reports

1. Nesheiwat, K. 1996. Property rights in low rainfall areas in Jordan.
2. Salem, M., R. Swaiti, and Q. Mamdouh. 1996. Drought management component review of past and recent government drought relief programs.
3. Naser, R., E. Al-Karablieh, and A. Salman. 1997. Comparative production and economics in Jordanian sheep reared under different hormonal and nutritional treatments.

Theses

1. Chemak, F. 2000. Système foncier et mutations du système agraire dans le semi-aride Tunisien: Cas de la communauté agraire de Zoghmar. Mémoire de Diplôme d'Etudes Approfondies présenté a l'Ecole Nationale Supérieure Agronomique de Montpellier, Université de Montpellier 1, Montpellier, France, September.
2. Ezzedine, A. 2000. Gestion des eaux d'épandage des crues d'oued El Fekka: Analyse comparative des fonctionnements de trois groupements d'intérêt collectif de noueyel. Projet de Fin d'études de 'Ecole Supérieure d'Agriculture de Mograne, Tunisie.

3. Khelifi-Touhami, R. 2000. An examination of the factors affecting the changing role of women in small ruminant production systems in Northwestern Syria. M.S. thesis prepared at the University of Guelph, Guelph, Canada. January

Fund-Raising and Proposal Development

Ngaido met with Drs. Marina Puccioni Segatta and Tiberio Chiara on behalf of IFPRI in Aleppo to brief them on PRI research and outreach activities. Following this meeting, the government of Italy granted $250,000 of unrestricted funds of which $65,000 was allocated to the property-rights initiative for research in West Asia and North Africa.

Contributed to the drafting of the M&M second-phase proposal — $3 million funded by IFAD and AFESD.

1. Chaherli received a grant from the FEMISE Network (Forum Euro-Mediterraneen des Instituts des Sciences Economiques) for €50,000 for community bioeconomic modeling in Algeria and Jordan.
2. Ngaido also received $96,250 for the joint proposal with the University of Guelph on the Increasing Role of Women in Resource Management and Household Livelihood Strategies, CGIAR-CANADA Linkage Fund.
3. Ngaido and Chaherli received $179,980 from IDRC for the Community-Level Impacts of Policy, Technology, and Institutional Options in Low Rainfall Areas of Morocco, Syria, and Tunisia, 1999.
4. Ngaido was awarded $125,000 from the System-Wide Program on Collective Action and Property Rights (CAPRi), $100,000 from the Ford Foundation-Cairo, and $79,000 from EU (through IFPRI) for the 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 proposal.
5. Ngaido was awarded $36,000 and Food Aid from the British Embassy in Damascus and the World Food Program to support the rehabilitation of 47 water cisterns in the Jub-Jamaa community.
6. The World Bank awarded a research grant of $15,000 to conduct a review of institutional issues of rangeland development with Nancy McCarthy.

Outreach Activities

1996

1. Community Modeling workshop organized by the IFPRI/ICARDA M&M project in Amman, Jordan, May 12–16.
2. Native and Exotic Fodder Shrubs in Arid and Semi-Arid Zones, organized by ICARDA and CIHEAM in Tunis, October 27–November 2. Paper by Jonathan Rae, Georges Arab, Khaleel Jani, Nabih Murad, Tidiane Ngaido, and Thomas Nordblom on "Socioeconomics of shrub plantations in Syria."

3. International Workshop on Sustainable Use of Rangeland and Desertification Control organized by MEPA, MAW, and IFAD in Jeddah, Saudi Arabia, November 3–6. Presented joint paper by Tidiane Ngaido, Tom Nordblom, Gus Gintzburger, and Ahmed Osman on "From nomads to rangelands: A policy shift toward sustainable resource development."

1997

1. Resource person at the IFPRI/ILRI Methodology workshop on property rights in Nairobi, June.
2. Workshop on Property Rights and Collective Action, and Technology Adoption, Aleppo, Syria, November 22–25.
3. IFAD consultant for the Appraisal of the Rangeland Development program in Jordan, June.
4. IFAD consultant for Appraisal of the Badia Rangeland Development Project in Syria, November 12–December 7.

1998

1. Ngaido was co-rapporteur at the IFPRI-DSE international conference on Strategies for Poverty Alleviation and Sustainable Resource Management in the Fragile Lands of Sub-Saharan Africa, Entebbe, Uganda, May 24–29.
2. Ngaido attended the Systemwide Program on Property Rights and Collective Action (SP-PRCA) Steering Committee meeting and Devolution workshop, Vancouver, Canada, June 15–16.
3. Ngaido presented a paper at the DSE/IFPRI/ILRI symposium on Property Rights, Risk, and Livestock Development, Feldafing, Germany, September 27–October 1.
4. Ngaido gave a presentation at the BMZ/GTZ Forum on Land policies, Bonn, Germany, November 18.

1999

1. Ngaido attended the Program Committee meeting of the SP-PRCA at IFPRI, March 15–16, to discuss the organization and papers of the upcoming workshop on devolution and the Steering Committee meeting of the SP-PRCA; March 17–18, to award reviewed proposals and discuss future directions of the program.
2. Ngaido attended the three-day workshop in Iraq, May 3–5, organized by Chaherli on community modeling. This was a good exposure to the community model and help in conceptualizing the inclusion of property rights in the community model.
3. Ngaido attended the first community workshop at Arsal, Lebanon on June 6. All the different stakeholders were present to discuss results of the Rapid Rural Appraisal and focus groups. This was the first step for implementing M&M Phase 2 activities.

4. On behalf of IFPR, Ngaido attended the Stakeholders/Steering Committee Meeting of the Integrated Feed and Livestock Production in the Steppes of Central Asia, June 6–7, Aleppo, Syria.

5. Ngaido participated as resource person in the Community Approach and Gender Analysis workshop, Amman, Jordan, June 12–16, and gave two presentations on "Community Approach and Selection" and on "Working with Communities: Mechanisms and implementation."

6. Ngaido attended international workshop on Collective Action, Property Rights, and Devolution of Natural Resource Management in Puerto Azul, Philippines, June 21–25, and presented a jointly commissioned paper with Michael Kirk (University of Marburg, Germany) on "Collective Action, Property Rights, and Asia."

7. Ngaido gave two presentations on (1) the Rangeland Management Options Project at the lunch seminar organized by the Systemwide Program on Collective Action and Property Rights, October 28, and on (2) Sustaining Production Systems and Livelihood Strategies in the Low Rainfall Areas of West Asia and North Africa at the Forum on Land Policies, GTZ-Eschborn, Germany, November.

2000

1. Ngaido attended the Technical Advisory Notes (TAN) workshop organized jointly by IFAD and ICARDA, Aleppo, Syria, February 28–29.

2. Ngaido attended the executive committee meeting of the Systemwide Program on Collective Action and Property Rights (CAPRi), Managua, Nicaragua, March 11–12.

3. Ngaido was a resource person to the Policy, Legislation and Property Rights workshop, Amman, Jordan, September 27–30. The workshop was organized by the ICARDA project on Conservation and Sustainable Use of Dryland Agrobiodiversity in Jordan, Lebanon, Syria, and Palestinian Authority funded by GEF and UNDP.

4. Ngaido attended the Third Regional Technical Coordination and Planning Meeting of the Mashreq and Maghreb (M&M) Project, Algiers, Algeria, November 9–12.

5. Ngaido participated in the Regional Consultation on IFAD's Strategy for Agricultural Research and Technology Transfer in NENA Region workshop at ICARDA, May 13–14. He was co-rapporteur of the Livestock and Range Management working group.

6. Ngaido conducted a consultancy for The World Bank on June 10–24 in Washington, DC, on tenure and pastoralism in Africa. He also gave a brown-bag seminar on Conflicts and Conflict Management Over Pastoral Resources, June 21.

7. Ngaido was keynote speaker and resource person at the workshop on Institutional Options for the Management of Rangelands organized by the Tunisian Ministry of Agriculture and the Livestock and Pastures Office (OEP), June 29–30, Kairouan, Tunisia. The workshop focused on alternative institutional options for the management of rangelands in Tunisia. The CAPRi Tunisian team gave a presentation on the policies and results of the RRA studies.

8. Ngaido attended the Institutions and Uncertainty meeting organized by the Institute of Development Studies (IDS), Sussex, UK, November 6–8, and presented a paper.

9. Ngaido was sponsored by the World Bank to attend the regional workshop on Les approches de la gestion des paturages et les projets de developpement: Quelles perspectives?, Niamey, Niger, October 2–6.

10. Ngaido co-authored the paper presented at the international conference on Drylands Biodiversity Management and Rehabilitation in the Context of Education and Policy-Making, March 27–29, Kuwait, on "Policy and Education Reform Needs for Conservation of Dryland Biodiversity" (co-authors: A. Solh, T. Amri, and J. Valkoun).

2001

1. Ngaido visited IFAD with Ruth Meinzen-Dick to give a presentation on Property Rights and Collective Action and confer with IFAD staff, May 1–3.

2. Ngaido attended and gave a presentation at the preparatory meeting of the Rabat Ministerial Meeting in Cairo, May 2001. Contributed to the formulation of policy recommendations that were included in the document that was presented at the Ministerial meeting in Rabat, Morocco.

3. Ngaido attended the executive committee meeting of the Systemwide Program on Collective Action and Property Rights (CAPRi) in Hammamet, Tunis, May 5–6.

4. Ngaido participated in the workshop on Policy, Legislation, and Property Rights organized by the ICARDA Project on Conservation and Sustainable Use of Dryland Agrobiodiversity in Jordan, Lebanon, Syria, and Palestinian Authority funded by GEF and UNDP and held in Amman, Jordan, in February. Ngaido helped in the development of the research framework that is being used by the four countries involved in the project.

5. Gave two-day lectures on Property Rights in Africa and the Middle East at the Master's Program on Land Management and Land Tenure, organized by the Institute of Geodesy, GIS and Land Management (Technological University of Munich) in cooperation with GTZ (German Development Co-operation, October 25–26.

2002

1. Ngaido attended the Regional Workshop on Land Issues in Africa, April 29–May 2, Kampala, Uganda, sponsored by the World Bank. He presented the rangeland framework developed by the World Bank.

2. Ngaido gave a presentation at the Workshop on Agriculture, Environment, and Human Welfare in West Asia and North Africa, May 5–7, and prepared a paper co-authored with Peter Hazell and N. Chaherli.

3. Ngaido was a panel member at the ESSD Session on Integrated Land and Water Management at the World Bank, April 8. Presentation was on Access to Land and Water for the Poor.

4. Ngaido was a consultant to FAO to contribute to the development of an agricultural-sector paper on property rights for Morocco and Tunisia, June 6–13, Rome, Italy.

John H. Sanders is a Professor in the Department of Agricultural Economics, Purdue University. Hassan Serghini works at the Ministry of Agriculture in Morocco.